

CONSUMERS PURCHASE INTENTION OF
RECOMBINANT COLLAGEN-LIKE PROTEIN AS HALAL
COLLAGEN IN MALAYSIA: MEDIATING ROLE OF RISK
PERCEPTION

BY

SITI FATIMAH MOHAMED NOOR

A dissertation submitted in fulfilment of the requirement of the
degree of Doctor of Philosophy (Economics).

Kulliyyah of Economics and Management Sciences
International Islamic University Malaysia

NOVEMBER 2024

ABSTRACT

This study conducted a mixed-method approach to explore both experts' and consumers' perceptions towards the development of recombinant CLP as halal and vegetarian collagen. The experts' perceptions were explored through interviews, while surveys were conducted to investigate the consumers' intention to purchase products containing recombinant CLP. The interview outcome demonstrated that the experts have favorable opinions about the development of recombinant CLP as halal collagen. Meanwhile, the consumers' perception was drawn upon the prospect theory and risk perception framework to investigate their intention to purchase the CLP. Consumers' attitudes, religiosity, trust, and risk perceptions influence their intention to purchase. The framework also explained the mediating role of consumers' attitude and risk perception as well as the role of knowledge as a moderator. Five hundred and fifty questionnaires were distributed for the survey and the outcome showed that consumers' risk perception influences their intention to purchase and mediates the relationship between attitude and purchase intention, as well as the relationship between trust and purchase intention. Meanwhile, religiosity factors did not influence consumers' risk perception and purchase intention but, attitude does mediate the relationship between religiosity factors and purchase intention. In the meantime, consumers' knowledge did not moderate the relationship between the factors and consumers' intention to purchase. This study has opened the door for additional research on topics including the potential of recombinant CLP in the halal industries, the mediating role of attitude and risk perception, and the moderating role of consumer knowledge. Furthermore, initiating CLP as halal collagen can help Malaysia expand its position in the global halal market.

خلاصة البحث

أجريت هذه الدراسة باستخدام نهج مختلط لاستكشاف تصورات الخبراء والمستهلكين تجاه تطوير الكولاجين النباتي والحلال. تم استكشاف تصورات الخبراء من خلال المقابلات، في حين أجريت استطلاعات الرأي للتحقيق في نية المستهلكين لشراء المنتجات التي تحتوي على الكولاجين النباتي والحلال. أظهرت نتائج المقابلات أن الخبراء لديهم آراء إيجابية حول تطوير الكولاجين النباتي والحلال. وفي الوقت نفسه، تم رسم تصور المستهلكين على أساس نظرية التوقعات وإطار إدراك المخاطر للتحقيق في نيتهم لشراء الكولاجين النباتي والحلال. يؤثر موقف المستهلكين وتدينهم وثقتهم وإدراكهم للمخاطر على نيتهم في الشراء. كما أوضح الإطار الدور الوسيط لموقف المستهلكين وإدراكهم للمخاطر بالإضافة إلى دور المعرفة كوسيط. تم توزيع 550 استبانة للاستطلاع حيث أظهرت النتيجة أن إدراك المستهلكين للمخاطر يؤثر على نيتهم في الشراء ويتوسط العلاقة بين الموقف ونية الشراء والعلاقة بين الثقة ونية الشراء. وفي الوقت نفسه، لم تؤثر عوامل التدين على إدراك المستهلكين للمخاطر ونوايا الشراء، ولكن الموقف يتوسط العلاقة بين عوامل التدين ونية الشراء. وفي الوقت نفسه، لم تخفف معرفة المستهلكين من العلاقة بين العوامل ونية المستهلكين في الشراء. وبالنظر إلى كل شيء، فتحت هذه الدراسة الباب أمام إجراء أبحاث إضافية حول مواضيع تشمل إمكانات CLP المؤلف في صناعات الحلال، والدور الوسيط للموقف وإدراك المخاطر، والدور المعتدل لمعرفة المستهلكين. علاوة على ذلك، فإن بدء CLP باعتباره الكولاجين الحلال يمكن أن يساعد ماليزيا على توسيع مكانتها في سوق الحلال العالمية.

APPROVAL PAGE

The dissertation of Siti Fatimah Mohamed Noor has been approved by the following:

Mohamed Asmy Mohd Thas Thaker
Supervisor

Jarita Duasa
Co-Supervisor

Internal Examiner

Internal Examiner

External Examiner

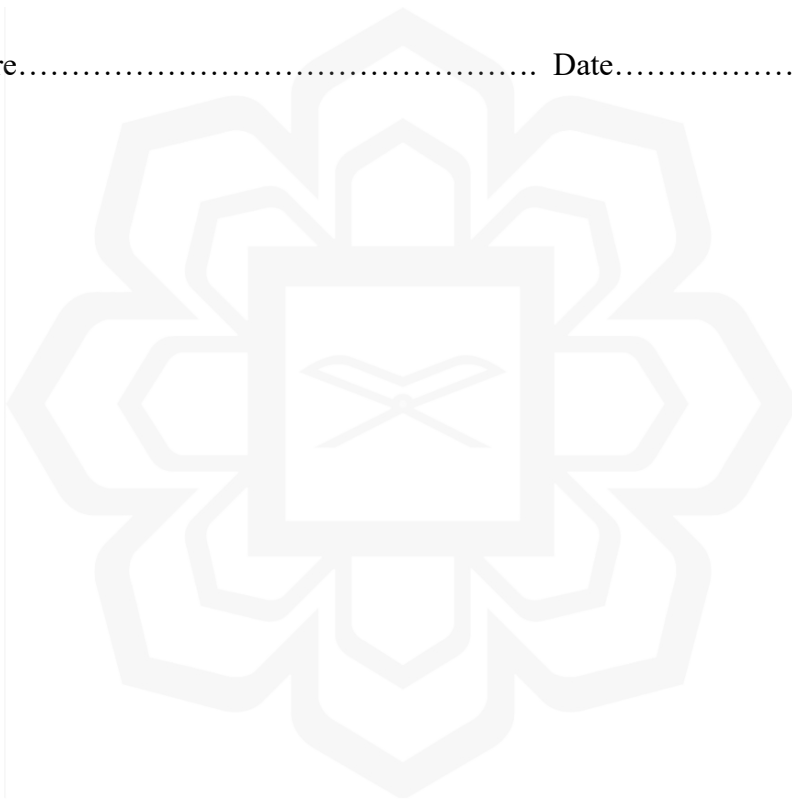
Chairperson

DECLARATION

I hereby declare that this dissertation is the result of my own investigation, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

Siti Fatimah Mohamed Noor

Signature..... Date.....



INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

**DECLARATION OF COPYRIGHT AND AFFIRMATION OF
FAIR USE OF UNPUBLISHED RESEARCH**

**CONSUMERS PURCHASE INTENTION OF RECOMBINANT
COLLAGEN-LIKE PROTEIN AS HALAL COLLAGEN IN MALAYSIA:
MEDIATING ROLE OF RISK PERCEPTION**

I declare that the copyright holder of this dissertation is International Islamic
University Malaysia.

Copyright © 2024 International Islamic University Malaysia. All rights reserved.

No part of this unpublished research may be reproduced, stored in retrieval system,
or transmitted, in any form or by any means, electronic, mechanical, photocopying,
recording or otherwise without prior written permission of the copyright holder
except as provided below

1. Any material contained in or derived from this unpublished research may only be used by others in their writing with due acknowledgement.
2. IIUM or its library will have the right to make and transmit copies (print or electronic) for institutional and academic purpose.
3. The IIUM library will have the right to make, store in a retrieval system and supply copies of this unpublished research if requested by other universities and research libraries.

By signing this form, I acknowledged that I have read and understand the IIUM Intellectual Property Right and Commercialization policy.

Affirmed by Siti Fatimah Mohamed Noor

.....
Signature

.....
Date

INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA

**DECLARATION OF COPYRIGHT AND AFFIRMATION OF
FAIR USE OF UNPUBLISHED RESEARCH**

**CONSUMERS PURCHASE INTENTION OF RECOMBINANT
COLLAGEN-LIKE PROTEIN AS HALAL COLLAGEN IN MALAYSIA:
MEDIATING ROLE OF RISK PERCEPTION**

I declare that the copyright holder of this dissertation is Siti Fatimah Mohamed Noor.

Copyright © 2024 Siti Fatimah Mohamed Noor. All rights reserved.

No part of this unpublished research may be reproduced, stored in retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without prior written permission of the copyright holder except as provided below

1. Any material contained in or derived from this unpublished research may only be used by others in their writing with due acknowledgement.
2. IIUM or its library will have the right to make and transmit copies (print or electronic) for institutional and academic purpose.
3. The IIUM library will have the right to make, store in a retrieval system and supply copies of this unpublished research if requested by other universities and research libraries.

By signing this form, I acknowledged that I have read and understand the IIUM Intellectual Property Right and Commercialization policy.

Affirmed by Siti Fatimah Mohamed Noor

.....
Signature

.....
Date

O' Allah, may this research benefit all mankind

To husband, Muhammad Tarmizi and the kids, AnnurSyifaa Kholeela and Muhammad

Anas Syarif



ACKNOWLEDGEMENTS

My utmost gratitude goes to Allah, The Most Gracious and The Most Merciful, for granting me the strength throughout my journey. Even though the journey is tough but, His Mercies and Blessings on me ease the herculean task of completing this thesis. The completion of this study is all due to the favour of Allah that He has bestowed upon me for I, as His slave, has no ability to achieve anything without His grants and blessings.

I am most indebted to my supervisor, Assoc. Prof. Dr. Mohamed Asmy Mohd Thas Thaker for his advise and kindness, which have facilitated the successful completion of my work. Despite his busy schedule and commitment, he spent his time to listen and attend to me whenever requested. Apart from that, I would also want to express my respect and admiration to my co-supervisor, Prof Dr Jarita Duasa for her precious guidance.

I also want to extend my appreciation to the interviewees who spent their valuable time attending to my interviews and provide their honest responses. Not to be overlooked are the respondents who gave up their time and effort to complete the survey, even though they did not know me and were not offered any remuneration for their participation.

I dedicated this study to my parents, Mohamed Noor Adam and Lijah Mohamed for their pray and care. Also, to my siblings who constantly provide moral support to me. My gratitude also goes to my husband for giving his permission to be in this journey. I am extending my dedication to him for providing financial support throughout the duration of my studies. Most importantly, I am highly appreciate my kids who grew up alongwith me in this journey since they were two and three years old. This thesis is specially for both of them who always attach to me throughout my journey, witnessing and bearing with my emotional breakdown. Hope I can become an inspiration to them.

Finally, I would like to dedicate my appreciation to my relatives and friends for their support and care, especially to my closest friends from the 2007 UiTM Machang batch who have never stopped encouraging and morally supporting me from the beginning of my journey to the present.

Once again, this is all by the grace of my Lord, Allah.

Table of Contents

Abstract	ii
Abstract in Arabic	iii
Approval Page.....	iv
Declaration	v
Copyright	vi
Dedications	viii
Acknowledgements.....	ix
List of Tables	xiv
List Of Figures	xvii
CHAPTER ONE: INTRODUCTION	1
1.1 Introduction.....	1
1.2 Background of the Study	1
1.3 Problem Statement	4
1.4 Research Questions	7
1.5 Research Objectives.....	7
1.6 Significance of the Study	8
1.7 Organisation of the Remaining Chapters	9
CHAPTER TWO: OVERVIEW OF THE COLLAGEN	10
2.1 Introduction.....	10
2.2 Collagen in Human	10
2.3 Collagen	12
2.4 Gelatine	15
2.5 Collagen in Industries	17
2.6 Mammal Collagen.....	18
2.7 Marine Collagen.....	19
2.8 Issues in Collagen	22
2.8.1 The Transmission of Diseases	22
2.8.2 Greenhouse Gas (GHG) Emissions.....	23
2.8.3 Halal Issues	23
2.9 The Development of Recombinant Collagen-Like Protein.....	25
2.10 The Emergence of Recombinant Collagen-Like Protein	26
2.10.1 The Development of the Recombinant Collagen-Like Protein by TRGS Project.....	29
CHAPTER THREE: THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT	32
3.1 Introduction.....	32
3.2 Theoretical Underpinning	32
3.3 Risk Perception Framework.....	33
3.4 Prospect Theory	35
3.4.1 The Application of the Prospect Theory	38
3.5 Purchase Intention.....	41
3.5.1 Determinants of Purchase Intention.....	44

3.6	Gaps in The Literature	45
3.7	Proposed Framework and Conceptual Overview	46
3.8	Development of Hypotheses	49
	3.8.1 Religiosity, Attitudes, Risk Perception and Purchase Intention	50
	3.8.2 Attitudes, Risk Perception, and Purchase Intention.....	51
	3.8.3 Risk Perception, Trust and Purchase Intention	52
	3.8.4 Trust and Purchase Intention	54
	3.8.5 The Mediating Effect of Attitude and Risk Perception	57
	3.8.6 The Moderating Effect: Knowledge	59
3.9	Summary of Research Hypotheses	62
3.10	Chapter Summary	64

CHAPTER FOUR: RESEARCH METHOD..... 66

4.1	Introduction.....	66
4.2	Research Design.....	66
4.3	Qualitative Research Method.....	67
	4.3.1 Data Collection: Semi-Structured Interview	68
	4.3.2 Sampling Technique	68
	4.3.3 Selection of Interviewee.....	69
	4.3.4 Research Instruments	72
	4.3.5 Interview Data Analysis.....	72
4.4	Quantitative Research Method (Questionnaire).....	72
	4.4.1 Sampling Technique	73
	4.4.2 Sample Size.....	74
4.5	Data Collection Technique.....	76
4.6	Questionnaire Design.....	77
	4.6.1 Development of Questionnaire	78
	4.6.2 Operationalisation and Measurement of Constructs	79
	4.6.3 Structure of the Questionnaire	86
4.7	Pretest.....	87
	4.7.1 Content Validation	88
4.8	Pilot Test	92
	4.8.1 Descriptive Analysis	92
	4.8.2 Reliability Testing.....	93
	4.8.3 Validity Testing	95
4.9	Quantitative Data Analysis	98
	4.9.1 Statistical Analyses using Statistical Package of Social Science (SPSS).....	98
	4.9.2 Statistical Analyses using Structural Equation Model (SEM). 99	
	4.9.3 Hierarchical Component Model (HCM) Type Identification 101	
	4.9.4 Measurement Model Assessment.....	103
	4.9.5 Common Method Variance (CMV).....	106
	4.9.6 Structural Model Assessment	110
4.10	Chapter Summary	113

CHAPTER FIVE: INTERVIEW ANALYSIS 115

5.1	Introduction.....	115
5.2	Background of the Interviews	115
5.3	Data Analysis	118

5.3.1	Information on the Collagen	119
5.3.2	Information on the Suitability of the Recombinant Collagen-Like Protein	122
5.3.3	The Viability of the Recombinant Collagen-Like Protein.....	126
5.4	Chapter Summary	131

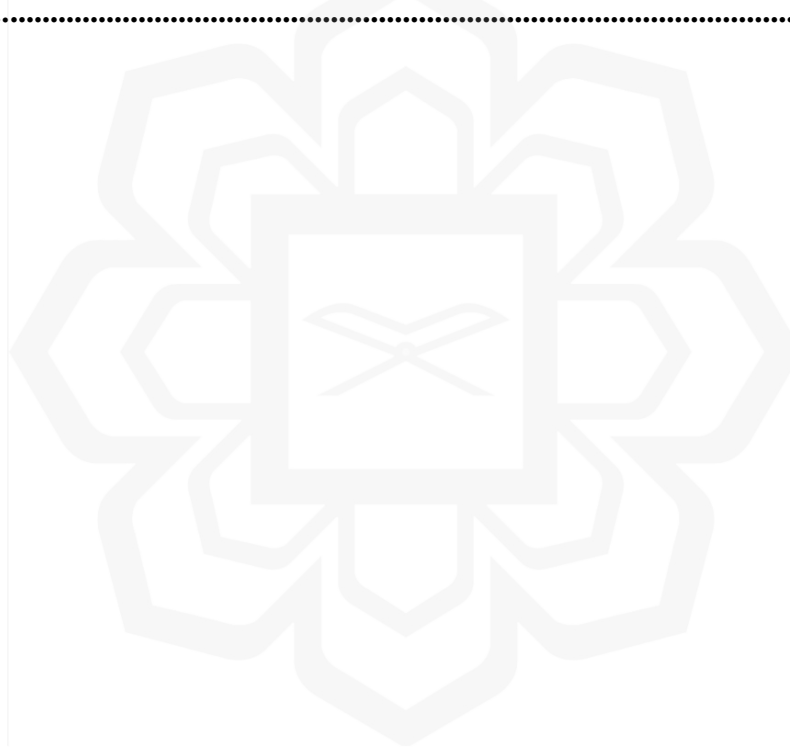
CHAPTER SIX: FINDINGS AND THE ANALYSIS OF SURVEY 133

6.1	Introduction.....	133
6.2	Data Assessment	133
6.2.1	Data Screening	134
6.2.2	Eliminating Outliers.....	134
6.2.3	Normality Test	135
6.3	Descriptive Analysis	135
6.3.1	Demographic Profile of the Respondents	136
6.3.2	Distribution of the Respondents.....	137
6.3.3	Mean and Standard Deviation.....	165
6.4	Measurement Models (PLS-SEM Analysis).....	172
6.4.1	Type of Construct Identification	173
6.5	Lower (First)-Order Constructs Assessment.....	177
6.5.1	Construct Reliability	178
6.5.2	Convergent Validity	179
6.5.3	Discriminant Validity.....	182
6.6	Higher (Second)-Order Construct Assessment.....	187
6.6.1	Reliability and Convergent Validity	188
6.6.2	Discriminant Validity.....	189
6.7	Structural Model	190
6.7.1	Collinearity Assessment.....	191
6.7.2	Path Coefficient and Hypothesis Testing.....	192
6.7.3	Assessment of R ²	194
6.7.4	Assessment of Effect Size (f ²)	195
6.7.5	Assessment of the Predictive Power	197
6.7.6	Robustness Check	200
6.8	Assessment of Mediation Analysis.....	203
6.9	Assessment of Moderation Analysis.....	208
6.10	Hypotheses Testing.....	212
6.10.1	Research Objective 2: To Investigate Consumers' Risk Perception of Recombinant CLP.....	216
6.10.2	Research Objective 3: To investigate consumers' purchase intention towards recombinant CLP	220
6.10.3	Research Objective 4: The Mediating Role of Risk Perception and Attitude on the relationship between predictor variables and consumers' purchase intention.....	226
6.10.4	Research Objective 5: To examine the moderating effect of knowledge on the relationship between predictor variables and consumers' purchase intention.....	229
6.11	Summary	232

CHAPTER SEVEN: CONCLUSION, IMPLICATION, LIMITATION, AND FUTURE RESEARCH..... 233

7.1	Introduction.....	233
-----	-------------------	-----

7.2	Conclusion	233
7.3	Research Implication	234
	7.3.1 Theoretical Implications	234
	7.3.2 Practical Implications.....	236
	7.3.3 Policy Implications	238
7.4	Limitation of the Study	240
7.5	Recommendations for Future Research	241
7.6	Chapter Summary	242
17	BIBLIOGRAPHY	244
18	APPENDIX A: INTERVIEW QUESTIONS.....	295
19	APPENDIX B: CONTENT VALIDATION	298
20	APPENDIX C: SURVEY QUESTIONNAIRE	310
21	APPENDIX C: RESULT FOR ALL INDICATOR BEFORE DELETION	321



LIST OF TABLES

Table 3.1 Research Objectives, Research Questions, and Research Hypotheses	63
Table 4.1 Information of the Interviewees	69
Table 4.2 Measurement Items for Attitude	79
Table 4.3 Measurement Items for Religiosity	80
Table 4.4 Measurement Items for Trust	81
Table 4.5 Measurement Items for Risk Perception	82
Table 4.6 Measurement Items for Knowledge	84
Table 4.7 Measurement Items for Purchase Intention	85
Table 4.8 Amended items in questionnaire.	88
Table 4.9 Descriptive Analysis	93
Table 4.10 Reliability Analysis	94
Table 4.11 Convergent Validity	96
Table 4.12 Fornell-Larcker criterion for all constructs	97
Table 4.13 Rule of Thumb to Choose CB-SEM or PLS-SEM	99
Table 4.14 Summary of factor analysis of the Harman's single-factor test	108
Table 4.15 Collinearity Analysis Result	109
Table 5.1 List of Interview Questions	115
Table 5.2 Interviewees Background	118
Table 5.3 General information on the collagen	122
Table 5.4 The suitability of the recombinant collagen-like protein	126
Table 5.5 The viability of the recombinant collagen-like protein	131
Table 6.1 Mardia's Multivariate Skewness and Kurtosis	135
Table 6.2 Demographic Profile of the Respondents	137
Table 6.3 Cross-tabulation of respondents' gender and their age, education level, and employment	138
Table 6.4 Distribution of respondents' age by their educational level	139
Table 6.5 Distribution of respondents' age by their employment type	140
Table 6.6 The respondents' perception on the development of the recombinant CLP in relation to their health risk perception	141
Table 6.7 The perception of respondents on the substitution of animal-based collagen due to halal status in relation to their health risk perception	143

Table 6.8 Respondents' preference on the recombinant CLP over the animal-based collagen disregard of the price in relation to their health risk perception	145
Table 6.9 The respondents' perception on the development of the recombinant CLP in relation to their social risk perception	146
Table 6.10 The perception of respondents on the substitution of animal-based collagen due to halal status in relation to their social risk perception	148
Table 6.11 Respondents' preference on the recombinant CLP over the animal-based collagen disregard of the price in relation to their social risk perception	149
Table 6.12 The respondents' perception on the development of the recombinant CLP in relation to their environmental risk perception	151
Table 6.13 The perception of respondents on the substitution of animal-based collagen due to halal status in relation to their environmental risk perception	152
Table 6.14 Respondents' preference on the recombinant CLP over the animal-based collagen disregard of the price in relation to their environmental risk perception	154
Table 6.15 The respondents' perception on the development of the recombinant CLP in relation to their quality and halal risk perception	155
Table 6.16 The perception of respondents on the substitution of animal-based collagen due to halal status in relation to their quality and halal risk perception	157
Table 6.17 Respondents' preference on the recombinant CLP over the animal-based collagen disregard of the price in relation to their quality and halal risk perception	159
Table 6.18 The respondents' perception on the development of the recombinant CLP in relation to their financial risk perception	161
Table 6.19 The perception of respondents on the substitution of animal-based collagen due to halal status in relation to their financial risk perception	162
Table 6.20 Respondents' preference on the recombinant CLP over animal-based collagen disregard of the price in relation to their financial risk perception	164
Table 6.21 Descriptive Statistics for Knowledge	166
Table 6.22 Descriptive Statistics for Attitude	166
Table 6.23 Descriptive Statistics for Religiosity	167
Table 6.24 Descriptive Statistics for Health Risk Perception	168
Table 6.25 Descriptive Statistics for Social Risk Perception	168
Table 6.26 Descriptive Statistics for Environmental Risk Perception	169
Table 6.27 Descriptive Statistics on Quality and Halal Risk Perception	169
Table 6.28 Descriptive Statistics of Financial Risk Perception	170

Table 6.29 Descriptive Statistics of Trust	171
Table 6.30 Descriptive Statistics of Purchase Intention	171
Table 6.31 Construct Levels and Type	175
Table 6.32 Construct Reliability	179
Table 6.33 Measurement Model for Lower (First) Order Constructs	180
Table 6.34 Cross-Loadings for All Construct Indicators	183
Table 6.35 Fornell-Larcker Criterion for Lower (First) Order Constructs	186
Table 6.36 HTMT Correlation Ratio for Lower (First) Order Constructs	186
Table 6.37 Factor Loading, AVE and CR values for the Higher Order Construct	189
Table 6.38 Cross Loadings for Higher Order Construct	189
Table 6.39 Fornell-Larcker Criterion for Higher Order Construct	190
Table 6.40 HTMT Ratio for Higher Order Construct	190
Table 6.41 Lateral Collinearity Assessment	192
Table 6.42 Path Coefficient and Results of Hypothesis Testing	193
Table 6.43 The f^2 Effect Size	196
Table 6.44 Structural Model Analysis	199
Table 6.45 Output of Quadratic Effect	200
Table 6.46 Endogeneity test using the Gaussian Copula	201
Table 6.47 Fit Indices for the one- to six-segment solutions	202
Table 6.48 Results of Significance Testing for Indirect Effect	207
Table 6.49 Result of Moderation Effect	208
Table 6.50 Summary of Hypotheses Testing	213
Table 6.51 Research Objectives and Hypotheses	216

LIST OF FIGURES

Figure 2.1 Connective Tissue of an Individual	11
Figure 2.2 Supramolecular Assemblies Formed by Collagens (Ricard-Blum, 2011)	13
Figure 2.3 Preparation of Collagen From Animal By-Product, and the General Process of Their Application in the Food System (Cao et al., 2021)	15
Figure 2.4 Industrial Setup for Manufacturing and Production of Porcine or Bovine-Based Gelatine (Alipal et al., 2021)	16
Figure 2.5 Crown-of-thorn Starfish (Tan et al., 2013)	21
Figure 2.6 Raw Product of the Recombinant of CLP (Salleh, 2023b)	30
Figure 2.7 Collagen in Capsule (Salleh, 2023)	31
Figure 3.1 Reference point (Kahneman, 1979)	37
Figure 3.2 Proposed framework (author's illustration)	49
Figure 4.1 Sample size calculation using G Power software	76
Figure 4.2 Measurement Model Assessment Procedures (Hair et al., 2021).	104
Figure 4.3 Steps in structural model assessment (Hair et al., 2021)	111
Figure 6.1 Conceptual Representation of Proposed Hierarchical Component Model	173
Figure 6.2 Path Coefficient and Outer Loadings	176
Figure 6.3 Lower (First) Order Construct Model	178
Figure 6.4 AVE and Outer Loadings for Lower Order Constructs	180
Figure 6.5 The Higher (Second)-Order Measurement Construct	187
Figure 6.6 Outer Loadings and AVE of the Higher Order Constructs	188
Figure 6.7 R^2 and Path Coefficient values of the model construct	195
Figure 6.8 Cross-Validated Redundancy	198
Figure 6.9 Mediating Effect	204
Figure 6.10 Mediator Analysis Procedure in PLS. Source: (Nitzl et al., 2016; Zhao et al., 2010)	205
Figure 6.11 Mediating Effect	206
Figure 6.12 Interaction Plot MV_KN x IV1_ATT	209
Figure 6.13 Interaction Plot MV_KN x IV2_REL	210
Figure 6.14 Interaction Plot MV_KV x IV4_RISK	211
Figure 6.15 Interaction Plot MV_KN x IV5_TRUST	212
Figure 6.16 Result of the Consumers' Purchase Intention on the Recombinant CLP	215

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

This chapter briefly explain the study of consumers' intention to purchase a product containing the recombinant collagen-like protein (CLP). This collagen was developed mainly as a substitute for natural collagen, which has a number of problems, most notably with regard to halal status. Therefore, the words “halal collagen” and “recombinant of CLP” will be used interchangeably in this study. The chapter will first describe the background of the study and then, highlight the problem statement. Later, research objectives and questions will be listed, and the significance of the study will be explained.

1.2 BACKGROUND OF THE STUDY

Most consumable goods in the market, including food and cosmetics, require collagen as one of their raw ingredients. Not to mention that medications and ointments need collage, even in trace amounts (Gupta & Prakash, 2015; Raman & Gopakumar, 2018). The global collagen peptides market report was valued at US\$3227.7 million in 2019 and is expected to grow to US\$4377.8 million by 2026. Thus, it provides evidence of the rising consumer demand for nutricosmetics infused with collagen peptides across the region as a result of the desire to avoid premature ageing (360 Market Updates, 2020). Aside from cosmetics and other beauty products, collagen appears to be a necessary component in many sectors due to its unique properties (Borumand & Sibilla, 2014; Chattopadhyay & Raines, 2014; Clark et al., 2008; Deal & Moskowitz, 1999; Gorgieva & Kokol, 2011; Grand View Research, 2021; Mahesh et al., 2015; Omar et al., 2019).

Additionally, collagen is found naturally in the human body and is so important to the body that a person born without it can suffer from a variety of diseases (Sandhu et al., 2012). Collagen has unique characteristics and physicochemical, and the majority of the industries use collagen their products, such as supplements, food and beverages, and many others (Duasa et al., 2020; Hashim et al., 2015; León-López et al., 2019).

Collagen provides an indispensable role in various industries such as foods and beverages (Hashim et al., 2015), cosmetics (Faria-Silva et al., 2020), and pharmaceuticals (Raman & Gopakumar, 2018). Its features make it essential in industries, and they can be divided into two categories: the first is connected to its gelling behaviour, such as texturizing, thickening, gel formation, and water binding capacity.

Meanwhile, the second attribute is related to their water-binding capacity, which act as emulsion, foam creation, stability, adhesion and cohesion, protective colloid function, and film-forming capacity (Gómez-Guillén et al., 2011). Collagen is also an excellent surface-active agent with the ability to permeate a lipid-free interface (D. Liu et al., 2015; Matmaroh et al., 2011; Nalinanon et al., 2007).

The reason for the controversy about halal status stems from the fact that collagen is derived from animals, especially swine, which has been used for a very long time in the food industry. Since it's the quickest and least expensive method available, swine skin is typically used to manufacture gelatine (Batu et al., 2015). Aside from the food sector, halal concerns have also surfaced in the pharmaceutical industry, albeit there are thought to be minor problems than those in the food industry (Tumkur, 2010).

However, the primary sources of collagen are porcine and bovine (Markets and Markets, 2022). Thus, it has raised concerns among consumers. Most consumers, particularly halal and vegetarian consumers, were concerned about the origin of collagen because most of the collagen on the market was derived from swine, which was claimed to be the quickest and cheapest way to create collagen (Batu et al., 2015). Aside from that, there was a side effect on consumers' health conditions if they suddenly

consumed a product containing collagen sourced from animals with poor wellbeing (Gómez-Guillén et al., 2011).

According to reports, swine skin accounts for 41% of global gelatine production, whereas 28.5 percent of bovine hide, and 29.5 percent of bovine bones (Lestari et al., 2019). However, due to the growing fret of mad cow disease, the gelatine business has been impacted, and producers have shifted their focus to porcine gelatine, a swine by-product, resulting in 90 to 95 percent of global gelatine production coming from non-halal sources (Lestari et al., 2019). Fish gelatine can be used to substitute non-halal gelatine sources; however, their output is minimal (Gómez-Guillén et al., 2011; Lestari et al., 2019).

These issues caused the emergence of the recombinant collagen-like protein (CLP), which is the collagen made in the lab through the recombinant process with similar characteristics and benefits as mammal collagen. Generally, recombinant CLP has been studied as a potential replacement for animal-based collagen (Aly et al., 2022; An et al., 2014; Chunlin et al., 2004; Fertala, 2020; Meganathan et al., 2022; Olsen et al., 2003; Ramshaw et al., 2019; Wenbo et al., 2022; Y. Yang et al., 2021).

Moreover, consumers essentially consume collagen-based products with various purposes such as their perception of the health benefits in general as well as avoiding ageing (Campos et al., 2023; Pongluxna, 2017). Therefore, the demands for collagen as beauty and health products are escalating among all consumers including Muslims consumers (Campos et al., 2023; Pongluxna, 2017; Sidek et al., 2024).

For over ten years, recombinant CLP development has been underway (Xu et al., 2010) for various purposes. In the meantime, the recombinant CLP of which the subject in this study was created as halal collagen to substitute the mammal collagen (Awang et al., 2020, 2021). It was developed by a team of researchers at the International Institute for Halal Research and Training (INHART) with the purpose of alternating the animal-based collagen as halal collagen (Abd Samad et al., 2017; Awang et al., 2020, 2021, 2023; Salleh, 2023b; Salleh et al., 2021).

Recombinant CLP has not been commercialised in Malaysia yet, despite being studied for a while. Nonetheless, a survey found that low-income and high age consumers would choose recombinant CLP (Duasa et al., 2021). However, in light of the innumerable research on technology-based food (Annunziata & Vecchio, 2013; Ardoin & Prinyawiwatkul, 2020; Hu et al., 2020; Kuang et al., 2020; Siegrist, 2008; Siegrist et al., 2007, 2015; W. Zhu et al., 2018), it is also crucial to look into Malaysian Muslim consumers' views of risk perceptions and intentions with regard to recombinant CLP as halal collagen.

Therefore, main objective of this study is to find out consumers' perception and intention upon the development of recombinant CLP as alternative to mammal collagen. The study also investigated how they perceived the risk associated with technology-based collagen. This study also provides insights and perceptions from experts on the development of recombinant CLP as an alternative to animal-based collagen.

1.3 PROBLEM STATEMENT

There were several issues concerned with mammal collagen, which including (1) the transmission of diseases (An et al., 2014; Chunlin et al., 2004; Davison-Kotler et al., 2019; Fertala, 2020; Olsen et al., 2003; Ramshaw et al., 2019; Wenbo et al., 2022); (2) greenhouse gas emissions (Bainbridge, 2022; Hörtenhuber et al., 2022; Y. Yang et al., 2021); and (3) halal issues (Al-Bakri, 2023; Boran & Regenstein, 2010; Demirhan et al., 2012; Hashim et al., 2015; Sultana et al., 2018b).

Since collagen has become an essential raw material in almost all items on the market, numerous studies have been conducted in an attempt to identify healthy and halal collagen, which is primarily derived from bones, skin, and fish scales (Abdul Jabar, 2011; Mahboob et al., 2014; Nagai et al., 2004; Okazaki & Osako, 2014; M. A. Rahman, 2019; Subhan et al., 2015).

On the other hand, marine collagen was less of a concern since marine life is halal for Muslims, but the source of marine collagen in Malaysia is rarely available. The

source of marine collagen includes the use of aquatic invertebrates and vertebrates such as fishes, starfish, jellyfish, sea urchins, octopuses, squid, cuttlefish, and sea anemones and prawn (Krishnan & Perumal, 2013; E. Song et al., 2006; Sugiura et al., 2009).

Meanwhile, it was the best solution to reduce environmental pollution when the bones, skin, fins, and scales of fresh or saltwater fish, which are considered waste, were processed as marine collagen (Silvipriya et al., 2015). Apparently, the marine collagen source appears problematic, as it varies on the type of fish. For example, by-products from salmon skin are rich in collagen and can be used to make value-added goods through enzymatic hydrolysis (R. Wu et al., 2018).

Nevertheless, it is crucial to ensure that a product is produced using halal materials. Therefore, efforts have been made to produce halal product such as *Istihalah* as one of the methods in the production of halal products either in food, cosmetics, nutraceuticals, or even medical supplies, from an Islamic and scientific approach (Jamaludin et al., 2011). In addition, recombinant CLP is also an attempt to halal collagen-based products (Ambali & Bakar, 2013; Sugibayashi et al., 2019).

Moreover, the growing number of Muslim population has escalated the demand for halal products (MIDA, 2023). Halal products are not limited to food and beverages only, but also halal pharmaceuticals, medicines, and tourism (Battour et al., 2021; Islamic Tourism Centre, 2021; MIDA, 2023). Nevertheless, the recombinant CLP under this study developed as one of the halal raw materials for halal pharmaceuticals (Salleh, 2023b).

Recombinant CLP was experimented explicitly with and developed as halal collagen to alternate the natural collagen in wound healing material (Awang et al., 2020, 2021). In addition, the purposed of this technology-based collagen was developed not only to address halal concerns but also to solve other aforementioned issues. Besides, the studies of recombinant CLP have been conducted for several decades and could be a promising product that is able to alternate collagen mammals (Fertala, 2020; T. Wang et al., 2017).

However, due to modern technology, recombinant CLP has been found to be a viable alternative to animal-based collagen. Aside from halal issues, the development of recombinant CLP also considers the problems of animal health conditions, which

may have an impact on the consumers. Furthermore, vegetarians prefer to ingest collagen derived from non-animal sources; thus, recombinant CLP is a potential answer (Davison-Kotler et al., 2019) to substitute animal-based collagen.

The development of CLP through the recombinant process might be new to the consumers or public; thus, they must have perceived risk upon hearing about the development of collagen through the recombinant process. On top of that, consumers are often concerned about the impact of consumable products on their health while adopting them, especially since there are constantly health risks associated with food consumption (Di Vita et al., 2019).

Therefore, they would be concerned about their well-being and quality of life (Ghali, 2019; Westhoek et al., 2014). Hence, risk perception is one of the predictors in this study, which examines its relationship with consumers' risk perception. Trust factors are also important because they have been empirically proven to influence consumers' acceptance of the products. Moreover, risk perception and trust were influenced by the context of the study (Lusk et al., 2014; Siegrist, 2000, 2021) for instance, the new food technologies and gene technology influenced the consumers' trust and risk perceptions.

Several studies have shown that consumers' perceived risks have a negative impact on their acceptance, while their perceived benefits positively affect their acceptance (Hu et al., 2020; Siegrist, 1999, 2000, 2021). In addition, people's trust in scientific knowledge behind the technology of concern significantly indirect affects consumers' acceptance (Hu et al., 2020).

Furthermore, religious factors were also considered since the purpose of the recombinant CLP development was halal assurance. Besides, spiritual factors have been studied to significantly influence consumers' attitudes (Iranmanesh et al., 2019; Rizkitysha & Hananto, 2020).

Meanwhile, consumers' knowledge is assumed to have a moderating role in the framework after referring to several pieces of literatures (K. Chen & Deng, 2016; Ghali-Zinoubi & Toukabri, 2019; Huei-Shan et al., 2015; Kim & Bonn, 2015; Suki, 2016; X. Wang et al., 2019). Consumers usually depend on the knowledge of how to behave on the information (Ghali, 2019; Huei-Shan et al., 2015) thus, knowledge might have a moderating effect on the consumers' intention to purchase.

1.4 RESEARCH QUESTIONS

1. What is the perception of experts regarding the issues with collagen, suitability, and viability of recombinant CLP development as an alternative to halal collagen?
2. How do consumers perceive the risk of recombinant CLP?
3. What is their purchase intention of products containing recombinant CLP?
4. Do risk perception and attitude have a mediating effect on the relationship between predictor variables and consumers' purchase intentions?
5. Does knowledge has a moderating role in the relationship between the predictor variable and consumers' purchase intentions?

1.5 RESEARCH OBJECTIVES

The main objective of this research is to investigate the consumers' willingness to purchase products containing recombinant collagen-like protein in Malaysia. Due to the several phases required to carry out the investigation, the specific objectives are as follows.

1. To explore experts' perception on the issues regarding collagen, the suitability and viability of recombinant CLP as an alternative to halal collagen.
2. To investigate consumers' risk perception of recombinant CLP.
3. To investigate consumers' purchase intention towards recombinant CLP.
4. To examine the mediating role of risk perception and attitude on the relationship between predictor variables and consumers' purchase intentions.

5. To examine the moderating effect of knowledge on the relationship between the predictor variables and consumers' purchase intention.

1.6 SIGNIFICANCE OF THE STUDY

The research would contribute to knowledge expansion, industrial players, and the economy at large. In terms of theoretical significance, this study adopts the risk perception framework and assumes the research outcome would be aligned with the prospect theory developed by Kahneman and Tversky (Kahneman, 1979).

Since the recombinant CLP is collagen made through a recombinant process, consumers will likely perceive risk prior to purchase decision-making, and on whether to alternate to CLP made with animal-based collagen.

Based on the concept of prospect theory, consumers would have risk-seeking when they felt they were at a loss. This study assumes that consumers might perceive high risk because recombinant CLP is a new product to their knowledge. However, they would take a risk and agree to accept the new technology-based collagen in the market depending on their trust in the institutions responsible for the recombinant of CLP. Therefore, this would be the baseline study on empirical studies on the new technology acceptance analysis. It was imperative to assess the risk perception, trust, and public acceptance of further action, which is commercialisation.

The dimension of risk perception in this study may have served as the critical antecedent of risk assessment to acceptance analysis in future research. In halal and tourism research, health and environment risk perceptions are the antecedents of risk assessments (Al-Ansi et al., 2019). Therefore, this study will extend the dimensions of risk perception to investigate other dimensions of risks perceived by consumers.

Aside from that, this study would contribute to the literature on the role of knowledge as a moderator that might affect the relationship between several predictors of the consumers' intention to purchase, especially between risk perception and purchase intention as well as trust and purchase intention. Previous studies on knowledge as moderating role have reported both significant and insignificant effects moderating role (Siyal et al., 2021; X. Wang et al., 2019).

Furthermore, the cost of production is much less expensive (Awang et al., 2021; Salleh et al., 2021, 2023) compared to the product containing animal-based collagen because the CLP did not involve any animals. Hence, it would benefit the industrial player to commercialise the recombinant CLP. Besides, the recombinant CLP produced by the INHART team is mainly halal collagen. Hence, this will further expand the Malaysian halal industry and contribute to the country's gross domestic product.

1.7 ORGANISATION OF THE REMAINING CHAPTERS

This thesis consists of eight chapters including the introductory chapter. The first chapter briefly explains the recombinant CLP, the aim of this study, and its significance. Chapter Two describes collagen in general, and Chapter Three will answer the first research question. Chapter four further discusses the theory underpinning this study, the endogenous and exogenous variables, as well as the mediating and moderating constructs. The methods for this study will be explained in Chapter Five, where this study was conducted using mixed methods, qualitative and quantitative methods. Chapter Six presents the analysis of qualitative data collection followed by Chapter Seven, which presents the quantitative data collection. Finally, Chapter Eight summarises the study.

CHAPTER TWO

OVERVIEW OF THE COLLAGEN

2.1 INTRODUCTION

The chapter will describe collagen in general. It starts with the function of collagen in the human body followed by an explanation of the collagen in industry. The process of extraction will also be explained. Aside from that, the process of creating gelatine was presented followed by the description of mammal and marine collagen, which are two main types of collagens that were commonly used in the industry. Finally, this chapter also answered the research question regarding the issues of collagen.

2.2 COLLAGEN IN HUMAN

Collagen naturally exists in the human body. In fact, it is one of the essential parts of the human body that functions perfectly (Duasa et al., 2020; Malfait, 2015). In the human body, it exists in connective tissue such as skin, bone, cartilage, smooth muscle, and basal lamina. The role of collagen in our body is to provide rigidity, elasticity, and strength. Besides, it dictates the structure of skin, connective tissues, tendons, and cartilage, as exhibited in Figure 2.1 below (Sandhu et al., 2012).

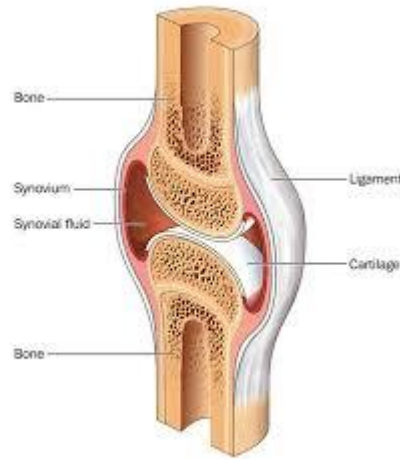


Figure 2.1 Connective Tissue of an Individual

An individual could suffer if (s)he was born with collagen disorders, where three health issues that may impact a person with collagen disorders (Sandhu et al., 2012). One of these three health issues can be known as Ehlers-Dalnos syndrome (EDS) and Osteogenesis imperfecta (OI), which involve muscle and bone illness or known as musculoskeletal, also cardiovascular (circulatory system comprises of health and blood vessels), ophthalmologic (optical system), auditory (hearing), and cutaneous (skin) system. Usually, in patients with EDS and OI, musculoskeletal problems predominate the clinical picture and often lead to a reduction in quality of life (Malfait, 2015).

Aside from that, among the aforementioned health issues caused by collagen disorder is Stickler syndrome. Patients with Stickler syndrome may have skeletal abnormalities that affect the joints (U.S National Library of Medicine, 2016). Epidermolysis bullosa and Marfan syndrome are also the health issues caused by collagen syndrome, where patients will have blisters on their skin that affect their connective tissue. Moreover, patients with collagen disorders may suffer autoimmune diseases, where the disease causes their immune system to attack its own tissue. Hence, they could suffer from arthritis and inflammation of arteries in their tissue (Medline Plus, 2020). This proved that collagen was essential to human wellbeing. Besides, the disturbance in collagen synthesis and degradation has been linked to inflammatory diseases including cardiovascular pathological syndromes thus, stimulating the search in the pharmacological area (Peralta, 2018).

Due to its importance, collagen is an ideal material for regenerative medicine (Pawelec et al., 2016), which mainly focus on human cells (Mason & Dunnill, 2008). Regenerative medicine focuses on restoring the tissues' native function (Pawelec et al., 2016). For instance, patients with a malignant tumour of the thyroid are required to go through resection. Due to the resection, the trachea has failed to function as it used to be (Cotton, 2000; Marino et al., 1961). Eventually, in 1995, an artificial trachea was developed, of which a collagen sponge was used in the reconstruction of a functional respiratory act (Nakamura et al., 2000; Tada et al., 2012). Afterward, Omori et al. reconstructed the cervical trachea, which is a conventional collagen sponge, and it has shown good progress (Omori et al., 2005).

However, the results from the experiments were according to the specific conditions acquired (Omori et al., 2005; Tada et al., 2012). Subsequently, Tada et al. performed the experiments using a collagen vitrigel scaffold on rats and rabbits to accelerate the trachea regeneration process (Tada et al., 2012). The outcome from their experiments thus concluded that their technique is a feasible approach compared to the conventional collagen sponge, which was previously used (Tada et al., 2012). Usually, in the medical field, collagen has been studied in regenerative medicine and tissue engineering. Anyhow, collagen is used for far-ranging purposes such as wound healing, vessel prosthesis, and as a bone cartilage substitute and haemostatic agent (Minakuchi et al., 2004; Ochiya et al., 2001). Haemostatic agents are used as an alternative to standard surgical techniques to manage bleeding from surgical surfaces (Peralta, 2018).

2.3 COLLAGEN

Scientifically, the collagen family comprises 29 members, and it plays structural roles that contribute to the mechanical properties, organisation, and shape of tissues (D. Liu et al., 2015; Ricard-Blum, 2011). It can be subdivided into subfamilies based on their supramolecular assemblies, which are named fibrils, beaded filaments, anchoring fibrils, and networks as portrayed in Figure 2.2 below (Ricard-Blum, 2011). It is crucial and needed in various industries such as foods, cosmetics, pharmacology, and medicine.

Collagen is often derived from animals and used in a variety of products; nevertheless, because of its properties as gels and edible films, it has piqued scientists' curiosity. It is rare in plants due to its physicochemical properties. However, it is plentiful in animals and contains a variety of collagen forms that can be employed in a variety of goods.

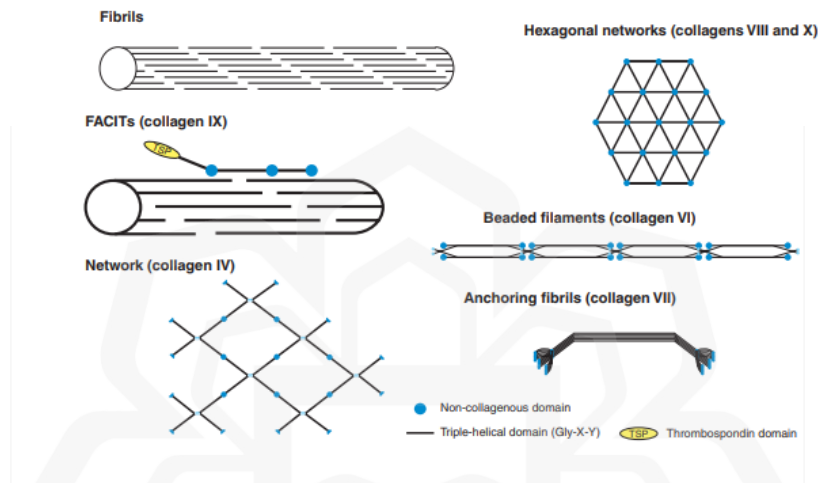


Figure 2.2 Supramolecular Assemblies Formed by Collagens (Ricard-Blum, 2011).

Collagen is one of the critical structural proteins found in the extracellular matrix, where it functions as a supporter of most of the tissues and gives structure to the cells (see example in Figure 2.2) (Gorgieva & Kokol, 2011; Silvipriya et al., 2015), where it is primarily found in connective tissues. Besides, it has excellent tensile strength, which is exhibited by its presence in tendons, bones, and cartilage; thus, makes it rare in plants but mostly in animals. It varies in sequence, and each type has different structures and functions distributed differently in the skins, bones, tendons, vascular systems, and connective tissues, where they act to maintain the stability and structural integrity of the corresponding tissues and organs (D. Liu et al., 2015).

Among the types of collagen, collagen type I is abundance due to its wide prevalence in almost all connective tissues, whereby this type is located in the skin,

bone, teeth, tendons, ligaments, vascular ligature, and organs (Silvipriya et al., 2015). Aside from that, among 29 types of collagens, four other types were most common. Type II collagen is from eyes and cartilage, and type III is from reticular fibres in skin, muscle, and blood vessels. Meanwhile, type IV collagen forms the epithelium-secreted layer of the basement membrane and the basal lamina.

During the extraction of the collagen, the raw material must be maintained at the temperature of -25°C (Celsius) or -4°C . Then, the process of removal of non-collagenous pigments and proteins from the raw material is done using chemical solutions. After that, the demineralisation process took part in the morphological analysis and series of processes involving several types of specific chemical solutions (Silvipriya et al., 2015). The extraction was the first step in preparing the collagen, and the extraction process differs based on the sources as exhibited in Figure 2.4, where the preparation of collagen and collagen peptides from animal by-products (Cao et al., 2021).

There were several types of collagens namely collagen peptide and collagen hydrolysed, where each type was extracted using different extraction methods. The difference in extraction methods was due to different physicochemicals of both collagen and each has different function (Z. Zhang et al., 2006). Also, a process involving the breakdown of collagen polypeptide chain and cross-linkages by partial thermal hydrolysis can form gelatine (Hashim et al., 2015), which is mostly used in food industries (Alipal et al., 2021). It contains a high protein content in certain nutritionally balanced foods and can substitute fat and carbohydrates (Lv et al., 2019).

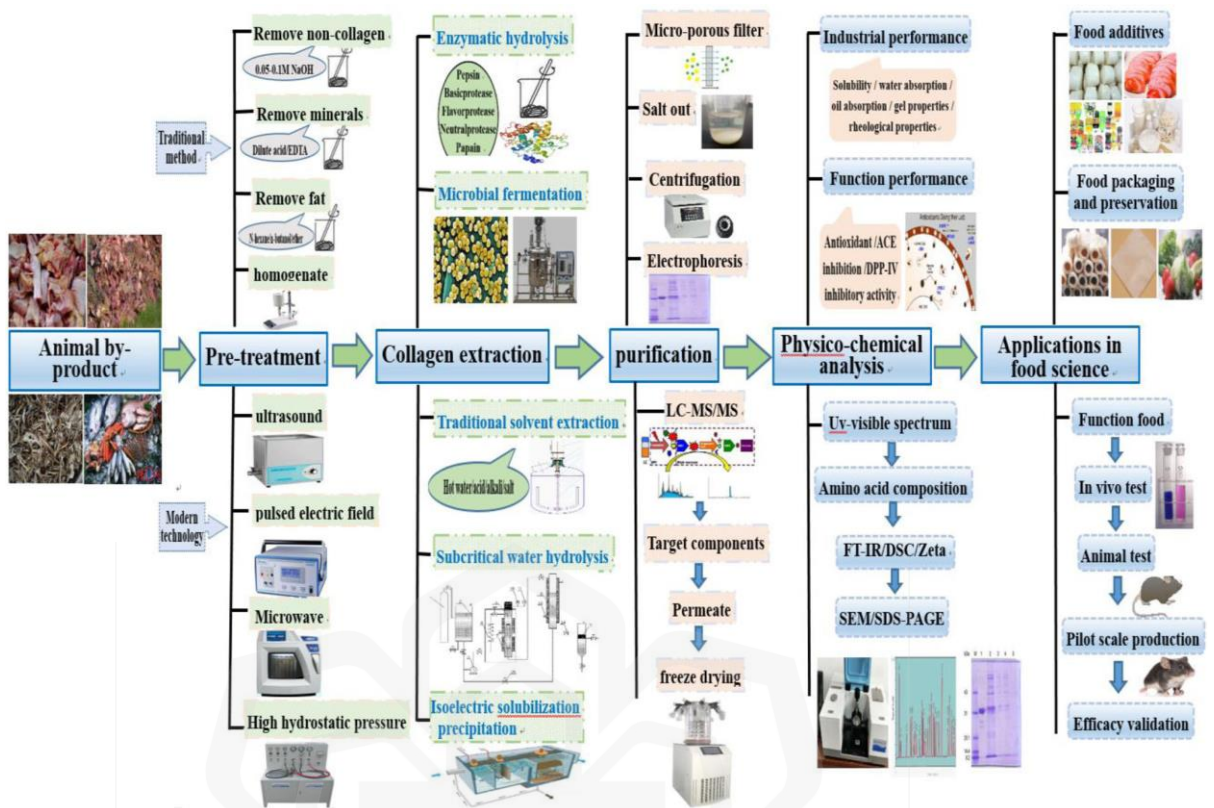


Figure 2.3 Preparation of Collagen From Animal By-Product, and the General Process of Their Application in the Food System (Cao et al., 2021).

2.4 GELATINE

Gelatine is a type of protein extracted from collagen, which as specific amino acids that have several medical benefits (Kumosa et al., 2018). Scientifically, amino acids have an essential role in humans because they are the molecules that combine to form proteins, and both amino acids and proteins are the building blocks of life. In addition, amino acids are also a source of energy in the human body (Medline Plus, 2022).

As mentioned previously, collagen can also be known as collagen peptide and collagen hydrolysates based on its extraction method. Likewise, gelatine that was derived from collagen, could either be gelatine, gelatine-derived peptides, or gelatine hydrolysates based on its purpose and extraction method. They are the heterogenous

mixture of peptides derived from parent protein collagen by procedures, namely the destruction of cross-linkages between the polypeptide chains and some other procedures (D. Liu et al., 2015; P. Zhou & Regenstein, 2005). Anyhow, all of them are among those materials that have been studied for their potential biological benefits, such as antioxidant, antihypertensive, anticancer, antiphotoaging, and cholesterol-lowering effects (D. Liu et al., 2015). In addition, hydrolysed gelatine is widely used to improve the functional and nutritional properties of food proteins (Samaranayaka & Li-Chan, 2011).

Gelatine can be extracted from animal sources such as porcine, bovine, and fish, which are the main sources of gelatine (Alipal et al., 2021). Figure 2.4 portrays the process of gelatine extracted from mammals, mainly bovine or porcine. Though several attempts research were conducted to discover alternatives to the mammals' sources, the process from other sources makes it difficult to beat the rapid and low-cost production of mammalian-based gelatine especially from rapid breeding animals such as porcine (Alipal et al., 2021).

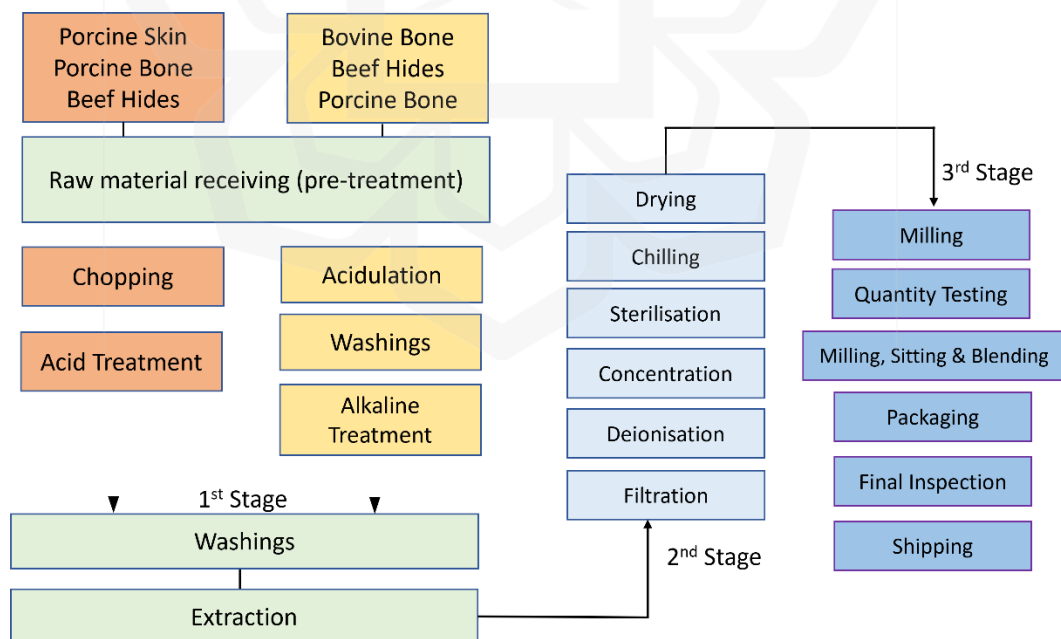


Figure 2.4 Industrial Setup for Manufacturing and Production of Porcine or Bovine-Based Gelatine (Alipal et al., 2021).

Though currently the commercially viable source of collagen is demineralised cattle bone, porcine and bovine hides (Sultana et al., 2018a), gelatine also come from other animal by-products such as fish (Lv et al., 2019), poultry (Abedinia et al., 2017; Chakka et al., 2017; Nik Muhammad et al., 2018), camels (Z. Ahmed et al., 2022; Al-Hassan, 2020), and even the amphibians such as frogs (Karnjanapratum et al., 2017) and salamander (Jin et al., 2019). However, for these sources to be commercialised is still in question as, seemingly, researchers are attempting to alternate the mammals' sources of gelatine with fish sources (Anunciato & da Rocha Filho, 2012; Faria-Silva et al., 2020; Feetham et al., 2018; M. A. Rahman, 2019; Salvatore et al., 2020). Besides, the stability of the target market for fish-based gelatine can be said to be the most promising alternatives to mammalian gelatine (Alipal et al., 2021). In a nutshell, collagen can be obtained from mammals, marine, and many other animals that have the potential to provide collagen, as mentioned above. Even so, for commercialisation, most of the collagen was extracted from mammals and marine sources (Hashim et al., 2015; Market Study Report, 2020; Markets and Markets, 2022).

2.5 COLLAGEN IN INDUSTRIES

Many articles related to collagen focused on collagen use in various industries, such as food and beverages (Hashim et al., 2015). Aside from food and beverages, nutraceuticals products that were focused on geriatric or older patients also contain collagen (Gupta & Prakash, 2015). Nowadays, wide range of cosmetics products exist in the industry, and most consumers seek collagen-based products due to their function as anti-ageing. There are a variety of concepts related to cosmetics and skin products, such as cosmeceuticals, which are typical products that affect the skin's appearance and functioning (Faria-Silva et al., 2020). These products are more than simple cosmetics, where it is a mixture of "cosmetics" and "pharmaceutical", which have similar properties to pharmaceuticals (Anunciato & da Rocha Filho, 2012; Faria-Silva et al., 2020; Feetham et al., 2018).

Usually, cosmetics contain bioactive peptides that are derived from collagen with increased bioavailability and solubility (Faria-Silva et al., 2020). There are various

types of collagen and its suitability for human health, skin beauty, nutraceuticals, and others. As for anti-ageing skin, collagen types I and III are vital as they constitute 90% of the dermis (Avila Rodríguez et al., 2018). Nutritional supplements are the most common way to obtain collagen, and fish collagen has been proven to be an efficient and suitable source of collagen on skin properties (Ambali & Bakar, 2013). Aside from that, mammal collagen contains high amino acids, and it is a promising solution for osteoporosis (Hsiuying, 2021).

Since collagen originated from mammals, concerns about safety religion have emerges, as well as interest in fish collagen and gelatine (Ma, 2016; Omar et al., 2019). The process and extraction of collagen have gone through various modern technologies. The structure of collagen also varies with sources and according to its application (D. Liu et al., 2015). Marine collagen has been studied and applied to various conditions, such as wound healing, and it has been proven that it may enhance the process of wound healing (Diogo et al., 2023). As mentioned previously, collagen varies according to its extraction methods such as collagen hydrolysates (Dybka & Walczak, 2009), where this type of collagen is usually used in anti-ageing supplements, though the source of this kind of collagen can be mammal or marine, it was proven that ingesting hydrolysed collagen could be an excellent method to counteract with skin ageing (Borumand & Sibilla, 2014).

2.6 MAMMAL COLLAGEN

As mentioned previously, collagen is responsible for forming the proper structure of bones, tendons, skin, and other tissues in organs (Teixeira et al., 2018), which means collagen is abundantly contained in animals, especially vertebrates and mammals (Chunlin et al., 2004; Rahman, 2019; Teixeira et al., 2018). Collagen can be applied in various fields of study and commercialised in industries as well (Radhakrishnan et al., 2020; Teixeira et al., 2018). Besides, it plays an essential role in numerous approaches to the engineering of human tissues for medical applications related to tissue, bone and skin repair, and reconstruction (An et al., 2014; Chunlin et al., 2004; Teixeira et al., 2018).

Collagen can be extracted from the skin and bones of cows, and it is one of the major industrial sources of collagen (Silvipriya et al., 2015). The collagen from bovine is applied in different development stages. For instance, foetal bovine dermis extracted from a bovine foetus could be used for tendon reinforcement as well as skin and wound healing. Meanwhile, the neonatal bovine dermis is used for hernia repair, plastic, and reconstructive surgery. On the other hand, adult bovine pericardium is used for hernia repair and muscle flap reinforcement (Ahuja et al., 2012; Parenteau-Bareil et al., 2010; Silvipriya et al., 2015). Aside from bovine-based collagen, porcine is also widely used in industries. Besides, porcine-based collagen was said to have similarities with the collagen contained in the human body (Silvipriya et al., 2015).

Both bovine and porcine-based collagen are widely used in the industry (Hashim et al., 2015; Hsiuying, 2021; Silvipriya et al., 2015). Collagen from poultry was discovered in an attempt to reduce the usage of bovine and porcine sources, while being one of the solutions to reduce wastage since it has become one of the fastest-growing agri-food sectors (Chakka et al., 2017). Usually, chicken feet were underutilized by-products and often discarded; hence, they were extracted to acquire the gelatine owing to the fact that the chicken feet are collagenous (Chakka et al., 2017). However, mammal sources have become an issue among consumers, especially the halal status; thus, consumers are meticulous when the product is said to have collagen or gelatine (Sugibayashi et al., 2019).

2.7 MARINE COLLAGEN

Due to the growing concern about mammal-based collagen, marine collagen was found to be the alternative to mammal collagen (Coppola et al., 2020; Y.-S. Lim et al., 2019). Commonly, marine collagen is derived from fish by-products such as fish scales, skin, and fins of both fresh and saltwater fish (Silvipriya et al., 2015). The discovery of collagen in freshwater fish occurred years ago, thus causing to the emergence of the investigation on the structures and physicochemical properties of fish collagen (Shalaby et al., 2020).

In fish processing operations, the removal of collagen-containing materials can account for up to 30% of the total fish by-products, such as fish scales. However, not all fish have scales that can be extracted to get collagen. The discovery of marine collagen has attracted researchers in the last two decades to which these “blue sources” have contributed to significant scientific and industrial interest with the potential to be used in various health-related sectors, such as food, medicine, pharmaceuticals, and cosmetics (Salvatore et al., 2020). For instance, a product named Pure Gold Collagen has been experimented with and showed the results of an excellent anti-ageing supplement after 130 days consumption. Apparently, the product consisted of hydrolysed collagen from fish scales (Borumand & Sibilla, 2014).

Research into marine collagen emerged because it has a low environmental impact and a large availability of fish by-products such as fish scales or skin (Salvatore et al., 2020). The blue sources, especially fish, came from various kinds of namely Japanese sea bass skin, clown featherback skin, yellow fin tuna bladder, Japanese seer fish skin and bone, Japanese sturgeon cartilage and fins, scales, skin, bones and swim bladder from bighead carp are considered the finest marine collagen extraction (Schmidt et al., 2016). The emergence of marine collagen has contributed to the idea of alternating the mammal collagen and also as a solution to waste management. For instance, in Indonesia, since fish waste is abundant, thus collagen extraction has reduced the waste (Susanti et al., 2019).

Fish collagen can also be applied in food (Raman & Gopakumar, 2018), such that with its highly valued salubrious ingredient, it improves the nutritional attributes in biscuits, which have the potential for geriatric nutrition (Kumar et al., 2019). Moreover, fish collagen also contains in medical treatments such as collagen dressing (Avila Rodríguez et al., 2018; Mahesh et al., 2015), and wound healing medication as well (T. Wang et al., 2015; T. Zhou et al., 2015). In the meantime, the marine population also contributes to wound healing medications such as snakehead *Channa striatus* or “*haruan*”, which is a good remedy for wound healing and is traditionally used, especially for women after giving birth (Sahid et al., 2018).

There were a variety of marine sources in Malaysia that have the potential as marine collagen, such as the crown-of-thorn starfish (Figure 2.5), which has various commercial applications (C. C. Tan et al., 2013). Also, an experiment reported that sea cucumber has the potential to replace mammal collagen in food, nutraceuticals, and pharmaceutical industries (Abedin et al., 2013). Sea cucumbers already exist in the market, where Malaysia is one of the exporters, with the price per kilogram equal to US\$8.84 in 2019, and it increased approximately between US\$12.95 and US\$24.6 per kilogram in 2022 (Selina Wamucii, 2022).

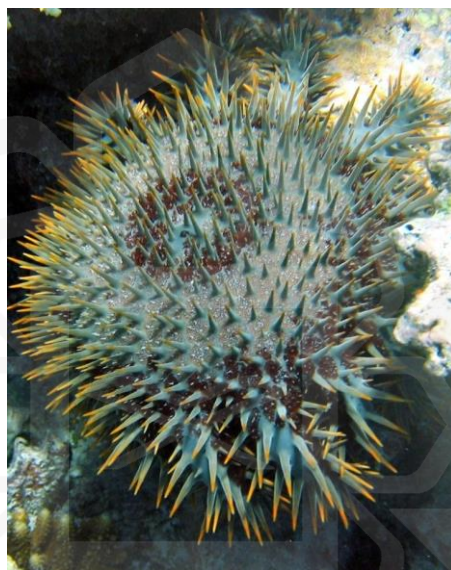


Figure 2.5 Crown-of-thorn Starfish (Tan et al., 2013).

The marine source of collagen can be an alternative to mammal collagen, mainly to solve the halal status concerns among consumers, and it could be a competitive product for the recombinant collagen-like protein (CLP) development as the main highlight in this study. Even so, there also exist limitations in marine collagen, such as the high cost (Schmidt et al., 2016). Apart from that, there were challenges addressed in the marine collagen extraction process (Diogo et al., 2023), which can be one of the points of the argument on why recombinant CLP should be developed and commercialized.

2.8 ISSUES IN COLLAGEN

Collagen is good in treating comorbid diseases, including the coronavirus outbreak in 2019, which caused the global pandemic (Hsiuying, 2021). However, apart from the challenges that were described previously, there were several other issues in relation to the sources of collagen as well as gelatine (Sultana et al., 2018b)

2.8.1 The Transmission of Diseases

Since the sources of collagen are primarily from animals, there were studies reported that a small percentage of consumers might have an inherent immunity, which caused them to have an allergic reaction to the collagen (Davison-Kotler et al., 2019; Fertala, 2020). Natural collagen also causes issues of allergy and immunogenicity among patients in tissue engineering (An et al., 2014; Chunlin et al., 2004; Davison-Kotler et al., 2019; Fertala, 2020; Olsen et al., 2003; Ramshaw et al., 2019; Wenbo et al., 2022).

Moreover, an experiment in neurological surgery discovered that the usage of bovine collagen induced an inflammatory response (MacEwan et al., 2018). The animal-based collagen has been recorded to have substantiated concerns such as pathogenic contamination and transmission, and immunogenicity (Binlath et al., 2022). The transmission of diseases occurs from animal-based collagen if the animal itself accidentally suffers from a disease (Davison-Kotler et al., 2019). For instance, bovine spongiform encephalopathy (BSE) is disease that commonly outbreaks among bovine, and there is a possibility that this disease can be transmitted to humans through the usage of bovine collagen (Binlath et al., 2022; Davison-Kotler et al., 2019; Shoseyov et al., 2014).

In another study, it was discovered that two to four per cent of the treated population experienced an allergic reaction to both bovine- and porcine-derived collagen when both cellular and humoral immune responses were evoked (Davison-Kotler et al., 2019). The cellular and humoral immune systems are two main

mechanisms of immunity, in which cellular immune responds within the infected cells while humoral immunity responds outside the infected cells (Healio, 2023).

2.8.2 Greenhouse Gas (GHG) Emissions

Another issue of animal-based collagen that led the researchers to discover their alternative is greenhouse gas (GHG) emissions (Bainbridge, 2022). Even though livestock farming has a significant economic relevance, it also severely contributes to environmental impacts on GHG emissions (Hörtenhuber et al., 2022).

Bovine was one of livestock farming's leading contributors to GHG emissions (Gerber et al., 2013; Hörtenhuber et al., 2022). The issue of GHG emissions from livestock is not current. In 2009, the United Kingdom asserted that the reduction in meat consumption was one of the solutions to reduce GHG emissions (Gerber et al., 2013). Aside from that, the development of the recombinant CLP also could reduce the GHG emissions (Duasa, Radzman, et al., 2023; Y. Yang et al., 2021).

2.8.3 Halal Issues

The halal status of the products containing collagen and gelatine has been concerning Muslim consumers because 90% of the global gelatine production is from non-Muslim countries (Al-Bakri, 2023). According to the gelatine manufacturers in Europe, porcine is the primary source of raw materials (Gelatine Manufacturers of Europe, 2023). This is due to the fact that pork skin made up 80% of the production of edible gelatine powder, followed by beef hide (15%) and bones of porcine and beef (5%) (Boran & Regenstein, 2010; Demirhan et al., 2012; Sultana et al., 2018b).

Porcine has been widely used because it has similar characteristics to human collagen. Thus, it has a low risk of allergic response (Silvipriya et al., 2015). Besides, manufacturers are much more prone to porcine in collagen and gelatine production due

to the outbreaks of bovine spongiform encephalopathy (BSE), foot and mouth disease, and mad cow disease (Hashim et al., 2015).

However, porcine-based products are strictly prohibited among Muslim consumers (Hashim et al., 2015). Even though bovine-based collagen was produced, the cow should be appropriately slaughtered according to Islamic law and principles (Sultana et al., 2018b). Nevertheless, consumers among other religious groups, such as Hindus and Jews, are sensitive to bovine-based collagen, and vegetarian consumers are sensitive to all animal-based products (Sultana et al., 2018b).

2.8.3.1 The Overview of Halal Products from an Islamic Point of View

Quran and as-Sunnah are the primary sources for Muslims that provide clear guidance on matters of our daily lives. Similar to our daily consumption, various verses in the Quran teach us what is pleasing to consume as well as what is prohibited for Muslims to consume. Muslims are forbidden to consume any product that is related to porcine, as it was clearly mentioned and explained in the Quran, Sunnah, and the consensus of Muslim jurists (*Ijma'*). Aside from that, one of the verses in the Quran also clearly states the prohibition of the consumption of pigs as well as the materials made thereof. In al-Quran, Allah mentioned:

He has forbidden you what dies of itself, the blood, and flesh of swine, and that over which any other name than that of Allah has been invoked; but whoever is driven to necessity, not desiring, nor exceeding the limit, no sin shall be upon him; surely Allah is Forgiving, Merciful (Al-Baqarah 2:173).

As mentioned in al-Baqarah, Muslims are also prohibited from consuming any foods and goods that are made from carrion disregarding any animal except marine livings, such as collagen, for instance (The Quran, 2:173). Natural collagen, which is animal-based collagen was usually extracted from swine and cattle since there were many by-products from these animals in the market (Zin et al., 2021). Even though the

production of collagen from cattle, Muslims still have doubt about consuming it because Islam has instructed that the animals should be slaughtered properly, or it will be considered carrion. Muslims are strictly prohibited from consuming them. Allah said:

Forbidden to you is that which dies of itself, and blood, and flesh of swine, that on which any other name than that of Allah has been invoked, and the strangled animal and that beaten to death, and that killed by a fall and that killed by being smitten with the horn, and that which wild beasts have eaten, except what you slaughter, and what is sacrificed on stones set up (for idols) and that you divide by the arrows; that is a transgression. This day have those who disbelieve despaired of your religion, so fear them not, and fear Me. This day have I perfected for you, your religion and completed My favour on you and chosen for you, Islam as a religion; but whoever is compelled by hunger, nor inclining wilfully to sin, then surely Allah is Forgiving, Merciful (Al-Ma'idah 5:3).

Based on the above statements, efforts to produce halal products are utmost important. Ultimately, recombinant collagen-like protein is one of the effort to alternate mammal collagen (An et al., 2014; Chunlin et al., 2004; Davison-Kotler et al., 2019; Duasa et al., 2020; Fertala, 2020; Olsen et al., 2003; Ramshaw et al., 2019; T. Wang et al., 2017; Wenbo et al., 2022).

2.9 THE DEVELOPMENT OF RECOMBINANT COLLAGEN-LIKE PROTEIN

The development of the recombinant collagen-like protein mainly developed by a team of researchers from the International Institute for Halal Research and Training (INHART) under the International Islamic University Malaysia (IIUM). Prior to describing the development of the recombinant of CLP, this sub-section explained how the idea of this technology-based collagen emerged.

The development of the recombinant collagen-like protein as an animal-based substitution for halal and vegetarian industries was funded by the Transdisciplinary Research Grant Scheme (TRGS/1/2018/UIAM/01/1/1)). The title of the grant was Evaluating Recombinant Collagen-Like Protein as Animal-based Collagen Substitution for Halal and Vegetarian Industries, which was carried out by a team of researchers from different fields of study and was led by Prof Ts Dr Azura Amid. She is the dean of the International Institute for Halal Research and Training (INHART) under International Islamic University Malaysia (IIUM). The main objective of the project was to develop and characterize recombinant collagen-like protein via molecular biology and biochemistry approaches that are suitable for halal and vegetarian product industries.

This chapter described the development of the recombinant *Escherichia coli* harbouring collagen-like protein from DNA fragments isolated from *Rhodopseudomonas palustris* and *Methylobacterium* sp 4-46 using recombinant DNA technology. The method described in this chapter was extracted with consent and permission from the candidate who worked on this experiment for the TRGS project. The thesis title was Cloning Purification and Characterisation of Collagen-Like Protein from *Rhodopseudomonas Palustris* and its Application in Cosmetics Industry, written for Doctor of Philosophy in Halal Industry, International Islamic University Malaysia (IIUM) by Faqihah Salleh (G1829146).

2.10 THE EMERGENCE OF RECOMBINANT COLLAGEN-LIKE PROTEIN

Several academic papers discuss the alternative to bovine and porcine collagen, such as poultry (Radhakrishnan et al., 2020) and camel (M. A. Ahmed et al., 2020; Al-Hassan, 2020). Despite the discussion, bovine sources were widely applied in the collagen supplement market, followed by porcine and marine sources (Global Market Insights, 2023).

Meanwhile, marine sources were said to be the most suitable alternatives to animal-based collagen, according to an experiment, which reported that collagen from fish scales has advantages in wound healing. Also, it has a substantial antimicrobial activity, which means it acts as a killer to microorganisms such as bacteria, thus stopping them from causing diseases (Shalaby et al., 2020). Furthermore, collagen extraction from fish scales can be the solution to waste management, as collagen extraction will involve the fish by-products (Oslan et al., 2022; Susanti et al., 2019).

Commonly, research was performed on wound healing materials since the wounds have a pretty high cost to patients and the country's economy as well (Sood et al., 2014), and the fish by-products were said to have advantages in wound healing medications (Oslan et al., 2022). Moreover, marine sources have been considered to be promising sources of collagen, mainly when they cause less harm to consumers, such as transmissible diseases (Coppola et al., 2020; Y.-S. Lim et al., 2019). In addition, marine collagen has advantages due to its biocompatibility, biodegradability, easy extractability, water solubility, low immunogenicity, and low production cost (Y.-S. Lim et al., 2019).

However, it comes to wonder why marine collagen was not placed as the number one most demanding collagen in the collagen market. Instead, bovine and porcine-based collagen were widely demanded and applied in the industries because it was reported that marine collagen costs relatively higher than bovine and porcine variants (Global Market Insights, 2023; Grand View Research, 2021; Markets and Markets, 2024). In contrast to that reported in the academic research, the researchers claimed that marine collagen production incurred lower costs, but the market research reported contrarily.

Apparently, the bovine-based collagen was cheaper than porcine and marine (Grand View Research, 2021). Besides, even though marine collagen was said to be a promising alternative to mammal collagen, after conducting comparative experiments, researchers reported that there were differences between marine and mammal-based collagen (Davison-Kotler et al., 2019). Consequently, marine collagen is unable to alternate with mammal-based collagen because of the differences discovered during

experiment studies (Davison-Kotler et al., 2019). Consequently, halal issues are the main concern for mammal-based collagen because Muslims are strictly prohibited from consuming porcine (Yuswan et al., 2021; Zin et al., 2021).

Previously, the issues regarding animal-based collagen have been outlined, and due to those issues, researchers came up with the idea of developing collagen in the lab, namely, recombinant collagen (Davison-Kotler et al., 2019). The CLP has been identified from numerous bacterial genome databases (An et al., 2014). These bacterial collagens can be developed to have similar physicochemical properties to animal collagen, though some structures are lacking if compared to animal or mammalian-derived collagen (Yu et al., 2014). Meanwhile, another experiment reported that the recombinant human collagen had been tested as materials to repair tissues, deliver drugs, and serve as therapeutics. The tests demonstrated that the recombinant collagen performed as its native counterparts (Fertala, 2020).

Therefore, the experiments on recombinant CLP have continued for more than three decades since it has the potential to be applied in medicine, drugs, food, and cosmetics industries (Fertala, 2020). The outcome of the experiments presented evidence that the development of recombinant CLP can alternate the animal-based collagen because it can be derived from non-animal sources (Awang et al., 2020; Awang et al., 2021; Campuzano & Pelling, 2019).

The experiments were conducted to produce the recombinant collagen with a variety of cell cultures and cellular, for example, the non-animal sources to develop the recombinant collagen. It was reported that the recombinant collagen from non-animal sources has the potential to resemble native tissue closely. The experiment purposely to innovate the agriculture cell for the biomedical field (Campuzano & Pelling, 2019).

Apparently, non-animal collagen is existed and can be developed with similar characteristics to mammal collagen (Aly et al., 2022; Awang et al., 2020, 2021; Chunlin et al., 2004; Ramshaw et al., 2019; T. Wang et al., 2017; Wenbo et al., 2022). While

marine collagen can be a solution to waste management in the fish industry, recombinant collagen can also be developed with minimal cost (Awang et al., 2021).

Moreover, even though marine collagen has plentiful sources of collagen-containing tissues (Davison-Kotler et al., 2019), it still has different characteristics from animal collagen and limited its usage in tissue engineering (Binlatah et al., 2022; Davison-Kotler et al., 2019; Subhan et al., 2015). Therefore, the recombinant CLP is the solution to alternate the animal-based collagen (Chunlin et al., 2004; Olsen et al., 2003; Wenbo et al., 2022).

Several studies have discovered the bacteria species to produce the CLP (Aly et al., 2022; Chunlin et al., 2004; Ramshaw et al., 2019; T. Wang et al., 2017; Wenbo et al., 2022). The recombinant expression systems have emerged as a potentially alternative synthetic method (Binlatah et al., 2022). The bacteria that were commonly used to develop recombinant of CLP is called *Escherichia Coli* (*E. Coli*) (Gameil et al., 2023; Ramshaw et al., 2019).

2.10.1 The Development of the Recombinant Collagen-Like Protein by TRGS Project

In the project conducted by TRGS, collagen-like protein is processed from selected bacteria, namely, *Escherichia Coli* (*E. Coli*). The bacteria is used in the development of the recombinant CLP due to its potential as a disease-free collagen (Awang et al., 2023). The methods in developing the recombinant CLP using *E. coli* were divided into four primary processes: (1) clone the CLP from *Methylobacterium* sp. 4-46 into *E. coli* strain; (2) optimisation the media, which is the place for bacteria to grow the CLP; (3) purification method of CLP; and (4) structural and functional characterisation of CLP using Fast Protein Liquid Chromatography (FPLC).

A protein sequence of *Methylobacterium* sp. 4-46 that contains a collagen domain was obtained from the National Centre for Biotechnology Information (NCBI).

The NCBI database was utilized to get the collagen-like protein DNA sequence. Later, it was processed and delivered to Malaysia from Hong Kong. Later, the bacteria were transformed into *E. coli* through an experimental process.

The *E. coli* was next transferred (check again) into Luria Bertani broth, which is a medium used to grow the bacteria. The Luria Bertani permits fast growth and yields for many species (Salleh, 2023a; Salleh et al., 2021; Sezonov et al., 2007). *E. coli* was put on the Luria Bertani supplemented with ampicillin and then grew exponentially. In other words, *E. coli* lives and consumes supplemented Luria Bertani and grows. The Luria Bertani is vegetarian and halal.

It has been explained that the process to get the recombinant CLP as a substitution for non-halal collagen has low-processing time, low-cost material, and low-energy consumption (Abd Samad et al., 2017; Awang et al., 2020, 2021; de Albuquerque Wanderley et al., 2017). The purification method was performed using Fast Protein Liquid Chromatography (FPLC) to extract the recombinant CLP from the microorganisms. The outcome from purification later transformed into *E. coli* and several other processes were executed to eventually obtain the final material of the recombinant CLP. Figure 2.6 illustrates the final raw recombinant CLP that is purposely developed to substitute for non-halal collagen.

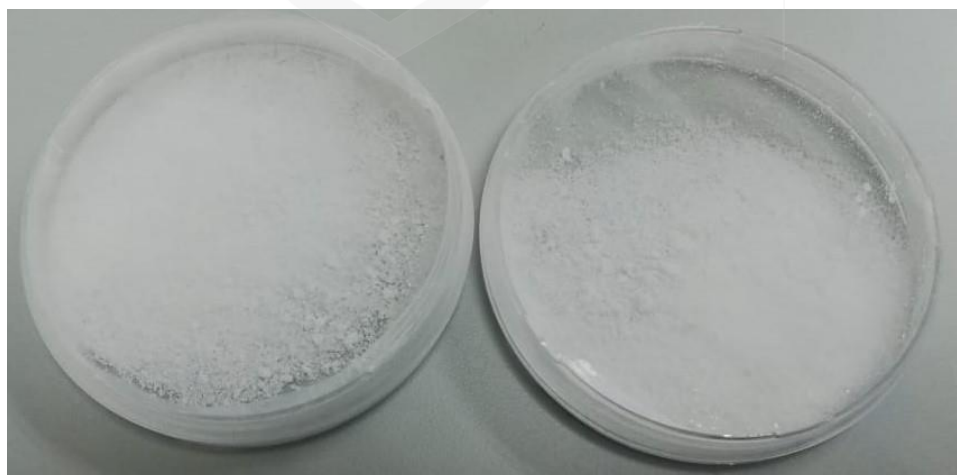


Figure 2.6 Raw Product of the Recombinant of CLP (Salleh, 2023b)

This halal collagen could be produced as halal wound healing medication and contribute to the halal pharmaceutical industry (Salleh et al., 2023). Meanwhile, Figure 2.7 shows the sample of collagen as an end-product, which is a supplement (Salleh, 2023a). However, the supplements need to be tested clinically prior to commercialisation.



Figure 2.7 Collagen in Capsule (Salleh, 2023)

Even though test on recombinant collagen have been done, and those tests showed that the recombinant collagen as potential, it has still yet to be commercialised (Campuzano & Pelling, 2019). The development of recombinant collagen also purposely to alternates mammal collagen due to its halal issues, especially for medical purposes (Awang et al., 2020, 2021).

The recombinant CLP in this study has a promising wound-healing feature for the biomedical and pharmaceutical industries (Salleh et al., 2023). Moreover, the technologies to produce recombinant CLP are often the only sustainable source of therapeutic proteins, and it can cost less compared to the extraction from animal sources (Fertala, 2020).

CHAPTER THREE

THEORETICAL FRAMEWORK AND HYPOTHESES DEVELOPMENT

3.1 INTRODUCTION

The chapter will discuss the theory involved in this study starting with the meaning of theoretical underpinning. Later, the chapter directly emphasises the prospect theory, which is the adopted theory for the study. After the explanation of the theory, the chapter further explains the variables involved in the study, which consist of purchase intention as the dependent variable and several factors as independent variables. Before describing the relationships of the variables, the chapter explained gaps in the literature and the overall proposed framework. Later on, the chapter explained each variable and their relationships. This chapter also presented the moderating variable of knowledge, and the hypotheses were listed as well.

3.2 THEORETICAL UNDERPINNING

The theoretical framework is one of the crucial parts of the research, where the nature and function of a theoretical framework could be conveniently understood if it is viewed as the answer to these two basic questions: (1) what is the problem or questions? (2) why is your approach to solving the problem or answering the question feasible? (Lederman & Lederman, 2015). A theoretical framework helps the develop a conceptual framework, thus showing how a study theorises the relationship among variables that have been identified as significant determinants of the study (Sekaran & Bougie, 2016).

This study aims to investigate the consumers' purchase intention of the recombinant CLP as halal collagen with the least knowledge about the collagen. Usually, consumers are highly concerned about accepting various technology-based goods such as genetically modified foods or cultured meat; thus, they would

meticulously figure out the risk of consuming particular products. Therefore, prospect theory is suitable for this study as suggested by a critical review paper on food technology (Lusk et al., 2014).

3.3 RISK PERCEPTION FRAMEWORK

The development of an explicit theory of risk has been made impracticable by the fame of expected utility. However, since expected utility had difficulty in explaining human preferences, researchers sought other variables of which one of the approaches was to expand the concept and role of risk to explain human preferences (Kahneman, 1979; Slovic & Lichtenstein, 1983; Weber et al., 1992).

Recently, several theories related to risk perception have been found in the literature. For instance, van der Linden has been working on the theory of risk perception to be applied in climate change and pandemics, whereby the theory focuses beyond the environment and aims to examine how the public perceives risk during pandemics or endemic as well as during climate change (Dryhurst et al., 2020; Van der Linden, 2014). This theory refers to over 50 years of risk perception research in which the model recommends the inclusion of clusters of variables. These variables correspond to the cognitive tradition, such as people's knowledge and understanding of risk, the emotional and experiential tradition, such as personal experience, the social-cultural paradigm such as the social amplification of risk, cultural theory, trust, and values, and relevant individual differences such as gender, education, and ideology (Dryhurst et al., 2020; Van der Linden, 2017).

One of the works integrated into the theory of risk perception by van der Linden (Dryhurst et al., 2020; Van der Linden, 2014, 2017) was the development of the theory of risk perception in 1982 by Paul Slovic. During that time, the public had negative perceptions of the technology, which brought confusion and frustration to the policymakers (Slovic et al., 1982). According to the outcome of the study, they have

come to the conclusion that perceived risk is quantifiable and predictable and that it has different meanings depending on the person's point of view (Slovic et al., 1982).

The first risk perception concept was from Bauer (1960), which has been referred to most of the studies on the risk perceptions impact on consumers' behaviour (Ashoer & Said, 2016; E. Choi & Lee, 2019; Pelaez et al., 2019; Y. Yang et al., 2015; M. Zhang et al., 2017). His point of view was that decision-making among consumers also involves risk perception (Bauer, 1960).

According to Bauer (1960), risk perception is a common thread that runs through decision-making process with several factors that have a strong bearing on the problems of risk-taking, including brand loyalty, added value, personal and group influence, and impulse buying (Bauer, 1967). Moreover, risk perception is an important factor affecting how individuals evaluate risk, make decisions and behave (Li et al., 2020).

The definition of risk perception varies according to particular fields (Li et al., 2020). The most popular definition was from Bauer (1960), who defined risk perception as a the possibility of consumers' subjective feelings of various losses when purchasing goods (Bauer, 1960). Aside from that, risk can be generally defined as the chance of injury, damage, or loss (Weber et al., 1992). There is a long-standing interest in risk as a clear attribute of decision alternatives; thus, it was applied in a wide variety of studies, for instance, in a consumer's acceptance of purchase intention of genetically modified foods (Hakim et al., 2020; Li et al., 2020; Weber et al., 1992).

The study of which that adopted risk perception mostly focused on the new technology that entered the market, which led consumers to contemplate prior to consuming the new technology because of their risk perception (Slovic et al., 1982). It can be presented with the study that adopted perceived risk theory to examine how various uncertainties result in different risk dimensions in the consumers acceptance of new things in the market, such as mobile payment (Y. Yang et al., 2015).

Perceived risk has been identified as an important factor in purchase behaviour (Dowling & Staelin, 1994; Pelaez et al., 2019; Weber et al., 2002). The theory-based risk perception commonly adapted into the study according to the context of the study. For instance, the perceived risk theory adopted into the study on e-commerce (Ashoer & Said, 2016; E. Choi & Lee, 2019; Pelaez et al., 2019; Y. Yang et al., 2015). Meanwhile, the risk perception theory was applied in a wide variety of research such as online reviews (J. Yang et al., 2016), behavioural intention on the environment (Saari et al., 2021), willingness to buy foods with nanotechnology (Kuang et al., 2020), consumers' willingness to buy expiration date-based priced perishable food products (Konuk, 2018), nuclear power plant (Xiao et al., 2017), intention on halal food (Al-Ansi et al., 2019), and tourism (Olya & Al-ansi, 2018) among others.

Therefore, this study also adopted the risk perception framework after referring to the literature review related to the risk perception framework on consumers' behaviour. This study also adopted the prospect theory into the risk perception framework. Commonly, there were several of these studies applied theory-based risk perception with prospect theory such as hazard insurance (F. Yang et al., 2020), mobile payment (Y. Yang et al., 2015), intention on halal food (Al-Ansi et al., 2019), tourism (Olya & Al-ansi, 2018), intention to recommend takeaway food during pandemic (Yeni et al., 2021), and digital food ordering during pandemic (Leung & Cai, 2021) among others. Apparently, the prospect theory was developed to explain human preferences (Weber et al., 1992).

3.4 PROSPECT THEORY

Prospect theory was the alternative theory developed by Kahneman and Tversky (Kahneman, 1979) from expected utility theory. The expected utility proposes that individuals are utility maximizes, where they aim to maximise the utility of their choices (Ruggeri et al., 2020). The expected utility theory proposes how people behave, while the prospect theory proposes how people make decisions (Treadwell & Lenert, 1999). Prospect theory explains how individuals form decisions about prospects and prospects can be said to gamble because it is about risk and uncertainty (Kahneman, 1979). The

development of prospect theory was motivated by several compelling and replicable findings that could not be explained by the expected utility theory (Allais, 1953; Ellsberg, 1961; Treadwell & Lenert, 1999; Y. Wang & Hazen, 2016).

Prospect theory is a consumer behaviour model for those who make decisions on different values of gain and losses (Kahneman, 1979) where the decision under risk was made based on real-life choices rather than optimal decisions (Camerer, 2005; Chiu et al., 2014). It descriptively predicts an individual's actual decision behavior, where it assumes decision makers are mostly risk averse for gains and risk seeking for losses (S. Zhao & Yue, 2020).

The prospect theory was developed followed by the result of the experiments conducted by Allais in 1953 and Ellsberg in 1961, where their experiments described the specific choice situations in which the results were in contrast with the expected utility principles, maximising their utility (Allais, 1953; Ellsberg, 1961; Kahneman, 1979). The experiments of economics theory showed that people more concerned with losses than gains, which means they tend to be risk-averse when it comes to gain and become risk-seeking when they face loss options (Kahneman, 1979).

Literally in prospect theory, an individual will face the alternatives prior to deciding, which these alternatives will be reduced into a series of prospects. The individual shall take a risk to choose the specific prospect that will yield specific outcome "x" with probability "p" and outcome "y" with probability "q", where $p + q = 1$. Then, (s)he evaluates each prospect according to the value function, which is hypothesized into the s-shaped curve, where centred on the reference point, concaves for gain and convex for losses as shown in Figure 3.1 below (Kahneman, 1979; Levy,

1992). Reference point act as dependent variable of which determines the outcomes of a decision maker (Helson, 1964).

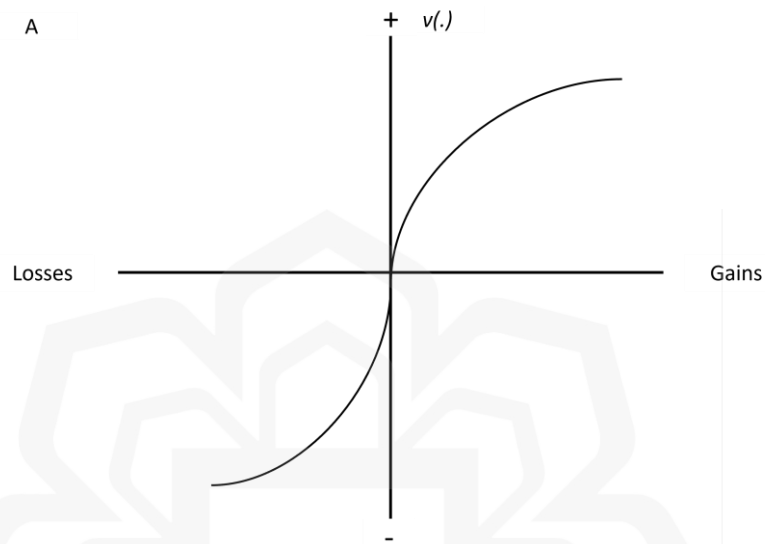


Figure 3.1 Reference point (Kahneman, 1979)

The slope is steeper for losses compared to gains, which results in losses being overweighed compared to equal gains (Kahneman, 1979; Tversky & Fox, 1995). The value function usually overweighs the small probabilities and underweight large and moderate probabilities (Tversky & Kahneman, 1992).

Two stages are involved in the decision-making under prospect theory, where an individual will go through the editing stage then proceed to the evaluating stage. The editing stage has a significant role because at this stage, the individuals identify the options available to them (Levy, 1992; Puto, 1987). For example, the individuals were given the alternative to show how they perceive values by paying for e-books (M. Zhang et al., 2017). The individuals will identify the reference point and the outcomes of their

choices are the deviations on the reference point of which they would gain or loss (refer to Figure 3.1).

After going through the editing stage, the individuals then evaluate their options in the evaluation stage (Levy, 1992). The individuals evaluate the outcomes of their options and whether they would gain or loss (Levy, 1992). For instance, an individual would choose the options that determine their willingness to pay for e-books and evaluate the outcome if they choose to pay for the e-books (M. Zhang et al., 2017).

Nevertheless, prospect theory has strong applicability in describing and predicting behaviours that are inconsistent with traditional expectations (Baker et al., 2010; Cui & Yang, 2017; Luo et al., 2018), and it is often adopted when the study investigates the effect of risk perception on consumers' intention and their decision-making process (Leung & Cai, 2021; Luo et al., 2018).

In a study of health food safety risk, prospect theory was adopted in the strategic game models, which consists of parties responsible for health food, which are government regulators, health food consumers, and health food enterprises (Luo et al., 2018). Prospect theory was also made as a baseline in medical studies proposing a method for medical decision-making through value function (Adonis et al., 2015; Han et al., 2016).

3.4.1 The Application of the Prospect Theory

In the process of consumer choices, it was suggested that editing and evaluation be included (Puto, 1987). Editing plays a significant role by analysing the problem, and then a decision maker restructures or frames the problem and formulates a series of prospects to simplify the problem. Later, the evaluation stage involves the value

assignment on each prospect and chooses the prospects with the greatest value (Puto, 1987; Y. Wang & Hazen, 2016).

Based on the literature, prospect theory was explained based on consumers' risk perceptions (Baillon et al., 2020; Kahneman, 1979; Levy, 1992). Those perceptions of risk may influence the outcome, for example, to trust or not to trust (Lu et al., 2005; Olya & Al-ansi, 2018; Olya & Altinay, 2016; Olya & Han, 2020). For instance, in Olya and Al-ansi (2018) study, prospect theory was adopted to investigate the effects of risk factors on consumers' satisfaction, their intention to recommend, and their intention to continue.

Furthermore, Al-Ansi et al., (2019) studied the effect of general risk on trust, satisfaction, and recommendation for halal food, of which the study also adopted prospect theory. Meanwhile, another study solely adopted prospect theory to investigate the effect of perceived risk and trust on the intention to recommend takeaway food during the pandemic in 2020 (Yeni et al., 2021).

Aside from that, prospect theory is also suggested in the study of the determinants of acceptance in food technologies studies as the researchers reported that consumers' risk perception and day-to-day food decisions are influenced by intuitive judgement and heuristics such as prospect theory (Lusk et al., 2014).

Usually, consumers lack knowledge of the technologies. Thus, it is crucial to explain briefly to the consumers when a new food technology is introduced (Lusk et al., 2014). Usually, consumers decide whether to accept a new food technology heuristically or through self-discovery based on their information and experience, especially when the consumers are already familiar with the brand (Lusk et al., 2014).

If consumers have a positive belief in their expectations based on the performance of the brand, they will likely develop brand trust (Porral & Levy-Mangin, 2016).

As consumers decide on the acceptance of food technology heuristically, this leads to a misconception of the objective probability that influences the outcome. Therefore, prospect theory is suited to investigate the acceptance of new food technology as Kahneman (1979) formulates the prospect theory based on the idea of how heuristics affect the probability judgment and thus affect the decision or behaviour (Kahneman, 1979). Prospect theory posits that decision-makers multiply a subjective probability by a value function (Lusk et al., 2014).

Apparently, prospect theory applied to investigate consumers' acceptance of new food technologies, where they need to consider risk and what they may lose if they were to accept particular risky conditions. For instance, in an article by Yeni and colleague, the writers contend that consumers need to consider the probability of getting infected if they decide on takeaway food from restaurants in a time of pandemic or to just cook at home (Yeni et al., 2021).

Therefore, the current study chose to adopt and adapt the prospect theory in the development of recombinant collagen-like protein as an alternative to animal-based collagen. The development of collagen-like protein is not only for halal assurance but also for environmental sustainability (Duasa et al., 2020; Siegrist & Hartmann, 2020a). Hence, it is imperative to investigate the consumers' acceptance and their intention to purchase if the collagen were to be commercialized.

Risk perception and trust factors should be considered when investigating consumers' acceptance owing to the fact that collagen-like protein was developed in the lab (Salleh et al., 2021). Therefore, prospect theory is suitable to be adopted in this study

as referring to previous studies (Al-Ansi et al., 2019; Leung & Cai, 2021; Olya & Al-ansi, 2018; Olya & Altinay, 2016).

The prospect theory implies that individuals behave based on the value function under the condition of uncertainty. In contrast, the person is more sensitive to losses than gains when facing risky choices (Kahneman, 1979). Therefore, this study assumes that consumers will behave with the intention to purchase based on the risk that they perceive.

Besides, consumers would behave based on their evaluation of alternatives, outcomes, and risk perception (M. Zhang et al., 2017). It is apparent that a prospective study would suggest how the consumers' perceived risk influence their intention to buy products with recombinant CLP. In previous literature, prospect theory emphasises that risk perceptions and trust factors have the authority to influence the consumers' behaviour, and previous studies usually segregated the risk perceptions into several types of risk (Al-Ansi et al., 2019; Olya & Al-ansi, 2018; Olya & Han, 2020).

In addition, attitude and religiosity constructs were included as the factors that influence risk perception referring to several pieces of literature (Sánchez-Cañizares et al., 2021; Siegrist, 2008; Siegrist et al., 2007). This study also would further extend the theory with knowledge as moderator as referred to another literature explaining that knowledge variable has the availability of information that affect the consumers' risk perception and thus, influence their acceptance of a product (Y. Wang & Hazen, 2016).

3.5 PURCHASE INTENTION

Consumer behaviour is a process of decision-making and consumer action of that involves purchasing and using products (Hauser et al., 2013; R. A. Rahman et al., 2021). It covers various aspects, such as need recognition, information search, evaluation of

alternatives, the building of purchase intention, the act of purchasing, consumption, and final disposal (Hauser et al., 2013; R. A. Rahman et al., 2021; Sarker et al., 2013).

Consumer behaviour could describe the variables that influence consumers intention to purchase (Lazaroiu et al., 2019). Intention to purchase could also be termed as the willingness to buy such that in some work of literature, the terms ‘purchase intention’, ‘intention to buy’, and ‘willingness to buy’ were often used interchangeably and carried similar research objectives (Coderoni & Perito, 2021; Hoeksma et al., 2017; Kuang et al., 2020; Lazaroiu et al., 2019). Besides, willingness to buy is also an important indicator of consumers’ purchase behaviour since it expresses the effort expended by consumers toward a concrete behaviour (Ghali, 2019; Rather et al., 2022).

Purchase intention is a type of decision-making that investigates the reason to buy goods or services (Mirabi et al., 2015; Shah et al., 2012). It describes a situation when a consumer tends to buy a certain product in a certain condition (Mirabi et al., 2015; Shah et al., 2012). Purchase intention has been extensively employed as an indicator of conduct prediction (Grewal et al., 1994; Liao et al., 2021; Mirabi et al., 2015; Pelaez et al., 2019; Shah et al., 2012; Siyal et al., 2021; Yusoff et al., 2015).

Consumers’ intentions were assumed to capture the motivational factors that influence behaviour (Ajzen, 2020). For instance, in a study of insect-based food, researchers attempted to introduce curiosity factor that has the potential to influence people’s willingness to try insect food, which this factor was considered as powerful motivator of behaviour that can overcome negative emotion (Stone et al., 2022).

On the one hand, several theories were applied to investigate the consumers’ purchase intention such as the theory of reasoned action (TRA) and the theory of planned behaviour (TPB) (Bukhari et al., 2020; Hussain et al., 2016; Mukhtar & Butt, 2012). The purchase intention studies would be more systematic with the application of suitable theory (Bukhari et al., 2020; Mukhtar & Butt, 2012; Vizano et al., 2020).

On the other hand, prospect theory also could also be adopted in purchase intention studies when the studies investigate the influence of risk perception on consumers' intention behaviour (Al-Ansi et al., 2019; Leung & Cai, 2021; Olya & Al-ansi, 2018; Olya & Altinay, 2016). Besides, prospect theory is often applied when researchers attempt to discover how individuals behave when they are in risky and uncertain situations (Bahmanziari & Odom, 2015; Baker et al., 2010; Dhami & Al-Nowaihi, 2007; Han et al., 2016; S. Liu et al., 2017; Lude & Prüggl, 2019; Luo et al., 2018; Pandey, 2018; Rasiel et al., 2005; Sebora & Cornwall, 1995; Young et al., 2012).

Nevertheless, this study adopted the prospect theory as it referred to several literature reviews on consumer behaviour studies (Al-Ansi et al., 2019; Leung & Cai, 2021; Olya & Al-ansi, 2018; Olya & Han, 2020). Usually, in these studies, prospect theory modelled the consumers behaviour for consumers to behave based on different values of gains and losses (Al-Ansi et al., 2019; Olya & Al-ansi, 2018). These studies were conducted through survey studies with constructed questionnaires.

Commonly, the factors that might influence purchase intention particularly on halal products were religious beliefs (Mukhtar & Butt, 2012). Moreover, consumers' perception of halal products, quality, safety, and knowledge are also factors that could determine the purchase intention of halal products (Vizano et al., 2020).

The prospect theory could be adopted with the risk perception framework to explore consumers' behaviour. The framework consists of consumers' knowledge as a variable, which is related to risk perceptions, and the risk perceptions have a negative impact on purchase intention (Leung & Cai, 2021). Apparently, in the survey of consumers' intention to purchase, risk perceptions are the main independent variables (Al-Ansi et al., 2019; Olya & Al-ansi, 2018). Similarly, this study would adopt the prospect theory to investigate the consumers' purchase intention on the recombinant CLP.

3.5.1 Determinants of Purchase Intention

Risk perception is an essential variable that should be one of the variables that affect final decisions in the consumers' behaviour studies that adopted prospect theory (Al-Ansi et al., 2019; Olya & Al-ansi, 2018; Weber & Johnson, 2009). An article explained that risk perception would be the mediator variable between dependent variable and an independent variable (Y. Wang & Hazen, 2016).

Similarly, in another study, knowledge and competency have an impact on risk perception when ordering digital food deliveries (Leung & Cai, 2021). Apparently, risk perceptions were considered important in investigating consumers' behaviour towards technology-based goods and services (D. Chen & Liang, 2006; Kostyk et al., 2017; M. Zhang et al., 2017).

Moreover, risk-benefit communication was emphasized in the study on the safety and hazard impact of genetically modified foods and crops (Choi et al., 2013; Ishii & Araki, 2016). The risk-benefit communication is closely related to the trust variable, which is also included in several consumers' behaviour towards innovative food (Connor & Siegrist, 2010; Hakim et al., 2020; Hu et al., 2020; Siegrist & Hartmann, 2020b, 2020a).

In addition to trust and risk perception variables, knowledge factor is also considered imperative intention behaviour studies (Ghali, 2019; B. Zhang et al., 2018; Y. Zhang et al., 2018). Ghali (2019) reported that knowledge and health consciousness factors influence consumers' intentions to consume organic food (Ghali, 2019). Aside from that, safety concern among consumers positively influences the purchase intention of safe vegetables (B. Zhang et al., 2018). Aside from that, the age and education of consumers also contributing factors to the purchase intention, where young and educated consumers have positive attitudes on foods with nanotechnology and they are willing to buy them (Kuang et al., 2020).

In conclusion, this study decided that the determinant of consumers' intention to purchase the product based on CLP would be attitude, religiosity, trust, and risk perception after referring to halal products literature (Briliana & Mursito, 2017; Garg & Joshi, 2018; Hussain et al., 2016; R. A. Rahman et al., 2021), and food products (De Canio & Martinelli, 2021; L. Wu et al., 2013). This was owing to the fact that the purpose of the recombinant CLP development was halal.

3.6 GAPS IN THE LITERATURE

Based on the explanation of the issues of collagen as well as the development of recombinant CLP in Chapter Two and Chapter Three, there are limited studies on the consumers' perception of the technology-based collagen to alternate with natural collagen. Some studies that investigated the consumers' acceptance of the recombinant CLP, but those studies did not emphasise the consumers' risk perceptions.

Furthermore, this study determined the type of risk perceptions that could have a significant impact on consumers' intentional behaviour. This was owing to the fact that most of consumer behaviour studies that construct risk perception framework investigate perceived risks in general without specifically segregating them.

Several pieces of literature regarding risk perceptions were found. however, there was limited evidence investigating the mediating role of risk perception in the relationship between other factors and consumers' intention to purchase. In addition, the literature on the moderating effect of knowledge is lacking, especially in the study of technology-based consumer goods. Hence, this study investigates the moderating effect of knowledge on the relationship between the factors and consumers' purchase intention.

This study also proposed the prospect theory focusing on consumers' risk perceptions' impact on consumers' intention to purchase the recombinant CLP. This study proposes prospect theory on risk perceptions to add to the evidence gap that

individuals should behave based on their evaluation of the alternatives, and outcomes from their risky options.

Moreover, this study would fill the practical gap through the outcome of the interviews with the academician regarding technology-based consumers goods, the entrepreneur who is directly involved in the industry, and the officer who is involved in halal certificate affirmation.

3.7 PROPOSED FRAMEWORK AND CONCEPTUAL OVERVIEW

After an extensive literature review, the study decides to adopt prospect theory to investigate the purchase intention of the recombinant CLP products. Conceptually, risk perception was the main factor in influencing consumers' intention to purchase (Al-Ansi et al., 2019; Han et al., 2016; Luo et al., 2018; Olya & Al-ansi, 2018; Olya & Han, 2020).

The risk perceptions were categorised into specific domains according to the study objectives, such as general risk (Al-Ansi et al., 2019). Aside from that, another study focuses on four dimensions of perceived risk, including financial loss, product performance, privacy and product delivery (Chiu et al., 2014).

Also, there is a study that defined perceived risk as a function of uncertainty regarding the outcome with the expectation of losses associated with a purchase. The perceived risk that obstructs the purchase behaviour could be financial, performance, social, physical, privacy, and time risk (Grewal et al., 1994; Y. Wang & Hazen, 2016).

Risk perceptions have been discussed since for a few decades. For instance, Paul Slovic (1987) discusses risk perceptions in his paper to provide the basis for understanding and anticipating a public response to hazards in order to improve risk communication among lay people, technical experts and decision-makers (Slovic, 1987).

In addition to Slovic (1987), Weber and colleagues conducted a survey by presenting a psychometric scale that assesses risk-taking in five content risk domains, which include financial decisions, health or safety, recreational, ethical, and social decisions (Slovic, 1987; Weber et al., 2002). Henceforth, this study has constructed the risk perception variable by segregating them into several types of risk perceptions after referring to previous studies (Slovic, 1987; Slovic et al., 1982; Slovic & Peters, 2006; Weber et al., 2002) consisting of health, social, environmental, quality, and financial risks.

In uncertain conditions, it is suitable to focus on health and quality risks as consumer considerations (Al-Ansi et al., 2019; Yeni et al., 2021). Health risk refers to the probability of getting sick from consuming a product with uncertain ingredients, while quality risk is the risk of unknown quality of the product (Yeni et al., 2021). Meanwhile, social risk refers to the risk of concern in the consumers' minds regarding others' perceptions of the product (Olya & Al-ansi, 2018). Environmental risk refers to considering the occurrence of threats to the environment that result from innovations (Liobikienė & Juknys, 2016; Onel & Mukherjee, 2016). Financial risk refers to consumer perception of the possible monetary loss (Y. Yang et al., 2015).

Several studies have presented evidence that risk perceptions influence consumers' intention behaviour. For instance, Olya and colleagues reported that health risk, psychological risks, environmental risks, social, quality, financial, and time risks influence the consumers' intention to continue using the halal items (Olya & Al-ansi, 2018). In addition, consumers' decision-making on buying takeaway food during the pandemic is also influenced by health, psychological, and quality risk (Yeni et al., 2021). Moreover, safety risk is also focus of another study on healthy food consumers (Luo et al., 2018).

In the meantime, the adoption of prospect theory is recommended for used in risk perception studies by using health and quality risk as consumer considerations (Al-Ansi et al., 2019; Yeni et al., 2021). Meanwhile, environmental risk focuses on the

individuals' perception of the outcomes in natural environments (Saari et al., 2021). Moreover, financial risk refers to consumers' perception of possible monetary loss (Y. Yang et al., 2015), and consumers might perceive social risk due to being advised to avoid risky consumption (Olya & Al-ansi, 2018).

The framework for this study was constructed with the risk perceptions that influenced the consumers' intention to purchase the recombinant CLP. It was then extended with several other variables consisting of attitude, religiosity, and trust. The consumers' attitude toward technology could influence their risk perceptions (Kuang et al., 2020; Siegrist, 2008; Siegrist et al., 2007), which eventually affects how they behave on final decisions (Weber et al., 2002).

In the meantime, the religiosity variable is also included as a factor to influence the purchase intention on the recombinant CLP because it is a significant predictor of the attitude toward halal products (Ngah et al., 2020). Moreover, several other studies have presented significant results exhibiting that the consumers' religious behaviour affects their consumption behaviour (Hussain et al., 2016; Mukhtar & Butt, 2012; Newaz et al., 2016; Nora & Minarti, 2017; Rizkitysha & Hananto, 2020).

The framework also extended with the trust variable after referring to several literatures (Al-Ansi et al., 2019; Hu et al., 2020; Mou et al., 2017; Siegrist, 2021). The relationship between trust and risk perception is interchangeably where; risk perceptions could influence consumer trust (Al-Ansi et al., 2019), and trust could influence risk perceptions (Hu et al., 2020; Mou et al., 2017; Siegrist et al., 2021). Nevertheless, trust has an impact on consumers' purchase intention (E. Choi & Lee, 2019), and is one of the predictors of consumer satisfaction (Druică et al., 2021).

This framework of the study was also constructed to investigate the moderating effect of knowledge on the relationship between attitude, religiosity, trust, and risk perceptions with the consumers' purchase intention. A study reported that environmental knowledge moderated the effect of consumer ecological attitudes toward

green behaviour (Suki, 2016). Meanwhile, in another study, knowledge was a moderator between trust and purchase intention among online consumers (Huei-Shan et al., 2015).

Besides, it was reported that respondents from low-risk and high-knowledge group had higher purchase intention for a new product evaluation. Even though consumers are at higher risk, but acquiring more knowledge will result in higher purchase intention (Tuu & Olsen, 2012). Figure 3.2 portrays the proposed research framework in this study. Further explanation of the selected determinants is described in the next section of the development of hypotheses.

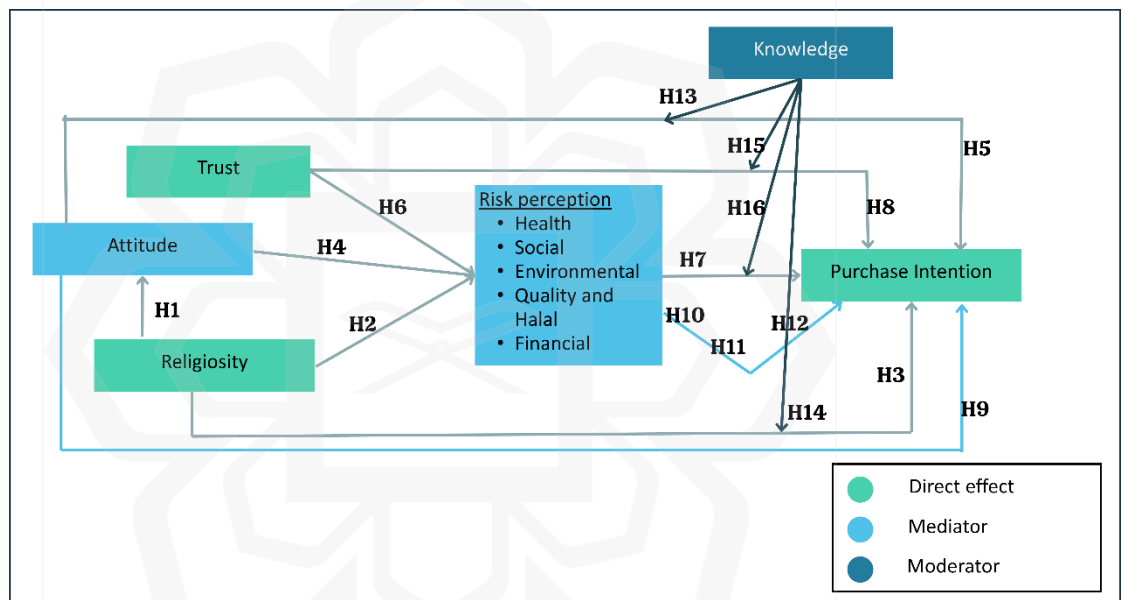


Figure 3.2 Proposed framework (author's illustration)

3.8 DEVELOPMENT OF HYPOTHESES

Based on the description of the conceptual framework above, sixteen hypotheses were developed to describe the relationship designed in the framework. These hypotheses were developed according to the objective, and they were tested to answer the research questions. The following sub-section shall explain each variable in detail and outline the hypothesis that has been developed for this study.

3.8.1 Religiosity, Attitudes, Risk Perception and Purchase Intention

Religiosity is a system of practices and beliefs that persuade people's decisions and satisfaction, and it plays a significant role in how people behave and act on a good and service (Garg & Joshi, 2018). It refers to the extent to which an individual is committed to the religion he/she professes and its teachings, such that the individual's attitudes and behaviours reflect this commitment (Johnson et al., 2001).

It was suggested that an individual's attitude reflects their religiosity. In contrast, a more religious individual would tend to align his/her behaviour in accordance with religious laws, and he/she would attitudinally be able to make coherent decisions with their religious laws (Newaz et al., 2016).

The passion and love of the religion made the believers commit to the rule, thus influencing their attitude toward consumption (Jamal, 2003). Hence, Muslim consumers would strive to live their way as how Islam taught them to be, which is called Shari'ah. It is the Islamic law, that governs Muslims in all activities, transactions, and ways to life (Ansari, 2014).

Moreover, since religion provides values and principles, it affects a consumer's attitude and behaviour, mainly in the buying and consumption process (Garg & Joshi, 2018; Newaz et al., 2016). Therefore, religiosity and attitude have a positive relationship as reported in pieces of literature. For instance, religiosity affects consumers' likes and dislikes (Shabbir, 2010).

Religiosity also has a role in shaping consumer decisions, particularly in the Halal context (Rizkitysha & Hananto, 2020), where a review paper strongly implied that religiosity is an important factor in shaping Muslim consumers' lives and decisions (Salam et al., 2018).

Besides, religiosity also has a positive effect on the purchase intention of halal detergent (Rizkitysha & Hananto, 2020) since it shapes the consumers' decision on buying and consuming. In another study, religiosity was also significant predictor of the intention to consume halal products in international chain restaurants (Asnawi et al., 2018).

Consumers would perceive risk to consume any product because they need to avoid any products that have the possibility of non-halal contamination (Tieman et al., 2013; Yaacob et al., 2016). This study will also attempt to investigate if there exists a relationship between religiosity and risk perception. It was due to several pieces of literature stated that, Muslim consumers perceived several types of risk due to the doubtful contents of halal items such as quality risk, health or safety risk, psychological risk, social risk, and environmental risk (Bonne & Verbeke, 2006, 2008; Olya & Al-ansi, 2018).

H1: Religiosity has a direct positive relationship with consumers' attitude.

H2: Religiosity has a direct relationship with consumers' risk perception of recombinant CLP.

H3: Religiosity influences consumers' purchase intention on the recombinant CLP.

3.8.2 Attitudes, Risk Perception, and Purchase Intention

People's attitude toward risk depends on their perceptions of the risk itself, and the information they have in their hands might have an impact on their attitude and perception toward risks (Slovic, 1987). Attitude refers to an individual's evaluation of a particular behaviour, which could be either positive or negative forms (Fishbein & Ajzen, 2011).

There were two types of attitudes: general attitudes on physical objects, ethnic or other groups, institutions, policies, events, or other general targets. The second type

is the attitude toward specific behaviour with respect to an object or target which is called an “attitude toward a behaviour” (Ajzen et al., 2018).

The perspective of attitude has been used for a century, and it seems that Fishbein and Ajzen’s perspective of attitude is novel and gives fewer issues (Douglass et al., 1977). It determines the intention to behave, where a positive attitude contribute to a greater individual intention to purchase (Ajzen, 1989; Douglass et al., 1977) such that consumers with a positive attitude toward nanotechnology food would likely have an intention to purchase the products (Kuang et al., 2020).

H4: Attitude has a direct relationship with consumers’ risk perception on recombinant CLP.

H5: Attitude influences consumers’ purchase intention on the recombinant CLP.

3.8.3 Risk Perception, Trust and Purchase Intention

Indeed, people usually vary in making decisions in either work-related or personal matters when involving risk and uncertainty. People’s attitudes differ according to their perception of risk (Loewenstein et al., 2001; Weber et al., 2002).

Weber (2002), in his paper, assumed that attitude toward risk perception determines the consumers’ behavioural intention. In most studies, risk perception has been associated with trust thus, lead to the intention to buy (Al-Ansi et al., 2019; E. Choi & Lee, 2019; Connor & Siegrist, 2010; Hakim et al., 2020; Hu et al., 2020; Ross et al., 2014; Xiao et al., 2017). Particularly, risk significantly and positively affects consumers’ trust, and it stands as a variable that determines the consumers’ decision-making (Al-Ansi et al., 2019; Olya & Al-ansi, 2018).

Moreover, Siegrist (1999) proposed a simple model, which suggests that trust influences the risks and benefits of consumers’ food technology studies (Siegrist, 1999).

Both trust and risk constructs affect the consumers' perception and acceptance of the new technology in the food industry since the researchers were contemplating whether the trust could directly or indirectly influence the acceptance (Bronfman & Vázquez, 2011; Siegrist, 2021; Terwel et al., 2009; Tsujikawa et al., 2016; Visschers et al., 2011)

Therefore, both risk and benefit constructs should be included to determine the public acceptance of new technology. The causal model identifies the perceived benefit, perceived risks, and trust as the three most important factors that affect public acceptance (Siegrist, 1999, 2000). The causal model theoretically explains that trust indirectly influences consumers' perception and acceptance, whereby trust positively influences perceived benefit and negatively influences perceived risk, and both risk and benefits positively influence consumers' acceptance (Siegrist, 1999).

Furthermore, in the studies of consumers risk perception as well as consumers' willingness to buy genetically modified food (GMF), trust was proposed to influence the risk perception (Hakim et al., 2020; Hu et al., 2020). Trust also influences risk perception in nuclear power plant studies (Xiao et al., 2017) and in consumers' acceptance of e-service (Mou et al., 2017). Therefore, this study proposed that trust affects consumers' perception of risk when developing recombinant CLP.

The concept of risk perception was proposed by Bauer in 1960 with the hope that it would attract both practitioners and researchers (Bauer, 1960; Mitchell, 1999). The concept then attracted both practitioners (Farquhar, 1994) and academicians in the 1990s (Grewal et al., 1994). The risk perception concept was then applied in innumerable areas (Alden et al., 1994; Coleman et al., 1994; Ho & Ng, 1994; Jasper & Ouellette, 1994).

In the emergence of the perceived risk concept, both academicians and practitioners are interested in the concept because the perceived risk theory has intuitive appeal and helps marketers have consumers' perceptions. The perceived risk concept is also powerful in explaining consumers' behaviour since consumers' priorities are avoiding mistakes rather than maximising their utility (Mitchell, 1999). Aside from that,

risk analysis can also be used in marketing resource allocation decisions and be helpful in brand-image development, targeting, positioning, and segmentation. Moreover, examining risk perceptions can generate new product ideas (Mitchell, 1999).

Meanwhile in the halal study, perceived risk constituted several types of risk: health, psychological, environmental, social, quality, financial, and time loss risk (Al-Ansi et al., 2019; Olya & Al-ansi, 2018; Yeni et al., 2021). These risks could result in bad consumer decision-making (Mai, 2001; Olya & Al-ansi, 2018). Consumers usually perceive environmental risks, quality risks, and health risks in halal food because of the possible contamination in the products due to the direct contact between, and mixture of, halal products and forbidden harmful ingredients (Al-Ansi et al., 2019; Olya & Al-ansi, 2018).

Besides, Muslim consumers always raise concerns about the health risks prior to consuming halal food. Aside from that, they would also perceive social risk due to the doubtful contents of halal items because they have been advised to avoid the consumption of prohibited items to safeguard their religion and honour (Olya & Al-ansi, 2018). Time loss and financial risks are also perceived among Muslim consumers since they might need to spend more time and effort in finding, purchasing, and consuming halal items (Bonne et al., 2007; Bonne & Verbeke, 2006; Olya & Al-ansi, 2018). Therefore, the hypotheses postulated for risk perception are listed below.

H6: Consumers' trust affects their risk perception of the recombinant CLP.

H7: Consumers' risk perception influences their purchase intention on the recombinant CLP.

3.8.4 Trust and Purchase Intention

On the one hand, trust is a psychological state comprising the intention to accept the vulnerability based upon positive expectation of the intention or behaviour of another (Rousseau et al., 1998; Siegrist, 2021). On the other hand, trust was defined as the

expectation that buyers and sellers would behave according to the implied commitment (Pullman & Wu, 2012). Literally, trust is somewhat of a psychological stated between two parties (Connor & Siegrist, 2010; Ross et al., 2014; Xiao et al., 2017), business providers and customers (Al-Ansi et al., 2019; Artigas et al., 2017), the supplier and buyer relationships (Mallet et al., 2022; Zulfakar et al., 2014), and patient-consultant relationships (Druică et al., 2021).

Various studies were found in relation to trust where information or knowledge and trust are related to each other, but usually, consumers lack information on new technology, such as genetically modified foods, genome editing crops, nanotechnology foods, and others (Hakim et al., 2020; Ishii & Araki, 2016; Kuang et al., 2020). Hence, they will partially rely on the individual or an institution to determine their acceptability on these new technologies, especially when the product could cause a hazard, which is a major concern among consumers (Siegrist, 2021).

Aside from that, patient satisfaction in community pharmacy is correlated with trust, which involves the relationship between patient and pharmacist's consultations (Druică et al., 2021). In another study, trust positively mediates the relationship between supplier and buyer, and supply chain sustainability (Mallet et al., 2022).

Several pieces of literature explain that trust requires not only emotional acceptance among the public but also the affirmation of the competence of the party involved (Blomqvist, 1998; Xiao et al., 2017). It is crucial to investigate trust among the public to get a better understanding of the public's risk perceptions since trust might directly influence risk or benefit perception (Xiao et al., 2017).

In some empirical investigations, trust is directly influenced by the perceived risk and benefit prior to accepting the technology (Hu et al., 2020; Ross et al., 2014; Siegrist, 1999; Siegrist, 2000; Siegrist, 2021; Wang et al., 2019).

However, in another study of halal such as halal tourism and halal food, trust was affected by the general risk and it affected the behavioural intention (Al-Ansi et al.,

2019; Olya & Al-ansi, 2018; Olya & Han, 2020). It also plays a vital role in influencing consumer purchasing behaviour as reported by an empirical study of the halal food industry in non-Muslim countries like Canada and Belgium (Zulfakar et al., 2014).

Aside from that, trust determines the consumers' intention to halal food consumption (Vanany et al., 2019). The trust among customers is usually influenced by several factors, such as treatment, attitude, and honesty as represented by the sellers or consultants (Artigas et al., 2017; Druică et al., 2021).

In the halal food supply chain study, trust is also one of the essential factors in enhancing halal integrity, where it was reported that trust and commitment were interrelated (Zulfakar et al., 2014). The study explained that the higher the trust, the higher the willingness of the parties to commit to any specific matter (Kwon & Suh, 2005; Zulfakar et al., 2014).

Halal labels could also induce trust among consumers in multiracial society, where the halal label plays a vital role. However, some Muslim consumers were still sceptical and had less trust in the halal label itself, especially when there was a case of fraud involving a fake halal label and certification to attract Muslim consumers (Al-Ansi et al., 2019; Zulfakar et al., 2014).

Trust has contributed significantly to business and communication objectives; for example, trust has been linked to loyalty (E. Choi & Lee, 2019). Meanwhile, public trust in an institution also determines their trust in halal labels and certificates, where public trust in the responsible institution contributes to an increase in purchase intention (Zulfakar et al., 2014). Therefore, we assumed that trust contributes to consumers' purchase intention.

H8: Consumers' trust influences their purchase intention on the recombinant CLP.

3.8.5 The Mediating Effect of Attitude and Risk Perception

A variable is called a mediator when it is involved in the relationship of two variables, namely predictor and criterion (Baron & Kenny, 1986). Attitude has been found in several literature that it has a mediating effect on the relationship between exogenous and endogenous variables generally (Bae & Chang, 2021; Baron & Kenny, 1986; Khurana et al., 2020; López-Bonilla & López-Bonilla, 2017; Wardana et al., 2020). Attitude also has a mediating effect on the relationship between predictors and consumers' purchase intention (Chin et al., 2020; Garg & Joshi, 2018; Indriani et al., 2019; Koththagoda & Herath, 2018; Lim et al., 2017; Pop et al., 2023).

More specifically, for this study, the attitude was proposed to have a mediating effect on the relationship between religiosity and purchase intention. It has an essential role as a mediator that it mediates the relationship between religiosity and purchase intention (Garg & Joshi, 2018). Moreover, attitude also mediates the relationship between religiosity and willingness to pay for halal transportation (Nghah et al., 2020).

Aside from that, attitude could mediate the relationship between religiosity and the intention to buy halal food by the millennial generation (Setiawati et al., 2019). Furthermore, attitude has been proposed as a mediator in the relationship between religiosity and purchase intention and lifestyle (Nora & Minarti, 2017).

Therefore, this study proposed the variable as a mediator variable for religiosity and purchase intention after referring to several works of literature. In conclusion, attitude could have both direct and indirect effects on behavioural intention (Çabuk et al., 2014; Garg & Joshi, 2018; Hussain et al., 2016). Therefore, the attitude will act as a mediator variable for this study as well.

H9: Attitude mediates the relationship between religiosity and purchase intention on the recombinant CLP.

In the meantime, considering the risk perception model as well as the prospect theory, the study also proposed to test the mediating effect of risk perception on the relationship between predictors in this study and purchase intention. Risk perception has been proposed and tested to have a mediating effect such as on the relationship between trust and contract enforcement (Yao et al., 2019).

Innumerable studies exhibited the role of risk perception as a mediator. However, these studies were performed in different areas of study, such as air pollution and health symptoms (Bergstra et al., 2018), the individual's risk perceptions during the pandemic outbreak (Adam et al., 2022; Heydari et al., 2021), investors' behaviour (Z. Ahmed et al., 2022; Waheed et al., 2020), tourists' behaviour (Yazid et al., 2018; Zhu & Deng, 2020), and several others (Sozer, 2019; Sulaiman et al., 2018; Zhang et al., 2022).

Among the literature, several studies investigated the mediating role of consumers risk perception on their purchasing behaviour, as presented by Zhang et al. (2022). Their paper reported a significant result on risk perception mediating the influence of word of mouth from artificial intelligence on consumers' purchasing behaviour (Zhang et al., 2022). Aside from that, risk perceptions also mediate the effect of e-marketing on consumers buying decisions (Adam et al., 2022).

In other studies, the risk perception showed a mediating effect of dynamic pricing during holidays on consumers' purchase intention (Sozer, 2019) and the impact of green halal consumption on halal consumption patterns (Sulaiman et al., 2018). Nevertheless, for this study, risk perceptions were proposed as a mediator variable that mediates the relationship between attitude, religiosity, and trust in consumers' purchase intention in recombinant CLP products.

H10: Risk Perception mediates the relationship between attitude and purchase intention on the recombinant CLP.

H11: Risk Perception mediates the relationship between religiosity and purchase intention on the recombinant CLP.

H12: Risk Perception mediates the relationship between trust and purchase intention on the recombinant CLP.

3.8.6 The Moderating Effect: Knowledge

The prospect theory suggests that people make decisions based on the information they have (Adonis et al., 2015). Literally, there was objective and subjective knowledge (Park et al., 1994), where the former is the accurate and actual information about the product category and can be measured with a tailored test.

Meanwhile, subjective knowledge is a self-assessment of an individual's knowledge, thus representing what the individual thinks (s)he knows about the product category (Piha et al., 2018). Usually, laypeople often act on the risk based on their subjective perception rather than objective knowledge since they have less information on the risk (Leung & Cai, 2021). Consumers' knowledge of products is a key factor in influencing their decision-making process (Bettman & Park, 1980; Kim & Bonn, 2015; Rao & Monroe, 1988).

Consume knowledge is an important factor that contributes to consumers' behaviour (Ghali, 2019; Megido et al., 2016; Siegrist & Hartmann, 2020a; Wang et al., 2019). Consumer knowledge is a significant driver of their willingness to buy (Ghali, 2019), and influences their acceptance (Megido et al., 2016; Siegrist & Hartmann, 2020a). In addition, knowledge also has a positive relationship with public acceptance of nuclear energy (Wang et al., 2019) and is suitable to be included in investigating the consumers' behaviour toward a product that is still nascent in the market (Ghali, 2019; Kuang et al., 2020).

On top of that, knowledge regarding risk perception on certain diseases is also important, whereby knowledge of an infectious disease is negatively related to the public's risk perceptions (Iorfa et al., 2020). Hence, this contributes to an increase in pre-cautionary behaviour (Iorfa et al., 2020; Zhong et al., 2021).

Various studies have been conducted on the relationship between product knowledge, brand knowledge, and knowledge in general. These variables have been described to have a moderating effect on the relationship between the predictors and the intention variables depending on the context of the study (Kim & Bonn, 2015; Suki, 2016; Wang et al., 2019).

In the study of wine knowledge, Kim and Bonn (2015) proposed the moderating role of product knowledge on the relationship of predictor variables (consumers' perception of organic wine, environmental factor, trust factor, and taste factor) on their intention to purchase organic wine. The study reported that the knowledge factor did have a moderating role in the relationship between consumers' perceptions of the trust factor and their intention to purchase. At the same time, other hypotheses were rejected (Kim & Bonn, 2015).

In another study regarding green brand knowledge, it was explained that green brand knowledge moderated the relationship between green brand positioning and the purchase intention of the green product. However, the proposed hypothesis was rejected (Suki, 2016).

Meanwhile, in the organic food purchase intention study, the researchers attempted to explore the role of knowledge as a moderating variable on consumers' intention to purchase organic foods. The study theoretically hypothesised that knowledge positively moderates the relationship between subjective norms, personal attitude, perceived behavioural control, and health consciousness with consumers' purchase intention (Shaharudin et al., 2010). Their analysis outcome showed that the knowledge significantly moderates the relationship as proposed in their hypothesis (Wang et al., 2019).

Therefore, this study explored the role of knowledge as a moderating variable on the relationship between the predictors and consumers' purchase intention. During

the literature finding, the literature on consumers' knowledge as moderators is lacking. Thus, this study attempts to analyse knowledge as a moderator.

Moderating variables are able to show the strength or direction of a relationship between independent and dependent variables (Baron & Kenny, 1986). For instance, in a study of the online shopping experience, product knowledge is able to examine the strength of the relationship between recommendation quality and customer satisfaction (Yoon et al., 2013); thus, knowledge as a moderator can affect the intensification of the relationship between variables (Pacheco et al., 2018).

In this study, knowledge may also act as a moderating variable that might intensify the relationship between variables. In a study on the determinant of the likelihood of choosing alternative sources of collagen, where recombinant CLP was the alternative source, 70 percent of the respondents were said to be familiar with the concept of recombinant CLP (Duasa & Husin, 2020). These 70 percent of respondents implied they were aware of the current method of extracting collagen, which has been used in health care and cosmetic industries (Duasa & Husin, 2020). Moreover, 58.4 percent of respondents heard about the recombinant CLP in Malaysia (Duasa & Husin, 2020). Apparently, consumers might know the recombinant CLP, which this study can further investigate if their knowledge might affect the relationship among other variables.

H13: Knowledge moderates the relationship between attitude and purchase intention on the recombinant CLP.

H14: Knowledge moderates the relationship between religiosity and purchase intention on the recombinant CLP.

H15: Knowledge moderates the relationship between trust and purchase intention on the recombinant CLP.

H16: Knowledge moderates the relationship between risk perception and purchase intention on the recombinant CLP.

3.9 SUMMARY OF RESEARCH HYPOTHESES

As explained in the previous section, the study has provided evidence to prove the need to investigate the consumers' decision to purchase or not to purchase the recombinant CLP. Based on the reviews and former discussion, this section thus summarises sixteen (16) research hypotheses, which have been postulated in this study below. Meanwhile, Table 4.1 summarizes the research objectives, research questions, and research hypotheses.

- H1:** Religiosity has a direct positive relationship with consumers' attitude.
- H2:** Religiosity has a direct relationship with consumers' risk perception of recombinant CLP.
- H3:** Religiosity influences consumers' purchase intention on the recombinant CLP.
- H4:** Attitude has a direct relationship with consumers' risk perception on recombinant CLP.
- H5:** Attitude influences consumers' purchase intention on the recombinant CLP.
- H6:** Consumers' trust affects their risk perception on the recombinant CLP.
- H7:** Consumers' risk perception influences their purchase intention on the recombinant CLP.
- H8:** Consumers' trust influences their purchase intention on the recombinant CLP.
- H9:** Attitude mediates the relationship between religiosity and purchase intention on the recombinant CLP.
- H10:** Risk Perception mediates the relationship between attitude and purchase intention on the recombinant CLP.
- H11:** Risk Perception mediates the relationship between religiosity and purchase intention on the recombinant CLP.
- H12:** Risk Perception mediates the relationship between trust and purchase intention on the recombinant CLP.

H13: Knowledge moderates the relationship between attitude and purchase intention on the recombinant CLP.

H14: Knowledge moderates the relationship between religiosity and purchase intention on the recombinant CLP.

H15: Knowledge moderates the relationship between trust and purchase intention on the recombinant CLP.

H16: Knowledge moderates the relationship between risk perception and purchase intention on the recombinant CLP.

Table 3.1 Research Objectives, Research Questions, and Research Hypotheses

Research Objectives	Research Questions	Research Hypotheses
<p>RO3: To investigate consumers' risk perception and their purchase intention towards development of recombinant CLP.</p>	<p>RQ3: How do consumers perceive the risk of recombinant CLP and what is their purchase intention on products containing recombinant CLP?</p>	<p>H2: Religiosity factors have a direct relationship with consumers' risk perception of recombinant CLP.</p>
		<p>H4: Attitude has a direct relationship with consumers' risk perception on recombinant CLP.</p>
		<p>H6: Consumers' trust affects their risk perception on the recombinant CLP.</p>
		<p>H3: Religiosity factors influence consumers' purchase intention on the recombinant CLP.</p>
		<p>H5: Attitude influences consumers' purchase intention on the recombinant CLP.</p>
		<p>H7: Consumers' risk perception influences their purchase intention on the recombinant CLP.</p>
		<p>H8: Consumers' trust influences their purchase intention on the recombinant CLP.</p>

<p>RO4: To examine the mediating role of risk perception and attitude and the moderating effect of knowledge on the relationship between the predictor variables and consumers' purchase intention.</p>	<p>RQ4: Do risk perception and attitude have a mediating effect and does knowledge has a moderating role on the relationship between the predictor variables and consumers' purchase intention?</p>	<p>H9: Attitude mediates the relationship between religiosity and purchase intention on the recombinant CLP</p>
		<p>H10: Risk Perception mediates the relationship between attitude and purchase intention on the recombinant CLP.</p>
		<p>H11: Risk Perception mediates the relationship between religiosity and purchase intention on the recombinant CLP.</p>
		<p>H12: Risk Perception mediates the relationship between trust and purchase intention on the recombinant CLP.</p>
		<p>H13: Knowledge on moderates the relationship between attitude and purchase intention on the recombinant CLP.</p>
		<p>H14: Knowledge on moderates the relationship between religiosity and purchase intention on the recombinant CLP.</p>
		<p>H15: Knowledge on moderates the relationship between trust and purchase intention on the recombinant CLP.</p>
		<p>H16: Knowledge on moderates the relationship between risk perception and purchase intention on the recombinant CLP.</p>

3.10 CHAPTER SUMMARY

Chapter 4 established the foundation of the study after the extensive literature review on each variable. Prospect theory was adopted into the risk perception framework, which extended with three additional variables: attitude, religiosity, and trust. The prospect theory suggests that consumers become risk-averse when facing gains but become risk-seeking when they face losses. Moreover, the mediating role of risk

perceptions and attitude was verified in this chapter as well as the moderating effect of knowledge. At the end of the chapter, the framework was portrayed, together with the description of the hypotheses. Later, Chapter 4 explains the methods used to explore all hypotheses proposed in this study.



CHAPTER FOUR

RESEARCH METHOD

4.1 INTRODUCTION

This chapter explains the procedure carried out to perform the research of, which is comprised of the research design, research method, sample size, sampling technique, and data collection techniques. The chapter also described the tools used to analyse the data, which were the Statistical Package of Social Sciences (SPSS) for data entry and SmartPLS for measurement and structural analysis.

4.2 RESEARCH DESIGN

Research design can be defined as a blueprint of data collection, measurement, and analysis planned to answer specific research questions (Sekaran & Bougie, 2016). In other words, research design outlines the methods that are going to be used in collecting the data, suitable tools to be used, and how these are going to answer the research questions. The function of research design is to ensure that the data collected by the researchers is able to effectively answer the research questions (De Vaus, 2001). Therefore, the design should specify the methods and procedures for collecting and analysing the required information (Zikmund et al., 2013).

This study is designed to use mixed methods, which consist of qualitative (interview) and quantitative (survey) techniques to efficiently observe the acceptance of the development of the recombinant CLP for halal collagen. The mixed method is designed to combine the elements of several different methods such as interviews and survey questions (Axinn, 1991). The method provides the opportunity to use multiple sources of information from various approaches to gain new insights into the social world (Axinn, 1991; Axinn & Pearce, 2006; Kertzer & Fricke, 1997). Through a mixed

method approach, the researcher incorporates both quantitative and qualitative methods of collecting and analysing data in a single research study (Creswell & John, 2018).

A qualitative, semi-structured interview was conducted among experts regarding the recombinant CLP as halal collagen. The interview method can be described as an organized conversation that is guided by new information obtained as the interactive discussion unfolds (Ahlin, 2019). Meanwhile, a quantitative technique would involve a self-constructed questionnaire will be distributed among consumers to investigate their acceptance and intention to purchase the product containing recombinant CLP.

A cross-sectional study will be carried out using a quantitative approach from the selected population sampling (Garg & Joshi, 2018). Commonly, cross-sectional studies are carried out to estimate the prevalence of the outcome of interest for a given population (Levin, 2006). Besides, based on the previous studies on behavioural intention, most studies applied cross-sectional for their methods of research (Garg & Joshi, 2018; Rahman et al., 2021; Shan et al., 2017; Zhang et al., 2018; Zhang et al., 2020) thus, it will be performed for this study as well.

4.3 QUALITATIVE RESEARCH METHOD

A semi-structured interview was conducted using a qualitative approach, which involves data collection, analysis, and report writing (Ollerenshaw & Creswell, 2002). It begins with a set of standardized questions constructed by the researchers for selected respondents. The interview could also be described as an organized conversation that is guided by new information obtained as the interactive discussion unfolds (Ahlin, 2019).

This method helps to strengthen the findings of the study through the information obtained from the experts. Moreover, through this method, rather than relating the variables or finding the association, it typically describes the perspective about the recombinant CLP developed as halal collagen. It may answer the question of “what”, “how”, and “why”.

The steps for the analysis in the interview method include: (1) audiotape the interview and transcribe them; (2) read the transcript thoroughly to code the data by segmenting the text; (3) develop themes using the codes by aggregating similar codes together; (4) connecting and interrelating themes; and (5) construct a narrative (Ollerenshaw & Creswell, 2002).

4.3.1 Data Collection: Semi-Structured Interview

Semi-structured interviews are a research method for collecting data from a group of subject matter experts (Ahlin, 2019). It can be much more flexible, allowing the respondents to change the course of conversation and relate the topic with current issues that researchers had not preconceived (Axinn & Pearce, 2006). In other words, it incorporates opportunities for more detailed inquiry into topics that arise during researcher-respondent discussions (Ahlin, 2019).

At this stage, this study aims to obtain the expertise perception in the related field regarding the development of recombinant CLP as halal collagen. The experts were asked about their knowledge regarding collagen in general, the suitability of the recombinant CLP, and the viability of the recombinant CLP. The interviews were recorded with suitable instruments and all interviewees were aware of them being recorded. The interview protocols have fulfilled the required conditions such as a list of questions, information about interviewees, their positions, and the date and time of interviews conducted.

4.3.2 Sampling Technique

A purposive sampling technique will be applied in this study to specify categories of experts to be included in the interview. This technique was chosen because research has

set the categories of individuals that may have an important perspective to answer the questions that arose in the study (Robinson, 2014).

4.3.3 Selection of Interviewee

The interviewees were selected based on their possessed knowledge, exposure, and expertise in the related field. In general, for qualitative data, there were different recommendations on the accurate number of interviewees; where a study suggested that nine to seventeen interviewees can reach data saturation, but it is depending on the type of study (Hennink & Kaiser, 2022).

Aside from that, other scholars stated that the number of unique answers from a study's questions for an interview is not huge. For instance, if a study interviews a hundred experts, it will not obtain a hundred unique answers but rather several opinions that are repetitive (Cobern & Adams, 2020). For experts' interviews, identifying a small number will provide in-depth information and insights (Creswell et al., 2006). Hence, four to five should be enough for this study (Creswell & John, 2018).

This study somehow attempted to approach seven experts to be interviewed with various expertise and experiences related to the development of recombinant CLP and its purpose. Seven experts were chosen because the study would like to analyse whether their insights and perceptions are unique. The table below describes the background of the interviewee for this study. Table 5.1 lists the interviewees.

Table 4.1 Information of the Interviewees

Name	Background of Interviewee
Muhammad Shirwan bin	Deputy Dean, Assistant Professor, International Institute for Halal Research and Training (INHART)

Abdullah Sani (Dr.)	<p>Area of expertise.</p> <ul style="list-style-type: none"> - Natural Sciences - Chemical Sciences - Analytical Chemistry - Instrumental Sciences
Mohammad Aizat bin Jamaludin (Dr)	<p>Head, Associate Professor, International Institute for Halal Research and Training (INHART)</p> <p>Area of expertise.</p> <ul style="list-style-type: none"> - Social Sciences - Syariah Law - Islamic Jurisprudence - Fiqh Halal and Consumerism
Mohd Azemi bin Mohd Noor (Prof Dato Dr)	<p>Deputy President at Academic and Technology in UniKL</p> <p>The Senior Professor in University Kuala Lumpur (UniKL)</p> <p>Area of expertise.</p> <ul style="list-style-type: none"> - Food Technology - Food Biotechnology
Mohd Adzim Khalili bin Rohin (Dr)	<p>Academician in University Sultan Zainal Abidin (UNISZA)</p> <p>Area of expertise.</p> <ul style="list-style-type: none"> - Functional Food and Nutraceuticals - Hazard Analysis and Risk Assessment - Halal Products - Entrepreneurship - Food Safety - Food Chemistry - Nutritional Sciences - Community Nutrition
Sharifah Emilia binti Tuan Sharif (Dr)	<p>Head of Department, Pathology, School of Health Science, Universiti Sains Malaysia.</p> <p>Academician in Universiti Sains Malaysia (USM), Health Campus</p> <p>Area of expertise.</p>

	- General Histopathology with a particular interest in Soft Tissue and Bone Pathology
Azilawati binti Mohd Ismail (Dr)	Food Technologist, Hub Halal Division, Malaysia Halal Analysis Centre, JAKIM Area of expertise. - Food Technology
Zahin Ilman bin Othman	Managing Director, Superfood Biotech Sdn. Bhd. Area of expertise - Master Business Administration - Bachelor of Applied Science

The interviewees were selected considering the study's subject matter, the development of recombinant CLP for halal collagen. Since the recombinant CLP is for halal purposes, interviewees from the halal research institute under the International Islamic University Malaysia (IIUM) were selected.

Aside from that, academicians from other universities also approached who were from Universiti Sultan Zainal Abidin (UniSZA), Universiti Sains Malaysia (USM), and Universiti Kuala Lumpur (UniKL). The science officer from Jabatan Kemajuan Islam Malaysia (JAKIM) is also one of the experts to be interviewed. Another interviewee is the managing director of the halal nutraceuticals food supplements, Superfood Biotech.

The academicians selected acquired pieces of expertise that are suitable for our purpose. For instance, the interviewee from UniSZA has expertise in functional food, nutraceuticals, nutrition, food safety and halal products. Meanwhile, the academician from USM is a Pathologist with a particular interest in Soft Tissue. The senior professor from UniKL is a Professor Emeritus who is not only an expert in food technology but also has experience with the halal industry, for which he worked closely with JAKIM regarding halal issues. Moreover, the study succeeded getting close and interviewed the science officer from JAKIM, who also obtained her PhD in Food Technology from UPM.

4.3.4 Research Instruments

The instrument used in this study through a qualitative approach is a semi-structured interview. Through interviews, the researcher could get firsthand information directly from knowledgeable informants (Zohrabi, 2013). An interview is good for measuring attitudes and most other content of interest, and it allows the interviewer to ask probing questions to the interviewee to get in-depth information (Zohrabi, 2013). The study constructed the interview questions covering the information on collagen in general and the information on the suitability and viability of the recombinant CLP.

4.3.5 Interview Data Analysis

Analysing qualitative interviews may generate large amounts of data, which involve up to six hours of transcribing (Neuman, 2011; Zohrabi, 2013). However, the data can be systematically analysed through coding where two steps of coding that have been discussed in social science research were (1) generating meaningful data units; and (2) classifying and ordering these units (Dörnyei & Taguchi, 2009; Zohrabi, 2013). The interviews for this study were recorded using suitable and convenient instruments. The recording is then transcribed into field notes and analysed using the thematic content analysis method, which is an independent qualitative descriptive approach (Vaismoradi et al., 2013). It is described as a method for identifying, analysing, and reporting patterns (themes) within data (Braun & Clarke, 2006).

4.4 QUANTITATIVE RESEARCH METHOD (QUESTIONNAIRE)

In contrast to qualitative measures, quantitative has several steps of techniques because the aim to capture the details of the social world precisely (Neuman, 2011). A survey study is one of the quantitative research methods performed in this study to investigate the acceptance of prospective Muslim consumers on the recombinant CLP as an

alternative to halal collagen. The population of this study is Muslim consumers, disregarding their ethnicity. In Malaysia, 63.5 percent of the population were Muslims (Statista, 2022).

4.4.1 Sampling Technique

A sampling method is required to find the accurate sample or respondents of the study. There were two types of sampling methods: probability and non-probability sampling. The former means the population has an equal chance to be included in the sample. Meanwhile, the latter is often associated with case study research and qualitative research (Taherdoost, 2016a).

The non-probability sampling is divided into convenient and purposive sampling (Sekaran & Bougie, 2016). Convenience sampling is a technique where members of the target population meet certain practical criteria, such as easy accessibility, geographical proximity, availability at a given time, or the willingness to participate (Dörnyei & Taguchi, 2009; Etikan et al., 2016).

Besides, convenience sampling is often chosen by the researchers because it is less expensive and more convenient (Taherdoost, 2016a). Convenient sampling is adopted in this study since it helps to overcome many limitations in research (Taherdoost, 2016a). Besides, there were several previous research that used convenience sampling for their study (Al-Ansi et al., 2019; Garg & Joshi, 2018; Rizkitysha & Hananto, 2020).

The target respondents for the study are Muslim consumers who were also prospective consumers of collagen products. These Muslim consumers could be the prospective consumers for collagen because the information about the benefits of collagen in general, could reach consumers from various backgrounds (Zolkepli et al., 2023), especially these days when the internet is only at their fingertips. Besides, word-

of-mouth and social media advertising significantly influence the purchase of health supplement products (Dal et al., 2017; Zolkepli et al., 2023).

Moreover, Malaysians should have the least basic knowledge about the compulsory to consume halal products (Ngah et al., 2020). Furthermore, for the quality of the data, respondents were asked their willingness to answer the questionnaire. The convenience sampling technique was applied to investigate the purchase intention among Muslim consumers in Malaysia. Total of the population in Malaysia by 2020, according to the census, was 32.47 million (DOSM, 2023) and 63.5% of the population is Muslims (Statista, 2022).

4.4.2 Sample Size

The sample size is essential in a study because the researcher may or may not get a significant result if they disregard the determination of sample size. The determination of sample size is rather contemplating because it may result in either type I or type II errors, which is quite disappointing after a huge effort poured into a study (VanVoorhis & Morgan, 2007).

Several methods in determining sample size were found where some said that small sample size is enough to give a solution when researchers adopt PLS-SEM because the PLS-SEM was said to be a silver bullet as it can solve the issues of small sample size (Hair et al., 2021). Another way to determine the sample size is the ten-times rule method (Kock & Hadaya, 2018), where it should ten-times the formative indicators used to calculate one latent variable (Hair et al., 2021).

Meanwhile, this study chooses the G power tool to determine the sample size, as it has also been used in several other studies (Faul et al., 2007; Faul et al., 2009; Lee & Hallak, 2018). It is a software to calculate the adequate sample size (Faul et al., 2007).

All reflective and formative measurement models must be considered when determining the sample size using this tool. This study adopted the reflective measurement model hence, eight (8) predictors included; attitude, religion, trust, health risk, social risk, environmental risk, quality and halal risk, and financial risk. The effect size was set as medium (0.15) as recommended by (Cohen,1992a; Cohen, 1992b), and power was set as default at 0.95. The calculated sample size was 160, as exhibited in Figure 5.1 below.

However, this study decided to collect more because a large sample size was needed to avoid sampling error (Cochran, 1977). Research that requires a factor analysis procedure should obtain a sample size minimum of five times greater than the items that want to be analysed (Hair et al., 2007; Rahi, 2018) since this study has 47 items to be analysed thus, $47 \times 10 = 470$. Hence, 470 respondents would be the number that should be collected. Nevertheless, it was said that the study with 500 samples would receive a very good result for the analysis (Comrey & Lee, 2013). Therefore, this study would distribute 550 questionnaires considering any possibility of data elimination.

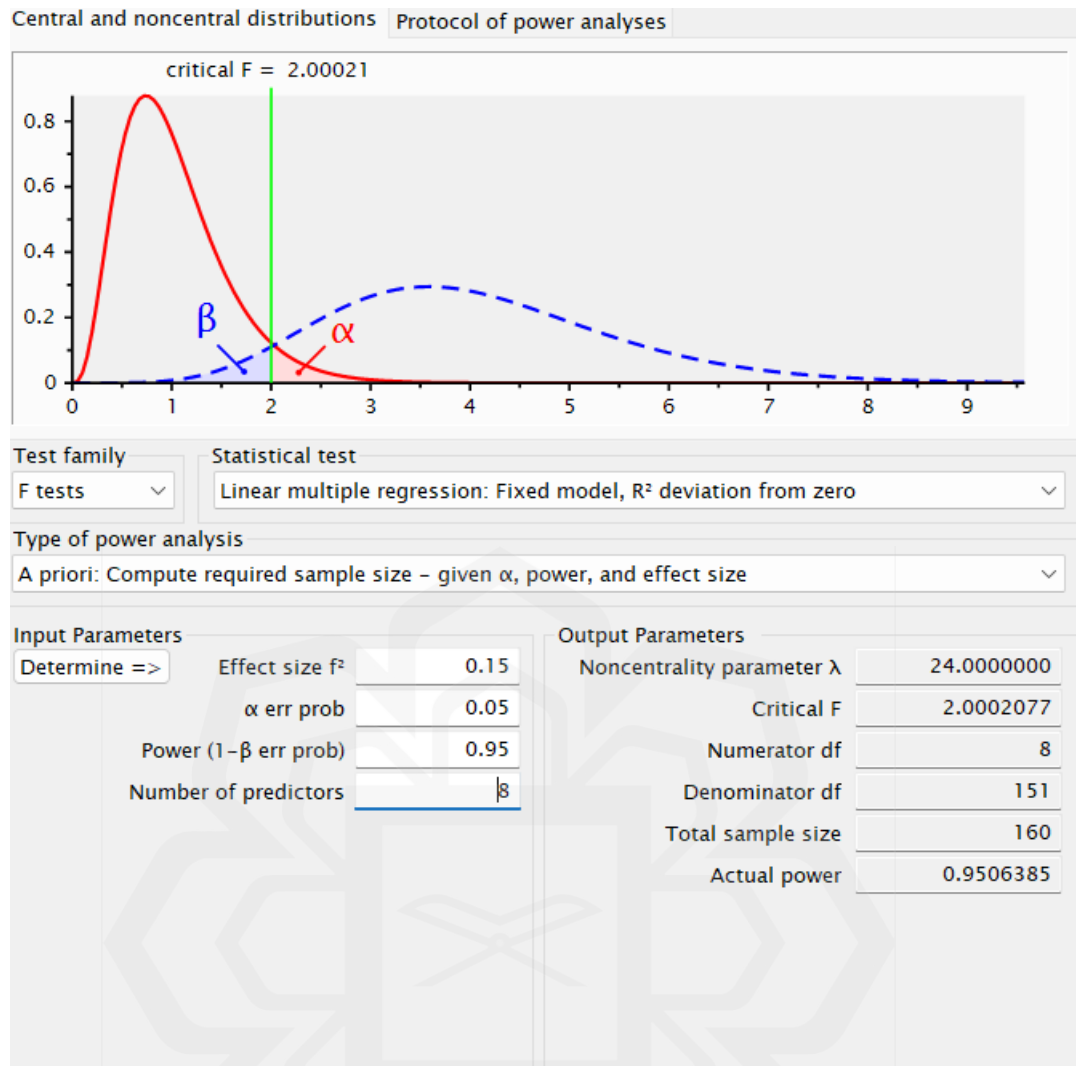


Figure 4.1 Sample size calculation using G Power software

4.5 DATA COLLECTION TECHNIQUE

A survey will be conducted for this study to collect the data using a quantitative method that involves prospective consumers who have a variety of educational background and employment. It is defined as a system to collect information from a group of individuals to explain their behaviour (Sekaran & Bougie, 2016).

This study employed a self-administered questionnaire focusing on Muslim consumers covering all states in Malaysia. The questionnaires were also created in Google Forms and could be assessed by clicking the link that was sent to consumers.

The researcher approached an individual, asking for their consent and asking if they were willing to participate in the survey.

The respondents were from various education and employment backgrounds. After getting their consent, a brief explanation written in layman's terms sent to them along with the link. The message contains an introduction to the researcher, the aim of the research, and an explanation of the recombinant CLP.

This study is a cross-sectional study in which the data was collected between June 2023 and November 2023, where the response was closed with 523 respondents. The data were collected both online and offline. The online data were collected using Google Forms, while offline data were collected by giving out questionnaires to Muslim consumers. The returned questionnaires were then keyed in along with the online data.

The data in Google Forms were then transformed into Google Sheets, downloaded, and saved as Microsoft Excel 360. In the next step, the Excel sheet was imported into Statistical Package Social Science (SPSS) version 27 to perform data cleaning, and analysis of respondents' sociodemographic and descriptive statistics. Later, the data was saved as SPSS Statistic Data Format and then imported into SmartPLS to assess the measurement and structural model.

4.6 QUESTIONNAIRE DESIGN

Designing a questionnaire is crucial because the response received from these questionnaires shall determine the outcome of the analysis. The questionnaire can be defined as a formalised framework that comprises questions as well as scales for the acquisition of primary data (Hair, 2009).

Three key components need to be given emphasis, which consist of the wording of the questions, the planning of the issues on how variables will be categorised, scaled and coded after responses have been collected, and the general appearance of the questionnaire (Sekaran & Bougie, 2016). It is imperative to pay attention to the wording in the questions, especially when the research adopts prospect theory since this theory explains how the framing method works to influence the individual's decision-making (Bahmanziari & Odom, 2015; Grewal et al., 1994; Zhu et al., 2020). Nevertheless, the questions and statement should be concise and direct to the point because the respondents that the study was aiming at consumers consist of laymen with a variety of education levels and professions.

In designing the questionnaire, it is important to consider the procedure to avoid bias. Thus, common method variance (CMV) shall be considered by taking into account several procedural remedies prior to collecting the data. To minimise CMV, the wording of the items should be meticulously placed, and contextual impacts such as media, time, and location should be used to measure the constructs (van Witteloostuijn et al., 2020). After the collection, the CMV will be tested using Harman's single-factor test and full collinearity.

4.6.1 Development of Questionnaire

The questionnaire design is crucial since the response shall determine the outcome of the analysis. The questionnaire can be defined as a formalised framework that comprises questions as well as scales for the acquisition of primary data (Hair, 2009). It is imperative to develop a good question because it may influence the consumers' final decision; hence, how the wording should be put is important.

Therefore, the items or questions were carefully constructed and modified. The questionnaire was divided into three sections: the respondents' basic information, socio-demographic, and their health status. The second section consists of the independent variables: religiosity factors, trust, attitude and risk perception as the mediator variables,

and knowledge as a moderator variable. Meanwhile, the third section consists of the items for intention to purchase.

The questionnaires were constructed as referred to and adopted from the literature review and written in English and Malay language. Prior to the distribution of the questionnaires, the items were validated by scholars from different fields of study and universities. The measurement of all items will be in the form of a seven-point Likert scale, as it was mentioned that inter-rater reliability is optimised and the reliability was maximised when the questionnaire appointed a seven-point Likert scale (Taherdoost, 2019).

4.6.2 Operationalisation and Measurement of Constructs

The measurement scales were identified and chosen for each operational variable as described below:

4.6.2.1 Attitude

Attitude is one of the drivers of intention, where it expresses “a learned predisposition to respond in a consistently favourable or unfavourable manner with respect to a given object” (Fishbein & Ajzen, 1977). Attitude is shaped by both perceived risks and benefits as people engage in behaviour that determines behavioural intention (Ajzen, 1985; Ajzen, 1989; Choi et al., 2013; Parsons et al., 1997). Table 4.2 describes the measurement items for the attitude variable, which consists of six items.

Table 4.2 Measurement Items for Attitude

Indicator	Measurement Statement	Reference
ATT1	I think the production of Collagen-Like Protein is a great idea	(Garg & Joshi, 2018; Kuang et al., 2020;

ATT2	I think the Collagen-Like Protein would have better wound healing ability	Ngah et al., 2020; Suki, 2016)
ATT3	I feel that the Collagen-Like Protein would have better skin aging ability	
ATT4	The Collagen-Like Protein will also be preferred by non-Muslim consumers	
ATT5	I think the Collagen-Like Protein would have sustain the environment	
ATT6	I think the Collagen-Like Protein would improve the health condition of the consumers	

4.6.2.2 Religiosity

Religiosity is the level at which people adhere to their religious beliefs, values, and practices and how they are applied in daily living (Worthington Jr et al., 2003). The religion belief affects consumers' lifestyles, thus affecting consumer decision-making behaviour (Delener, 1994). Table 4.3 describes the items to measure the religiosity variable.

Table 4.3 Measurement Items for Religiosity

Indicator	Measurement Statement	Reference
REL1	The belief I have on my religion leading the way I live	(Briliana & Mursito, 2017; Garg & Joshi, 2018;
REL2	I am very meticulous prior consuming a product because of my religious belief	Hussain et al., 2016; R. A. Rahman et al., 2021)
REL3	My religious belief influences the choice on my daily consumption	
REL4	I often study about my religious teaching	

REL5	I would be happy when there are products that prioritise halal regulations
------	--

4.6.2.3 Trust

As tabulated in Table 4.4, five items were listed to measure the variable trust. Trust is the willingness to be vulnerable to the actions of a party and disregard the ability to monitor or control them, which depends on the positive expectation that (s)he would perform certain actions that are important to the trustor, given the context of the trustor's awareness of the risk relates (Kee & Knox, 1970; Rousseau et al., 1998).

Table 4.4 Measurement Items for Trust

Indicator	Measurement Statement	Reference
TR1	I am literally trusting the Halal Agency in Malaysia	(Al-Ansi et al., 2019; Connor & Siegrist, 2010;
TR2	I am more convinced when I saw Halal logo from Malaysian Halal Agency	Druică et al., 2021; Hakim et al., 2020; Ruan
TR3	I trust the halal from other countries affirmed by Malaysian Halal Agency	et al., 2016)
TR4	I doubt Halal research institute in Malaysia producing halal collagen.	
TR5	I will not consume the product contained the Collagen-Like Protein if it did not certify as halal	

4.6.2.4 Perceived Risk

Bauer (1960) defined perceived risk as the risk that consumers actively perceive because they do not understand product information. Risk can be considered as a concept of uncertainty, which is negatively associated with expected responses from customers (Bauer, 1960). The perceived risk is the combined effects of probabilities, the uncertainty involved in purchase decision, and the consequences of taking undesirable action (Choi et al., 2013). In prospect theory, Kahneman and Tversky's concept of risk is a mean-variance of potential outcomes (Tversky & Kahneman, 1985; Van't Riet et al., 2014). Importantly, variance consists of both upside and downside potential, which means that the outcome could be positive or negative (Cox et al., 2006; Van't Riet et al., 2014). Table 4.5 describes the measurement items for risk perception. There were five types of risk perception: health, social, environmental, quality, halal, and financial risk. Each risk perception has four measurement items except for quality and halal risk perception, which has five measurement items.

Table 4.5 Measurement Items for Risk Perception

Indicator	Measurement Statement	Reference
HR1	The information about Collagen-Like Protein made me feel concern on its effect on my health after consuming it	(Al-Ansi et al., 2019; Connor & Siegrist, 2010; Hakim et al., 2020;
HR2	Consuming Collagen-Like Protein might cause sickness	Liobikienė & Juknys, 2016; Olya & Al-ansi, 2018; Onel &
HR3	Collagen-Like Protein might be hazardous	Mukherjee, 2016; Siegrist, 2021; Siegrist et
HR4	Collagen-Like Protein might cause one to have chronic illness	al., 2000; Siegrist & Hartmann, 2020b; Yang et al., 2015; Yeni et al., 2021)
SR1	I worried if my family members might get sick after consuming Collagen-Like Protein	
SR2	My family might did not agree with the Collagen-Like Protein development	
SR3	I worried my peers might got sick after consuming the Collagen-Like Protein	

SR4	My peers might have negative perception on Collagen-Like Protein
-----	--

ER1	I am worried about the environmental problems occurred these days
ER2	I am concern about the impact of the production on the environment when the product contained animal-based collagen
ER3	I believe halal production will not give negative impact on the environment
ER4	I think the Collagen-Like Protein will not harm the environment because it was grown in lab by the Halal institute

QHR1	I am concern on the hygiene of the Collagen-Like Protein
QHR2	I am concern on the quality of the Collagen-Like Protein
QHR3	I am concern whether Collagen-Like Protein follows the halal requirement to be halal collagen
QHR4	I am concern on the physical product of the Collagen-Like Protein
QHR5	A product contain Collagen-Like Protein will have a good quality because researchers must have done thorough studies to produce it

FR1	The animal-based collagen products in the current market are expensive
FR2	I assume the production on the collagen product contain Collagen-Like Protein will be cheaper because it will not involve the animals

FR3	I assume the products contain recombinant of CLP would be cheaper because it is local product
FR4	I would spend my money on the product contain recombinant of CLP because it is not involving animal-based collagen and I know collagen has many benefit

4.6.2.5 Knowledge

Table 4.6 describes six measurement items for the knowledge variable. (Alavi & Leidner, 2001) defined knowledge as several perspectives of a state of mind, which consists of an object, a process, a condition of having access to information, or a capability. Usually, laypeople gain their knowledge through a wide variety of media (Maesele & Schuurman, 2008).

Table 4.6 Measurement Items for Knowledge

Indicator	Measurement Statement	Reference
KN1	Generally, I know collagen and its benefit on me	(Connor & Siegrist, 2010; Ghali, 2019; Kuang et al., 2020; Ngah et al., 2020).
KN2	I know there were halal and non-halal collagen	
KN3	I find it quite hard to determine whether the collagen product is halal or not	
KN4	To my knowledge, Collagen-Like Protein is different from animal-based collagen	

KN5	I know that Collagen-Like Protein can be an alternative to the animal-based collagen
KN6	I acknowledged that the Halal Research Institutions in Malaysian (eg: JAKIM, INHART etc) will focus on research and strengthen the halal industry

4.6.2.6 Purchase Intention

The dependent variable for the study is consumers' decision to purchase or not to purchase the product containing Collagen-Like Protein. Purchase intention refers to the possibility of a consumer purchasing the product or service, which is accompanied by changes in consumer psychology during the process (Y. Song et al., 2019). Moreover, it indicates that the belief, attitude, and value perception are highly correlated with the transition to the actual purchase of the product (Anderson & Narus, 1998). The measurement items for purchase intention are described in Table 4.7.

Table 4.7 Measurement Items for Purchase Intention

Indicator	Measurement Statement	Reference
PI1	I have no problems with the development of Collagen-Like Protein.	(Choi & Lee, 2019; Roselli et al., 2018;
PI2	If I found the product based on Collagen-Like Protein, I would think before buying them	Wang & Hazen, 2016; Yunus et al., 2014).
PI3	I would substitute the animal-based collagen with Collagen-Like Protein if I	

PI4	<p>were too anxious on the halal status of the product contain animal-based collagen</p> <p>I would prefer the Collagen-Like Protein product even if the price is more expensive than animal-based product</p>
-----	--

4.6.3 Structure of the Questionnaire

After the operational items for each construct had been determined, all items were combined to create a questionnaire. The questionnaire begins with the cover page explaining the recombinant collagen-like protein (CLP), which also has a picture of the collagen. The explanation was written in both English and Malay Language, and the respondents were also informed that their responses would only be used for academic purposes. The questionnaire was constructed using Microsoft Word and Google Forms.

Section 1: This section consists of the socio-demographics and socioeconomics of the respondents, including their age, level of education and type of employment. Respondents were also asked whether they knew the collagen, and they were also asked about their health status.

Section 2: This section consists of the independent or exogenous variables that determine the consumers' decision to purchase the products containing recombinant CLP. A seven-point Likert scale (1 = strongly disagree, 7 = strongly agree) was employed on the items for the variables in this section.

Section 3: This section measures the respondents' decision to purchase, which is the dependent or endogenous variable. A seven-point Likert scale measurement (1 = strongly disagree, 7 = strongly agree) was employed on the items for the variable in this section.

4.7 PRETEST

The pretest was conducted after constructing the questionnaire with the purpose of assessing the appropriateness and the understandability of the questions prior to conducting the real study (Sekaran & Bougie, 2016). The outcome of the pretest result indicated that all items in the questionnaire have comprehensible language quality.

The aim of the pretest is to point out the problem with the items, reduce measurement error, and improve the quality of the data (Grimm, 2010). In this study, an expert-driven pretest was conducted, where the related experts were appointed to review the items for the questionnaire and identify the problems, thus providing their response options (Presser & Blair, 1994). The content validation for the questionnaire in this study went through a two-stage process, which was the development and judgment-quantification (Lynn, 1986).

In the developmental stage, it consists of domain identification, item generation, and instrument construction (Carmines & Zeller, 1979; DeVellis & Thorpe, 2021; Gable & Wolf, 2012; Nunnally & Bernstein, 1994). The domain identification in developing and effective measure is usually accomplished through extensive literature review and after the items are developed to measure them (Gable & Wolf, 2012; Lynn, 1986).

Later, instrument construction is the process when the items are refined and organized in an appropriate sequence and format (Lynn, 1986). The second stage was judgment-quantification, which entails asking a specific number of experts to evaluate the items (DeVellis & Thorpe, 2021; Gable & Wolf, 2012; Lynn, 1986). The experts usually have hawk-like eyes to critically look at the questions and comment on the items (Grealish, 2004). Therefore, the experts reviewed questionnaires prior to real data collection which has become common practice in questionnaire development (Yan et al., 2012).

4.7.1 Content Validation

It was recommended that the number of experts for content validation should be at least six and not exceed 10 (Davis, 1992; Lynn, 1986; Polit & Beck, 2006). Emails have been sent to the experts that who have more than five years of experience in academics who serve in public universities, and an email sent to the producer. Seven have agreed to do the content validity, and the appointment letter attached to the content validity form was sent to the experts. The content validity form consists of the items constructed in the questionnaire and it also explains that the items employed a seven-point Likert scale.

Those selected experts were among the academicians who had already acquired their PhD in their respective fields attached to International Islamic University Malaysia (IIUM), Universiti Putra Malaysia (UPM) and Universiti Kebangsaan Malaysia (UKM). They are from various fields of expertise, such as medicine, public health, economics, and management. Based on their review and refinement, the earlier questionnaire has been amended in terms of its grammar, and phrase structure, and items were also added as recommended. Table 4.8 lists the items that have been amended.

Table 4.8 Amended items in questionnaire.

No	Original Items	Amended Items
KN1	Generally, I know collagen and its benefit on me	I generally know the benefits of the collagen on me
	To my knowledge, Collagen-Like Protein is different with animal-based collagen	To my knowledge, Collagen-Like Protein different from animal-based collagen
KN6	I acknowledge that the halal institute will focus on research and strengthen the halal industry	I acknowledged that the Halal Research Institutions in Malaysia (eg: JAKIM, INHART etc) will focus on research and strengthen the halal industry

	Added as new item in knowledge construct	I am aware of the pro and contra between Collagen-Like Protein and animal-based collagen
ATT1	I think the production of Collagen-Like Protein is a great idea	I think the production of Collagen-Like Protein is a bad idea
ATT3	I feel that the Collagen-Like Protein would have better skin aging ability	I feel that the Collagen-Like Protein has better ability to reduce skin aging
ATT5	I think the Collagen-Like Protein would have sustain the environment	I think the Collagen-Like Protein causing harm to the environment
ATT6	I think the Collagen-Like Protein would improve the health condition of the consumers	I think the Collagen-Like Protein in general would improve the health condition of the consumers
	Added as new item in attitude construct	I would choose Collagen-Like Protein product relative to animal-based collagen
REL1	The belief I have on my religion leading the way I live	The belief I have on my religion leads the way I live
REL2	I am very meticulous prior consuming a product because of my religious belief	I am very meticulous before consuming a product because of my religious belief
REL3	My religious belief influences the choice on my daily consumption	My religious belief does not influence the choice on my daily consumption
REL4	I often study about my religious teaching	I rarely study about my religious teaching
REL5	I would be happy when there are products that prioritise halal regulations	I would be happy when there are products that prioritise halal compliant
HR1	The information about the Collagen-Like Protein made me feel concern on its effect on my health after consuming it	I am very concern on how the Collagen-Like Protein affect my health and the risk upon consuming the product

HR3	Collagen-Like Protein might be hazardous	Collagen-Like Protein might not cause any hazardous to my health such as skin irritation or after-affect
SR1	I worried if my family might get sick after consume Collagen-Like Protein	I worried if my family might get sick after consuming the Collagen-Like Protein
SR2	My family might did not agree with Collagen-Like Protein development	My family and friends might have different views regarding Collagen-Like Protein
SR3	I worried my peers might got sick after consume Collagen-Like Protein	I worried my peers might get sick after consuming the Collagen-Like Protein
SR4	I worried my peers might have negative perception on Collagen-Like Protein	- Omit because
	Added as new item risk perception on social construct	I think I would suggest the Collagen-Like Protein to my family and friends
	Added as new item in risk perception on social construct	I think I would encourage the society to use the product contain Collagen-Like Protein
ER2	I am concern about the impact of the production on the environment when the product contains animal-based collagen	I think the animal-based collagen production will give the negative impact the environment
ER3	I believe halal production will not give negative impact on the environment	I belief halal compliant processed and procedures will not give negative impact on the environment
ER4	I think the Collagen-Like Protein will not harm the environment because it was grown in lab by the Halal institute	I think the Collagen-Like Protein will not harm the environment because it was grown in research lab
QHR1	I am concern on the hygiene of the Collagen-Like Protein	I am concern on the hygiene aspect of the Collagen-Like Protein

QHR2	I am concern on the quality of the Collagen-Like Protein	I am concern on the quality of the products contain Collagen-Like Protein
QHR3	I am concern whether Collagen-Like Protein follows the halal requirement to be halal collagen	I am concern whether Collagen-Like Protein follows the halal requirement and guidelines
QHR4	I am concern on the physical product of the Collagen-Like Protein	I am concern on the end-products contained Collagen-Like Protein
FR1	The animal-based collagen products in the current market are expensive	The animal-based collagen products in the market are currently expensive
FR2	I assume the production on the collagen product contain Collagen-Like Protein will be cheaper because it will not involve the animals	I believe the production of Collagen-Like Protein will be cheaper because it will not involve the animals
FR3	I assume the products contain recombinant of CLP would be cheaper because it is local product	I believe that products contain Collagen-Like Protein would be cheaper if locally produced
FR4	I would spend my money on the product contain recombinant of CLP because it is not involving animal-based collagen and I know collagen has many benefit	I will spend my money on the products contain Collagen-Like Protein if it is not expensive
TR2	I am more convinced when I saw Halal Logo from Malaysian Halal Agency	I am more convinced when I saw the certified Halal Logo from Malaysian Halal Agency
TR3	I trust the halal from other countries affirmed by Malaysian Halal Agency	I trust the halal certification from other countries affirmed by Malaysian Halal Agency
TR4	I trust that Halal research institute produce a halal collagen	I doubt Halal research institute in Malaysia producing halal collagen
TR5	I am convinced to consume the product contained the Collagen-Like Protein	I will not consume the product contained the Collagen-Like Protein if it did not certify as halal

PI1	I accept the development of Collagen-Like Protein	I have no problem with the development of Collagen-Like Protein
PI2	If I found the product based on Collagen-Like Protein, I would certainly buy it	If I found the products based on Collagen-Like Protein, I would think before buying them

4.8 PILOT TEST

It is important to conduct the pilot test, in which the questionnaires were distributed among a small number of selected respondents before going to the real data collection that involves the calculated sample size. It is to test the reliability and validity of the questionnaire. Moreover, the pilot study was able to verify whether the study could proceed with the questionnaire (In, 2017). A pilot study is feasible and beneficial to the main study, which can improve the quality and efficiency of the research (In, 2017).

Determination of the sample size is important prior to conducting the pilot study. It was recommended that 35 responses for the pilot trial should be enough to reduce the imprecision around the estimate of the standard deviation (Teare et al., 2014). Another suggestion said that at least 30 samples or more are needed to estimate the parameter (Browne, 1995). Apparently, huge sample size for a pilot study is better thus, this study collected fifty (50) responses. This study was conducted among Muslim Malays to check for ambiguity in the scale items and to identify their reliability.

4.8.1 Descriptive Analysis

The pilot study was carried out, and 46 samples were collected, which were automatically saved in Microsoft Excel directly from Google Forms. The data was then exported into SPSS version 27 and SmartPLS4 for the next analysis. SmartPLS can be used to check for reliability and validity analysis for a pilot study or preliminary study as it can analyse a smaller sample (Hair et al., 2021).

As tabulated in Table 4.9, the descriptive analysis for respondents' sociodemographic showed that female respondents were higher compared to males. Most of the respondents were between 30 to 39 years old.

Table 4.9 Descriptive Analysis

Item	Category	Frequency	Percent
Gender	Male	15	32.6
	Female	31	67.4
Age	Below 20 years old	17	37.0
	20 – 29 years old	7	15.2
	30 – 39 years old	18	39.1
	40 – 49 years old	3	6.5
	50 years and above	1	2.2
Education	Secondary school	5	10.9
	Diploma/ pre-University	17	39.0
	Degree	16	34.8
	Postgraduate	8	17.4
Employment	Private	10	21.7
	Government services	12	26.1
	Self-Employed	2	4.3
	Students	22	47.8
Health status	Good	40	87.0
	Average	6	13.0
	Poor	0	0

4.8.2 Reliability Testing

To test whether the questionnaire is reliable and valid, several test analyses have been performed, whereas Cronbach alpha has been measured along with the composite

reliability to check for internal consistency reliability, while the outer loadings were the value to check for indicator reliability (Hair et al., 2021).

The value for Cronbach alpha should be higher than 0.7 for the items to be counted as reliable (DeVellis et al., 2003; Pallant, 2001). Meanwhile, composite reliability is considered technically appropriate for measuring internal consistency. Here, the value should be between 0.6 and 0.9 (Hair et al., 2021). Table 4.10 tabulated the Cronbach alpha, composite reliability, and outer loadings value for pilot study analysis. Several items in the knowledge variable coded as KN1 and KN2, and an item in the purchase intention variable (PI2) were deleted because their loadings were lower than 0.5 (Hair et al., 2021).

Even though the Cronbach alpha's value for the purchase intention construct was lower than 0.70, it can be accepted because the value of composite reliability was higher than 0.7 (Nunnally & Bernstein, 1994). It was due to composite reliability has been proposed as an alternative method to replace the weakness of Cronbach alpha (Nunnally & Bernstein, 1994).

Table 4.10 Reliability Analysis

Constructs	Indicators	Loadings	Composite Reliability	Cronbach Alpha
Knowledge	KN1	-0.431-	0.859	0.810
	KN2	-0.473-		
	KN3	0.786		
	KN4	0.821		
	KN5	0.755		
	KN6	0.596		
	KN7	0.733		
Attitude	ATT1	0.738	0.915	0.891
	ATT2	0.776		
	ATT3	0.715		
	ATT4	0.855		
	ATT5	0.795		
	ATT6	0.721		

	ATT7	0.840		
Religiosity	REL1	0.914	0.933	0.910
	REL2	0.850		
	REL3	0.862		
	REL4	0.784		
	REL5	0.875		
Health Risk	HR1	0.407	0.847	0.768
	HR2	0.706		
	HR3	0.804		
	HR4	0.844		
	HR5	0.816		
Social Risk	SR1	0.506	0.829	0.723
	SR2	0.771		
	SR3	0.852		
	SR4	0.804		
Environmental risk	ER1	0.584	0.840	0.744
	ER2	0.686		
	ER3	0.871		
	ER4	0.850		
Quality and Halal Risk	QHR1	0.762	0.879	0.828
	QHR2	0.847		
	QHR3	0.757		
	QHR4	0.623		
	QHR5	0.845		
Financial Risk	FR1	0.702	0.920	0.881
	FR2	0.936		
	FR3	0.914		
	FR4	0.878		
Trust	TR1	0.922	0.921	0.890
	TR2	0.890		
	TR3	0.866		
	TR4	0.829		
	TR5	0.662		
Purchase Intention	PI1	0.857	0.771	0.569
	PI2	-0.443-		
	PI3	0.759		
	PI4	0.549		

4.8.3 Validity Testing

Validity is concerned with the extent to which an instrument measures what it is intended to measure (Tavakol & Dennick, 2011). For the pilot study, convergent

validity was tested to seek the agreement between a theory and specific measuring instruments from the value of factor loadings and average variance extracted (AVE) (Hair et al., 2010) the validity to check how accurately a construct reflect what it is meant to measure and to use SmartPLS.

The AVE was determined by the loadings value as tabulated in Table 4.11, which measures how much variance is explained by the corresponding latent variables (Chin, 1998). The value of the average variance extracted should be above 0.50 (Afthanorhan, 2014; Fornell & Larcker, 1981; Hair et al., 2021).

Previously, the items in knowledge and purchase intention were deleted because the value for loading was lower than 0.5, which affected the AVE. Before the deletion of KN1, KN2, and PI2, the AVE for knowledge and purchase intention variables were 0.423 and 0.440, respectively. On the other hand, the loadings for an item in health risk perception (HR1) were lower than 0.5 but, it was not deleted because the AVE of the variable was higher than 0.5.

Table 4.11 Convergent Validity

Constructs	AVE
Knowledge	0.551
Attitude	0.606
Religiosity	0.736
Health Risk	0.538
Social Risk	0.556
Environmental Risk	0.573
Quality and Halal Risk	0.595
Financial Risk	0.744
Trust	0.704
Purchase Intention	0.537

Discriminant validity was duly represented in the table below as recommended by Fornell & Larcker (1981), which measures the extent to which a construct is empirically distinct from other constructs in the structural model. It indicates that the items on each construct measure the theoretical assigning construct and not on other constructs in the study, which implies that measurement items within the same construct must be highly correlated (Sekaran & Bougie, 2016).

It was established that the items loaded higher on their respective construct compared to other constructs. The square root of the AVE coefficient for each construct was replaced with the correlation matrix along the diagonal (Fornell & Larcker, 1981), where the AVE of each latent variable should be greater than the latent variable highest squared correlation with one other latent variable (Afthanorhan, 2014). Table 4.12 tabulated the Fornell-Larcker criterion for all constructs. The bold value represented the average variance extracted, and apparently, the value was higher on its own construct, indicating sufficient discriminant validity (Fornell & Larcker, 1981).

Table 4.12 Fornell-Larcker criterion for all constructs

	DV- PI	IV1- ATT	IV2- REL	IV3- TR	IV4- HR	IV5- SR	IV6- ER	IV7- QHR	IV8- FR	MV- KN
DV- PI	0.73 3									
IV1- ATT	0.54 9	0.77 9								
IV2- REL	0.63 4	0.49 1	0.85 8							
IV3- TR	0.68 2	0.55 9	0.78 8	0.83 9						
IV4- HR	0.51 5	0.53 6	0.41 5	0.48 2	0.73 3					
IV5- SR	0.59 2	0.55 5	0.41 8	0.50 4	0.66 7	0.74 6				
IV6- ER	0.53 9	0.49 9	0.50 5	0.50 7	0.52 1	0.52 7	0.75 7			

IV7- QH R	0.72 4	0.52 1	0.51	0.63	0.60 5	0.67	0.53 1	0.77 1		
IV8- FR MV- KN	0.60 6	0.58 4	0.38 4	0.41 8	0.52 7	0.58 5	0.43 1	0.58 4	0.86 2	
	0.62	0.61	0.49	0.53	0.48	0.56	0.46	0.61	0.49	0.74
	8		4	4		6	9		2	2

Since this is the pilot test, Fornell-Larcker alone was considered enough to measure the discriminant validity as performed by another thesis (Shariff, 2023). Besides, previous studies considered only the Fornell-Larcker criteria alone enough to measure the discriminant validity (Mohd Dzin & Lay, 2021). In addition, between 2011 and 2020, it was reported that 176 studies were performed by Fornell-Larcker alone to measure the discriminant validity of their data (Sarstedt et al., 2022).

4.9 QUANTITATIVE DATA ANALYSIS

The crucial part of the research is data analysis where the researcher going to test the hypotheses and answers the research questions. It involves assigning data to the constructs and established the links among them.

The data collected were analysed through a series of processes. First, after the data was collected, it was processed by editing, coding, and classifying it accordingly. Even though the process can be performed directly in IBM SPSS, it depends on the researcher's preference to complete the first process in Microsoft Excel. Besides, the data was in Microsoft Excel format after being extracted from Google Forms. After the first process, the data was exported into IBM SPSS version 27 and finally into the SmartPLS to examine the prediction capability of the structural model and the link among constructs.

4.9.1 Statistical Analyses using Statistical Package of Social Science (SPSS)

In the first steps of the analysis, the responses were extracted from Google Forms in the Microsoft Excel and the researcher decided to process (edit and code) in the software prior to export into the SPSS. SPSS is statistical software that can be used for data entry. The next process was data cleaning, which was done to see if there were any missing data, unanswered items in the data.

Data procedures include testing the normality and data entry errors. Furthermore, the descriptive statistics of the categorical data for the demographic profile and the respondents' health status can be examined using the software. Through the SPSS, the researcher performed frequency and descriptive analysis on the respondents' demographic profile and the descriptive analysis was also performed to examine the minimum and maximum number, mean, and standard deviation of each item for the constructs.

4.9.2 Statistical Analyses using Structural Equation Model (SEM)

The research model for this study was evaluated using the Partial Least Squares (PLS-SEM) method. Its first appearance was in the early 1980s, and its usage has been widespread (Bagozzi & Yi, 1988; J. F. Hair et al., 2011). For many researchers, SEM is equivalent to carrying out covariance-based SEM (CB-SEM) analyses, but then, researchers thought to include another useful approach into SEM named partial least square-SEM (PLS-SEM). Table 4.13 lists the rule of thumb for choosing PLS-SEM over CB-SEM.

Table 4.13 Rule of Thumb to Choose CB-SEM or PLS-SEM

	Criteria to evaluate	CB-SEM	PLS-SEM
1	Research goal.		

	<ul style="list-style-type: none"> • Predicting key target constructs or identifying key “driver” construct. • Theory testing, theory confirmation, or comparison of alternative theories. • The research is exploratory or an extension of an existing structural theory. 	√	√
2	Measurement model specification <ul style="list-style-type: none"> • The structural model contains formative constructs. • If the model require additional specification in error terms such as covariation. 	√	√
3	Structural model <ul style="list-style-type: none"> • The model is complex and contains many constructs and indicators. • The model is nonrecursive. 	√	√
4	Data characteristics and algorithm. <ul style="list-style-type: none"> • Meet the distributional assumptions of data. • Did not meet the distributional assumptions of data. • Consider a smaller sample size. • Consider a large sample size. • Non-normal distribution. • Normal distribution. 	√ √ √ √	√ √ √ √
5	Model evaluation. <ul style="list-style-type: none"> • Need to use the latent variable scores in subsequent analyses. • Research requires a global goodness-of-fit criterion. • Need to test for measurement model invariance. 	√ √	√

Source: Hair and Alamer, 2022; Hair et al., 2011.

4.9.2.1 Justification to Use PLS-SEM

Based on the table describing the rule of thumb to choose either PLS-SEM or CB-SEM, this study chose PLS-SEM for the measurement model because of several conditions of which, this study focused on new theory development and prediction (Hair & Alamer, 2022; Hair et al., 2011). Aside from that, the model has many constructs and indicators, which makes the model complex and needs a second layer (Becker et al., 2012).

Moreover, the data for the study is also not normally distributed. Also, the latent variables scores were needed for subsequent analyses (Sarstedt et al., 2017a).

Aside from the conditions that met the criteria for choosing PLS-SEM, this study also chose the technique after referring to several literature reviews. The studies that choose prospect theory choose PLS-SEM techniques to predict their model (Al-Ansi et al., 2019; Leung & Cai, 2021; Olya & Al-ansi, 2018; Yang et al., 2020). Moreover, the studies that predict the risk perception on consumers behaviour also used PLS-SEM in their prediction analyses (Deng & Liu, 2017; Wang et al., 2019; Wang et al., 2019).

There were two stages involved in analysing the data using the PLS-SEM technique, of which, in the first stage, reliability and validity were checked. The composite reliability and outer loadings were checked for internal consistency and indicator reliability under construct reliability. The AVE was checked to determine the convergent validity and discriminant validity was checked by looking at the cross-loadings, Fornell-Larcker, and heterotrait-monotrait ratio (HTMT).

Later, the second stage involved the evaluation of the structural model, in which all the hypotheses that were formulated were tested. Through this stage, the model's predictive capabilities and the relationship between constructs were assessed. Furthermore, the stage also involves the assessment of collinearity issues, significance and relevance of structural model relationships, coefficients of the determinant (R^2 values), effect size, and predictive relevance of the constructs. The analysis in this study was carried out in two parts, which tested the direct hypothesis and then tested the hypotheses on the mediating variable of attitude and the moderating effect of knowledge construct.

4.9.3 Hierarchical Component Model (HCM) Type Identification

PLS-SEM is represented by two basic models, measurement, and structural models. The measurement model, also called as the outer model is a path model that contains the

items or indicators and their relationships with the constructs. Meanwhile the structural model known as the inner model, represents the constructs or variables and the relationship between them (Hair et al., 2021).

The measurement model can be formed into two types: formative or reflective. On the one hand, the model is formative when the constructs are constituted by its items. The formative measurement model is indicated by the arrows, where the directions of the arrows are pointing from the indicators to the construct. On the other hand, the measurement model is reflective when a construct is represented by its items or indicators, which can be indicated when the direction of the arrow's points from the construct to the indicators (Hair et al., 2021).

Some studies can apply two layers of constructs in the measurement models when the items are complex, where researchers usually establish higher-order models or hierarchical component models (HCMs). HCM is an explicit representation of multidimensional constructs that exist at a higher level of abstraction and are related to other constructs at a similar level of abstraction, completely mediating the influence from or to their underlying dimensions (Becker et al., 2012; Chin, 1998).

There are three main reasons for a researcher to develop two layers of constructs in their measurement models (Hair et al., 2021) where, researchers could reduce the number of relationships in a structural model. Hence, making the PLS path model more parsimonious and easier to grasp. Aside from that, HCM can reduce collinearity issues and may solve discriminant validity problems. Furthermore, HCM can solve the collinearity problem in formative measurement models.

HCM can be distinguished into four types of models, namely (1) reflective-reflective type I, (2) reflective-formative type II, (3) formative-reflective type III, and (4) formative-formative type IV (Becker et al., 2012). These types of models were differentiated by the relationship among (1) the first-order latent variable and their manifest variables; and (2) the second-order latent variable(s) and the first-order latent variables (Becker et al., 2012; Jarvis et al., 2003; Ringle et al., 2012). This model in this

study is the type I model where the path relationship from higher-order constructs (HOC) to lower-order constructs (LOC) is reflective and the relationship between LOC and indicators is reflective as well.

4.9.4 Measurement Model Assessment

The structural model was termed when the latent variables were modelled and analysed to predict their relationships. Meanwhile, the measurement models represent the relationship among constructs and their corresponding indicators, generally called outer models (Hair et al., 2021).

After the initiation of the constructs, the next step was to analyse the evaluation criteria of the model. A disjoint two-stage approach was used to evaluate the models (Agarwal & Karahanna, 2000; Becker et al., 2012, 2023; Sarstedt et al., 2019). This approach considered only the LOC of the HOC in the model but, without the HOC.

To execute, the latent variables or construct scores of the LOC need to be saved in the first stage. Then, in the second stage, the scores were used to measure the HOC. The analysis first started with the reliability and validity test of all constructs (Becker et al., 2012). The two-stage approach is preferable for the measurement model assessment because it produces more accurate results compared to another approach, such as the repeated indicator approach (Becker et al., 2012; Becker et al., 2023; Sarstedt et al., 2019).

For the evaluation of the HCM, all constructs were evaluated for reliability and validity in PLS-SEM. The figure below portrays the steps for checking the reliability and validity of the model. The content validity was addressed during the pretest stage of the questionnaire, as it needed to be performed since content validity is subjective in nature (Sekaran & Bougie, 2016). The construct reliability was established because of convergent and discriminant validity. Therefore, the convergent and discriminant validity were tested concurrently to affirm the construct validity.

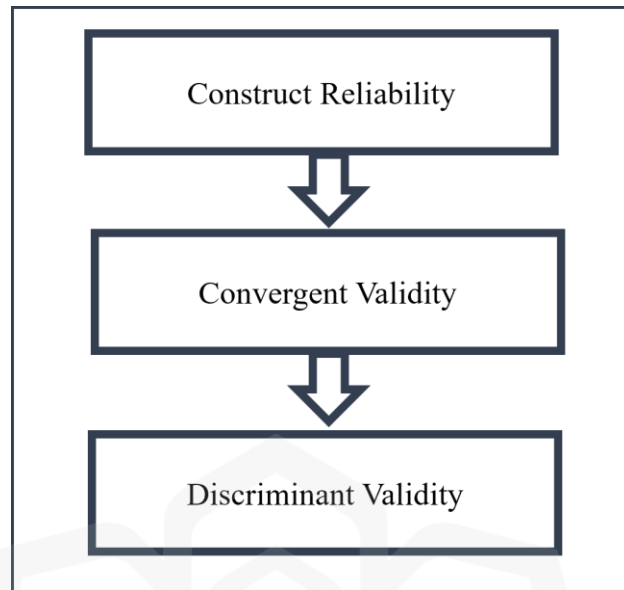


Figure 4.2 Measurement Model Assessment Procedures (Hair et al., 2021).

4.9.4.1 Construct Reliability

The reflective measurement models should be tested their internal consistency and indicator reliability to avoid random error (Taherdoost, 2016b). The internal consistency reliability was tested by referring to the composite reliability, which has been proposed by Nunnally & Bernstein (1994) to replace the traditional Cronbach alpha, where composite reliability manage to overcome the Cronbach alpha deficiency (Afthanorhan, 2014).

Indicator reliability describes the extent to which a variable or set of variables is consistent regarding what it extends to measure (Urbach & Ahlemann, 2010).

4.9.4.2 Convergent Validity

It refers to the degree to which two measures of constructs that theoretically should be related are in fact, related (Taherdoost, 2016b). The criterion that was commonly applied in testing the convergent validity was Average Variance Extracted (AVE). If the value of AVE is higher than 0.5, it indicates the construct is captured to explain more than the half variance of its indicators, thus demonstrating sufficient convergent validity (Afthanorhan, 2014; Fornell & Larcker, 1981).

The AVE is the total factor loading power of two divided by a number of items, and if the AVE value is lower than 0.5, it indicates the measurement residual (Afthanorhan, 2014). The constructs with lower AVE should be checked by referring to their items or indicators, where the items or indicators with lower factor loading should be removed (Hair Jr, Hult, Ringle, & Sarstedt, 2021).

4.9.4.3 Discriminant Validity

Discriminant validity is the extent to which a latent variable differs from another construct by empirical standards (Afthanorhan, 2014; Hair et al., 2021; Taherdoost, 2016b). It was verified based on three criteria, (1) factor loadings of all items for each construct must exceed the cross-loadings; (2) all the correlations among the constructs should be below 0.85 threshold; and (3) the correlations between the construct and other constructs in the model should be lower than the square root of AVE for the construct (Wang et al., 2019).

To check for discriminant validity, it can be referred from the cross-loading obtained by correlating each latent variable component scores with all other items (Chin, 1998), where the items' loading on the associated construct should be greater than any of its correlation on other constructs (Chin, 1998; Hair et al., 2021).

The second approach to check for discriminant validity was the Fornell-Lacker criterion that was executed in the pilot data. The squared root of AVE on each construct should be greater than its highest correlation with any other constructs (Fornell & Larcker, 1981; Hair et al. 2021). However, recent research critically examined the performance of both cross-loadings and the Fornell-Larcker criterion to check on discriminant validity and the examination reported discriminant validity issues (Hair et al., 2019; Hair et al., 2021).

Therefore, it leads to the recommendation of a heterotrait-monotrait ratio (HTMT) of correlation (Henseler et al., 2015). It is the mean of the average correlations for the items measuring the same construct (Hair et al., 2019; Henseler et al., 2015). They propose a threshold value of 0.90 for structural models with constructs that are conceptually very similar, where the discriminant validity is sufficient if the value is lower than 0.90 (Henseler et al., 2015). Moreover, it is more conservative if the value is lower than 0.85 (Franke & Sarstedt, 2019; Hair et al., 2019).

4.9.5 Common Method Variance (CMV)

Common method variance (CMV) or common method bias is the systematic error variance that is shared among variables that are measured with the same sources or method, which may cause an impact on the relationships among variables and measures (Jakobsen & Jensen, 2015; Tehseen et al., 2017).

It is vital to assess the bias to ensure the reliability and validity of the instruments, which can lead to false internal consistency (Podsakoff et al., 2003). Moreover, CMV has the potential to threaten the validity of data when the data, which often makes it an issue for the researchers; thus, it has to be controlled prior to the reliability and validity test of the data (Podsakoff et al., 2003; Tehseen et al., 2017).

This study applied two approaches to control the CMV, namely procedural and statistical remedies.

4.9.5.1 Procedural Remedy

This remedy is to control the CMV, which shall be performed while constructing the questionnaire and conducting the survey. Researchers were unable to avoid the CMV completely, but there were several procedural remedies that can be considered to control the bias.

During the questionnaire construction, this study referred to two or more literature information sources to gather data about the construct (Podsakoff et al., 2003, 2012). Aside from that, the wording in each question should be put in layman's terms to avoid respondents misinterpreting the statements and scale items by stating a clear, concise and accurate statement (MacKenzie & Podsakoff, 2012; Podsakoff et al., 2003).

The questionnaire for this study also included both positive and negative worded items for the same scale to prevent extreme responses (Podsakoff et al., 2003; Rodríguez-Ardura & Meseguer-Artola, 2020).

4.9.5.2 Statistical Remedy

Statistical remedies are conducted to detect bias, of which is also known as post-hoc techniques (Rodríguez-Ardura & Meseguer-Artola, 2020). Harman's single-factor test and full collinearity test were performed to test for CMV. Harman's single-factor test was performed using SPSS version 27 (Fuller et al., 2016) by entering all dependent and independent variables into factor analysis. The unrotated factor solution was then examined to obtain the number of factors with eigenvalues greater than one that explain

aggregate variance. As summarized in Table 4.14 the first unrotated factor generated percentage of the variance of 25.866 of which far less than 50% (Podsakoff et al., 2012). Meanwhile, all 47 factors accounted for 100% of the total variance. Since no single factor emerged and the first factor did not capture most of the variance (25.866% of the variance), thus CMV is not the issue for this study.

Table 4.14 Summary of factor analysis of the Harman's single-factor test

Component	Total Variance Explained					
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	14.166	30.141	30.141	13.472	28.664	28.664
2	3.673	7.816	37.957			
3	2.704	5.754	43.711			
4	1.916	4.076	47.787			
5	1.581	3.365	51.152			
6	1.400	2.978	54.130			
7	1.182	2.516	56.646			
8	1.108	2.358	59.003			
9	1.069	2.275	61.278			
10	1.039	2.210	63.488			
11	.934	1.987	65.474			
12	.923	1.963	67.438			
13	.844	1.796	69.234			
14	.807	1.717	70.951			
15	.767	1.631	72.582			
16	.756	1.609	74.191			
17	.731	1.556	75.747			
18	.694	1.476	77.223			
19	.677	1.440	78.663			
20	.629	1.338	80.001			
21	.603	1.284	81.285			
22	.579	1.231	82.516			
23	.560	1.192	83.709			
24	.521	1.108	84.816			
25	.517	1.100	85.916			

26	.467	.994	86.910
27	.449	.954	87.865
28	.419	.890	88.755
29	.415	.883	89.638
30	.403	.858	90.497
31	.384	.818	91.315
32	.370	.786	92.101
33	.356	.758	92.859
34	.351	.747	93.606
35	.335	.712	94.318
36	.306	.652	94.970
37	.299	.637	95.607
38	.290	.616	96.223
39	.275	.584	96.808
40	.266	.566	97.373
41	.245	.522	97.895
42	.221	.469	98.364
43	.202	.429	98.793
44	.180	.383	99.176
45	.157	.335	99.511
46	.134	.286	99.797
47	.096	.203	100.000

The second common method bias or variance test is performed by checking the full collinearity of the variables (Table 4.15). It is considered a comprehensive procedure for the simultaneous evaluation of vertical and lateral collinearity (Kock & Lynn, 2012). For the rigorous test, the value for the variance inflation factor (VIF) should not exceed 5.0 (Hair & Alamer, 2022; Sarstedt et al., 2017). The test was performed by computing the variance inflation factor (VIF) for all the constructs. As for the result, the collinearity on the data did not exist because the VIF value for all constructs was lower than 5.0 (Hair et al., 2019; Sarstedt et al., 2017).

Table 4.15 Collinearity Analysis Result

Constructs	VIF
Knowledge	1.685

Attitude	2.607
Religiosity	1.846
Health Risk	2.314
Social Risk	2.164
Environmental Risk	2.144
Quality and Halal Risk	2.220
Financial Risk	2.028
Trust	2.028
Purchase intention	2.197

4.9.6 Structural Model Assessment

After the reliability and validity of the measurement model are tested, the next step is the assessment of the structural model. In this step, it will determine the capabilities of the model to predict one or more constructs. The procedures for structural model assessment are exhibited in Figure 4.3 (Hair et al., 2017; Sarstedt et al., 2017).

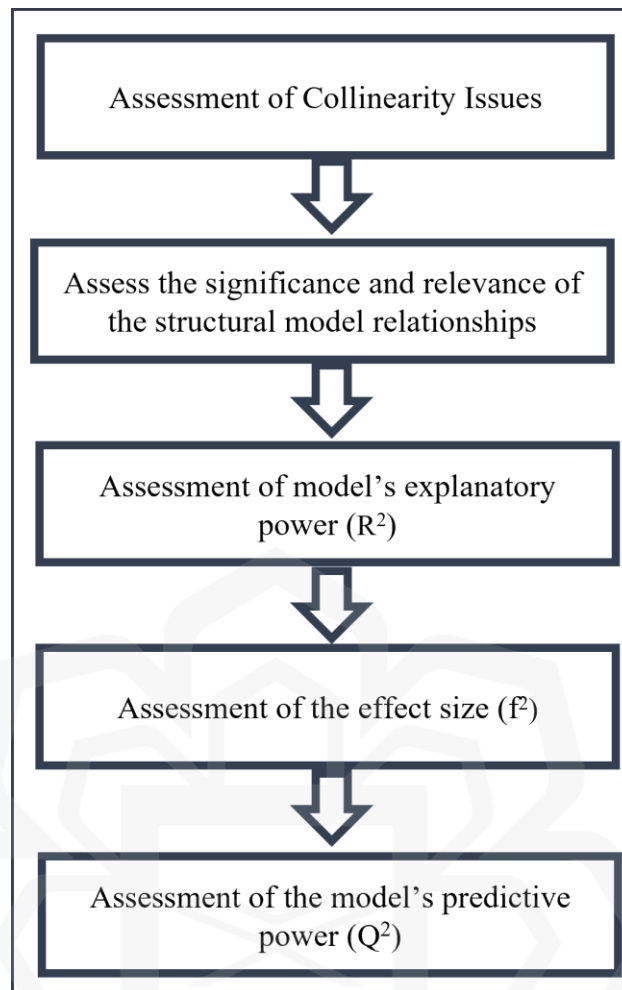


Figure 4.3 Steps in structural model assessment (Hair et al., 2021)

4.9.6.1 *Assessment of Collinearity Issues*

The structural model coefficients for the relationships between constructs are derived from estimating a series of regression equations where it should be tested for the collinearity issues (Sarstedt et al., 2017a). Therefore, prior to further assessment, collinearity issues were examined by executing the lateral collinearity test. It typically occurs when two variables that are hypothesized to be causally related measure the same construct. The issues in lateral collinearity can lead to misleading results in a “stealth” way because they can be masked by the appearance of a strong causal effect in the model (Kock & Lynn, 2012). The value of the variance inflation factor (VIF) indicates whether the lateral collinearity issues exist or not, where the values should be lower than 3.3 (Kock & Lynn, 2012; Lowry & Gaskin, 2014).

4.9.6.2 Structural Model Relationship

The bootstrapping procedure was executed, and the result of each path relationship was generated to test the proposed hypothesis.

4.9.6.3 Assessment of R^2

The R^2 is the measure of variance explained in the endogenous construct. Thus, it measures the model's explanatory power and can also be referred to as in-sample predictive power (Hair et al., 2019).

The value of R^2 ranges from 0 to 1, where the higher values indicate a greater explanatory power and as a guideline, R^2 values of 0.75, 0.50, and 0.25 can be considered substantial, moderate, and weak, respectively (Hair et al., 2011; Henseler et al., 2009). However, there are no specific acceptable R^2 values, and it shall depend on the context and discipline of the studies (Hair et al., 2019). For instance, an R^2 values of 0.10 can be considered satisfactory in predicting the stock exchange (Raithel et al., 2012).

Most of all, the R^2 is a function of the number of predictor constructs, which means, the greater the number of predictor constructs, the higher the R^2 hence, R^2 should be explained in relation to the context of the study where it should be based on previous literature (Hair et al., 2019). However, the R^2 can also be huge when the partial regression model is too complex or overfitting the data, which results in fitting the random noise inherent in the sample rather than reflecting the overall population. The R^2 value of 0.90 might be reasonable to measure the concept that is inherently predictable and overfit (Hair et al., 2019). Above all, the R^2 can be high when researchers decide to add more constructs to the model, and different areas of studies produce different cut-off values for R^2 .

4.9.6.4 Assessment of the effect size (f^2)

The effect size is the measure of the magnitude of an effect that is independent of the size of the sample analysed (Kock & Hadaya, 2018). The effect size indicates the assessment of how the removal of a selected predictor construct affects an endogenous construct's R^2 value (Hair et al., 2021). The effect sizes of 0.02, 0.15 and 0.35 were termed as small, medium and large, respectively (Cohen, 1992b; Kock, 2014).

4.9.6.5 Assessment of the predictive power (Q^2)

The predictive power (Q^2) is another means to assess the predictive accuracy of the model through a blindfolding procedure (Sarstedt et al., 2017a). The predictive relevance shall obtain the cross-redundancy for each construct (Hair et al., 2011). Q^2 measures the combination of the out-of-sample and in-sample explanatory power (Hair et al., 2019; Shmueli et al., 2019). The exogenous constructs are considered to have predictive relevance on the endogenous constructs if the value of Q^2 is higher than zero (Hair et al., 2011).

4.10 CHAPTER SUMMARY

This chapter discusses the research design and the methodology used to collect the data to answer the research question and achieve the research objectives. Qualitative and quantitative data collection strategies were described as mixed method approaches being used. The procedure of both data collection strategies was explained, where expert interviews were conducted using the qualitative approach, and consumer surveys were carried out using the quantitative approach. The data analysis techniques were also described in detail, especially for the quantitative approach. PLS-SEM was used to analyse the data for the quantitative survey questionnaire, and the steps to process the

data were outlined. Chapters Six and Seven will discuss the analyses and findings of qualitative and quantitative data, respectively.



CHAPTER FIVE

INTERVIEW ANALYSIS

5.1 INTRODUCTION

This chapter represents the analysis of interviews with experts in related field. Experts are those with sufficient knowledge and experience in halal, collagen, biotechnology, and food technology, and they could explain their perception of the development of recombinant collagen-like protein (CLP). The findings strengthen the reason why the recombinant CLP should be considered to be involved as raw materials in cosmetics and other consumption goods. The interview questions were segregated into three themes: the information on the collagen, information on the suitability of the recombinant CLP, and the viability of the recombinant CLP.

5.2 BACKGROUND OF THE INTERVIEWS

The study conducted interviews among the experts with the purpose of obtaining information on their perceptions and opinions on the development of the recombinant CLP as halal collagen. The interview questions also included information on collagen in general. The following table briefly describes the interviewees.

Table 5.1 List of Interview Questions

Themes	Questions
Information on the collagen	<ol style="list-style-type: none">1. Do you know what collagen is? Could you explain collagen from your understanding? 2. Could you please explain the usage or benefit of collagen?

Information on the suitability of the recombinant collagen-like protein	<p>3. Could you explain what the sources of collagen are?</p> <p>4. What are the debatable issues pertaining to these sources, if any? Do you know why a particular group of people does not prefer animal-based collagen?</p> <hr/> <p>5. A new source of collagen extraction that is based on bacteria has been discovered. Are you aware of this?</p> <p>6. What do you think of this new source in terms of its suitability?</p> <p>7. Do you think bacteria-based collagen is suitable for use in lab experiments only, or is it suitable for mass production? Could you please explain the reason?</p> <p>8. Do you think bacteria-based collagen is suitable and safe for public to use? May I know why?</p> <p>9. Could you explain if the bacteria-based collagen is suitable to be produced in Malaysia?</p> <p>10. Do you think bacteria-based collagen is halal? Why?</p> <p>11. What do you think of the prospects of bacteria-based collagen in Malaysia?</p>
Information on the viability of the recombinant collagen-like protein	<hr/> <p>12. Would you provide your opinions on whether producers or manufacturers are interested in producing collagen that is based on bacteria?</p> <p>13. Do you think producers or manufacturers are interested in investigating in the production of collagen-based on bacteria? Why do you think so?</p> <p>14. Is bacteria-based collagen profitable to manufacturers? Why?</p>

15. Will bacteria-based collagen boost production and increase the demand for collagen-based products? Why do you think so?
 16. Will the bacteria-based collagen industry stay in the economy longer?
 17. From your understanding, what is/are the factor(s) that can make a company remain relevant?
 18. In Malaysia, is halal certification important? Why?
 19. Will halal certification guarantee the company's place in the industry? Why do you think so?
 20. Some collagen products in Malaysia state that the ingredients come from natural ingredients without halal certification. Is it safe for Muslim consumers to ingest that product?
 21. Could you explain why collagen is considered well-accepted among Muslims in Malaysia nowadays?
 22. If this product complies with the halal requirement, are you there to consume this product from bacteria?
 23. Could you provide your knowledge on collagen-like protein?
 24. Are you aware of collagen-like proteins as new things? Could you provide your thoughts about the collagen-like protein being a new thing?
 25. As a Muslim, would you consume this product if it is commercialized and certified as halal?
-

5.3 DATA ANALYSIS

The responds were divided into three main themes: The information on collagen in general, the information on the suitability of the recombinant CLP, and the information on the viability of recombinant CLP.

Table 5.2 presents the list of interviewees with respective academic qualifications and current positions.

Table 5.2 Interviewees Background

Code	Gender	Highest Qualification	Current Position	WE
E01	Male	PhD in Halal Product Science	Deputy Dean, International Institute for Halal Research and Training (INHART)	<10 years
E02	Male	PhD in Shariah and Halal Laws	Head, International Institute for Halal Research and Training (INHART)	<10 years
E03	Male	PhD in Food Science and Technology	Dean, Institute of Chemical Engineering, Universiti Kuala Lumpur (UniKL) Malaysia	>20 years
E04	Male	PhD in Functional Food and Nutraceuticals	Senior Lecturer, Universiti Sultan Zainal Abidin (Unisza)	<10 years
E05	Female	MPath (Anat Path)	Senior Lecturer, Universiti Sains Malaysia (USM)	>10 years
E06	Female	PhD in Halal Products Science	<i>Penolong Pengarah Kanan, Bahagian Hab Halal JAKIM</i>	>10 years
E07	Male	Master of Business Administration	Managing Director, Superfood Biotech Sdn. Bhd.	<10 years

WE: Work Experience

5.3.1 Information on the Collagen

The introduction part of the interview was the expert's knowledge of the collagen. Among seven interviewees, five of them gave similar opinions on the meaning of collagen.

"... you must understand what collagen is. It is a natural product, extracted from animals. Mainly from thigh, bones ... collagen is essential amino acid ... a source of protein." (E03).

"Collagen is part of a protein, and you can get it from different types of sources of animal and different parts. You can get it from many of their joints, bones, or something like that. It is a combination of animal acids" (E01).

"Collagen comes from an animal, and none come from plants. It is because collagen has two typical components, hydroxyproline and proline. These two components must have in collagen." (E06).

E06 is a JAKIM science officer who specialises in food quality and safety at JAKIM also added.

"Plant is not a source of collagen. For example, in the current industry, there is also a company that uses seaweed, such as pectin, carrageenan which are plant-based. Those are plant-based, but they do not contain hydroxyproline and proline compounds. Besides, the amount of amino acids in the plant is small, while the amount of protein in collagen and gelatine is more than 80%." (E06).

Based on the above interviews, collagen can only be found in the mammal since it mainly exists in tendons, muscles, bones, and cartilage, which has been highlighted in innumerable studies on collagen (Gorgieva & Kokol, 2011; D. Liu et al., 2015; Ricard-Blum, 2011; Silvipriya et al., 2015). On another note, the pathologist and the Superfood Sdn. Bhd., who is the industry player, provided their point of view.

"Collagen is produced from fibroblast, which are mesenchymal cells created by God to secure our bodies and allow them to function beautifully." (E05).

"Collagen is a protein block that helps to hold tissue" (E07).

Scientifically, collagen also exists naturally in the human body, and it holds an essential role in the human body (Malfait, 2015; Sandhu et al., 2012), where it secures human body to function beautifully. If an individual is born with a lack of collagen,

(s)he could suffer from illness (Malfait, 2015; Medline Plus, 2020; Sandhu et al., 2012; U.S National Library of Medicine, 2016).

Regarding collagen's application, the experts concurrently stated that it is primarily found in foods, medicines, and cosmetics. Likewise, as numerous academic works have elucidated, collagen serves a multitude of purposes, rendering it advantageous for various sectors including medicine and cosmetics (Faria-Silva et al., 2020; Feetham et al., 2018).

“Well, the application is mainly in foods. They serve as a stabilizer and sweetener. Lately, a lot of collagen is used in cosmetics and pharmaceutical products.” (E03).

“Its (collagen) benefit for all products because it can upgrade the products’ quality to support the food or cosmetics production” (E02).

“If gelatine is mainly used in the food industry, it is because the texture of gelatine itself is like jelly. Gelatine has a reversible function, unlike starch (carrageenan) ... collagen is currently used mainly in cosmetic products. Also, it is used in nutraceuticals.” (E06).

“Normally, collagen is used in pharmaceuticals and beauty products” (E03).

On the other hand, the industry player clarified the benefit of collagen-based on his perceptions.

“... collagen is a useful protein that helps to hold and maintain tensile strength of our body tissue. It also helps to hold muscle and joints, and also keep our skin elastic” (E07).

Based on his point of view, collagen that naturally exists in the human body rules the structure of the skin, connective tissues, tendons, and cartilage (Sandhu et al., 2012).

In the meantime, the collagens that are currently used for products in the market are mostly from mammals, usually either bovine or porcine, as described by the experts.

“... normally, the collagen in the industrial market comes from swine or pork” (E04).

“As far as I know, most of it is from animals. I am not sure about plants, but since it is a protein-based, so most of it is from animals” (E01).

“The source of collagen is from animals such as bovine and porcine, and also can be found in buffalo and horses. In the global market, porcine has been commonly used in collagen-based products. I am telling you this because the production cycle only take three to six months if the company uses porcine. Meanwhile, for bovine, a company may need to take a year producing cycle” (E06).

Meanwhile, the industry player stated that collagen is mainly fish. In fact, the marine collagen market is emerging (Market Study Report, 2020). This was due to the fact that fish collagen also has a function similar to mammal collagen and could be applied in food and pharmaceuticals as well (Faria-Silva et al., 2020).

However, most of the sources of collagen were either bovine or porcine (Markets and Markets, 2022); thus, there were debatable issues. The issues are not confined to the halal status per se but also include issues such as diseases.

“Two issues from these sources are the halal status and the general animal animals since there are a lot of animals, we do not know they may have contracted with foot and mouth diseases, or mad cow disease” (E03).

“Among debatable issues pertaining to the source of collagen is the assurance of its halal status especially when collagen is derived from animal.” (E07).

The above findings aligned with previous pieces of literature on the concern of collagen sources (Batu et al., 2015). Besides, due to the outbreak of mad cow disease, consumers are being sceptical about consuming the collagens that are extracted from bovine (Hashim et al., 2015). Therefore, producers are prone to use porcine-based collagen, which is prohibited from being consumed by Muslim consumers (Hashim et al., 2015).

Consequently, consumers switched their demand to marine-based collagen due to the doubtfulness of the halal status based on religious belief and the health conditions of the animal. The science officer from JAKIM asserted,

“There are consumers who demand marine collagen, which is from fish skin. Somehow, the contamination issues arose. There was this case; a company

claimed that their product is based on marine collagen, but they discreetly contaminated the product with other sources of collagen” (E06).

Marine collagen is a famous alternative to mammal collagen since there are several concerns about mammal collagen (Coppola et al., 2020; Dave et al., 2019; Felician et al., 2018; Lim et al., 2019; Salvatore et al., 2020; Subhan et al., 2015).

However, there are also drawbacks to marine collagen, whereby it incurs higher production costs (Global Market Insight, 2022; Grand View Research, 2021; Markets and Markets, 2022). Moreover, as stated by the JAKIM officer above, the products that contain collagen could have contamination and fraud issues hence, it is highly important to get certified as halal prior to being consumed by Muslim consumers (Mustaffa et al., 2017).

Table 5.3 General information on the collagen

	Expert’s opinion	E1	E2	E3	E4	E5	E6	E7	Total
a)	Understanding on the collagen	√	√	√	√	√	√	√	7/7
b)	The use of collagen	√	√	√	√	√	n/a	√	6/7
c)	Main issues regarding the collagen	√	√	√	√	√	n/a	√	6/7

5.3.2 Information on the Suitability of the Recombinant Collagen-Like Protein

This theme discussed the potential discovered in the recombinant CLP to substitute mammal-based collagen, which has issues such as the general health of the mammal as well as the halal status.

The experts were aware of the collagen when asked, whereby the bacteria-based collagen used media to grow its microorganisms for them to multiply. Since the source for the recombinant CLP was bacteria, experts in food technology and food chemistry gave their point of view and briefly explained on the recombinant process.

“As far as I am in the industry, I have still not found this type of collagen. Maybe it is produced in the lab, not in the manufacturing company” (E06)

“Collagen has its properties. DNA engineering requires specific properties when you apply certain products. We can produce collagen with specific properties through DNA for a particular purpose, but we have to be careful when producing this kind of collagen. It is because, during the cultivation, the media where we propagate the bacteria may not be halal” (E03).

From the above findings, the science officer of JAKIM (E06) did not find any of the products containing recombinant CLP. The CLP might not be introduced in the Malaysian market yet, but it could be found from other countries that promote non-animal-derived collagen (Lauret, 2023).

Besides, the recombinant CLP was discovered three decades ago (Fertala, 2020); hence, it must have been introduced in the market by those producers who target vegetarian consumers (Lauret, 2023).

Meanwhile, the academicians from the Institute of Halal Research and Training (INHART) stated:

“It is safe if it is from halal source” (E02).

The recombinant CLP was made in the lab by the researchers; hence, the quality and safety of the collagen could be tested and controlled by the researchers (Awang et al., 2023; Salleh et al., 2023). Therefore, according to the food biotechnologist in the interview:

“It is safe if it is properly controlled” (E03).

Likewise, the function and the usage of collagen can also be controlled through the process of producing collagen, such as for drug delivery (Olsen et al., 2003), cosmetics (Aly et al., 2022), tissue engineering (Chunlin et al., 2004; Yang et al., 2021), or several others (Ramshaw et al., 2019; Wang et al., 2017; Wenbo et al., 2022).

In addition, from the industry player’s perception, the new source might become a new substitute for the current source, which is animals. Somehow, it was assumed to

be risky to produce consumable products that were produced from bacteria and grew in the lab.

Therefore, experts were required to point out their view on whether collagen is safe if it is produced through the recombinant process or bacteria. In addition, they were also asked to state their opinion on whether the production is suitable for mass production. According to INHART researchers,

“We can do it (recombinant CLP) in the lab as well as in mass production because now we have the technology, which we call bioreactor. So, in this bioreactor, bacteria can be grown in a mass, and then you can extract a high amount or high content of collagen from these bacteria” (E01).

The research has been conducted, and evidence has been presented to support the possibility that the recombinant CLP can be manufactured in mass production with minimal production cost (Awang et al., 2021; Salleh et al., 2023). It is also supported by the claim made by food technologist (E03) and the industry player (E07).

“It is much easier to use bacteria-based collagen through mass production because you can control them” (E03).

“Bacteria-based collagen may be suitable for mass production. It can provide more benefits than current sources of collagen, such as cost-saving, stability assurance, ability to be applied in various industries and applications, superior health or beauty benefits, and sustainable supply” (E07).

Meanwhile, the halal expert and academician from UniSZA have different opinions regarding the mass production of the recombinant CLP. However, the studies have presented evidence that the production could minimise the production cost (Awang et al., 2021; Salleh et al., 2023).

“For the current situation, you can use bacteria-based collagen for lab experiments, but I doubt it can be produced in mass production. It could incur a high cost” (E04).

It is questionable if the recombinant of CLP is suitable and safe to be consumed where, in the concept of halalan toyyiban, the consumable products should also have the characteristics of safe and hygiene. From the experts' perspective, it is safe to be consumed by consumers, especially Muslims, if it is controlled adequately during its cultivation and production.

“It can be said, yes (safe) ... we should first test the toxicity before exposing the collagen to the public” (E01).

“It is safe if it is properly controlled and screened. We are concerned about the recombinant process. Because some changes may take place and it produces some effect.” (E03).

From the above findings, the recombinant CLP has the potential to enter the collagen market if it is tested and proven to be safe and halal. Likewise, the study has found that the recombinant CLP is safe to be consumed, and most importantly it could alternate with animal-based collagen (Campuzano & Pelling, 2019).

Moreover, the experts clarified that it will be regarded as halal if the media and microorganisms are obtained from reliable and halal sources. The assertion was consistent with the research that discovered the halal recombinant of CLP (Salleh et al., 2021). Additionally, the study has revealed discoveries that support the halal pharmaceutical industry (Salleh et al., 2023).

“If the sources of bacteria per se are from halal sources, then it is halal because it will not cause any harm and will not affect the users” (E02).

“In the recombinant process, e-coli is the host, the carrier of the gene of the collagen per se. Since we need the host to multiply into colonies, it must eat. Hence, the food that we ought to feed the host must be halal.” (E06).

“... I believe that bacteria-based collagen is halal.” (E07).

Apparently, the recombinant CLP is new among Malaysians, and the study attempts to investigate whether the collagen is suitable to be produced in Malaysia. Most experts agree that the recombinant CLP is to be produced in Malaysia and it might be a massive prospect in the industry.

“It (recombinant CLP) is suitable for producing new technology and new knowledge and for food security as well.” (E04).

“The recombinant CLP is suitable for production in Malaysia. The prospect is moving upward because collagen is also used in cosmetics aside from food production and pharmaceuticals.” (E01).

“Bacteria-based collagen may have promising future prospect. It has a unique selling proposition that can increase its value as compared to collagen source.” (E07).

Based on the above findings, the recombinant CLP was said to have a future in the collagen market. The recombinant CLP has the potential to offer to the market due to the customisation and scalability of its process (Aly et al., 2022). Besides, the products containing the recombinant CLP would be preferred by consumers who have environmental consciousness (Duasa & Husin, 2020).

Table 5.4 The suitability of the recombinant collagen-like protein

	Expert's opinion	E1	E2	E3	E4	E5	E6	E7	Total
a)	Information on bacteria-based collagen	√	√	√	√	√	n/a	√	6/7
b)	The suitability of bacteria-based collagen production	√	√	√	√	√	n/a	√	6/7
c)	The views on the effect of bacteria-based collagen production to the country	√	√	√	√	√	n/a	√	6/7

5.3.3 The Viability of the Recombinant Collagen-Like Protein

Based on the experts' point of view, producers or manufacturers may be interested in producing products with recombinant CLP because the technology is sustainable and cost-effective.

“From the manufacturers' perspective, they certainly think of the profit. Thus, if the recombinant CLP can minimise the cost of production, they will proceed the production best if there is demand.” (E06).

“... the technology is proven and sustainable, cost-effective as well. People will use it and it shall have good quality.” (E03).

According to the experts, the manufacturer should have carefully considered a few things prior to introducing the products containing the recombinant CLP to the market, which are cost and profit. The profit shall increase if the products meet the demand in the market, where previous research has presented the data that consumers with environmental awareness would opt for recombinant CLP products rather than animal-based collagen products (Duasa & Husin, 2020).

Moreover, the recombinant CLP may profit the manufacturers since the production cost is lower than animal-based collagen.

“... because it (the recombinant CLP) is cheap. It also generates more bacteria in one time instead of animal-based collagen during the production.” (E02).

“It (the recombinant CLP) is a profitable venture. For animal-based research, you have to find the sources, particularly for recombinant CLP, and everything can be controlled. For example, the cow may have a poor health condition, and we were not aware of it.” (E03).

The above findings could be supported by the findings from a previous study that discovered that the final product containing the recombinant CLP is environmentally friendly and supports sustainable development. Manufacturers would be willing to produce it (Duasa, Radzman, et al., 2023). Most importantly, the view of the industry player could be taken into consideration.

“Bacteria-based collagen may be profitable as it can easily be replicated to scale up the production output.” (E07).

Moreover, it was said that if the recombinant CLP has functions similar to those of natural collagen, it can boost production and increase demand. Nevertheless, an expert also doubts that manufacturers are willing to produce bacteria-based collagen, and he added that he doubts whether the production is making a profit.

“... they (the producer) may say they agree to the product, but then, they will ask who would bear the cost for this new technology ... they may look at their return on investment (ROI). If their ROI looks like five years, they would refuse this technology.” (E04).

He also emphasised that, the current situation, the recombinant CLP will not boost production and increase demand for collagen-based products, though the recombinant CLP is good in his perceptions. Nevertheless, the recombinant CLP could function better than natural-based collagen (An et al., 2014) and thus could have the potential to enter the halal cosmetics industry. Besides, the halal cosmetics industry has existed in Malaysia for more than four decades (Ali et al., 2019).

Aside from that, the recombinant CLP is engineered to function similarly to the natural collagen, where the researchers have the assets to the properties of the CLP (Wang et al., 2017). Therefore, prior to producing the final products, researchers could

ascertain the appropriate application of the recombinant CLP such as pointed out by the food technologist (E01) below.

“We can control the system, where we are the one who would be controlling the bacteria and the media itself.” (E01).

Moreover, clarification from industry player could be provided.

“Collagen is an essential protein in our body. Hence, the demand for collagen-based products will keep growing. A new technology of extracting collagen that has superior value from other sources of collagen may be the pivot point for the bacteria-based collagen to penetrate the market.” (E07).

Consequently, the recombinant CLP could penetrate various markets such as cosmetics, pharmaceuticals, and several others (Aly et al., 2022; Olsen et al., 2003; Ramshaw et al., 2019; Wenbo et al., 2022). Besides, if the manufacturers decide to produce the product containing the recombinant CLP and plan a wise strategy, they can stay in the economy longer.

“Company may stay longer in the industry if they can maintain their track record.” (E04).

“This is about competitiveness, the pricing and the strategy.” (E03).

“It is depending on the supply and demand aspect.” (E07).

Furthermore, a company might remain in the market for a longer period of time if it produces halal goods in Malaysia.

“If the company produced halal products in Malaysia, with a majority of Muslim consumers, they can sustain themselves, and they have chances to spread their wings to other Muslim countries. Thus, in my opinion, with the increasing numbers of Muslims nowadays, demand on halal products, including cosmetics with collagen, they can also increase their revenue.” (E01).

Based on the above perceptions, halal products might have a promising future due to the increasing Muslim population (Azam & Abdullah, 2020). This is due to the fact that halal is the benchmark of hygiene and safe (Ngah et al., 2020). The demand for halal products is not limited to food and beverages only; consumers also demand halal tourism and halal transportation as well (Ngah et al., 2020; Olya & Al-ansi, 2018).

Regarding halal issues, the experts explained that halal is vital in Malaysia, but firms are not required to issue halal certificates. Some experts also highlighted that the halal certification in Malaysia is essential to prove the raw material in the ingredients of the product.

Moreover, the need to apply the halal certification on the products containing the recombinant CLP is much more required (Mustaffa et al., 2017). All experts had a mutual agreement that halal certification may guarantee a place in the industry.

“... Malaysia is one of the halal hubs. Then, we are promoting halal hubs all over the world. Halal certification may guarantee a company’s place because it has undergone the integrity process from start to end.” (E02).

“In Malaysia, it (halal certification) is imperative because most of the raw ingredients that we use in our food production were imported from other countries. This halal certification guarantees the company’s place in the industry. (E01).

“Halal certificate is not mandatory; rather, it is voluntary. Even so, if you issued the certificate, it would be good. It may firm a company’s place in the industry.” (E04).

“Halal certification is important as it can help businesses to align with the majority of the consumers who are Muslims, especially when halal awareness is growing among consumers.” (E07).

The food technologist explained his view on halal certification.

“... I would say the halal certificate is important because halal is not only meant for Muslims. Halal is a benchmark for quality and setting, so when consumers want quality and setting, halal is a choice.” (E03).

Based on the above findings, halal certificates have a great impact, although they are not mandatory (Azam & Abdullah, 2020). Besides, a study reported that attitudes and halal awareness among consumers in Southeast Asia are considerably high (Bashir, 2020).

Furthermore, from the industry player’s point of view, a company's position may not be assured by halal certification. However, halal certification could benefit the business in terms of customer preferences. As a JAKIM officer pointed out, halal

certification is important to the extent that a company will do all sorts of things to get the halal certification, and this could be evidence that halal certification does benefit the company.

Even after obtaining the certificate, JAKIM has regularly assessed the businesses to make sure they continued to follow Shariah in their manufacturing. This move by JAKIM can make a company more vigilant in their production. Since the halal industry is the fastest-expanding market, a company that had its halal certification revoked would risk losing customers (Azam & Abdullah, 2020).

Basically, in contrast to other halal organisations in other nations that are mostly profit-based certification agencies with questionable transparency, JAKIM is the only halal authority under government control (Arif & Sidek, 2015; Fadzlillah et al., 2022). Owing to the ambiguity, JAKIM has audited halal certification authorities in a number of nations to make sure that the management complies with Islamic law (Arif & Sidek, 2015).

In conclusion, the experts have knowledge of the collagen-like protein, but their explanations of this alternative to replace natural collagen have differed. They were also aware that collagen-like protein is a new thing in collagen products.

“... there are some collagens that have some characteristics of elasticity, and it depends on the amino acid group. The bacteria used in the recombinant CLP have the same properties as elasticity. For instance, gelatine is also from protein, but because of the different composition of amino acid, we called it gelatine.” (E01).

“As long as it is not harmful and intoxicated and has a lot of benefits for consumers, then it would be alright.” (E02).

According to experts' statements, Despite being created in a lab, the recombinant CLP may be safe and beneficial to consumers. Thus, numerous research has been conducted to test the recombinant CLP with various purposes (Aly et al., 2022; Chunlin et al., 2004; Olsen et al., 2003; Ramshaw et al., 2019; Wenbo et al., 2022).

More notably, the recombinant CLP could be one of the alternatives to animal-based collagen, such as halal collagen (Salleh et al., 2023). Besides, it would incur minimum production cost as compared to the production involving animal-based collagen including marine sources (Awang et al., 2021; Salleh et al., 2021). Even though the collagen-like protein is a new thing, experts pointed out that they would consume the products containing the recombinant of CLP if it were certified as halal.

“Definitely (will consume a product containing the CLP) if it meets the halal requirements.” (E03).

“If the products comply with halal requirements, I am willing to consume the product. Complying with JAKIM halal requirements does not only mean it is halal from the raw materials but also considered as toyyiban elements that measure products safety and hygiene.” (E07).

Based on the above findings, experts agreed that they would like to consume the product containing the recombinant CLP if it is certified as halal. In fact, recombinant CLP is likely to attract many more Muslim consumers because they are certain that halal products are hygienic and safe to be consumed (Arif & Sidek, 2015; Yuswan et al., 2021).

Table 5.5 The viability of the recombinant collagen-like protein

	Expert’s opinion	E1	E2	E3	E4	E5	E6	E7	Total
a)	Producers’ interest on bacteria-based collagen	√	√	√	√	√	n/a	√	6/7
b)	The effect of bacteria-based collagen production on the country’s economy	√	√	√	√	√	n/a	√	6/7
c)	Information on halal	√	√	√	√	√	n/a	√	6/7
d)	Muslims consumers acceptance on collagen	√	√	√	√	√	n/a	√	6/7
e)	Information on collagen-like protein	√	√	√	√	√	n/a	√	6/7

5.4 CHAPTER SUMMARY

In this chapter, the expert interviews were covered. The inquiries started off asking about collagen in general and then shifted to asking about the recombinant CLP. The

experts were also asked about the recombinant CLP's future in the market. They agreed that the products containing the recombinant CLP would be a success, which also depends on the firms' strategy to stay in the industry longer. Consequently, a business that has received official halal certification will be assured of a long-term presence in the market since the halal market is projected to grow.



CHAPTER SIX

FINDINGS AND THE ANALYSIS OF SURVEY

6.1 INTRODUCTION

The chapter mainly presented the overall responses to the questionnaire survey. The discussions on the analysis were presented on a section-by-section basis according to the rationale of the questionnaire. The findings were structured into five main discussions: descriptive analysis (6.3), structural models (6.7), mediation analysis (6.8), moderation analysis (6.9), and the discussion on the hypotheses (6.10). The analysis of the robustness also presented after structural models analysis to check for the robustness of the model. Prior to the structural model (6.7), the analysis of the measurement model was presented as required by the PLS-SEM procedures (6.4). The chapter ends with its summary.

6.2 DATA ASSESSMENT

The data collection was carried out both online and offline through an online survey platform administered by Google, Google Forms (<https://docs.google.com/forms/u/0/>). Meanwhile, the questionnaires were printed out to be distributed physically as an offline method of data collection. Using the convenience technique, the invitation was sent to selected respondents who were Muslims and consumers through WhatsApp, Facebook, and Instagram Messenger applications. On the other hand, the questionnaires were distributed by approaching the respondents.

Although the calculated sample size using G*Power Calculator version 3.1.9.4 was 160 samples, the researcher decided to collect more to avoid sampling error. 550 questionnaires were distributed from June 2023 until November 2023 online and offline and managed to get 523 responses. Prior to sending the link to the questionnaire, the respondents gave their consent to answer the questionnaire, and a brief explanation regarding the recombinant CLP also described to them.

According to Prospect Theory, the explanation to the public may influence their perceptions toward the product (Bahmanziari & Odom, 2015; Puto, 1987; Tversky & Kahneman, 1985, 1989); thus, the explanation was written on the front page of the questionnaires. The pictures of the recombinant CLP were also attached to introduce the collagen to the consumers. In addition, the explanation was in simple words in both English and Malay language.

6.2.1 Data Screening

The first step in analysing the data was to screen it to ensure its usability. This process was to identify the missing values, problematic responses, redundant answers, and outliers. Due to the format of the Google Forms questionnaires that required respondents to answer all questions before getting to the next page and only allow for an answer per each question, missing data and unanswered questions can be avoided. The answers in Google Forms were automatically keyed in the Microsoft Excel format and the researcher downloaded it to Microsoft Excel and export the data file to SPSS version 27.

6.2.2 Eliminating Outliers

There was a tendency for the response to be too over- or under-estimate parameter value in statistical analyses. Thus, it is important to screen for multivariate outliers (Field & Miles, 2010). Usually, Mahalanobis distance is used to identify the multivariate outliers, but it was said that Mahalanobis distance might result in a false-negative or false-positive (El-Masri et al., 2021). Therefore, the researcher must be careful when using Mahalanobis distance, and it is important to consider using residual statistics as a combination to Mahalanobis distance (El-Masri et al., 2021).

The outlier was assessed by inspecting the Mahalanobis distance that was produced by multiple regression programs in SPSS version 27. Outliers were identified when the standardized residual values were greater than ± 3.29 (Field & Miles, 2010). For this study, the result reported that seven out of 523 respondents were outliers. Thus, these seven outliers were eliminated, which made the final number of respondents 516.

6.2.3 Normality Test

Normality is embodied by the normal distribution in each item and all linear combination of items, and non-normal data was one of the rationales for the researchers to use the PLS-SEM approach (Guenther et al., 2023). For this dataset, Mardia multivariate kurtosis was used to check for the normality of the data through the software available at <https://webpower.psychstat.org/models/kurtosis/> as suggested (Cain et al., 2017; Hair et al., 2019). The result reported in the Table 6.1 below showed that Mardia's multivariate skewness where it indicates that the data was not normally distributed as shown by the skewness ($\beta = 18.361$, $p < 0.001$) and kurtosis ($\beta = 158.581$, $p < 0.001$). Therefore, the non-normal data implies the rationale for using the PLS-SEM approach.

Table 6.1 Mardia's Multivariate Skewness and Kurtosis

	b	z	p-value
Skewness	18.361	1579.040	$p < 0.001$
Kurtosis	158.581	328.285	$p < 0.001$

6.3 DESCRIPTIVE ANALYSIS

The analysis of respondents' demographic characteristics consists of the mean and standard deviation of every item in the questionnaire.

6.3.1 Demographic Profile of the Respondents

The descriptive analysis was executed through SPSS software to obtain the demographic profile of the respondents, consisting of their gender, age, education, employment, and race. Table 6.2 tabulated the analysis, where apparently 74.6% of the respondents were female. Apparently, the majority of the respondents are female, similar to the findings of several other consumers' behaviour studies (Mancuso et al., 2016; Rosa et al., 2018; H. S. G. Tan et al., 2016) as well as halal products' research (Ag Majid et al., 2021; Ali et al., 2019; Mahbubi et al., 2019). This was probably because collagen is a common ingredient in cosmetics products, thus attracting females more than males to respond to the questionnaire (Omar et al., 2019).

Among the respondents, 59.5% were aged between 30 and 39 years old, with the majority followed by those aged 40 to 49 years old (19.6%). It was consistent with findings from earlier studies that the majority of respondents were between the ages of 40 and 49 or 30 to 39 (Bukhari et al., 2020; Mahbubi et al., 2019; Shan et al., 2017). The age within 30 to 49 years was the productive age group thus, they were among the public that would contribute to the economy (Mahbubi et al., 2019).

In terms of education, the majority of the respondents acquired a bachelor's degree (53.9%) as their higher education, followed by postgraduate (20.7%). 35.7% of the respondents work in the private sector, 27.1% of them serve the government, 15.3% are self-employed, while 11.8% were housewives, followed by students (8.5%) and pensioners (1.6%). For races, almost all of the respondents were Malay (98.1%).

Apparently, most of the respondents were at the age of 30 to 39 years old and they were fairly educated, which is quite similar to the respondents of other consumers' behaviour studies (Ali et al., 2019; Bukhari et al., 2020; Shan et al., 2017). Moreover, the age group and education level are among the factors determining the acceptance and the intention to purchase a product (De Jong et al., 2003; Kraus et al., 2017). Consumers

in this age group would be considering purchasing a product that could give benefits and advantages to their lifestyle and well-being (Kraus et al., 2017).

Table 6.2 Demographic Profile of the Respondents

Profile	Description	Frequency	Percent (%)
Gender	Male	131	25.4
	Female	385	74.6
Age	Below 20 years old	25	4.8
	20 – 29 years old	36	7.0
	30 – 39 years old	307	59.5
	40 – 49 years old	101	19.6
	50 – 59 years old	47	9.1
Education	Primary school	2	4
	Secondary school	42	8.1
	Diploma / Pre-University	87	16.9
	Degree	278	53.9
	Postgraduate	107	20.7
Employment	Private	184	35.7
	Government services	140	27.1
	Self-employed	79	15.3
	Pensioners	8	1.6
	Students	44	8.5
	Housewife	61	11.8
Races	Malay	506	98.1
	Others	10	1.9

6.3.2 Distribution of the Respondents

Table 6.3 summarised a cross-tabulation of respondents' gender by their age, educational level, and employment type. Of 516 respondents, 385 were female, and 131 were male.

The table depicted that most of the respondents were between 30 and 39 years old, where 55.7% of them were male, and the remaining percentage were female,

followed by the age group of 40 to 49 years old. The p-value from the chi-square test showed that there is no significant difference between respondents' age and their gender.

Table 6.3 Cross-tabulation of respondents' gender and their age, education level, and employment

		Gender		Total	p-value
		Male (%)	Female (%)		
Age	Below 20 years old	10 (7.6)	15 (3.9)	25	0.241
	20 - 29 years old	11 (8.4)	25 (6.5)	36	
	30 - 39 years old	73 (55.7)	234 (60.8)	307	
	40 - 49 years old	22 (16.8)	79 (20.5)	101	
	50 years old and above	15 (11.5)	32 (8.3)	47	
Total		131 (100)	385 (100)	516	

Meanwhile, Table 6.4 tabulated the distribution of respondents' age with their educational level, which shows that most of the respondents hold bachelors' degree (278 respondents). The previous table reported that most of the respondents were between 30 and 39 years old; hence, it is common that consumers within that age hold at least a bachelor's degree.

Besides, the percentage of Malaysians who graduated with at least a bachelors' degree was quite high as of 2021 reported by the Ministry of Higher Education (MOHE, 2022). Moreover, previous studies regarding consumer acceptance also reported that the majority of the respondents in their study were degree holders (Shan et al., 2017; Zhang et al., 2020).

Table 6.4 Distribution of respondents' age by their educational level

	Age					Total
	Below 20 years old	20 - 29 years old	30 - 39 years old	40 - 49 years old	50 years old and above	
Primary school	1 (4)	0 (0)	0 (0)	0 (0)	1 (2.1)	2
Secondary school	9 (36)	5 (13.9)	7 (2.3)	4 (4)	17 (36.2)	42
Diploma/ Pre-University	12 (48)	14 (38.9)	26 (8.5)	21 (20.8)	14 (29.8)	87
Degree	2 (8)	10 (27.8)	227 (73.9)	34 (33.7)	5 (10.6)	278
Postgraduate	1 (4)	7 (19.4)	47 (15.3)	42 (41.6)	10 (21.3)	107
Total	25	36	307	101	47	516

In terms of employment type, Table 6.5 depicted 184 of 516 respondents working in the private sector, followed by government services (140 respondents), self-employed (79 respondents), housewives (61 respondents), students (44 respondents), and pensioners (8 respondents). According to the table:

- 16% of the respondents, who are below 20 years old, are working in private sector, while 4% of them are self-employed, and the remaining are still students.
- 307 respondents were within the age range of 30 to 39 years old, with 49.8% of them working in the private sector, followed by self-employed or doing business (19.2%), government services (15%), and housewives (15%). 1% of them are students.
- Of 101 respondents between 40 and 49 years old, 69.3% of them worked in government service, followed by private sector (11.9%), housewives (10.9), and self-employed (7.9%).

- d) Of the 47 respondents aged 50 years and above, 48.9% of them serve in government sectors, followed by pensioners (17%). 14.9% of them worked in the private sector, and 8.5% were housewives.

Table 6.5 Distribution of respondents' age by their employment type

		Age					Total
		Below 20 years old	20 - 29 years old	30 - 39 years old	40 - 49 years old	50 years old and above	
Employment	Private	4 (16)	8 (22.2)	153 (49.8)	12 (11.9)	7 (14.9)	184
	Government services	0 (0)	1 (2.8)	46 (15)	70 (69.3)	23 (48.9)	140
	Self- employed/ Business	1 (4)	6 (16.7)	59 (19.2)	8 (7.9)	5 (10.6)	79
	Pensioners	0 (0)	0 (0)	0 (0)	0 (0)	8 (17)	8
	Students	20 (80)	21 (58.3)	3 (1)	0 (0)	0 (0)	44
	Housewife	0 (0)	0 (0)	46 (15)	11 (10.9)	4 (8.5)	61
	Total		25	36	307	101	47

6.3.2.1 Cross-Tabulation of Respondents' Health Risk Perception and Their Intention to Purchase the Recombinant CLP.

Table 6.6 illustrates the respondents' intention to purchase according to their health risk perception. The table depicted that of 516 respondents, 398 were concerned about the effect of the recombinant CLP on their health upon consuming the product (Health risk_1). However, from 398 of them, 86.7% have no problems with the development of the recombinant CLP to alternate the animal-based collagen (Purchase Intention 1). Nevertheless, the chi-squares test shows an insignificant value, which means that health risk_1 is not associated with purchase intention 1. However, the other four health risk items (Health Risk_2, Health Risk_3, Health Risk_4, Health Risk 5) show a significant association between health risk perception and purchase intention 1.

295 respondents agreed that consuming the recombinant CLP might cause sickness (Health Risk_2), and the remaining respondents neither agreed nor disagreed. However, 88.1% of them agreed that they have no problems in the development of the recombinant CLP (Purchase Intention 1). Meanwhile, 225 of the respondents agreed that the recombinant CLP might not cause any hazard to their health (Health Risk_3), while 41 disagreed and 220 neither agreed nor disagreed. Nevertheless, 95.3% of respondents who agreed that the recombinant CLP is not hazardous also agreed that they have no problems with the development of recombinant CLP.

336 of the respondents agreed that the recombinant CLP might have a better effect on wound healing compared to the medication without collagen (Health Risk_4). Of 336 respondents, 93.5% of them have no problems with the development of the recombinant CLP. Aside from that, 91.1% of 302 respondents agreed that the collagen-like protein might cause one to have chronic illness (Health Risk_5) and that they have no problems with the development of the recombinant CLP.

Table 6.6 The respondents' perception on the development of the recombinant CLP in relation to their health risk perception

		Purchase Intention 1			Total (%)	χ^2
		Disagree (%)	Neutral (%)	Agree (%)		p-value
Health Risk_1	Neutral	3 (2.5)	21 (17.8)	94 (79.7)	118 (100)	3.842
	Agree	9 (2.3)	44 (11.1)	345 (86.7)	398 (100)	0.146
Health Risk_2	Neutral	2 (0.9)	40 (18.1)	179 (81)	221 (100)	13.403
	Agree	10 (3.4)	25 (8.5)	260 (88.1)	295 (100)	< 0.001*
	Disagree	5 (12.2)	9 (22)	27 (65.9)	41 (100)	64.737
Health Risk_3	Neutral	2 (0.9)	49 (22.3)	169 (76.8)	220 (100)	< 0.001*
	Agree	5 (2)	7 (2.7)	243 (95.3)	255 (100)	

	Disagree	6 (18.8)	5 (15.6)	21 (65.6)	32 (100)	95.079
Health Risk_4	Neutral	1 (0.7)	43 (29.1)	104 (70.3)	148 (100)	< 0.001*
	Agree	5 (1.5)	17 (5.1)	314 (93.5)	336 (100)	
Health Risk_5	Neutral	3 (1.4)	47 (22)	164 (76.6)	214 (100)	29.865
	Agree	9 (3)	18 (6)	275 (91.1)	302 (100)	< 0.001*

*Significant differences at $p < 0.05$

Meanwhile, for the second item in the purchase intention variable (Purchase Intention 2), the chi-square test indicates that three of five items of the respondents' health risk perception (Health Risk_3, Health Risk_4, Health Risk_5) significantly associated with the item (Purchase Intention 2). Apparently, despite having the perception that the recombinant CLP has a high risk to health, respondents choose to agree that they have no problems with the development of the recombinant CLP.

Similar to the study of nuclear power plants, the relationship between risk perception and local acceptance was negatively significant. The neighbourhood accepted that the nuclear power plant is a form of power generation if they felt that the plant might not harm them (Xiao et al., 2017).

Table 6.7 exhibits that 90% of respondents who agreed that the recombinant CLP might not cause any hazard to their health (Health Risk_3) also agreed that they would substitute the animal-based collagen if they were hesitant about the halal status.

Meanwhile, 336 of the respondents agreed that the recombinant CLP might have a better effect on wound healing compared to the medication without collagen (Health Risk_4). 89.3% of them also would be willing to substitute the animal-based collagen with the recombinant CLP if they felt anxious about the halal status of the animal-based collagen.

302 respondents also agreed that CLP might cause consumers to have chronic illnesses (Health Risk_5). Somehow, 89.1% of them were willing to substitute the animal-based collagen with the recombinant CLP if they felt hesitant about the halal status of the animal-based collagen.

Table 6.7 The perception of respondents on the substitution of animal-based collagen due to halal status in relation to their health risk perception

		Purchase Intention_2			Total (%)	χ^2 p- value
		Disagree (%)	Neutral (%)	Agree (%)		
Health Risk_1	Neutral	5 (4.2)	20 (16.9)	93 (78.8)	118 (100)	2.503
	Agree	9 (2.3)	53 (13.3)	336 (84.4)	398 (100)	0.281
Health Risk_2	Neutral	4 (1.8)	33 (14.9)	184 (83.3)	221 (100)	1.331
	Agree	10 (3.4)	40 (13.6)	245 (83.1)	295 (100)	0.520
Health Risk_3	Disagree	5 (12.2)	11 (26.8)	25 (61)	41 (100)	36.389
	Neutral	6 (2.7)	42 (19.1)	172 (78.2)	220 (100)	< 0.001*
	Agree	3 (1.2)	20 (7.8)	232 (91)	255 (100)	
Health Risk_4	Disagree	6 (18.8)	8 (25)	18 (56.3)	32 (100)	54.501
	Neutral	3 (2)	34 (23)	111 (75)	148 (100)	< 0.001*
	Agree	5 (1.5)	31 (9.2)	300 (89.3)	336 (100)	
Health Risk_5	Neutral	4 (1.9)	50 (23.4)	160 (74.8)	214 (100)	26.001
	Agree	10 (3.3)	23 (7.6)	269 (89.1)	302 (100)	< 0.001*

*Significant differences at $p < 0.05$

Table 6.8 tabulated that the respondents' intention to substitute the animal-based collagen with the recombinant CLP even though the price of the product with the recombinant CLP is much higher (Purchase Intention 3). According to the table:

- a) 398 respondents agreed that they were concerned about how the CLP would affect their health (Health Risk_1), but 68.1% of them agreed to substitute the animal-based collagen with recombinant CLP even though the price is much higher.
- b) 295 respondents agreed that consuming the recombinant CLP might cause sickness to their health (Health Risk_2), and only 10.2% of them were not willing to substitute the animal-based collagen with the recombinant CLP if the price of CLP is much higher. 72.5% of them agreed to substitute the animal-based collagen with the recombinant CLP even if the price of CLP is much more expensive.
- c) 41 of the respondents disagreed with the statement that the recombinant CLP might not have any hazardous effects (Health Risk_3), while 220 felt neither agreed nor disagree, and 255 agreed. However, of 41 respondents, 51.2% agreed to substitute the animal-based collagen with the recombinant CLP, even if the price is much more expensive. Aside from that, of 255 respondent who agreed, 80.8% willing to substitute the animal-based collagen with CLP even if the price is much higher.
- d) 336 of the respondents agreed that the product with the recombinant CLP might have a better effect in treating wounds (Health Risk_4). Among them, 79.2% agreed to substitute the animal-based collagen with the recombinant CLP even though the price of the products with CLP is much more expensive.
- e) 302 respondents agreed that the recombinant CLP might cause chronic illness (Health Risk_5), while 214 felt neither agree nor disagree. 75.2% of 302 respondents were willing to substitute animal-based collagen with the recombinant CLP even if the price of CLP is higher. Meanwhile, 54.7% of 214 respondents disagree that they are willing to substitute the animal-based collagen with the recombinant CLP.

The p-value from the chi-square test showed that all five health risk perception items (a, b, c, d, and e) have a significant difference with the respondent's preference on their willingness to substitute the animal-based collagen with the recombinant CLP.

Table 6.8 Respondents' preference on the recombinant CLP over the animal-based collagen disregard of the price in relation to their health risk perception

		Purchase Intention_3			Total	χ^2 p- value
		Disagree (%)	Neutral (%)	Agree (%)		
Health Risk_1	Neutral	6 (5.1)	39 (33.1)	73 (61.9)	118 (100)	6.847
	Agree	38 (9.5)	89 (22.4)	271 (68.1)	398 (100)	0.034*
Health Risk_2	Neutral	14 (6.3)	77 (34.8)	130 (58.8)	221 (100)	21.440
	Agree	30 (10.2)	51 (17.3)	214 (72.5)	295 (100)	< 0.001*
Health Risk_3	Disagree	10 (24.4)	10 (24.4)	21 (51.2)	41 (100)	60.177
	Neutral	18 (8.2)	85 (38.6)	117 (53.2)	220 (100)	< 0.001*
	Agree	16 (6.3)	33 (12.9)	206 (80.8)	255 (100)	
Health Risk_4	Disagree	9 (28.1)	8 (25)	15 (46.9)	32 (100)	95.644
	Neutral	10 (6.8)	75 (50.7)	63 (42.6)	148 (100)	< 0.001*
	Agree	25 (7.4)	45 (13.4)	266 (79.2)	336 (100)	
Health Risk_5	Neutral	15 (7)	82 (38.3)	117 (54.7)	214 (100)	35.787
	Agree	29 (9.6)	46 (15.2)	227 (75.2)	302 (100)	< 0.001*

*Significant differences at $p < 0.05$

6.3.2.2 Cross-Tabulation of Respondents' Social Risk Perception and Their Intention to Purchase the Recombinant CLP.

Table 6.9 summarises the cross-tabulation of the respondents' perception of the development of the recombinant CLP (Purchase Intention 1) according to their social risk perception. According to the table:

- a) 311 respondents worried that their families might get sick after consuming the recombinant CLP (Social Risk_1). Somehow, 86.8% of them did not have any problems with the development of the recombinant CLP.
- b) 412 respondents agreed that their families and friends might have different views on the recombinant CLP (Social Risk_2). Anyhow, 89.1% of them did not have any problems with the development of the recombinant CLP.
- c) 356 respondents would be willing to suggest the recombinant CLP to their family and friends (Social Risk_3). 92.1% of them also did not have any problems with the development of the recombinant CLP.
- d) 356 respondents suggested that the product contains the recombinant CLP to society (Social Risk_4). 91.3% of them did not have any problems with the development of the recombinant CLP.

The chi-square test from the analysis also shows that three of four items (b, c, and d) have significant differences between social risk perception and their behaviour on the development of the recombinant CLP.

Table 6.9 The respondents' perception on the development of the recombinant CLP in relation to their social risk perception

		Purchase Intention 1			Total	χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)		
Social Risk_1	Neutral	3 (1.5)	33 (16.1)	169 (82.4)	205 (100)	4.674
	Agree	9 (2.9)	32 (10.3)	270 (86.8)	311 (100)	0.097
Social Risk_2	Neutral	2 (1.9)	30 (28.8)	72 (69.2)	104 (100)	31.237
	Agree	10 (2.4)	35 (8.5)	367 (89.1)	412 (100)	< 0.001*

Social Risk_3	Neutral	1 (0.6)	48 (30)	111 (69.4)	160 (100)	65.363
	Agree	11 (3.1)	17 (4.8)	328 (92.1)	356 (100)	< 0.001*
Social Risk_4	Neutral	1 (0.6)	45 (28.1)	114 (71.3)	160 (100)	52.487
	Agree	11 (3.1)	20 (5.6)	325 (91.3)	356 (100)	< 0.001*

*Significant differences at $p < 0.05$

The second item of the purchase intention regarding the respondents' perception to substitute the animal-based collagen with the recombinant CLP due to halal status (Purchase Intention 2) was tabulated in Table 6.10. In relation to their social health risk perception, the table summarised:

- a) 311 respondents worried that their family might fall sick after consuming the recombinant of CLP (Social Risk_1). Of the 311 respondents, 86.5% would be willing to substitute the animal-based collagen with the product with recombinant CLP if they were too anxious about the halal status of the animal-based collagen.
- b) 412 respondents agreed that their family and friends might have different point of view regarding the recombinant of CLP (Social Risk_2). 86.2% of them agreed to substitute the animal-based collagen with the product containing the recombinant CLP if there were issues regarding the halal status of the animal-based collagen.
- c) 356 respondents would suggest the product containing the recombinant CLP to their families and friends (Social Risk_3). 89.3% of them were willing to substitute the animal-based collagen with the product containing the recombinant CLP if they felt hesitant about the halal status of the animal-based collagen.
- d) 356 respondents would be willing to suggest the product containing the recombinant CLP to society (Social Risk_4). 89.6% of them agreed that they would substitute the animal-based collagen with the product containing the recombinant CLP if they felt hesitant about the halal status of the products containing animal-based collagen.

All items in the social risk perception are significantly different with their intention to substitute the animal-based collagen with the products containing the recombinant CLP if they felt hesitant about the halal status of the product containing the animal-based collagen (a,b,c, and d). It was apparent that social risk perceptions have a significant difference from the respondents' intention based on the p-value of the chi-square test.

Table 6.10 The perception of respondents on the substitution of animal-based collagen due to halal status in relation to their social risk perception

		Purchase Intention 2				χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)	Total	
Social Risk_1	Neutral	5 (2.4)	40 (19.5)	160 (78)	205 (100)	8.074
	Agree	9 (2.9)	33 (10.6)	269 (86.5)	311 (100)	0.018*
Social Risk_2	Neutral	3 (2.9)	27 (26)	74 (71.2)	104 (100)	15.115
	Agree	11 (2.7)	46 (11.2)	355 (86.2)	412 (100)	< 0.001*
Social Risk_3	Neutral	4 (2.5)	45 (28.1)	111 (69.4)	160 (100)	37.351
	Agree	10 (2.8)	28 (7.9)	318 (89.3)	356 (100)	< 0.001*
Social Risk_4	Neutral	4 (2.5)	46 (28.8)	110 (68.8)	160 (100)	40.770
	Agree	10 (2.8)	27 (7.6)	319 (89.6)	356 (100)	< 0.001 *

*Significant differences at $p < 0.05$

Third item for the purchase intention was whether the respondents were willing to substitute the products containing animal-based collagen with the recombinant CLP, disregarding the expensive price (Purchase Intention 3). According to Table 6.11:

- a) 311 respondents worried about the health consequences of consuming the products containing the recombinant CLP (Social Risk_1). Of the 311, 72.3% would substitute the products with animal-based collagen with recombinant CLP even if the price is much more expensive.
- b) 412 respondents agreed that their family and friends might have different views about the product containing the recombinant CLP (Social Risk_2). Meanwhile, 69.2% of them would be willing to substitute the animal-based collagen product with the recombinant CLP even if the price recombinant CLP is much more expensive.
- c) 356 respondents did have the thought to suggest their family and friends use the recombinant CLP-based products (Social Risk_3). 78.4% of them were willing to substitute the animal-based collagen products with the recombinant CLP despite the higher price.
- d) Of 516 respondents, 356 of them would suggest the products containing the recombinant CLP to society (Social Risk_4). Among 356 respondents, 77.8% of them were willing to alternate the animal-based collagen products with the recombinant CLP even though they needed to pay a higher price for the product with the recombinant CLP.

Furthermore, the chi-square test indicated that the study perceived a significant relationship between social risk perception and respondents' intention to alternate the animal-based collagen with the recombinant CLP, disregarding the higher price. All four items of social risk perception have a significant relationship with the third item of purchase intention (a, b, c, and d).

Table 6.11 Respondents' preference on the recombinant CLP over the animal-based collagen disregard of the price in relation to their social risk perception

		Purchase Intention 3			Total	χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)		
Social Risk_ 1	Neutral	16 (7.8)	70 (34.1)	119 (58)	205 (100)	15.959
	Agree	28 (9)	58 (18.6)	225 (72.3)	311 (100)	< 0.001*
Social Risk_ 2	Neutral	6 (5.8)	39 (37.5)	59 (56.7)	104 (100)	11.551
	Agree	38 (9.2)	89 (21.6)	285 (69.2)	412 (100)	0.003*
Social Risk_ 3	Neutral	12 (7.5)	83 (51.9)	65 (40.6)	160 (100)	92.379
	Agree	32 (9)	45 (12.6)	279 (78.4)	356 (100)	< 0.001*
Social Risk_ 4	Neutral	13 (8.1)	80 (50)	67 (51.9)	160 (100)	80.765
	Agree	31 (8.7)	48 (13.5)	277 (77.8)	356 (100)	< 0.001*

*Significant differences at $p < 0.05$

6.3.2.3 Cross-Tabulation of Respondents' Environmental Risk Perception and Their Intention to Purchase the Recombinant CLP.

Tables in this subsection presented the cross-tabulation of the respondents' purchase intention and their environmental risk perception. As previously mentioned, there were three items in the purchase intention constructs, and each was cross-tabulated with the respondents' perception of environmental risk. Table 6.12 (Purchase Intention 1) summarises:

- a) 448 out of 516 respondents worried about environmental problems nowadays (EnvRisk_1), and 87.5% of them did not have any problems with the development of the recombinant CLP.
- b) 369 respondents thought that animal-based collagen has a negative impact on the environment (EnvRisk_2), and 88.3% of them did not have any problems with the development of the recombinant CLP.
- c) 451 respondents believed that the halal-compliant processes and procedures would not have a negative impact on the environment (EnvRisk_3), and 89.6%

of them did not have any problems with the development of the recombinant CLP.

- d) 379 respondents thought that the recombinant CLP would not harm the environment because it was developed in the lab (EnvRisk_4). Among them, 92.6% of them agree that they have no problems with the development of the recombinant CLP.

All four items of environmental risk perceptions perceive a significant relationship with the intention to purchase (a, b, c, and d). This implies that the respondents' perceived environmental risk might influence their behaviour on the development of the recombinant CLP.

Table 6.12 The respondents' perception on the development of the recombinant CLP in relation to their environmental risk perception

		Purchase Intention 1			Total	χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)		
EnvRisk_1	Neutral	1 (1.5)	20 (29.4)	47 (69.1)	68 (100)	20.170
	Agree	11 (2.5)	45 (10)	392 (87.5)	448 (100)	< 0.001*
EnvRisk_2	Neutral	2 (1.4)	32 (21.8)	113 (76.9)	147 (100)	16.178
	Agree	10 (2.7)	33 (8.9)	326 (88.3)	369 (100)	< 0.001*
EnvRisk_3	Neutral	2 (3.1)	28 (43.1)	35 (53.8)	65 (100)	63.554
	Agree	10 (2.2)	37 (8.2)	404 (89.6)	451 (100)	< 0.001*
EnvRisk_4	Neutral	4 (2.9)	45 (32.8)	88 (64.2)	137 (100)	70.525
	Agree	8 (2.1)	20 (5.3)	351 (92.6)	379 (100)	< 0.001*

*Significant differences at $p < 0.05$

The second item of the purchase intention construct indicates that the respondents will substitute the products that contain animal-based collagen with the recombinant CLP if they feel too anxious about the halal status (Purchase Intention 2). According to Table 6.13:

- a) 86.2% of the 448 respondents who worried about the environmental problems (EnvRisk_1) will substitute the product with animal-based collagen with the products containing the recombinant CLP if they feel hesitant about the halal status of animal-based collagen products.
- b) 87.3% of the 369 respondents which agreed that the production of animal-based collagen would have a negative impact on the environment (EnvRisk_2) would be willing to use a product with recombinant CLP over animal-based collagen product if they were concerned about the halal status of the animal-based collagen products.
- c) 86.9% of 451 respondents agreed that halal-compliant processes and procedures would not have a negative impact on the environment (EnvRisk_3) and would prefer to use products containing the recombinant CLP rather than animal-based collagen products if they felt hesitant on the halal status.
- d) Among 379 respondents who agreed the CLP will not harm the environment (EnvRisk_4), 87.3% of them would be willing to substitute the animal-based collagen with the products containing the recombinant CLP if they felt hesitant about the halal status.

Table 6.13 The perception of respondents on the substitution of animal-based collagen due to halal status in relation to their environmental risk perception

		Purchase Intention 2			Total	χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)		
EnvRisk_1	Neutral	3 (4.4)	22 (32.4)	43 (63.2)	68 (100)	22.914
	Agree	11 (2.5)	51 (11.4)	386 (86.2)	448 (100)	< 0.001*

EnvRisk_2	Neutral	3 (2)	37 (25.2)	107 (72.8)	147 (100)	20.646
	Agree	11 (3)	36 (9.8)	322 (87.3)	369 (100)	< 0.001*
EnvRisk_3	Neutral	2 (3.1)	26 (40)	37 (56.9)	65 (100)	41.318
	Agree	12 (2.7)	47 (10.4)	392 (86.9)	451 (100)	< 0.001*
EnvRisk_4	Neutral	5 (3.6)	34 (24.8)	98 (71.5)	137 (100)	18.636
	Agree	9 (2.4)	39 (10.3)	331 (87.3)	379 (100)	< 0.001*

*Significant differences at $p < 0.05$

Third item in the purchase intention construct was whether the respondents would be willing to substitute the animal-based collagen with the recombinant CLP even though the price of the products containing the recombinant CLP is much more expensive (Purchase Intention 3).

In contrast with previous purchase intention items, a smaller percentage of respondents agreed to substitute the animal-based collagen with the recombinant CLP. It might be due to the item stating the expensive price. Table 6.14 is summarised as follows:

- a) 69.4% of the 448 respondents who worried about current environmental problems (EnvRisk_1) would be willing to consume the products containing the recombinant CLP even though the price is much more expensive.
- b) 71% of 369 respondents who agreed that animal-based collagen production would harm the environment (EnvRisk_2) would prefer the products containing the recombinant CLP even though the price is much more expensive.
- c) 71% of 451 respondents that believed halal-compliant processes and procedures would not have a negative impact on the environment (EnvRisk_3) would prefer the products containing the recombinant CLP even though the price is much more expensive.

- d) 73.1% of 379 respondents who thought that the recombinant CLP would not harm the environment (EnvRisk_4) would substitute the animal-based collagen with the recombinant CLP even though the price is much more expensive.

By performing the chi-square test, the result indicates that all items in environmental risk perception (a, b, c, and d) are significantly related to the respondents' preferences for recombinant CLP as a substitution to the animal-based collagen even though the price is much higher.

Table 6.14 Respondents' preference on the recombinant CLP over the animal-based collagen disregard of the price in relation to their environmental risk perception

		Purchase Intention 3			Total	χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)		
EnvRisk_1	Neutral	6 (8.8)	29 (42.6)	33 (48.5)	68 (100)	13.922
	Agree	38 (8.5)	99 (22.1)	311 (69.4)	448 (100)	< 0.001*
EnvRisk_2	Neutral	5 (3.4)	60 (40.8)	82 (55.8)	147 (100)	31.227
	Agree	39 (10.6)	68 (18.4)	262 (71)	369 (100)	< 0.001*
EnvRisk_3	Neutral	7 (10.8)	34 (52.3)	24 (36.9)	65 (100)	32.982
	Agree	37 (8.2)	94 (20.8)	320 (71)	451 (100)	< 0.001*
EnvRisk_4	Neutral	8 (5.8)	62 (45.3)	67 (48.9)	137 (100)	41.850
	Agree	36 (9.5)	66 (17.4)	277 (73.1)	379 (100)	< 0.001*

*Significant differences at $p < 0.05$

6.3.2.4 Cross-Tabulation of Respondents' Quality and Halal Risk Perception and Their Intention to Purchase the Recombinant CLP.

Quality and halal risk perception refer to how respondents behave regarding their purchase intention, considering the uncertainty of the quality and halal status of the recombinant CLP. According to Table 6.15 (Purchase Intention 1):

- a) 434 respondents were concerned about the hygiene aspect in the production of the recombinant CLP (QHRisk_1). 90.1% of them agreed that they did not have any problem in the development of the recombinant CLP.
- b) 427 respondents were concerned about the quality of the products containing the recombinant CLP (QHRisk_2). 89.9% of them agreed that they concurred that they have no issues with the recombinant CLP development.
- c) 405 respondents were concerned about whether the recombinant CLP follows halal requirements and guidelines (QHRisk_3). 88.4% of them have no problems with the development of the recombinant CLP.
- d) 336 respondents were concerned about the end-products that contain the recombinant of CLP (QHRisk_4). 89% of them have no problems with the recombinant CLP development.
- e) 399 respondents concurred that a product with the CLP recombinant would be of high quality since much research has been done by the researchers before it is produced (QHRisk_5). 93% of them agreed that they have no issues with the recombinant CLP development.

The p-value acquired through chi-square analysis implied that the study perceived a significant relationship between all items of quality and halal risk perception (a, b, c, and d) and respondents' perception of the development of the recombinant CLP.

Table 6.15 The respondents' perception on the development of the recombinant CLP in relation to their quality and halal risk perception

	Purchase Intention 1	Total	χ^2
--	----------------------	-------	----------

					p-value	
		Disagree (%)	Neutral (%)	Agree (%)		
QHRisk_1	Disagree	5 (26.3)	0 (0)	14 (73.7)	19 (100)	111.797
	Neutral	2 (3.2)	27 (42.9)	34 (54)	63 (100)	< 0.001*
	Agree	5 (1.2)	38 (8.8)	391 (90.1)	434 (100)	
QHRisk_2	Disagree	3 (20)	1 (6.7)	11 (73.3)	15 (100)	71.920
	Neutral	2 (2.7)	28 (37.8)	44 (59.5)	74 (100)	< 0.001*
	Agree	7 (1.6)	36 (8.4)	384 (89.9)	427 (100)	
QHRisk_3	Neutral	1 (0.9)	29 (26.1)	81 (73)	111 (100)	24.219
	Agree	11 (2.7)	36 (8.9)	358 (88.4)	405 (100)	< 0.001*
QHRisk_4	Neutral	4 (2.2)	36 (20)	140 (77.8)	180 (100)	13.771
	Agree	8 (2.4)	29 (8.6)	299 (89)	336 (100)	< 0.001*
QHRisk_5	Disagree	4 (26.7)	2 (13.3)	9 (60)	15 (100)	129.940
	Neutral	2 (2)	41 (40.2)	59 (57.8)	102 (100)	< 0.001*
	Agree	6 (1.5)	22 (5.5)	371 (93)	399 (100)	

*Significant differences at $p < 0.05$

Table 6.16 tabulated the respondents' behaviour towards substituting animal-based collagen with the recombinant CLP if they felt hesitant about the halal status of animal-based collagen product (Purchase Intention 2) in relation to their perception of halal and quality risk. According to the table:

- a) 88.7% of 434 respondents who were concern about the hygiene aspect of the recombinant CLP (QHRisk_1) agreed that they would substitute animal-based collagen with the recombinant CLP products if they feel anxious or hesitant about the halal status of animal-based products.
- b) 89.9% of 427 respondents who were concerned about the quality of the products containing recombinant of CLP (QHRisk_2) would be willing

- to substitute animal-based products with the recombinant CLP if they feel anxious about the halal status of the animal-based collagen products.
- c) 87.4% of 405 respondents who were concerned about whether the recombinant CLP follows the halal requirement and guidelines (QHRisk_3) would be willing to substitute animal-based products with the recombinant CLP products if they feel hesitant about the halal status.
 - d) 88.4% of 336 respondents who were concerned about the condition of the end-products containing the recombinant CLP (QHRisk_4) agreed that they would consume the recombinant CLP products as an alternative if they felt anxious about the halal status of animal-based products.
 - e) 89.5% of 399 respondents who believe that products containing the recombinant CLP will have a good quality (QHRisk_5) would be willing to substitute animal-based products with the recombinant CLP if they felt anxious about the halal status of animal-based collagen products.

Furthermore, all items for quality and perception of halal risk (a, b, c, and d) had a significant relationship with the second item of purchase intention. It was presented by the p-value from the chi-square test, which yielded values of less than 0.001. It implies that respondents' perception of quality and halal risk would influence their behaviour to substitute the animal-based collagen with the recombinant of CLP.

Table 6.16 The perception of respondents on the substitution of animal-based collagen due to halal status in relation to their quality and halal risk perception

		Purchase Intention 2			Total	χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)		
QHRisk_1	Disagree	3 (15.8)	2 (10.5)	14 (73.7)	19 (100)	79.942
	Neutral	4 (6.3)	29 (46)	30 (47.6)	63 (100)	< 0.001*

	Agree	7 (1.6)	42 (9.7)	385 (88.7)	434 (100)	
	Disagree	4 (26.7)	1 (6.7)	10 (66.7)	15 (100)	121.038
QHRisk_2	Neutral	3 (4.1)	36 (48.6)	35 (47.3)	74 (100)	< 0.001*
	Agree	7 (1.6)	36 (8.4)	384 (89.9)	427 (100)	
	Neutral	4 (3.6)	32 (28.8)	75 (67.7)	111 (100)	26.085
QHRisk_3	Agree	10 (2.5)	41 (10.1)	354 (87.4)	405 (100)	< 0.001*
	Neutral	5 (2.8)	43 (23.9)	132 (73.3)	180 (100)	21.774
QHRisk_4	Agree	9 (2.7)	30 (8.9)	297 (88.4)	336 (100)	< 0.001*
	Disagree	5 (33.5)	0 (0)	10 (66.7)	15 (100)	115.131
QHRisk_5	Neutral	1 (1)	39 (38.2)	62 (60.8)	102 (100)	< 0.001*
	Agree	8 (2)	34 (8.5)	357 (89.5)	399 (100)	

*Significant differences at $p < 0.05$

Meanwhile, Table 6.17 summarised the respondents' preference for the recombinant CLP over animal-based collagen, disregarding the price (Purchase Intention 3) in relation to their quality and halal risk perception. According to the table:

- a) 73.7% of 434 respondents who were concern about the hygiene aspect of the recombinant CLP (QHRisk_1) would be willing to substitute animal-based collagen with the recombinant CLP even though the price of the CLP-based product is much more expensive.
- b) 72.8% of 427 respondents who were concerned about the quality of the products containing the recombinant CLP (QHRisk_2) would be willing to consume the products containing recombinant CLP as an alternative to animal-based collagen products, disregarding the expensive prices.
- c) 71.9% of 405 respondents who were concerned about whether the CLP follows the halal requirement and guidelines (QHRisk_3) would be willing to alternate animal-based products with the products containing the recombinant CLP despite the expensive prices.

- d) 75.6% of 336 respondents who were concerned about the condition of the end-product containing the recombinant CLP (QHRisk_4) are willing to alternate animal-based collagen products with the products containing the recombinant CLP even though the price is much more expensive.
- e) 75.9% of 399 respondents that agreed the product containing CLP would have a good quality (QHRisk_5) would alternate animal-based collagen products with the recombinant CLP product even though the price is much higher than the animal-based collagen products.

The p-value from the chi-square test yielded values of less than 0.001 for all items in the quality and halal risk perception construct. This implied that there is a significant relationship between all items of quality and halal risk perception (a, b, c, and d) and the third item of purchase intention. Hence, respondents' perception of quality and halal risk would influence their behaviour to substitute animal-based collagen products with recombinant CLP products even though the price of CLP-based products is much higher.

Table 6.17 Respondents' preference on the recombinant CLP over the animal-based collagen disregard of the price in relation to their quality and halal risk perception

		Purchase Intention 3			Total	χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)		
QHRisk_1	Disagree	7 (36.8)	5 (26.3)	7 (36.8)	19 (100)	76.709
	Neutral	5 (7.9)	39 (61.9)	19(30.2)	63 (100)	< 0.001*
	Agree	32 (7.4)	84 (19.4)	318 (73.3)	434 (100)	
QHRisk_2	Disagree	5 (33.3)	3 (20)	7 (46.7)	15 (100)	61.084
	Neutral	6 (8.1)	42 (56.8)	26 (35.1)	74 (100)	< 0.001*
	Agree	33 (7.7)	83 (19.4)	311 (72.8)	427 (100)	

QHRisk_3	Neutral	12 (10.8)	46 (41.4)	53 (47.7)	111 (100)	24.234
	Agree	32 (7.9)	82 (20.2)	291 (71.9)	405 (100)	< 0.001*
QHRisk_4	Neutral	12 (6.7)	78 (43.2)	90 (50)	180 (100)	50.891
	Agree	32 (9.5)	50 (14.9)	254 (75.6)	336 (100)	< 0.001*
QHRisk_5	Disagree	5 (33.3)	6 (40)	4 (26.7)	15 (100)	98.067
	Neutral	5 (4.9)	60 (58.8)	37 (36.3)	102 (100)	< 0.001*
	Agree	34 (8.5)	62 (15.5)	303 (75.9)	399 (100)	

*Significant differences at $p < 0.05$

6.3.2.5 Cross-Tabulation of Respondents' Financial Risk Perception and Their Intention to Purchase the Recombinant CLP.

Financial risk perception refers to how respondents would behave with the intention to purchase the recombinant CLP considering the risk and uncertainty regarding their financial condition. According to Table 6.18 (Purchase Intention 1):

- a) 316 respondents perceived that the animal-based collagen products in the market are currently expensive (FinRisk_1). 90.2% of them concurred that they have no problems with the development of the recombinant CLP.
- b) 338 respondents believed that the production of the recombinant CLP would be cheaper because it does not involve animals (FinRisk_2). 92.3% of them concurred that they have no problems with the development of the recombinant CLP.
- c) 361 respondents thought that products containing the recombinant CLP would be cheaper because it is locally produced (FinRisk_3). 93.1% of them agreed that they have no problems with the development of the recombinant CLP.
- d) 396 respondents agreed that they would spend their money on products containing the recombinant CLP if it is not expensive (FinRisk_4). 93.2% of them agreed that they have no issues with the development of the recombinant CLP.

The chi-square test was performed on all items for financial risk perception. The p-value from the test yielded values of less than 0.001 for all items. It implied that the study perceived a significant relationship between financial risk perception (a, b, c, and d) and respondents' perception of the development of the recombinant CLP.

Table 6.18 The respondents' perception on the development of the recombinant CLP in relation to their financial risk perception

		Purchase Intention 1			Total	χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)		
FinRisk _1	Disagree	5 (17.9)	4 (14.3)	19 (67.9)	28 (100)	46.676 < 0.001*
	Neutral	2 (1.2)	35 (20.3)	135 (78.5)	172 (100)	
	Agree	5 (1.6)	26 (8.2)	285 (90.2)	316 (100)	
FinRisk _2	Disagree	5 (18.5)	1 (3.7)	21 (77.8)	27 (100)	77.988 < 0.001*
	Neutral	3 (2)	42 (27.8)	106 (70.2)	151 (100)	
	Agree	4 (1.2)	22 (6.5)	312 (92.3)	338 (100)	
FinRisk _3	Disagree	4 (15.4)	3 (11.5)	19 (73.1)	26 (100)	88.749 < 0.001*
	Neutral	2 (1.6)	43 (33.3)	84 (65.1)	129 (100)	
	Agree	6 (1.7)	19 (5.3)	336 (93.1)	361 (100)	
FinRisk _4	Disagree	6 (24)	3 (12)	16 (64)	25 (100)	147.613 < 0.001*
	Neutral	1 (1.1)	40 (42.1)	54 (56.8)	95 (100)	
	Agree	5 (1.3)	22 (5.6)	369 (93.2)	396 (100)	

*Significant differences at $p < 0.05$

The second item for purchase intention stated that the respondents would substitute the products made of animal-based collagen with the products containing the

recombinant CLP if they feel hesitant about the halal status of animal-based collagen products (Purchase Intention 2). According to Table 6.19:

- a) 90.2% of 316 respondents who agreed that the animal-based collagen in the market is currently expensive (FinRisk_1) also agreed to substitute the animal-based collagen with the recombinant CLP if they feel hesitant about the halal status of the animal-based collagen.
- b) 90.5% of 338 respondents who believe that the production of the recombinant CLP will be cheaper (FinRisk_2) would be willing to substitute the animal-based collagen with the recombinant CLP if they feel anxious about the halal status of the animal-based collagen products.
- c) 90.9% of 361 respondents who thought that the recombinant CLP would be cheaper because it is locally produced (FinRisk_3) concurred that they would substitute animal-based collagen with the products containing the recombinant CLP if they feel hesitant about the halal status of the products containing the recombinant of CLP.
- d) 91.7% of 396 respondents who would be willing to spend their money on the products containing the recombinant CLP (FinRisk_4) also would be willing to consume the recombinant CLP products if they feel anxious about the halal status of animal-based collagen products.

The p-value from the chi-square test yielded values of less than 0.001 for all items in the financial risk perception framework, which implies a significant difference. Therefore, the study perceived that the financial risk perceptions (a, b, c, and d) influenced the respondents' perception of substituting the animal-based collagen with the recombinant CLP due to halal status.

Table 6.19 The perception of respondents on the substitution of animal-based collagen due to halal status in relation to their financial risk perception

		Purchase Intention 2			Total	χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)		
FinRisk _1	Disagree	5 (17.9)	3 (10.7)	20 (71.4)	28 (100)	54.083 < 0.001*
	Neutral	4 (2.3)	44 (25.6)	124 (72.1)	172 (100)	
	Agree	5 (1.6)	26 (8.2)	285 (90.2)	316 (100)	
FinRisk _2	Disagree	6 (22.2)	4 (14.8)	17 (63)	27 (100)	72.486 < 0.001*
	Neutral	5 (3.3)	40 (26.5)	106 (70.2)	151 (100)	
	Agree	3 (0.9)	29 (8.6)	306 (90.5)	338 (100)	
FinRisk _3	Disagree	7 (26.9)	3 (11.5)	16 (61.5)	26 (100)	104.355 < 0.001*
	Neutral	4 (3.1)	40 (31)	85 (65.9)	129 (100)	
	Agree	3 (0.8)	30 (8.3)	328 (90.9)	361 (100)	
FinRisk _4	Disagree	5 (20)	6 (24)	14 (56)	25 (100)	110.631 < 0.001*
	Neutral	4 (4.2)	39 (41.1)	52 (54.7)	95 (100)	
	Agree	5 (1.3)	28 (7.1)	363 (91.7)	396 (100)	

*Significant differences at $p < 0.05$

Table 6.20 summarises the tabulation of the respondents' preference to choose the recombinant CLP over animal-based collagen even though the price of the product is expensive (Purchase Intention 3). From the table:

- a) 75.3% of 316 respondents who agreed that the animal-based collagen products in the market are currently expensive (FinRisk_1) would be willing to choose the products containing the recombinant CLP despite the high price. Meanwhile, 16.8% of them felt neither agreed nor disagreed, and the remaining disagreed.
- b) 75.1% of 338 respondents who believe that the production of the recombinant CLP will be cheaper (FinRisk_2) would be willing to substitute animal-based products with the products containing the recombinant CLP even though the price is much more expensive. Meanwhile, 15.7% of them felt neither agreed nor disagreed, and 9.2% were disagreed.
- c) 75.6% of 361 respondents would prefer to consume recombinant CLP products over animal-based products despite the expensive price (FinRisk_3).

Meanwhile, 15.8% of them felt neither agreed nor disagreed, and 8.6% were disagreed.

- d) 396 of 516 respondents agreed that they would spend their money on products containing CLP if the products were not too expensive (FinRisk_4). However, of 396 respondents, 75.8% of them were still willing to alternate the animal-based collagen with the recombinant CLP even though the prices of the products containing the recombinant CLP are much more expensive.

From the chi-square test, the p-value yielded values of less than 0.001. Therefore, the study perceived a significant relationship between all items of the financial risk perceptions construct and the third item in the purchase intention construct. This implies that the respondents' perception of financial risk (a, b, c, and d) would influence their behaviour to alternate the animal-based collagen with the recombinant CLP even though the price of the products containing the recombinant CLP is high.

Table 6.20 Respondents' preference on the recombinant CLP over animal-based collagen disregard of the price in relation to their financial risk perception

		Purchase Intention 3			Total	χ^2 p-value
		Disagree (%)	Neutral (%)	Agree (%)		
FinRisk_1	Disagree	6 (21.4)	7 (25)	15 (53.6)	28 (100)	< 0.001*
	Neutral	13 (7.6)	68 (39.5)	91 (52.9)	172 (100)	
	Agree	25 (7.9)	53 (16.8)	238 (75.3)	316 (100)	
FinRisk_2	Disagree	5 (18.5)	7 (25.9)	15 (55.6)	27 (100)	< 0.001*
	Neutral	8 (5.3)	68 (45)	75 (49.7)	151 (100)	
	Agree	31 (9.2)	53 (15.7)	254 (75.1)	338 (100)	

FinRisk _3	Disagree	7 (26.9)	7 (26.9)	12 (46.2)	26 (100)	70.933
	Neutral	6 (4.7)	64 (49.6)	59 (45.7)	129 (100)	< 0.001*
	Agree	31 (8.6)	57 (15.8)	273 (75.6)	361 (100)	
FinRisk _4	Disagree	8 (32)	7 (28)	10 (40)	25 (100)	87.475
	Neutral	7 (7.4)	54 (56.8)	34 (35.8)	95 (100)	< 0.001*
	Agree	29 (7.3)	67 (16.9)	300 (75.8)	396 (100)	

*Significant differences at $p < 0.05$

6.3.3 Mean and Standard Deviation

The descriptive analysis extracted from SPSS output was tabulated specifically into the minimum, maximum, mean, and standard deviation of all constructs. The analysis is presented in the tables as follows. All variables were scored using a seven-point Likert scale (1: strongly disagree, 2: disagree, 3: slightly disagree, 4: neither disagree nor agree, 5: slightly agree, 6: agree, 7: strongly agree). For a seven-point Likert scale, a mean value of four (4) is considered natural, where it can be determined that the mean value below four will show that the respondent disagreed with the item statements. Otherwise, respondents will agree with most of the item statements when the mean value is far higher than 4.

Table 6.21 tabulated the descriptive analysis of knowledge where the mean value was 5.5, indicating that respondents agree with most of the item statements. Consumers agreed that it is quite hard to determine whether the collagen product is halal or not, and they informed us that the recombinant CLP is different form animal-based collagen.

Most of the respondents also agreed that the recombinant CLP can alternate animal-based collagen, and they were aware of the pros and contras of the recombinant CLP and animal-based collagen. With a mean of 6.20, respondents acknowledged that

the halal research institute such as the International Halal Research and Training (INHART), will focus on research and strengthen the halal industry.

Table 6.21 Descriptive Statistics for Knowledge

	Minimum	Maximum	Mean	Standard Deviation
KN1	1	7	5.28	1.571
KN2	1	7	5.36	1.321
KN3	1	7	5.52	1.379
KN4	1	7	5.20	1.448
KN5	1	7	6.20	1.221
Knowledge			5.5105	1.00351

Table 6.22 shows the descriptive analysis of the attitude construct. The mean value of 5.4 indicates that respondents slightly agree with all item statements, which they thought the recombinant CLP would have better wound healing ability, and they had felt the recombinant CLP would have a better ability to reduce skin ageing.

The respondents also slightly agreed that the recombinant CLP would also be preferred by non-Muslim consumers, whereas they also agreed with the statement that the recombinant CLP would improve the health condition of the consumers. However, they thought that the recombinant CLP could cause harm to the environment and that producing the recombinant CLP would be a bad idea. Surprisingly, they would still choose the recombinant CLP instead of the animal-based collagen.

Table 6.22 Descriptive Statistics for Attitude

	Minimum	Maximum	Mean	Standard Deviation
ATT1	1	7	5.16	1.211
ATT2	1	7	5.26	1.192

ATT3	1	7	5.04	1.438
ATT4	1	7	5.47	1.186
ATT5	4	7	5.44	1.133
ATT6	4	7	5.69	1.143
ATT7	1	7	5.49	1.433
Attitude			5.3657	0.86851

The mean for the religiosity construct was 6.553, indicating that respondents agreed that their belief in religion leads to the way they live, but they were meticulous before consuming a product due to their religious belief. However, they agreed that their religious beliefs do not influence their choice of daily consumption. However, they would be excited when there are products that prioritise halal compliance.

Table 6.23 Descriptive Statistics for Religiosity

	Minimum	Maximum	Mean	Standard Deviation
REL1	3	7	6.64	.831
REL2	3	7	6.59	.844
REL3	4	7	6.41	.911
REL4	4	7	6.38	.883
REL5	3	7	6.75	.755
Religiosity			6.5531	0.66552

The mean value for risk perception on health as tabulated in Table 6.24 was 5.0787, where respondents were moderately concerned on how the recombinant CLP affect their health if they consumed the product based on the recombinant CLP, where they thought that consuming the collagen could cause sickness. However, they were in two minds that the recombinant CLP is not hazardous to their physical and causing after-affect. However, they slightly agreed that the recombinant CLP could cause one to have chronic illness.

Table 6.24 Descriptive Statistics for Health Risk Perception

	Minimum	Maximum	Mean	Standard Deviation
HR1	4	7	5.51	1.086
HR2	4	7	5.02	1.071
HR3	1	7	4.73	1.226
HR4	1	7	5.08	1.225
HR5	4	7	5.06	1.079
Risk Perception on Health			5.0787	0.78664

Table 6.25 shows the descriptive statistics for social risk perception with a mean of 5.2762, which indicates that, on average, respondents had a slight concern about their family and friends after consuming the product containing the recombinant CLP. Somehow, they would suggest and encourage the usage of the product containing the recombinant CLP.

Table 6.25 Descriptive Statistics for Social Risk Perception

	Minimum	Maximum	Mean	Standard Deviation
SR1	4	7	5.07	1.052
SR2	4	7	5.53	1.017
SR3	4	7	5.25	1.065
SR4	4	7	5.25	1.055
Risk Perception on Social			5.2762	0.78087

The mean value of environmental risk perception (Table 6.26) was 5.6943, which means that, on average, respondents were concerned about the environmental problems that occurred these days, and they thought that animal-based collagen production would have a negative impact on the environment. They also believe that

the halal-compliant process will not have bad effect on the environment, and the production of the recombinant CLP will not harm the environment.

Table 6.26 Descriptive Statistics for Environmental Risk Perception

	Minimum	Maximum	Mean	Standard Deviation
ER1	4	7	5.91	1.034
ER2	4	7	5.42	1.130
ER3	4	7	5.97	1.045
ER4	4	7	5.47	1.112
Risk Perception on Environmental			5.6943	0.82522

The mean value of quality and halal risk perception (Table 6.27) was 5.598, indicating that the respondents were concerned about the hygiene and quality aspects of the recombinant CLP. Respondents are also concerned about whether the development of the recombinant CLP follows the halal guidelines. Thus, they were concerned about the product containing the recombinant CLP. Somehow, they moderately believe that the recombinant CLP will be a good quality because the researchers must have done a thorough study to produce them.

Table 6.27 Descriptive Statistics on Quality and Halal Risk Perception

	Minimum	Maximum	Mean	Standard Deviation
QHR1	1	7	5.87	1.229
QHR2	1	7	5.79	1.209
QHR3	4	7	5.58	1.099
QHR4	4	7	5.22	1.099
QHR5	2	7	5.54	1.183

Risk Perception on Quality and Halal	5.5984	0.89824
--	--------	---------

Table 6.28 tabulated the descriptive statistics for financial risk perception, where its mean value was 5.3086. On average, respondents agreed that the animal-based collagen products in the market currently are expensive, and they believe the production of recombinant CLP will be cheaper since it will not involve animals. They also thought that the products containing CLP would be cheaper if they were produced locally. Moreover, they were moderately willingness to spend their money on products containing the recombinant CLP.

Table 6.28 Descriptive Statistics of Financial Risk Perception

	Minimum	Maximum	Mean	Standard Deviation
FR1	1	7	5.16	1.290
FR2	1	7	5.23	1.268
FR3	1	7	5.32	1.268
FR4	1	7	5.53	1.256
Risk Perception on Financial	2.00	7.00	5.3086	1.02248

The mean for trust construct (Table 6.29) was 6.2698, indicating that respondents agreed on the item statements of which they put their trust in Halal Agency in Malaysia, mainly JAKIM (Jabatan Kemajuan Islam Malaysia), which is governed under the Malaysian government. They also felt more convinced when they saw the Halal logo certified by the Malaysian Halal Agency, and they trusted the Halal certification from other countries as long as those certifications affirmed by the Malaysia Halal Agency (JAKIM). However, they have slight doubt about whether the Halal research institute in Malaysia will produce halal collagen. Above all, they quite

strongly agree that they will not consume a product containing the recombinant CLP if it is not certified as halal.

Table 6.29 Descriptive Statistics of Trust

	Minimum	Maximum	Mean	Standard Deviation
TR1	1	7	6.41	.954
TR2	1	7	6.50	.898
TR3	1	7	6.17	1.164
TR4	4	7	5.90	1.056
TR5	4	7	6.36	.946
Trust			6.2698	.76360

Purchase intention (Table 6.30) is the endogenous construct in this study as the mean value was 5.6124. It implies that respondents had no problems with the development of the recombinant CLP, and they would be willing to substitute the animal-based collagen with the recombinant CLP if they felt anxious about the halal status of the product containing animal-based collagen.

Table 6.30 Descriptive Statistics of Purchase Intention

	Minimum	Maximum	Mean	Standard Deviation
PI1	1	7	5.82	1.155
PI2	1	7	5.83	1.194
PI3	1	7	5.19	1.372
Purchase Intention	1.00	7.00	5.6124	1.00638

6.4 MEASUREMENT MODELS (PLS-SEM ANALYSIS)

The next step of the analysis is the assessment of measurement models. This study will use SmartPLS4 to assess the proposed measurement model in terms of the constructs' reliability and validity. The proposed conceptual representation of the research model is exhibited in the figure below. The proposed model contains two layers of constructs where the risk perception is the higher (second)-order constructs (HOC) represented by its types of risk dimension as the components of the lower (first)-order constructs (LOC). The constructs were labelled as shown in the figure, and the predictors or outer model were hidden for simplicity.



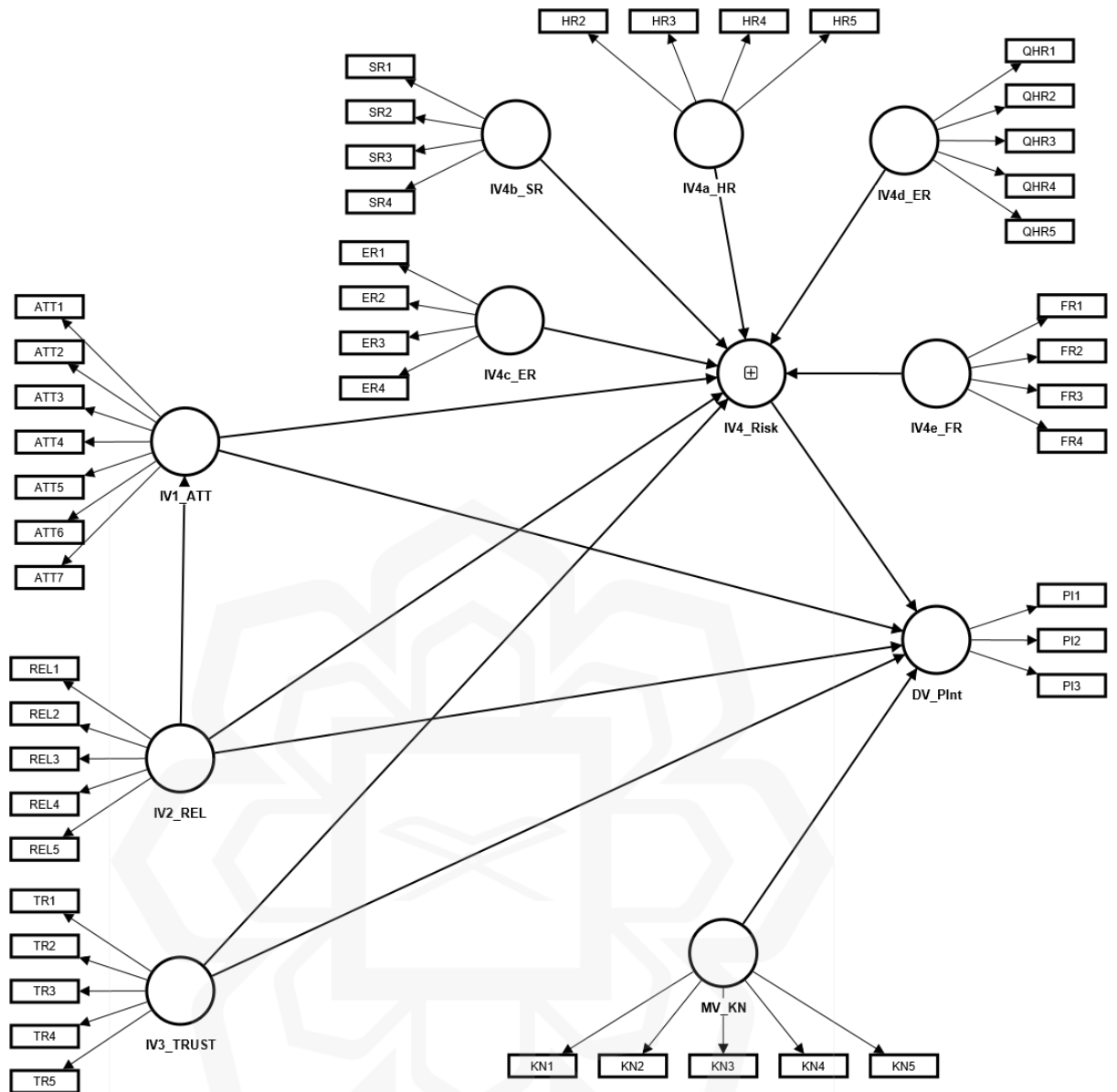


Figure 6.1 Conceptual Representation of Proposed Hierarchical Component Model

6.4.1 Type of Construct Identification

When the model is too complex with exogenous and endogenous complex, it can be operationalized at two-stages by establishing the higher-order models or hierarchical component models (HCMs) (Hair et al, 2021). Prior to assessing the measurement model, it is imperative that these multi-item constructs identified as reflective or

formative because it could cause a measurement error if the model were wrongly specified, thus affecting the result of the structural model (Jarvis et al., 2003).

Basically, a reflective measurement model is represented in the diagram by arrows pointing from the construct to the indicator variables, implying the assumption that the construct causes the measurement of the indicator variables (Hair et al., 2017). Meanwhile, for the formative measurement model, the diagram would show the arrows pointing from the indicator variable to the construct, implying the assumption that the indicator variables cause the measurement of the construct (Hair et al., 2017).

For this study, both theoretical and empirical were considered to determine whether the measurement of the proposed model is reflective or formative. From a theoretical aspect, all constructs in the proposed model are the cause of the indicators. Besides, eliminating an indicator does not alter the meaning of the construct, which indicates that the construct is reflective. From the empirical aspect, the item inter-correlation was used to determine the construct measurement by which a high positive correlation of internal consistency, AVE, and factor loading indicates that the constructs are reflective (Diamantopoulos & Siguaw, 2006).

Test on the expected correlational pattern among indicators were carried out through SmartPLS4. For the hierarchical component model, the strength of the path relationship between the higher-order component (HOC) and the lower-order component (LOC) was indicated by the path coefficient values (Sarstedt et al., 2019). Meanwhile, the strength of the relationship between LOC and its indicator is indicated by the outer loading values, in which any values exceeding 0.5 are considered high. Thus, they can be conceptualised as reflective.

Figure 6.2 exhibited the path coefficient and outer loading values for the research model when all variables were conceptualised as reflective. With the exception of the HR1 (first item in health risk variable), the outer loadings values of all items are more than 0.5.

Strong correlations were found between HOC and all LOCs, as well as between the LOCs and their indicators, as indicated by the values of more than 0.5. The outcomes confirmed that the suggested model's measurement constructs are reflective. Therefore, it can be concluded that the proposed measurement model is Type I Reflective-Reflective.

Table 6.31 Construct Levels and Type

Constructs	Label	Lower (First)- Order Constructs	Type of Construct
Attitude	IV1_ATT	Not applicable	Reflective
Religiosity	IV2_REL	Not applicable	Reflective
Trust	IV3_TRUST	Not applicable	Reflective
Risk Perception	IV4a_HR	Health Risk	Reflective
	IV4b_SR	Social Risk	Reflective
	IV4c_ER	Environmental Risk	Reflective
	IV4d_QHR	Quality and Halal Risk	Reflective
	IV4e_FR	Financial Risk	Reflective
Knowledge	MV_KN	Not applicable	Reflective

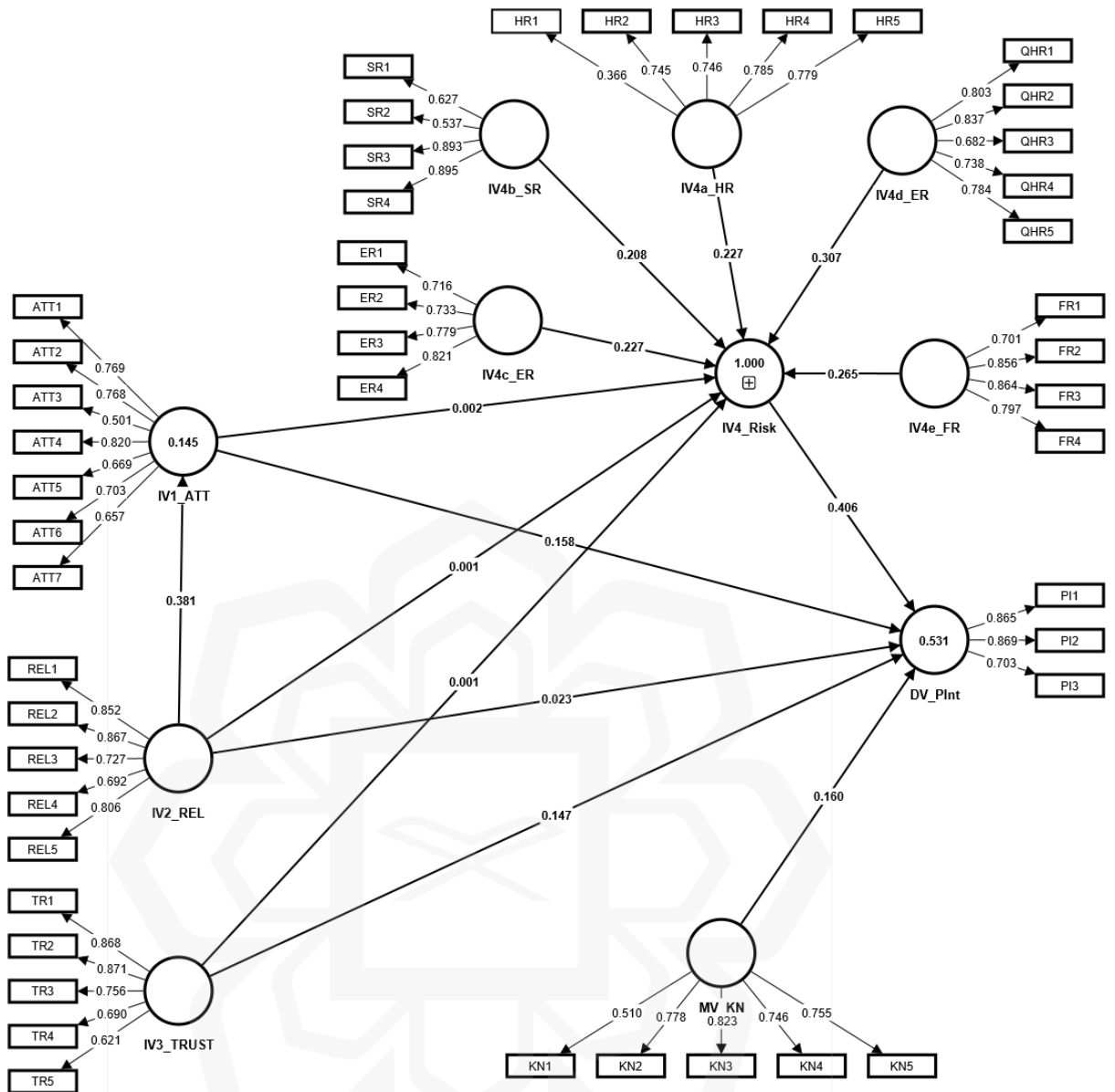


Figure 6.2 Path Coefficient and Outer Loadings

After establishing the measurement model, the next step was to analyse the evaluation criteria of the model. For the reflective measurement model, both the inner and outer models were checked for internal consistency, reliability, convergent validity, and discriminant validity before proceeding with the hypotheses testing. The bootstrapping method was performed to test the significance of the path coefficients thus checking the hypotheses.

The disjoint two-stage approach was adopted for the model to evaluate the lower (first)-order constructs (LOC) and higher (second)-order constructs (HOC). The latent variable scores were initially estimated with all the LOCs presented and used as indicants for HOC in a separate structural model regarding the HOC assessment. In the first stage, the reliability and validity of the constructs with all LOCs were assessed. The latent variable scores in the first stage were then used in the second stage to analyse the HOC. Both LOC and HOC were assessed separately.

6.5 LOWER (FIRST)-ORDER CONSTRUCTS ASSESSMENT

As mentioned in 5.9.3, two layers of constructs were applied for the model in this study, which was known as the hierarchical component model (HCM). A disjoint two-stage approach was used to estimate the HCM in this study, which was explained in 4.9.4.

In the first stage of HCM assessment, LOC will be evaluated first, which the health, social, environmental, quality and halal, and financial risk perception were evaluated together with other main constructs, attitude, religiosity, trust, and knowledge. Figure 6.3 demonstrates the model for the lower-order constructs.

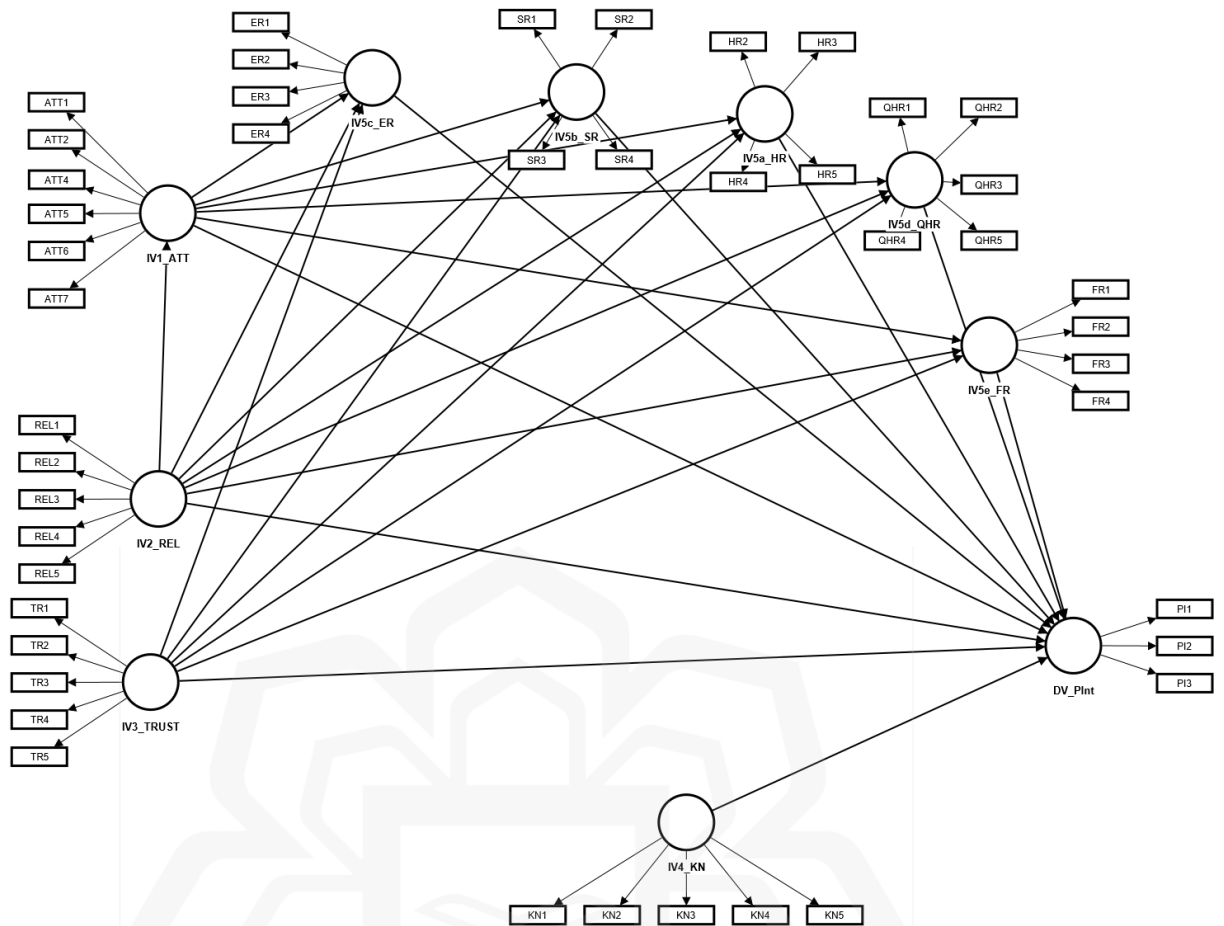


Figure 6.3 Lower (First) Order Construct Model

6.5.1 Construct Reliability

All latent constructs' reliability measurements were examined by assessing Cronbach's Alpha and composite reliability. Table 6.32 tabulated the results for the construct reliability, where Cronbach's alpha values were between 0.732 and 0.849 while composite reliability values were between 0.833 and 0.880. Both Cronbach's alpha and composite reliability exceeded the minimum threshold of 0.7. The result indicates the presence of internal consistency among multiple measurement items in all latent constructs. Therefore, the constructs for this study have good reliability measures.

Table 6.32 Construct Reliability

Latent Constructs	Label	Cronbach's alpha	Composite reliability
Purchase Intention	DV_PInt	0.745	0.856
Attitude	IV1_ATT	0.831	0.877
Religious	IV2_REL	0.849	0.893
Trust	IV3_TRUST	0.820	0.876
Perceived Risk on Health	IV4a_HR	0.778	0.856
Perceived Risk on Social	IV4b_SR	0.732	0.833
Perceived Risk on Environmental	IV4c_ER	0.762	0.848
Perceived Risk on Quality and Halal	IV4d_QHR	0.828	0.878
Perceived Risk on Financial	IV4e_FR	0.819	0.88
Knowledge	MV_KN	0.777	0.849

6.5.2 Convergent Validity

The convergent validity was assessed through outer loadings, composite reliability, and AVE. A complete result for all items, consisting of AVE and composite reliability for the respective constructs before deletion, was tabulated in Appendix C. Following the cut-off guideline, items with values less than 0.5 are considered as having low outer loading and thus are dropped from the model. Two items were deleted, ATT3 and HR1, with outer loading 0.497 and 0.313, respectively. The deletion caused the increase in the value of AVE, Cronbach's alpha, and composite reliability. Figure 6.4 displays the average variance extracted (AVE) and outer loadings for all LOCs in the measurement model. Most item loadings are greater than 0.5. Thus, all AVE and composite reliability values have exceeded the threshold minimum cut-off values of 0.5 and 0.7, respectively. The lowest AVE (0.534) was the independent variable of knowledge, and the lowest composite reliability (0.834) was the social risk perception construct.

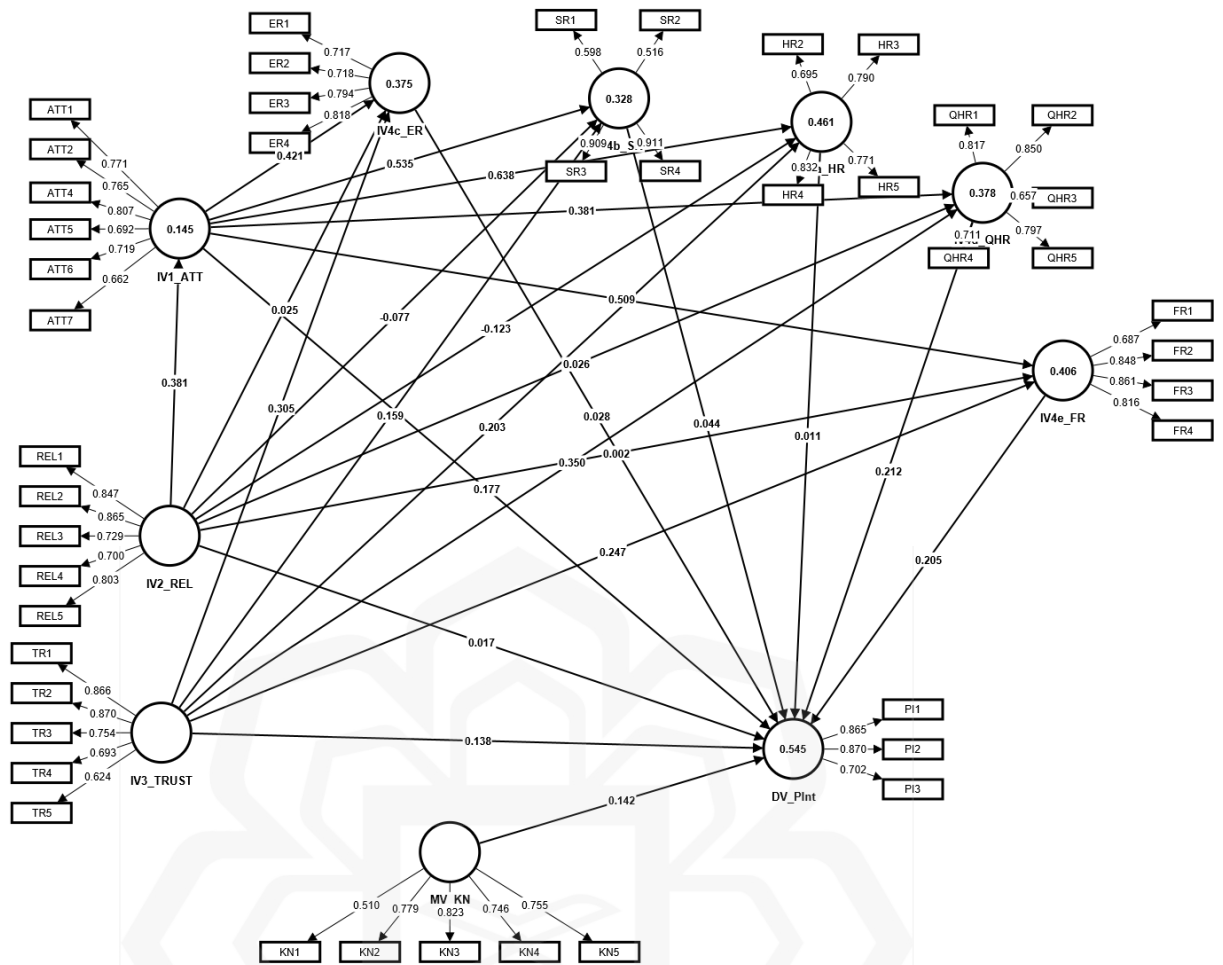


Figure 6.4 AVE and Outer Loadings for Lower Order Constructs

The result presented in Table 6.33 presented the result after the deletion of the items with low outer loading. The Cronbach's alpha and composite reliability before deletion can be referred to the appendix, where the values in the former table were slightly lower than the latter.

Table 6.33 Measurement Model for Lower (First) Order Constructs

Constructs	Items	Loadings	CR	AVE	α
DV_PInt Purchase Intention	PI1	0.865	0.856	0.666	0.745
	PI2	0.87			
	PI3	0.702			

IV1_ATT Attitude	ATT1	0.771	0.877	0.544	0.831
	ATT2	0.765			
	ATT4	0.807			
	ATT5	0.692			
	ATT6	0.719			
	ATT7	0.662			
IV2_REL Religiosity	REL1	0.847	0.893	0.627	0.849
	REL2	0.865			
	REL3	0.729			
	REL4	0.7			
	REL5	0.803			
IV3_TRUST Trust	TR1	0.866	0.876	0.589	0.820
	TR2	0.87			
	TR3	0.754			
	TR4	0.693			
	TR5	0.624			
IV4a_HR Perceived Health Risk	HR2	0.695	0.856	0.598	0.778
	HR3	0.79			
	HR4	0.832			
	HR5	0.771			
IV4b_SR Perceived Social Risk	SR1	0.598	0.833	0.570	0.732
	SR2	0.516			
	SR3	0.909			
	SR4	0.911			
IV4c_ER Perceived Environmental Risk	ER1	0.717	0.848	0.583	0.762
	ER2	0.718			
	ER3	0.794			
	ER4	0.818			
IV4e_FR Perceived Financial Risk	FR1	0.687	0.880	0.650	0.819
	FR2	0.848			
	FR3	0.861			
	FR4	0.816			
IV4d_QHR Perceived Quality and Halal Risk	QHR1	0.817	0.878	0.592	0.828
	QHR2	0.85			
	QHR3	0.657			
	QHR4	0.711			
	QHR5	0.797			
MV_KN Knowledge	KN1	0.51	0.849	0.534	0.777
	KN2	0.779			
	KN3	0.823			
	KN4	0.746			
	KN5	0.755			

At this point of the evaluation process, all LOCs achieved the required level of reliability and convergent validity. After the establishment of the convergent validity, the next step will be to establish the discriminant validity.

6.5.3 Discriminant Validity

Discriminant validity concerns the degree to which measures the different constructs that differ from one another (Afthanorhan, 2014; Hair et al., 2021). This study executes all three approaches to check for discriminant validity, i.e. the cross-loadings of the indicators, the Fornell-Larcker criterion, and the HTMT correlation ratio.

6.5.3.1 Cross-loading

Table 6.34 presents the cross-loadings for all indicators in the latent constructs for the proposed model. The loads of the predictors on their own construct were high, while the loads on other constructs were low. For instance, the load for the indicators in the attitude construct was much greater than the same indicators on other constructs, which were not their own. Therefore, this indicates that the constructs were distinctly different from each other. Hence, discriminant validity has been established.

Table 6.34 Cross-Loadings for All Construct Indicators

Items	DV PInt	IV1 ATT	IV2 REL	IV3 TRUST	IV4a HR	IV4b SR	IV4c ER	IV4d QHR	IV4e FR	MV KN
ATT1	0.395	0.771	0.253	0.227	0.505	0.403	0.339	0.349	0.483	0.486
ATT2	0.393	0.765	0.242	0.222	0.481	0.396	0.318	0.361	0.469	0.506
ATT4	0.478	0.807	0.337	0.289	0.499	0.394	0.397	0.386	0.474	0.528
ATT5	0.396	0.692	0.22	0.245	0.515	0.472	0.49	0.392	0.364	0.271
ATT6	0.464	0.719	0.293	0.259	0.508	0.457	0.458	0.381	0.389	0.297
ATT7	0.458	0.662	0.336	0.251	0.405	0.343	0.344	0.382	0.447	0.395
ER1	0.358	0.329	0.297	0.343	0.302	0.393	0.717	0.435	0.339	0.22
ER2	0.318	0.375	0.232	0.295	0.383	0.454	0.718	0.396	0.365	0.252
ER3	0.431	0.371	0.365	0.436	0.353	0.382	0.794	0.493	0.421	0.292
ER4	0.481	0.53	0.259	0.337	0.517	0.552	0.818	0.588	0.555	0.388
FR1	0.397	0.377	0.231	0.273	0.317	0.385	0.354	0.454	0.687	0.327
FR2	0.478	0.463	0.259	0.317	0.419	0.402	0.445	0.489	0.848	0.372
FR3	0.492	0.454	0.268	0.331	0.431	0.403	0.461	0.469	0.861	0.427
FR4	0.59	0.582	0.352	0.409	0.517	0.43	0.521	0.567	0.816	0.428
HR2	0.234	0.421	0.111	0.182	0.695	0.534	0.367	0.272	0.311	0.166
HR3	0.404	0.491	0.186	0.26	0.79	0.412	0.369	0.364	0.415	0.336
HR4	0.483	0.593	0.273	0.35	0.832	0.494	0.441	0.441	0.515	0.361
HR5	0.326	0.515	0.168	0.236	0.771	0.595	0.418	0.343	0.374	0.246
KN1	0.235	0.19	0.154	0.101	0.146	0.089	0.124	0.2	0.192	0.51
KN2	0.387	0.424	0.288	0.226	0.266	0.235	0.281	0.285	0.406	0.779
KN3	0.457	0.531	0.369	0.315	0.367	0.297	0.363	0.343	0.424	0.823
KN4	0.37	0.427	0.265	0.203	0.305	0.299	0.306	0.32	0.367	0.746
KN5	0.38	0.402	0.409	0.394	0.227	0.21	0.282	0.315	0.342	0.755
PI1	0.865	0.528	0.367	0.431	0.439	0.4	0.486	0.524	0.535	0.437
PI2	0.87	0.481	0.408	0.462	0.384	0.395	0.446	0.527	0.547	0.445
PI3	0.702	0.42	0.2	0.256	0.358	0.36	0.351	0.43	0.42	0.365
QHR1	0.467	0.356	0.346	0.386	0.291	0.316	0.45	0.817	0.436	0.306

QHR2	0.497	0.402	0.349	0.408	0.343	0.387	0.484	0.85	0.483	0.382
QHR3	0.352	0.221	0.213	0.312	0.253	0.353	0.384	0.657	0.33	0.205
QHR4	0.395	0.329	0.179	0.289	0.352	0.444	0.462	0.711	0.389	0.195
QHR5	0.572	0.564	0.367	0.467	0.507	0.516	0.617	0.797	0.658	0.406
REL1	0.356	0.336	0.847	0.513	0.197	0.156	0.294	0.304	0.318	0.404
REL2	0.33	0.327	0.865	0.582	0.2	0.168	0.278	0.371	0.302	0.371
REL3	0.302	0.231	0.729	0.399	0.172	0.227	0.301	0.237	0.21	0.269
REL4	0.28	0.291	0.7	0.41	0.213	0.24	0.347	0.3	0.232	0.231
REL5	0.343	0.312	0.803	0.571	0.2	0.116	0.277	0.326	0.316	0.368
SR1	0.248	0.291	0.153	0.204	0.463	0.598	0.337	0.307	0.268	0.165
SR2	0.277	0.259	0.179	0.223	0.226	0.516	0.379	0.394	0.275	0.18
SR3	0.423	0.53	0.154	0.199	0.595	0.909	0.488	0.443	0.452	0.296
SR4	0.434	0.53	0.211	0.272	0.602	0.911	0.544	0.456	0.474	0.299
TR1	0.41	0.295	0.544	0.866	0.283	0.231	0.373	0.424	0.354	0.338
TR2	0.399	0.288	0.587	0.87	0.259	0.219	0.35	0.432	0.371	0.346
TR3	0.307	0.156	0.443	0.754	0.197	0.158	0.254	0.296	0.296	0.211
TR4	0.378	0.321	0.368	0.693	0.352	0.296	0.415	0.356	0.317	0.205
TR5	0.317	0.2	0.459	0.624	0.19	0.191	0.358	0.366	0.254	0.23

6.5.3.2 *Fornell-Larcker criterion*

Under this approach of analysis, the discriminant analysis was checked and reported as sufficient, which it can be read in the table. The square root of AVE is greater than its correlation with all other constructs. The square root of AVE for all the constructs in first order met the criteria. The average variance shared between each construct should be greater than the variance shared between the construct and the other constructs in the model. For this proposed model, the square root of AVE for all LOCs met the criteria, as can be seen in Table 6.35. Thus, it provides strong support for the establishment of discriminant validity.

6.5.3.3 *Heterotrait-Monotrait (HTMT) ratio*

The confidence interval (CI) value of HTMT on any of the constructs must not be equal to 1 (Henseler et al., 2015). Henseler et al., (2015) proposed the threshold value of 0.9 for structural models with constructs whereby each construct with a value higher than 0.9 has discriminant validity problems.

The discriminant validity should be present, and it is more conservative if the value is much lower than 0.9 to 0.85 (Franke & Sarstedt, 2019; Hair et al., 2019; Henseler et al., 2015). As tabulated in Table 6.36, all values were less than the proposed threshold thus, indicating that the discriminant validity was present in the first-order constructs of this model.

After checking for all reliability, convergent validity, and discriminant validity, all LOCs have passed the test, and the second stage will be the test for higher (second) order constructs of the model before hypotheses testing can be carried out. The assessment of the HOC will be the same steps as the assessment carried out on LOC.

Table 6.35 Fornell-Larcker Criterion for Lower (First) Order Constructs

Constructs	DV PInt	IV1 ATT	IV2 REL	IV3 TRUST	IV4a HR	IV4b SR	IV4c ER	IV4d QHR	IV4e FR	MV KN
DV_PInt	0.816									
IV1_ATT	0.586	0.738								
IV2_REL	0.408	0.381	0.792							
IV3_TRUST	0.479	0.339	0.630	0.767						
IV4a_HR	0.483	0.660	0.249	0.342	0.774					
IV4b_SR	0.471	0.559	0.227	0.292	0.648	0.755				
IV4c_ER	0.528	0.534	0.377	0.463	0.517	0.587	0.763			
IV4d_QHR	0.607	0.51	0.392	0.495	0.468	0.529	0.635	0.77		
IV4e_FR	0.618	0.593	0.351	0.42	0.533	0.504	0.561	0.619	0.806	
MV_KN	0.511	0.56	0.418	0.353	0.371	0.322	0.385	0.406	0.486	0.731

Table 6.36 HTMT Correlation Ratio for Lower (First) Order Constructs

Constructs	DV PInt	IV1 ATT	IV2 REL	IV3 TRUST	IV4a HR	IV4b SR	IV4c ER	IV4d QHR	IV4e FR	MV KN
DV_PInt										
IV1_ATT	0.743									
IV2_REL	0.503	0.451								
IV3_TRUST	0.597	0.400	0.753							
IV4a_HR	0.614	0.81	0.293	0.407						
IV4b_SR	0.631	0.692	0.302	0.384	0.852					
IV4c_ER	0.686	0.657	0.472	0.579	0.659	0.785				
IV4d_QHR	0.754	0.585	0.449	0.583	0.554	0.688	0.773			
IV4e_FR	0.775	0.708	0.411	0.502	0.641	0.638	0.687	0.719		
MV_KN	0.662	0.679	0.500	0.425	0.448	0.405	0.475	0.481	0.592	

6.6 HIGHER (SECOND)-ORDER CONSTRUCT ASSESSMENT

After the evaluation of the lower-order construct (LOC), the next step would be to evaluate the higher-order construct (HOC). Similar to the LOC, the reliability and validity test will be carried out for HOC, which is risk perception. A disjoint two-stage approach was adopted, in which the approach only considered the LOC of the HOC but without the HOC. The latent variable scores, which were obtained from multiple items, were subsequently used to general single-item measures as manifest indicators for the corresponding HOC in a separate measurement model analysis, as displayed in Figure 6.5 below.

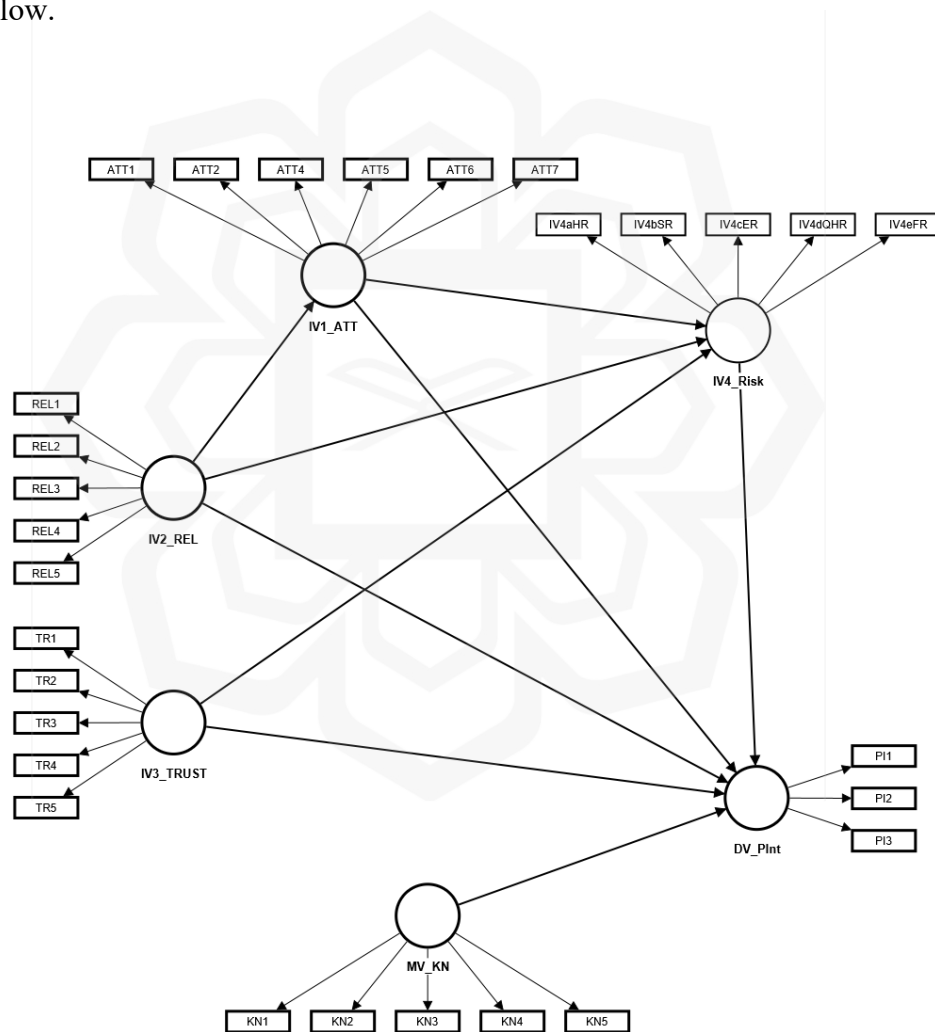


Figure 6.5 The Higher (Second)-Order Measurement Construct

The HOC risk perception has path relationships with five LOCs, namely health risk perception (IV4aHR), social risk perception (IV4bSR), environmental risk perception (IV4cER), quality and halal risk perception (IV4dQHR), and financial risk perception (IV4eFR).

6.6.1 Reliability and Convergent Validity

Overall, the result of the outer loadings and AVE HOC, which were the risk perception along with other constructs was shown in Figure 6.6.

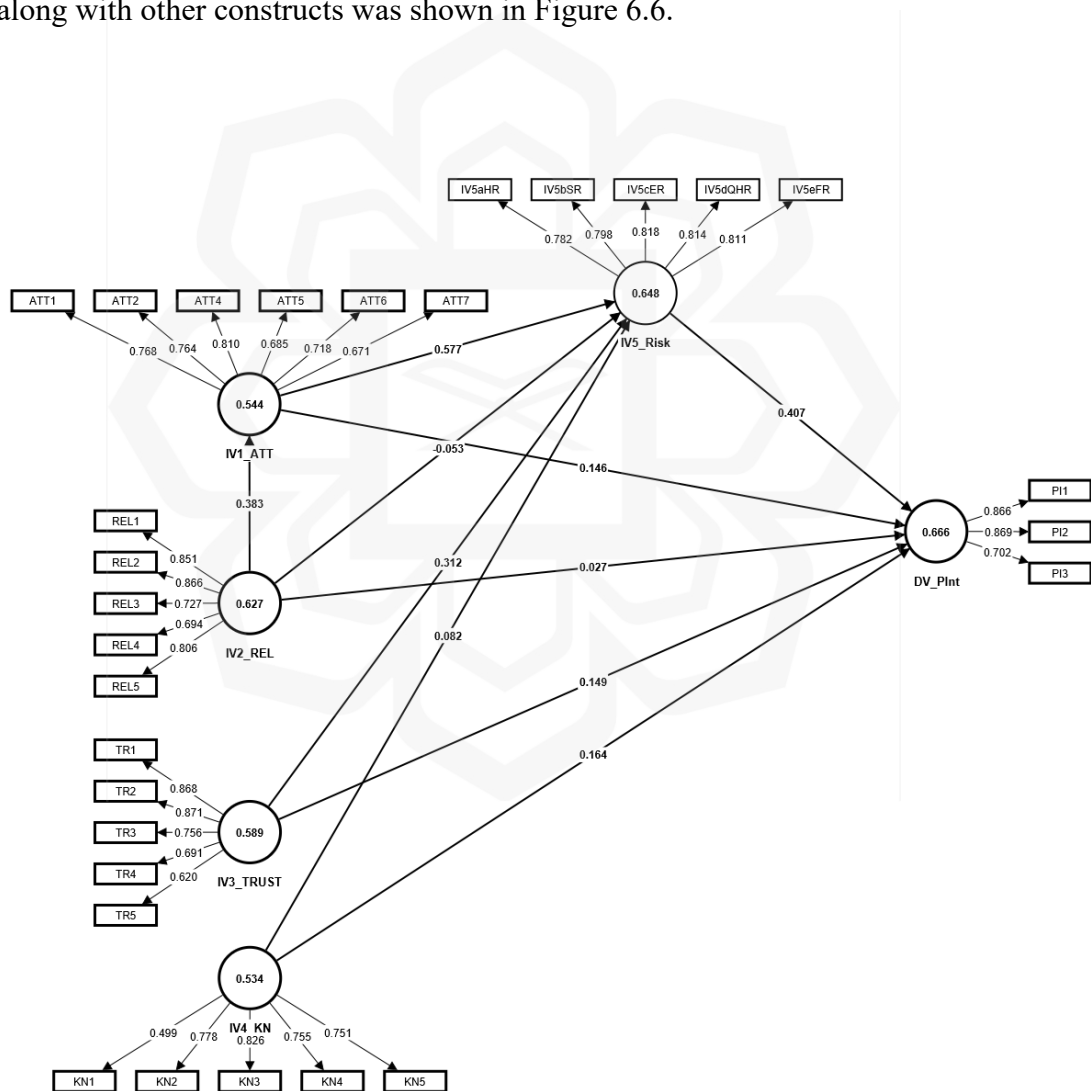


Figure 6.6 Outer Loadings and AVE of the Higher Order Constructs

Table 6.37 summarises the loadings, AVE, composite reliability, and Cronbach’s alpha results. Apparently, the results were well above the recommended threshold of 0.7 (Hair et al., 2017), where values of AVE were greater than 0.5, composite reliability reported value higher than 0.7, and Cronbach alpha value was greater than 0.7 (Hair et al., 2017). Therefore, the HOC has met the reliability and convergent validity requirements for second-stage analysis.

Table 6.37 Factor Loading, AVE and CR values for the Higher Order

Construct					
Constructs	Items	Loadings	CR	AVE	α
Perceived Risk IV4_Risk	IV4aHR	0.783	0.902	0.648	0.864
	IV4bSR	0.799			
	IV4cER	0.818			
	IV4dQHR	0.814			
	IV4eFR	0.810			

6.6.2 Discriminant Validity

Following the reliability and convergent validity testing, the discriminant validity of the HOC with the LOCs was assessed based on cross-loadings, the Fornell-Larcker criterion and HTMT. Table 6.38 reported the cross-loading for HOC, indicating the loads of the indicators of the constructs were higher on its own constructs (risk perception) compared to the loads on other constructs.

Table 6.38 Cross Loadings for Higher Order Construct

	DV PInt	IV1 ATT	IV2 REL	IV3 TRUST	IV4 Risk	MV KN
IV4aHR	0.483	0.659	0.248	0.342	0.783	0.37
IV4bSR	0.471	0.558	0.225	0.291	0.799	0.322
IV4cER	0.528	0.533	0.376	0.462	0.818	0.385
IV4dQHR	0.607	0.51	0.391	0.495	0.814	0.406

IV4eFR	0.617	0.594	0.352	0.42	0.81	0.486
--------	-------	-------	-------	------	-------------	-------

Table 6.39 summarised the result of the Fornell-Larcker criterion, which showed that the square root of AVE in risk perception is higher than its correlation with other constructs.

Table 6.39 Fornell-Larcker Criterion for Higher Order Construct

	DV PInt	IV1 ATT	IV2 REL	IV3 TRUST	IV4 Risk	MV KN
DV_PInt	0.816					
IV1_ATT	0.587	0.738				
IV2_REL	0.408	0.383	0.792			
IV3_TRUST	0.478	0.339	0.630	0.768		
IV4_Risk	0.677	0.709	0.399	0.503	0.805	
MV_KN	0.511	0.562	0.420	0.353	0.493	0.731

Furthermore, the HTMT values as reported in Table 6.40, showed that the values for all constructs were lower than the required threshold of 0.9. Therefore, it can be concluded that the discriminant validity has been established for the HOC.

Table 6.40 HTMT Ratio for Higher Order Construct

	DV PInt	IV1 ATT	IV2 REL	IV3 TRUST	IV4 Risk	MV KN
DV_PInt						
IV1_ATT	0.743					
IV2_REL	0.503	0.451				
IV3_TRUST	0.597	0.400	0.753			
IV4_Risk	0.837	0.836	0.463	0.588		
MV_KN	0.662	0.679	0.500	0.425	0.584	

6.7 STRUCTURAL MODEL

Once the constructs in the measurement model were proven to be reliable and valid, the next step in PLS-SEM was to assess the hypothesised relationship to substantiate the proposed hypothesis.

To test the hypothesis, the path coefficients were checked by executing bootstrapping to produce results for each path relationship in the model. In PLS-SEM, bootstrapping is a nonparametric test that comprises repeated random sampling with replacement from the original sample to produce a bootstrap sample and attain errors for hypothesis testing (Hair et al., 2011). For the number of resampling, it was recommended to perform a bootstrapping with minimum a number of 10000 re-samples (Streukens & Leroi-Werelds, 2016).

The structural (inner) model in this study was evaluated based on the same dataset ($n = 516$) used in the measurement model above. The analysis of the structural model was carried out to determine the magnitude and significance of every path coefficient between constructs. The exogenous variables covered in the dataset were Attitude (IV1_ATT), Religiosity (IV2_REL), Trust (IV3_TRUST), and Risk Perception (IV4_Risk). The endogenous variable was Purchase Intention (DV_PInt).

The key criteria to assess the hypothesized relationships are the significance of the path coefficients, R^2 values, the effect size (f^2) and the Q^2 prediction. The path coefficients show the relationships among the latent variables in the structural models. R^2 is the coefficient of determination and Cohen's pseudo-F-test (f^2 effect size) was assessed to determine the explanatory power of the structural model.

Meanwhile, the cross-validated redundancy measure Q^2 is assessed to determine the model's predictive power. Prior to employing the bootstrapping procedure, it is compulsory to make sure there are no collinearity issues with the data.

6.7.1 Collinearity Assessment

The collinearity will occur when two variables that are hypothesized to be causally related measure the same construct. The assessment of the lateral collinearity test for the data in this study was carried out for all the exogenous variables and moderating variables (attitude, religiosity, trust, risk perception, and knowledge). The result was reported in Table 6.41 below where there were no collinearity issues exist because the values for the VIF were lower than 3.3 as suggested by the scholars (Hair et al., 2019; Kock & Lynn, 2012).

Table 6.41 Lateral Collinearity Assessment

Constructs	Label	DV_PInt
Attitude	IV1_ATT	2.339
Religiosity	IV2_REL	1.822
Trust	IV3_TRUST	1.933
Perceived Risk	IV4_Risk	2.416

6.7.2 Path Coefficient and Hypothesis Testing

Bootstrapping procedures were executed to produce the result for the path coefficient and thus, test the proposed hypothesis. Table 6.42 summarizes the result for each path relationship in the model. Thirteen hypotheses were proposed in this study of which eight hypotheses were developed to describe the direct relationship between four independent variables (IVs) and a dependent variable (DV). One hypothesis was proposed to test the mediating role of attitude, and four hypotheses were proposed to test the moderating role of knowledge. The hypotheses were tested by generating the t-statistics and p-value for all paths through the SmartPLS4 bootstrapping function.

Table 6.42 Path Coefficient and Results of Hypothesis Testing

	Relationship	Std. Beta	Std. Dev	t-value	p-value	PCI LL	PCI UL	Decisions
H5	IV1_ATT -> DV_PInt	0.146	0.050	2.925**	0.002	0.066	0.229	Supported
H3	IV2_REL -> DV_PInt	0.027	0.041	0.659	0.255	-0.038	0.098	Not supported
H8	IV3_TRUST -> DV_PInt	0.149	0.047	3.171**	0.001	0.071	0.225	Supported
H7	IV4_Risk -> DV_PInt	0.406	0.057	7.156***	p<0.001	0.314	0.501	Supported
H1	IV2_REL -> IV1_ATT	0.383	0.037	10.271***	p<0.001	0.315	0.440	Supported
H4	IV1_ATT -> IV4_Risk	0.616	0.032	19.150***	p<0.001	0.560	0.665	Supported
H2	IV2_REL -> IV4_Risk	-0.037	0.039	0.952	0.171	-0.101	0.027	Not supported
H6	IV3_TRUST -> IV4_Risk	0.318	0.038	8.291***	p<0.001	0.256	0.384	Supported

Note: ***p<0.001, **p<0.01, *p<0.05

Based on the path coefficient result in Table 6.46, out of ten direct relationships, eight were found to present a t-value ≥ 1.645 and significance and 95% level. Three independent variables, attitude ($\beta = 0.146$, $t = 2.925$, $LL = 0.066$, $UL = 0.229$, $p < 0.001$), risk perception ($\beta = 0.406$, $t = 7.156$, $LL = 0.314$, $UL = 0.501$, $p < 0.001$), and trust ($\beta = 0.149$, $t = 3.171$, $LL = 0.071$, $UL = 0.225$, $p < 0.01$) were significantly and positively related with the dependent variable of purchase intention.

Meanwhile, the independent variable of religiosity significantly influenced the attitude ($\beta = 0.383$, $t = 10.271$, $LL = 0.315$, $UL = 0.440$, $p < 0.001$). Moreover, the independent variable of attitude also significantly and positively influences risk perception ($\beta = 0.616$, $t = 19.150$, $LL = 0.560$, $UL = 0.665$, $p < 0.01$). Also, the independent variable of trust also significantly and positively influenced risk perception ($\beta = 0.318$, $t = 8.291$, $LL = 0.256$, $UL = 0.384$, $p < 0.001$). Meanwhile, the independent variable of religiosity does not show any significant relationship with the dependent variable of purchase intention or two other independent variables.

6.7.3 Assessment of R^2

The next step in the structural model evaluation is the examination of the R^2 value of the endogenous construct or the dependent variable (purchase intention). The R^2 is the goodness of fit, which measures how good the model is.

Figure 6.7 shows the path coefficient and the R^2 value of the proposed model through the bootstrapping procedure in SmartPLS4. Commonly, the R^2 (coefficient of determination) was interpreted to assess the in-sample model fit of the dependent construct's composite score, by using the model estimates to predict the case values of the total sample (Shmueli et al., 2019).

The judgment of the R^2 level depends on the specific research discipline, such as a consumer behaviour study, the R^2 value of 0.2 is considered high (Hair et al., 2011). Nonetheless, the cut-off point for R^2 values is 0.75, 0.50, and 0.25, which can be considered substantial, moderate, and weak, respectively (Hair et al., 2011; Henseler et al., 2009).

The R^2 for this study was generated through a bootstrapping setting applied on 516 cases, where the result was exhibited in Figure 6.7. The result revealed that the R^2 for independent variable attitude was 0.147, and risk perception was 0.582. Meanwhile, the R^2 for the dependent variable purchase intention was 0.527. It can be concluded that religiosity explained 14.7% of the variance in attitude while, attitude, religiosity, and trust explained 58.6% of the variance in risk perception.

For the endogenous variable of purchase intention, 52.7% of its variance was explained by attitude, religiosity, trust, and risk perception. Above all, risk perception and purchase intention have moderate explanatory power, while attitude has weak explanatory power if it were to be referred to the aforementioned guideline (Hair et al., 2011; Henseler et al., 2009). However, 0.1 was considered high in the consumer

behaviour study (Hair et al., 2011) thus, the explanatory power for risk perception and purchase intention can be said to have high explanatory power.

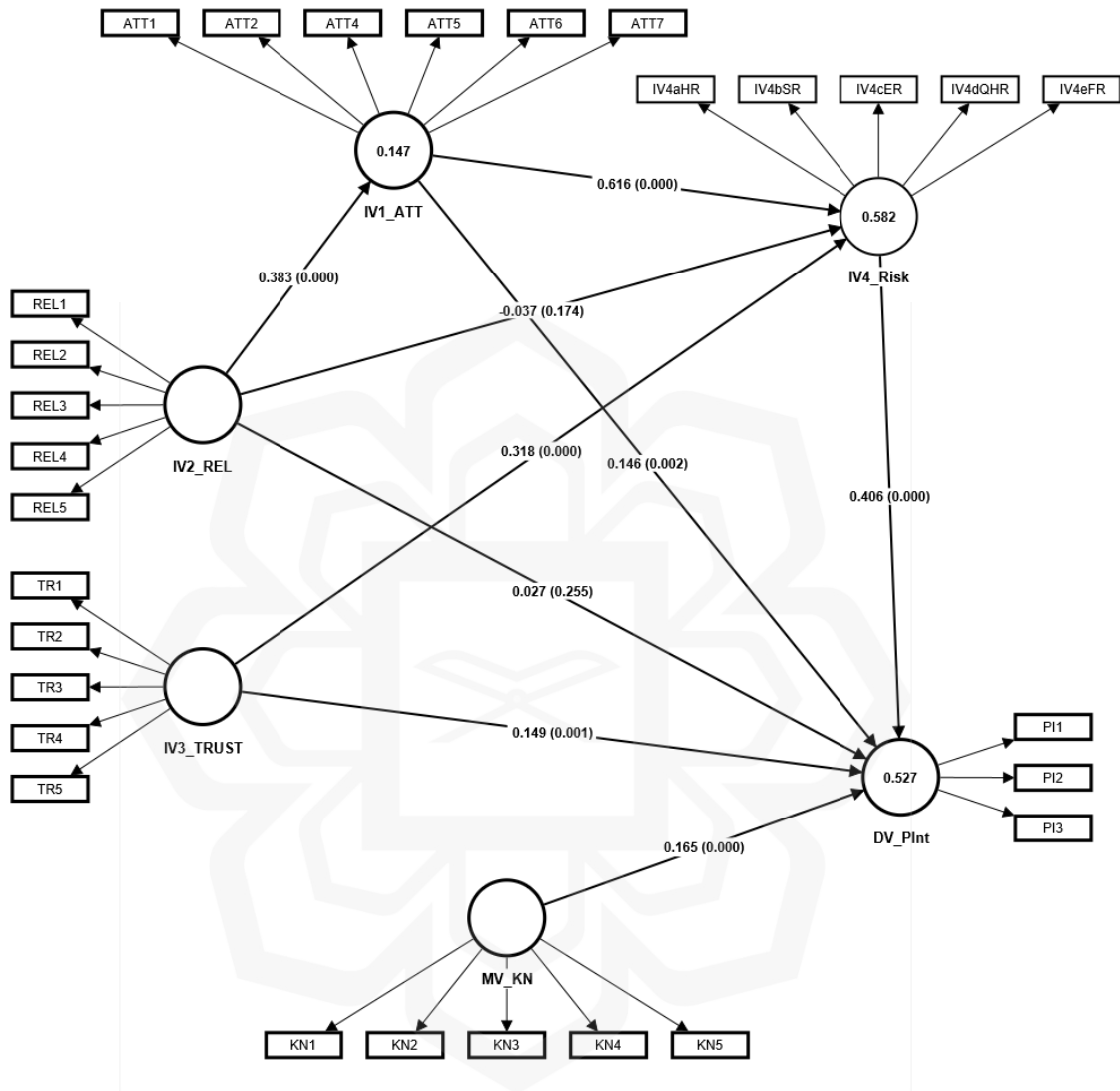


Figure 6.7 R^2 and Path Coefficient values of the model construct

6.7.4 Assessment of Effect Size (f^2)

The effect size (f^2) measures the change in the R^2 when a specified exogenous construct was removed from the model.

The purpose of effect size is to assess whether the removal of the exogenous construct has a substantive impact on the R^2 values of the endogenous construct. If the p -value implies the statistical significance of an effect, the f^2 indicates the substantive significance that the p -value cannot reveal (Sullivan & Feinn, 2012). The value of f^2 should be 0.02, 0.15, and 0.35, which represent small, medium, and large effects, respectively (Cohen, 1992a).

Table 6.43 summarises the f^2 effect size for all combinations of constructs. Attitude has a high effect on risk perception with a 0.760 f^2 value but no effect on purchase intention with an f^2 of 0.019. Aside from that, religiosity has a medium effect on attitude (0.172) but no effect on purchase intention (0.001) and risk perception (0.002).

Meanwhile, the trust construct has a small effect on purchase intention (0.024) and a medium effect on risk perception (0.143). Among all predictors, only risk perception has medium effect on the dependent variable purchase intention, with an f^2 of 0.145.

Table 6.43 The f^2 Effect Size

		Attitude	Risk perception	Purchase intention
Attitude	IV1_ATT		0.760	0.019
Religiosity	IV2_REL	0.172	0.002	0.001
Trust	IV3_TRUST		0.143	0.024
Risk Perception	IV4_Risk			0.145

In conclusion, attitude has a substantial effect on the R^2 for risk perception compared to trust and religiosity. Meanwhile, risk perception has a considerable effect on the R^2 for purchase intention compared to trust, attitude, and religiosity.

6.7.5 Assessment of the Predictive Power

The final step in the structural model is to measure the model's out-sample predictive power (Q^2). Q^2 is predictive relevance, which measures whether a model has predictive relevance or not.

The Q^2 values for the reflective endogenous construct should be larger than zero for the model to have predictive relevance otherwise, the path model lacks predictive relevance if its Q^2 values are less than zero (Chin, 2009).

The study applied the cross-validated redundancy measure to estimate the model's predictive relevance. The blindfolding procedure was performed in SmartPLS4 to obtain the Q^2 , where the result is shown in Figure 6.8. The endogenous construct of purchase intention obtained medium predictive relevance with a Q^2 value of 0.342.

Aside from that, risk perception also has a medium predictive relevance (0.371), while attitude has a small predictive relevance (0.078). The Q^2 values for purchase intention, risk perception, and attitude are considerably above zero, indicating that the model in this study has a predictive relevance.

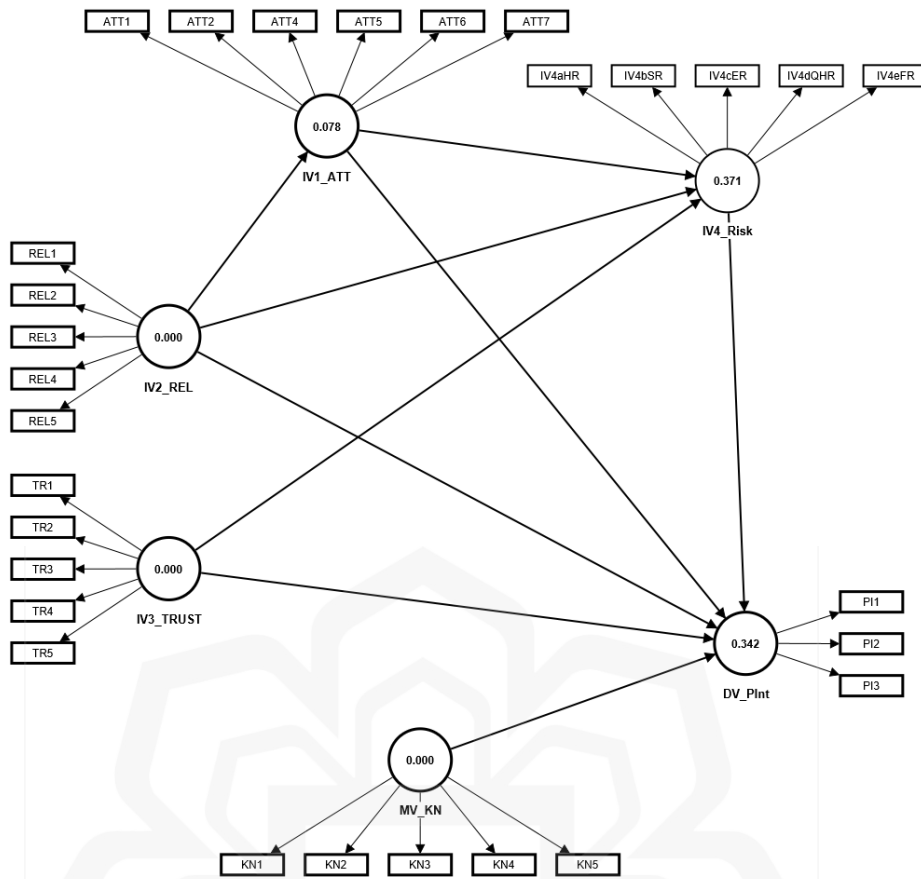


Figure 6.8 Cross-Validated Redundancy

Table 6.44 presents the summary of findings for the study’s structural model analysis. The next analysis will test the mediation and moderation role of attitude and knowledge.

Table 6.44 Structural Model Analysis

	Relationship	Std. Beta	Std. Dev	t-value	p-value	PCI LL	PCI UL	R2	f ²	Q2	VIF
H5	IV1_ATT -> DV_PInt	0.146	0.050	2.925	0.002	0.066	0.229	0.527	0.019	0.342	2.339
H3	IV2_REL -> DV_PInt	0.027	0.041	0.659	0.255	-0.038	0.098		0.001		1.822
H8	IV3_TRUST -> DV_PInt	0.149	0.047	3.171	0.001	0.071	0.225		0.024		1.933
H7	IV4_Risk -> DV_PInt	0.406	0.057	7.156	p<0.001	0.314	0.501		0.145		2.416
H1	IV2_REL -> IV1_ATT	0.383	0.037	10.271	p<0.001	0.315	0.440	0.147	0.172	0.078	1.000
H4	IV1_ATT -> IV4_Risk	0.616	0.032	19.150	p<0.001	0.560	0.665	0.582	0.760	0.371	1.194
H2	IV2_REL -> IV4_Risk	-0.037	0.039	0.952	0.171	-0.101	0.027		0.002		1.753
H6	IV3_TRUST -> IV4_Risk	0.318	0.038	8.291	p<0.001	0.256	0.384		0.143		1.693

Note: BC = Bias Corrected, UL = 96% Upper Level, LL = 95% Lower Level

6.7.6 Robustness Check

Owing to fact that this study extend the risk perception frameworks with several variables; thus, it opt to test for robustness of the structural model. Researchers were recommended to test for nonlinearity, endogeneity, and heterogeneity to affirm the robustness of the structural model (Sarstedt et al., 2020).

6.7.6.1 Assessment of Nonlinear Effects

The structural model showed robustness when there is nonlinearity through statistical significance using bootstrapping (Svensson et al., 2018). Statistically, when the relationships in the model are nonlinear, the sized of the effect among the constructs in the relationship depend on both its value and the magnitude of the change in the exogenous construct. This study considered the polynomial model and adds a quadratic effect as tabulated in Table 6.45. The results of bootstrapping 5000 samples (Sarstedt et al., 2020) shows that the p-values of all relationship were not significant, which implies nonlinear effet; thus the model is robust.

Table 6.45 Output of Quadratic Effect

Construct relationship	Std Beta	P values	f-square
QE (IV2_REL) -> DV_PInt	0.036	0.099	0.004
QE (IV2_REL) -> IV1_ATT	-0.015	0.262	0.001
QE (IV2_REL) -> IV4_Risk	-0.001	0.116	0.003
QE (IV1_ATT) -> DV_PInt	-0.025	0.215	0.004
QE (IV1_ATT) -> IV4_Risk	0.000	0.420	0.008
QE (IV3_TRUST) -> DV_PInt	0.012	0.365	0.002
QE (IV3_TRUST) -> IV4_Risk	-0.046	0.097	0.000
QE (IV4_Risk) -> DV_PInt	0.003	0.074	0.000
QE (MV_KN) -> DV_PInt	-0.016	0.276	0.001

Note: QE: Quadratic effect

6.7.6.2 Assessment of Endogeneity

The assessment of endogeneity in PLS-SEM is meaningful for predictive and explanatory modelling explanations (Hult et al., 2018). The procedure applies Gaussian copula in SmartPLS, where the p-values higher than 0.05 indicates nonexistence of endogeneity hence, the model is robust (Sarstedt et al., 2020). Table 6.46 exhibited the endogeneity test, which implies that the model is robust.

Table 6.46 Endogeneity test using the Gaussian Copula

Test	Coefficient	p-value
GC (IV2_REL) -> IV1_ATT	0.055	0.060
GC (IV2_REL) -> IV4_Risk	0.08	0.413
GC (IV2_REL) -> DV_PInt	0.022	0.224
GC (IV1_ATT) -> IV4_Risk	0.018	0.466
GC (IV1_ATT) -> DV_PInt	-0.078	0.072
GC (IV3_TRUST) -> IV4_Risk	0.082	0.233
GC (IV3_TRUST) -> DV_PInt	0.018	0.329
GC (IV4_Risk) -> DV_PInt	0.056	0.405
GC (MV_KN) -> DV_PInt	-0.036	0.302

Note:GC: Gaussian copula

6.7.6.3 Unobserved Heterogeneity

Heterogeneity often present in empirical research thus, the assessment should be performed. Several procedures involved to assess the heterogeneity through FIMIX-PLS procedure in SmartPLS. The procedure initiated the assumption of one-segment solution, using the default settings for the stop criterion ($10^{-10}=1.0E-10$), the maximum number of iterations, and the number of repetitions of 10 (Sarstedt et al., 2017b). Sarstedt et al., (2017b) proposed a systematic procedure to identify the unobserved heterogeneity, which draws on a combination of latent variables. FIMIX-PLS is appropriate for this procedure because it generates model selection criteria that direct

the decision of how many segments to keep from the data (Hair Joe F et al., 2016; Wilkinson & Klaes, 2017). The smaller value of a certain selection criteria, the better the segmentation solution (Sarstedt et al., 2017b).

The maximum number of segments was determined by dividing the sample size of this study with the minimum sample size required to each segment, which is 85 (Sarstedt et al., 2017b). The post hoc power analysis assuming an effect size of 0.15 and a power level of 80% thus, suggested a maximum of six segments. FIMIX-PLS was reran for one to six segments and the analysis was tabulated in Table 6.47, which exhibited an ambiguous picture.

Table 6.47 Fit Indices for the one- to six-segment solutions

Criteria	1	2	3	4	5	6
AIC ₃	3510.08	3475.903	3470.602	3375.97	3432.86	3418.024
CAIC	3578.02	3616.024	3682.907	3660.455	3789.536	3846.881
EN	0.000	0.337	0.406	0.801	0.532	0.609
Summed fit	7036.16	7091.93	7153.51	7036.42	7222.40	7264.91

Note: AIC: Akaike's information criterion; AIC₃: modified AIC with factor 3; CAIC: consistent AIC; EN: normed entropy statistic.

From the table, the results likely point to the appropriate number of segments according to (Sarstedt et al., 2020). Jointly, the AIC₃ and CAIC were considered together whereas, the AIC₃ indicates four-segment solution, while CAIC indicated two-segment solution. In the meantime, the segment must have EN value with more than 0.5, which were segment four, five, and six.

The analysis would be appropriate if the AIC₃ and CAIC have a smaller values under the same segment but apparently, it was not in this analysis; thus, no segment solution. However, another approach can be considered, which is the summed fit, whereas the lowest value was one-segment solution as exhibited in the table. Therefore, the heterogeneity are not in a critical level thus, the model is robust (Hair Joe F et al., 2016; Matthews et al., 2016; Ringle et al., 2024).

6.8 ASSESSMENT OF MEDIATION ANALYSIS

The mediation analysis for this data was also assessed to test the mediating role of attitude and risk perception. These two constructs intervene in the relationship between two other related constructs. More precisely, the change in the exogenous constructs will cause the change in the mediator constructs thus, causing the change in the endogenous construct.

Figure 6.9 illustrates the mediating effect in terms of direct and indirect effect, whereby the direct effect describes the relationship linking two constructs with a single arrow. Meanwhile, indirect effects are those structural model paths that involve a sequence of relationships with at least one intervening construct involved.

For instance, the attitude (IV1_ATT) mediates the relationship between religiosity (IV2_REL) and purchase intention (DV_PInt), which makes the attitude construct as an intervening construct. Meanwhile, risk perception (IV4_Risk) mediates the relationship between attitude (IV1_ATT), religiosity (IV2_REL), and trust (IV3_TRUST) with the dependent variable purchase intention (DV_PInt), which made the risk perception as an intervening construct.

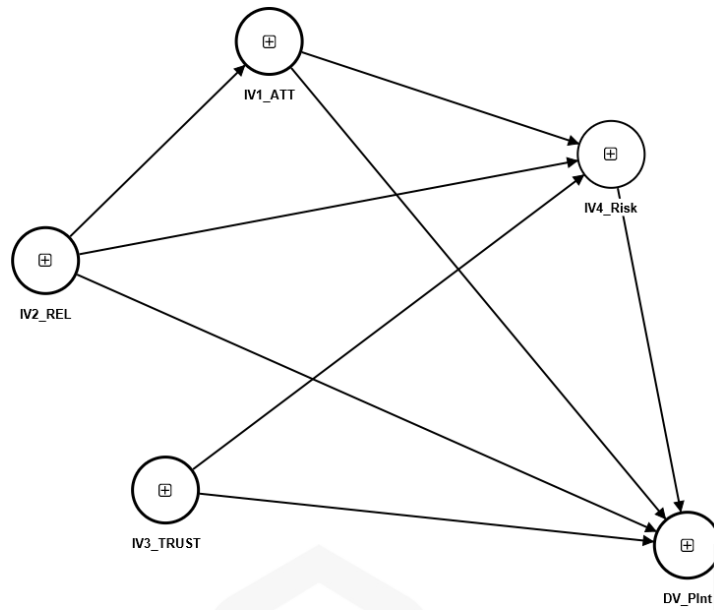


Figure 6.9 Mediating Effect

Therefore, the attitude and risk perception are the sequence of two direct effects and represented by multiple arrows in the form of (1) $IV2_REL \rightarrow IV1_ATT \rightarrow DV_PInt$, (2) $IV1_ATT \rightarrow IV4_Risk \rightarrow DV_PInt$, (3) $IV2_REL \rightarrow IV4_Risk \rightarrow DV_PInt$, and (4) $IV3_TRUST \rightarrow IV4_Risk \rightarrow DV_PInt$.

Therefore, the analysis tested the mediating role of attitude and risk perception following the approach of Preacher and Hayes to test for simple mediation analysis (Nitzl et al., 2016; Preacher & Hayes, 2004).

The mediation analysis should start by testing the indirect effects of which it was formulated that the results from the indirect effects test will be equivalent to the direct effects, and the test on a separate model should not be necessary anymore (Nitzl et al., 2016; Preacher & Hayes, 2004).

Figure 6.10 shows a decision tree that can be used to determine the type of mediation analysis (Nitzl et al., 2016; X. Zhao et al., 2010). A bootstrapping procedure was performed, and the results of the mediation analysis were summarised in Table 6.48.

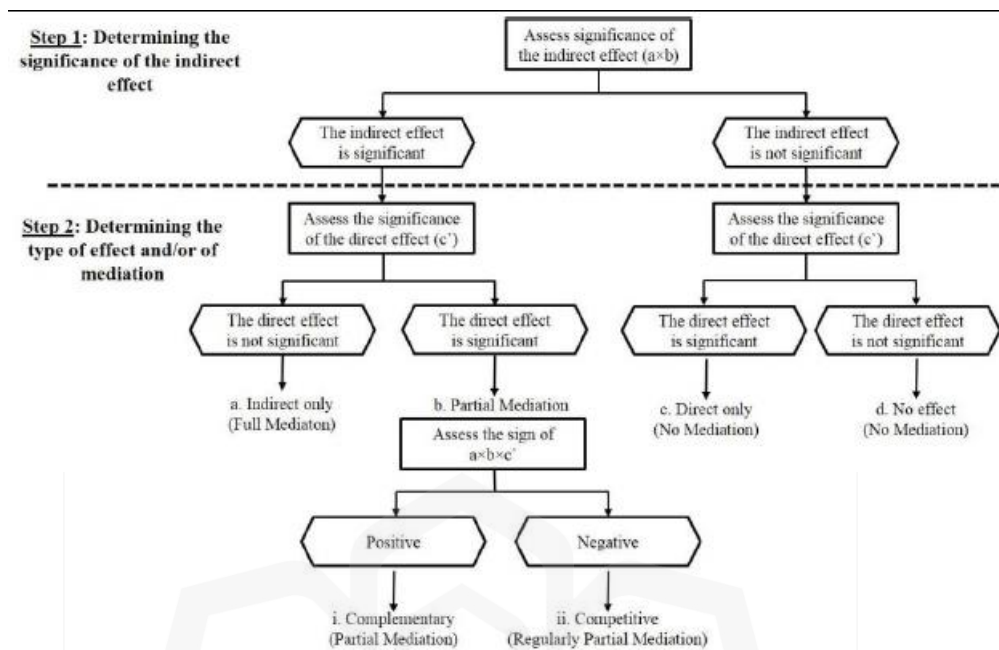


Figure 6.10 Mediator Analysis Procedure in PLS. Source: (Nitzl et al., 2016; Zhao et al., 2010)

From Figure 7.11, it can be concluded that the mediating construct of attitude has no mediation effect on the relationship between religiosity and purchase intention. Meanwhile, risk perception fully mediates the relationship between attitude and purchase intention, the relationship between religiosity and purchase intention, as well as the relationship between trust and purchase intention.

However, there was no mediation effect of risk perception on the relationship between knowledge and risk perception; rather, it was a direct effect only since the *p*-value for the relationship between knowledge and purchase intention was below 0.5. Referring to Figure 6.10, if the indirect effect is not significant but, the direct effect is significant then there will be no mediation effect but only the direct effect.

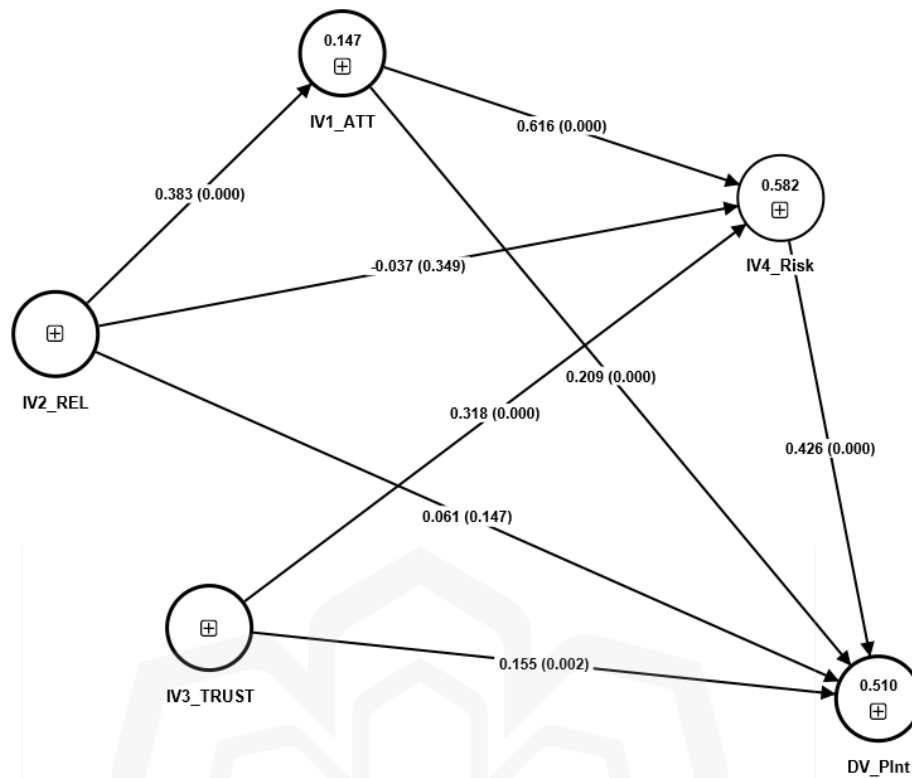


Figure 6.11 Mediating Effect

Referring to Table 6.48, the effect size of the mediating role on the relationship can be assessed. The threshold values for indirect effect size v^2 were 0.01, 0.04, and 0.09 indicating small, medium, and large indirect effects (Aguinis et al., 2005; Aiken et al., 1991; Ogbeibu et al., 2023).

The mediating role of risk perception exerts a relatively large value on the relationship between attitude and purchase intention ($v^2 = 0.197$) and has a medium effect on the relationship between trust and purchase intention. Meanwhile, on the relationship between religiosity and purchase intention, the mediating effect of risk perception was small ($v^2 = 0.014$).

Table 6.48 Results of Significance Testing for Indirect Effect

Hypothesis	Mediation variable	Std. Beta	Std Deviation	t-statistics	P values	PCI LL	PCI UL	v2	Decisions
H9	IV2_REL -> IV1_ATT -> DV_PInt	0.080	0.021	3.865***	0.000	0.043	0.124	0.007	Supported
H10	IV1_ATT -> IV4_Risk -> DV_PInt	0.262	0.036	7.241***	0.000	0.194	0.335	0.069	Supported
H11	IV2_REL -> IV4_Risk -> DV_PInt	-0.016	0.017	0.922	0.357	-0.050	0.016	0.000	Not supported
H12	IV3_TRUST -> IV4_Risk -> DV_PInt	0.135	0.025	5.420***	0.000	0.091	0.188	0.018	Supported

Note: ***p<0.001, **p<0.01, *p<0.05

6.9 ASSESSMENT OF MODERATION ANALYSIS

The final analysis is the moderating role assessment, in which the bootstrapping procedure was executed to test four proposed hypotheses. The proposed hypotheses were the moderating role of knowledge on the relationship between attitude, religiosity, trust and risk perception on consumers' purchase intention. Table 6.49 summarises the result of the path coefficient for the moderating effect.

The moderation assessment follows the orthogonalizing approach (Henseler & Chin, 2010), which builds on the indicators approach and requires creating the interaction terms for all product indicators (Ramayah et al., 2018).

First, the interaction effect is created between two indicators of each relationship. The R^2 for the main model before the interaction is 0.510, which means that a 51.0% change in purchase intention is accounted for consumers' attitudes, religious factors, risk perceptions and consumers' trust. With the inclusion of the interaction term, the R^2 increased to 0.540 or 54%. Hence, an increase of 3% in variance explained the purchase intention.

Table 6.49 Result of Moderation Effect

	Moderator	Std. Beta	Std. Deviation	t-statistics	P values	F^2	Decisions
H13	MV_KN x IV1_ATT -> DV_PInt	-0.017	0.046	0.376	0.707	0.001	Not supported
H14	MV_KN x IV2_REL -> DV_PInt	0.028	0.047	0.598	0.550	0.001	Not supported
H16	MV_KN x IV4_Risk -> DV_PInt	-0.048	0.047	1.025	0.305	0.003	Not supported
H15	MV_KN x IV3_TRUST -> DV_PInt	-0.066	0.052	1.257	0.209	0.006	Not supported

Apparently, the value did report that the moderating role of knowledge is not significant in determining the strength or changing the direction of a relationship between exogenous variables and endogenous variables. Even though the empirical result shows an insignificant result, the interaction plot could interpret how knowledge moderates the relationships.

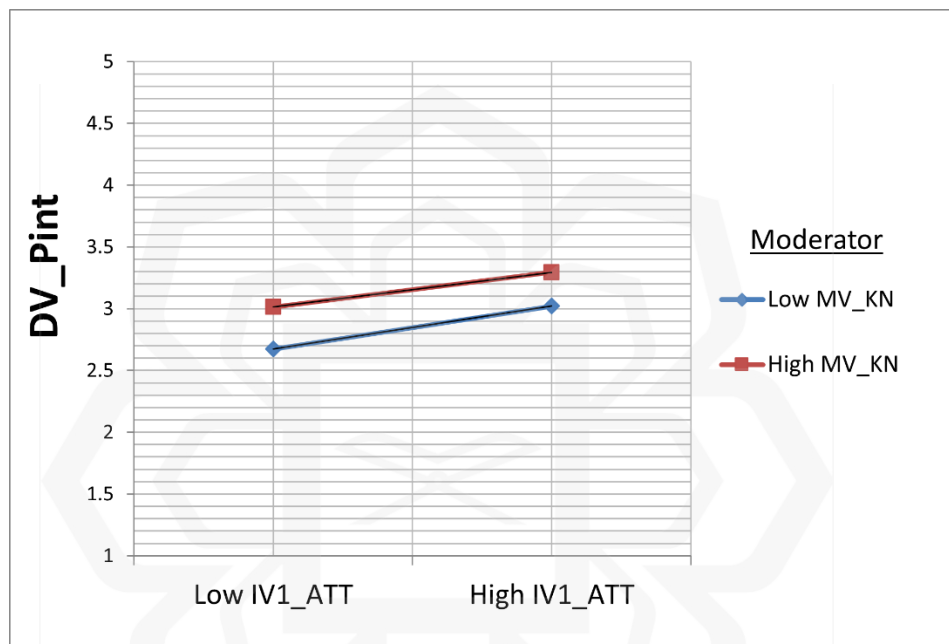


Figure 6.12 Interaction Plot MV_KN x IV1_ATT

Figure 6.12 exhibited the interaction slope for the moderating effect of consumers' knowledge on the relationship between consumers' attitude and their intention to purchase. The blue exhibits low knowledge, and the red implies high knowledge.

The slopes were quite parallel to each other, indicating that knowledge does not have a moderating effect on the relationship, but if knowledge does have a moderate effect on the relationship, it could dampen the positive relationship between consumers' attitude and their purchase intention. Meanwhile, Figure 6.13 exhibited the interaction

plot between religiosity and purchase intention, where knowledge could dampen the negative relationship between religious factors and consumers' purchase intention.

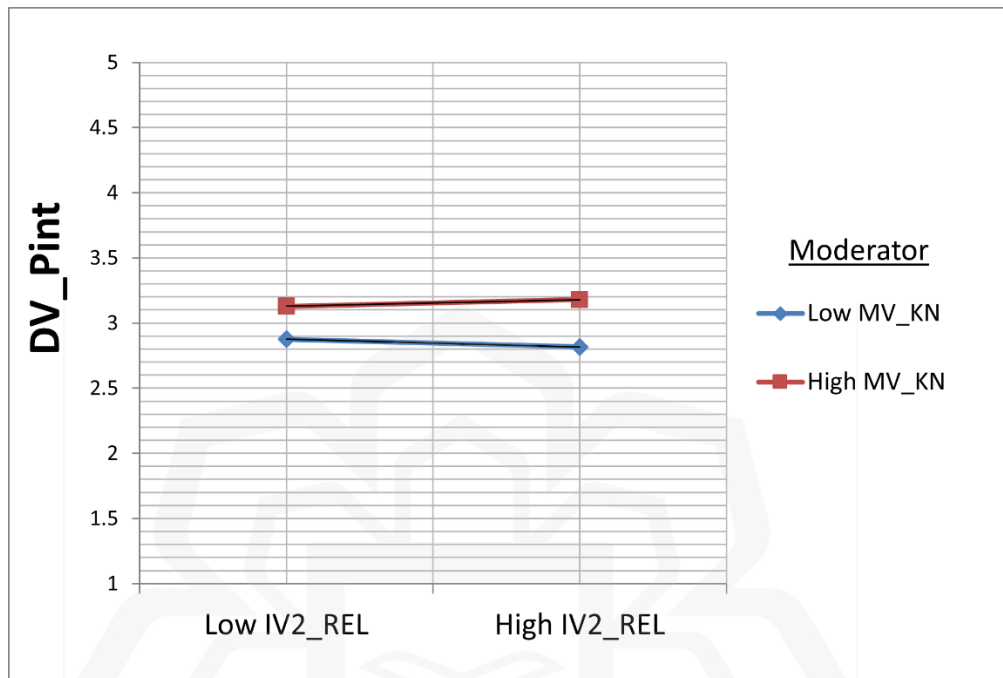


Figure 6.13 Interaction Plot MV_KN x IV2_REL

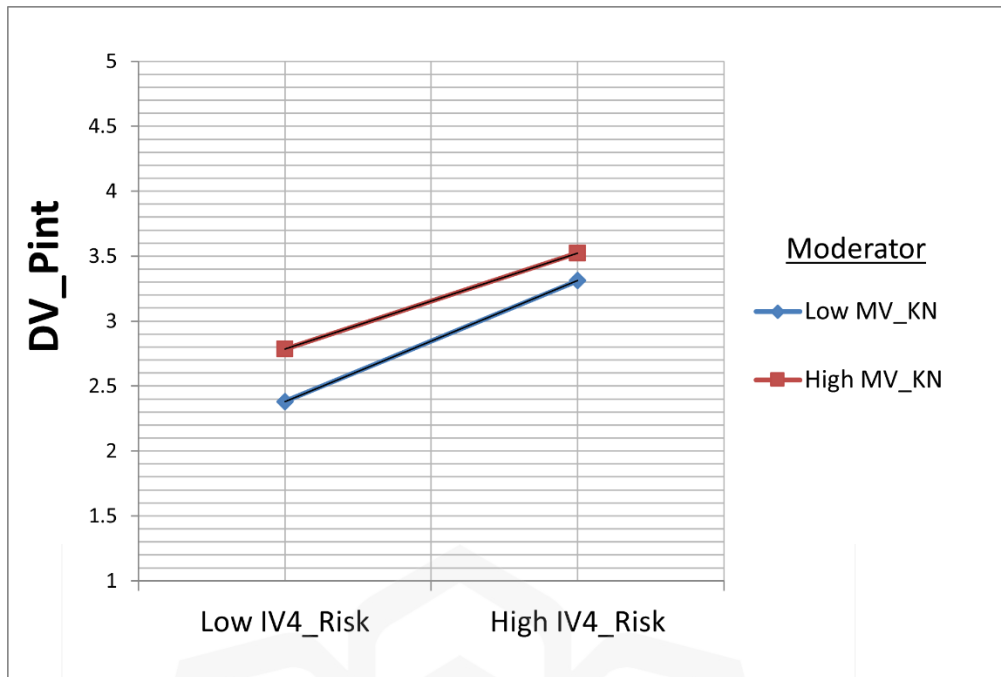


Figure 6.14 Interaction Plot MV_KV x IV4_RISK

The slope in Figure 6.14 implies that the positive effect on the relationship between risk perception and purchase intention was dampened by knowledge. The red slope, which indicates high levels of knowledge, was less steep than the blue slope. The figure indicates that, at a higher level of knowledge, when consumers perceived high risk, their purchase intention also became higher.

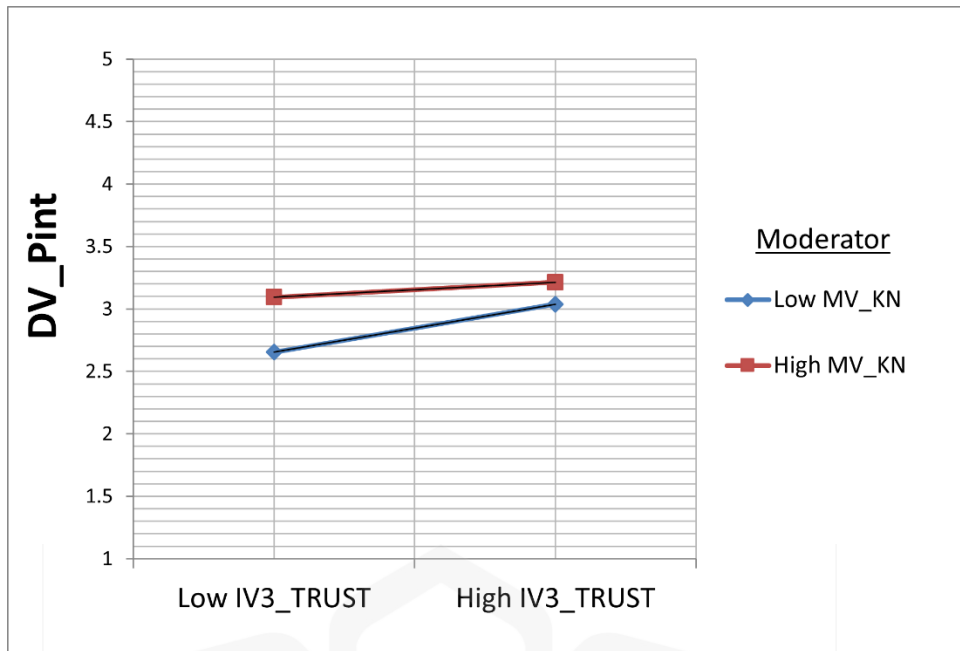


Figure 6.15 Interaction Plot MV_KN x IV5_TRUST

The simple slope in Figure 6.15 shows that the positive relationship between trust and purchase intention is dampened when consumers acquired knowledge on recombinant CLP. However, referring to the blue slope indicates that the relationship between trust and purchase intention has a steeper positive slope when consumers have less knowledge.

6.10 HYPOTHESES TESTING

The study's hypotheses were evaluated using the path coefficient, t-value, and p-value assessments, which were based on the structural model's overall evaluation.

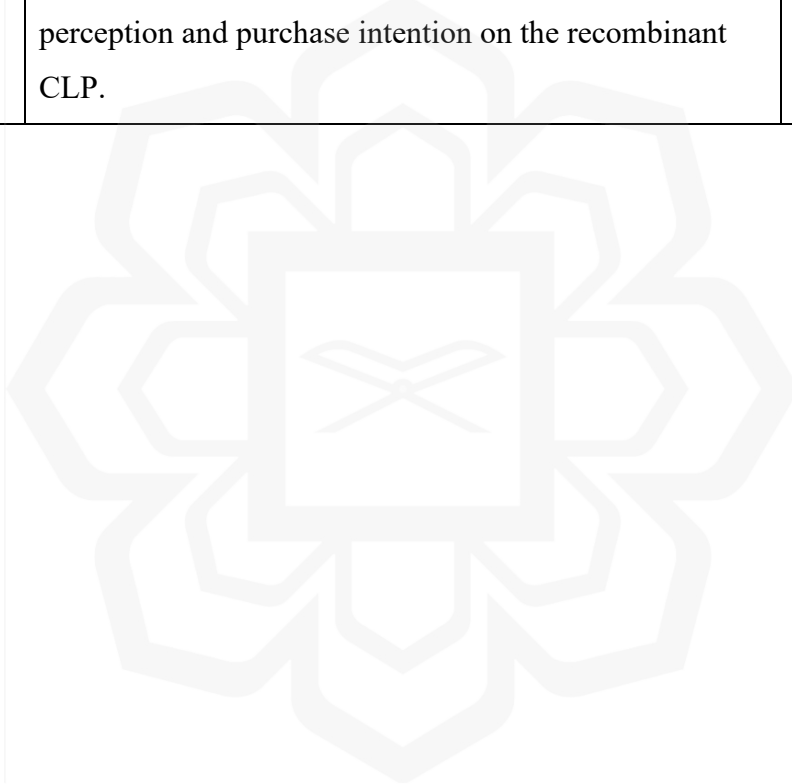
Eight out of sixteen hypotheses were found to be unsupported, as indicated by the tabulation in Table 6.50. In the meantime, Figure 7.16 shows the entire model, including all sixteen (16) possible pathways.

The hypotheses were evaluated in order to meet the study objectives, and as a result, the testing results will be described in accordance with the objectives, which are outlined in Table 6.50.

Table 6.50 Summary of Hypotheses Testing

No	Hypotheses Statement	Decision
H1	Religiosity has a direct positive relationship with consumers' attitudes.	Supported
H2	Religiosity has a direct relationship with consumers' risk perception of recombinant CLP.	Not Supported
H3	Religiosity influences consumers' purchase intention on the recombinant CLP	Not Supported
H4	Attitude has a direct relationship with consumers' risk perception of recombinant CLP.	Supported
H5	Attitude influences consumers' purchase intention of the recombinant CLP.	Supported
H6	Consumers' trust affects their risk perception of the recombinant CLP.	Supported
H7	Consumers' risk perception influences their purchase intention on the recombinant CLP.	Supported
H8	Consumers' trust influences their purchase intention on the recombinant CLP.	Supported
H9	Attitude mediates the relationship between religiosity and purchase intention on the recombinant CLP.	Supported
H10	Risk Perception mediates the relationship between attitude and purchase intention on the recombinant CLP	Supported
H11	Risk Perception mediates the relationship between religiosity and purchase intention on the recombinant CLP.	Not Supported

H12	Risk Perception mediates the relationship between trust and purchase intention on the recombinant CLP.	Supported
H13	Knowledge moderates the relationship between attitude and purchase intention on the recombinant CLP.	Not Supported
H14	Knowledge moderates the relationship between religiosity and purchase intention on the recombinant CLP.	Not Supported
H15	Knowledge moderates the relationship between trust and purchase intention on the recombinant CLP.	Not Supported
H16	Knowledge moderates the relationship between risk perception and purchase intention on the recombinant CLP.	Not Supported



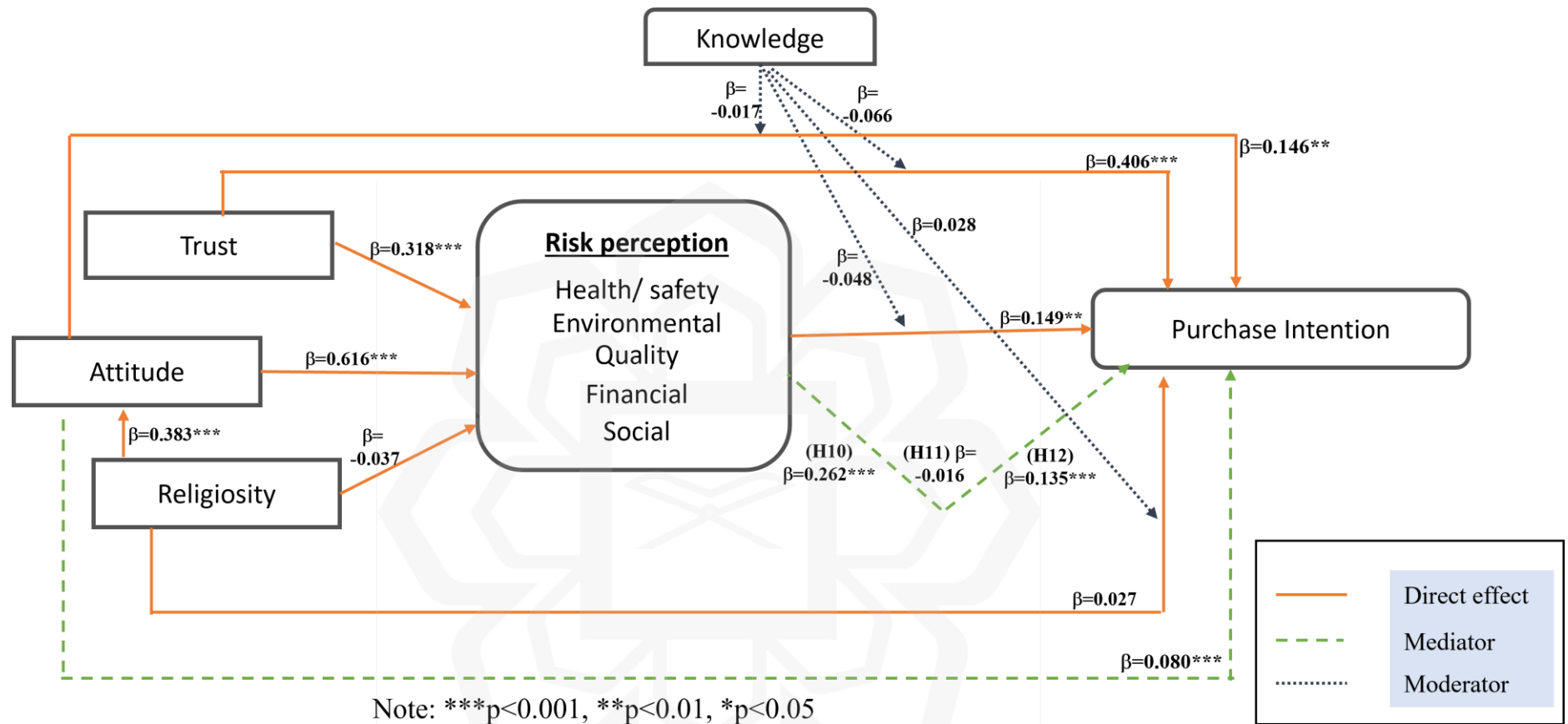


Figure 6.16 Result of the Consumers' Purchase Intention on the Recombinant CLP
(Author's illustration)

Table 6.51 Research Objectives and Hypotheses

Research Objectives	Research Hypotheses
RO2: To investigate consumers' risk perception of recombinant CLP.	H2: Religiosity factors has a direct relationship consumers' risk perception on recombinant CLP.
	H4: Attitude has a direct relationship with consumers' risk perception on recombinant CLP.
	H6: Consumers' trust affects their risk perception on the recombinant CLP.
RO3: To investigate consumers' purchase intention towards recombinant CLP	H3: Religiosity factors influences consumers' purchase intention on the recombinant CLP.
	H5: Attitude influences consumers' purchase intention on the recombinant CLP.
	H7: Consumers' risk perception influences their purchase intention on the recombinant CLP.
RO4: To examine the mediating role of risk perception and attitude on the relationship between predictor variables and consumers' purchase intention	H8: Consumers' trust influences their purchase intention on the recombinant CLP.
	H9: Attitude mediates the relationship between religiosity and purchase intention on the recombinant CLP
	H10: Risk Perception mediates the relationship between attitude and purchase intention on the recombinant CLP.
	H11: Risk Perception mediates the relationship between religiosity and purchase intention on the recombinant CLP.
RO5: To examine the moderating effect of knowledge on the relationship between variables and consumers' purchase intention	H12: Risk Perception mediates the relationship between trust and purchase intention on the recombinant CLP.
	H13: Knowledge on moderates the relationship between attitude and purchase intention on the recombinant CLP.
	H14: Knowledge on moderates the relationship between religiosity and purchase intention on the recombinant CLP.
	H15: Knowledge on moderates the relationship between trust and purchase intention on the recombinant CLP.
	H16: Knowledge on moderates the relationship between risk perception and purchase intention on the recombinant CLP.

6.10.1 Research Objective 2: To Investigate Consumers' Risk Perception of Recombinant CLP.

There were three research hypotheses to fulfil this research objective, and two of them were supported by the result. The discussion of the results is as follows.

6.10.1.1 Religiosity has a Direct Relationship with Consumers' Risk Perception on Recombinant CLP.

Through path analysis in structural equation modelling, where the result indicated that religiosity did not affect consumers' risk perception. The result was possible because the association between religiosity and risk perception is still in debate.

Even so, another study that examined the relationship between religiosity and risk perception found associations between religiosity and psychological and social risk (Baazeem et al., 2016; Mortimer et al., 2020). It can be assumed that the religiosity items in this study did not associate with the consumers' risk perception on the recombinant CLP.

In another research, a relationship between religiosity and risk perception was discovered in a situation where people perceive danger in the emergence of disasters (Bodas et al., 2022). Even though the context in the previous study is different from this study, it is apparent that there is a relationship between religiosity factors and risk perception. Nevertheless, the discrepancy in the research findings can potentially be attributed to variations in the questions posed to the participants. However, this finding might add to the body of research for further investigation.

6.10.1.2 Attitude has a Direct Relationship with Consumers' Risk Perception on Recombinant CLP.

The outcome of the analysis supported the hypothesis that attitude has a direct relationship with how consumers perceived risk on the recombinant CLP ($\beta = 0.616$, t -value = 19.150, $p < 0.001$). Consumers' attitude holds either favourable or unfavourable evaluation of a product (Wang et al., 2019).

The relationship between attitude and risk perception was interchangeable, where attitude could be the predictor of the risk perceived by consumers and risk perceived by consumers could influence their attitudes. For instance, earlier studies reported that consumers' attitude perceived greater risk from the technology, and they felt the companies were not sufficiently transparent in communicating with them (Kuang et al., 2020; Siegrist, 2008; Siegrist et al., 2007).

In the meantime, evidence of the association between risk perception and travellers' attitude is shown in a paper summarising the study on risk perception and attitudes during the endemic (Sánchez-Cañizares et al., 2021).

However, it has long been known that consumer perceptions of the risk involve in technical innovation processes play a critical role in determining the future adoption of new technologies (Bonne et al., 2007; Frewer, 2017).

This study postulates that consumers' attitude affects their risk perception of the recombinant CLP because risk perception is defined as the process of describing the subjective evaluation and assessment of an impending undesirable event (Kinateder et al., 2015). In addition, consumers are individual with highly variable psychological, attitudinal, and cultural characteristics (Frewer, 2017).

Respondents agreed with one of the attitude items, which was that they would rather use recombinant CLP instead of collagen derived from animals. Nevertheless, according to the descriptive analysis of the risk perception construct, most respondents agree with the items in risk perception to the extent that they would still recommend the product to others even though they would be concerned about their family members if they were to consume a product containing a recombinant CLP. Their response seems to be in line with the Prospect Theory idea, which states that consumers purchase products despite their perceived higher risk (Kahneman, 1979; Tversky & Kahneman, 1985, 1989).

On another note, research hypothesis one stated that religiosity has a direct positive relationship with consumers' attitude. The analysis was performed, and the result implies that the relationship between religiosity and attitude is statistically significant ($\beta = 0.383$, $t\text{-value} = 10.271$, $p < 0.001$) thus, support the hypothesis as summarised in Table 7.48.

The analysis suggests a significant positive relationship between religiosity and consumers' attitude, which aligned with the previous studies (Garg & Joshi, 2018; Newaz et al., 2016; Ngah et al., 2020). In halal research studies, consumers' attitude is positive toward halal food outlets and JAKIM' halal certification in Malaysia, where their attitude was influenced by religious belief (Khalek, 2014). More specifically, for the issue surrounding collagen, Muslim consumers are often concerned about the source of the collagen itself, especially gelatine, because gelatine is used in daily necessities as a multipurpose food additive (Batu et al., 2015). Moreover, the consumers in this study imply that their religious belief directs the way they live. Hence, they are meticulous in consuming any product (Ngah et al., 2020; R. A. Rahman et al., 2021).

6.10.1.3 Consumers' Trust affects Their Risk Perception on the Recombinant CLP.

Results from the structural equation modelling analysis were statistically significant ($\beta = 0.318$, $t\text{-value} = 8.291$, $p < 0.001$). The analysis's conclusion supported the notion that respondents' trust influences their risk perception. The outcome was expected after referring to other studies that had explained similar theories. For instance, a study on customers' acceptance of genetically modified foods confirmed the idea that trust affect how people perceive risk (Hakim et al., 2020).

Moreover, a meta-analysis study has shown evidence linking risk perception and trust, with trust being one of the key elements in customers' acceptance (Mou et al., 2017). Furthermore, respondents' perceptions of the risk associated with the product they were going to consume could also be influenced by their trust in the label (Wang et al., 2020), which is comparable to the items in the trust construct for this study.

The items in the trust constructs stated that consumers trust the halal agency such as *Jabatan Kemajuan Islam Malaysia (JAKIM)*, the halal certificate issued by JAKIM as well as the halal certification issued by other religious bodies but, under the assurance for JAKIM. For these items, the responses varied from strongly disagree to strongly agree (refer to Table 7.29) which means that, some respondents trusted JAKIM, and some did not.

The other two items stated that consumers doubted that the halal research institute in Malaysia could produce halal collagen, and they would not consume the product containing the CLP if it were not certified as halal. The responses on these two items were between neutral to strongly agree but averagely responded agree, which means respondents agreed that they doubted the halal research institute could produce halal collagen, and they agreed not to consume the product containing CLP if it did not certify as halal.

The result also shows the positive effect of trust on risk perception most likely due to the variation of the responses in the first three items (from strongly disagree to strongly agree). The respondents certainly agreed that they have little trust in halal institutions and will not consume if it is not certified as halal. It can be concluded that information on halal should be clear and convincing to the consumers, as explained in other previous studies (Fadzlillah et al., 2022; Muflih & Juliana, 2020; Mustaffa et al., 2017; Ngah et al., 2020).

6.10.2 Research Objective 3: To investigate consumers' purchase intention towards recombinant CLP

Three out of four hypotheses were supported to fulfill this objectives. To investigate the consumers' purchase intention, four independent variables were tested, religiosity, attitude, risk perception, and trust. Except of religiosity, other independent variables were significantly influence the consumers' purchase intention. The discussions are as follows.

6.10.2.1 Religiosity Influences Consumers' Purchase Intention on the Recombinant CLP.

The third hypothesis was analysed using the bootstrapping procedure in SmartPLS. The outcome obtained was not significant. It was in contrast with other literatures, which reported that religious factors would affect consumers behavioural intention (Hussain et al., 2016; Mukhtar & Butt, 2012; Newaz et al., 2016; Nora & Minarti, 2017; Rizkitysha & Hananto, 2020). Nevertheless, the results of this investigation provide a different picture, with the hypothesis being rejected as a consequence of an insignificant result (p-value greater than 0.05).

Furthermore, because the impact size was 0.001, it was objectively demonstrated that there was no effect as well. The difference in the final result could be caused by the product of the subject matter of the study. For instance, Hussain and colleagues did a survey among Pakistani consumers on halal foods (Hussain et al., 2016), and Mukhtar and Butt surveyed the intention to choose halal products (Mukhtar & Butt, 2012). Consequently, those studies produced significant findings. Yet, this study reports a different finding, and this may be due to the fact that the subject matter of this study was the recombinant CLP and the respondents merely had a vague idea about the recombinant CLP.

6.10.2.2 Attitude Influences Consumers' Purchase Intention on the Recombinant CLP.

The analysis performed yielded that the attitude significantly influences the consumers' purchase intention on the recombinant CLP ($\beta = 0.146$, $t\text{-value} = 2.925$, $p\text{-value} = 0.002$) as reported in previous studies that attitude commonly hypothesized as having a positive impact on consumers purchase intention (Bae & Chang, 2021; Briliana & Mursito, 2017; Garg & Joshi, 2018; Khalek, 2014).

Similarly, this study showed that consumers' attitudes have a beneficial impact on their intention to purchase the CLP recombinant. Evidence from Duasa and colleagues' acceptability study on the recombinant CLP supports the outcome.(Duasa et al., 2022).

Specifically, the group of consumers that concerned about the environment, agreed on the development of the recombinant CLP because it might help sustain the environment (Duasa et al., 2021). Using the Technology Acceptance Model (TAM) as the theoretical basis, a prior study examined the acceptability of the recombinant CLP. The analysis revealed that attitude had a favourable impact on the behavioural intention to use the product sources from the recombinant CLP (Duasa et al., 2022).

On average, respondents would agree to prefer a product containing the recombinant CLP over collagen derived from animals, even though they all agreed that the development of the recombinant CLP would hurt the environment (refer to table 7.22) and that it was a terrible idea.

Respondents generally agreed that the recombinant CLP has an exceptional ability to improve wound healing and minimise skin ageing, even though these attributes have been clinically established (An et al., 2014; Yu et al., 2014). Furthermore, the results demonstrated that customers would be eager to buy products containing the recombinant CLP if they were created and well-marketed.

6.10.2.3 Consumers' Risk Perception Influences Their Purchase Intention on the Recombinant CLP.

The hypothesis was tested using structural equation modelling, and the results showed a significant difference ($\beta = 0.406$, $t\text{-value} = 7.156$, $p < 0.001$). Concern over risk ranked highly among customers' concerns about the new technology-based consumption goods, especially when involving their safety and health. Consumers often

think that they are the experiments of the new technology in contrast with the authority's decision-making, which is made for the betterment of the society (Slovic, 1987).

Therefore, consumers' perceived risk is influenced upon being informed about the development of recombinant CLP, which in turn affects their intention to purchase. Similar to a previous study regarding the pandemic in 2019, consumers were more cautious and concerned about what they touched, going to hospital if they had sick, or ordering takeaway food. According to the study, customers are willing to pay extra for greater safety against potential health risks (Gursoy et al., 2021). Likewise, another study made in relation to the pandemic reported that risk perception positively influences consumer intention to recommend takeaway foods during the pandemic (Yeni et al., 2021).

Risk perception studies varied according to the context of the study. For instance, psychological risk influences the consumer intention to buy religiously questionable products, and consuming the religiously questionable products would give them discomfort (Mortimer et al., 2020). Meanwhile, al-Ansi et al. studies on risk perception and consumers' intention to recommend halal food also found a significant result (Al-Ansi et al., 2019).

Four categories of risk were identified for the risk perception variable in this study: financial, social, environmental, health, and quality and halal risk. The majority of respondents concurred that they were aware of these risks and that their opinions of them affected their intention to buy. Regarding health risk, participants acknowledged that the recombinant CLP may be unhealthy, but they also concurred that it would promote faster wound healing. Even though healthy organic foods would be a better choice, they would also have a bad effect if they were over-consumed (Çabuk et al., 2014; Shaharudin et al., 2010).

Aside from that, respondents were also concerned about their family and friends upon consuming the product containing recombinant CLP, but they also agreed to recommend the recombinant CLP to other consumers.

On environmental risk, the consumers expressed concern over the environmental problems nowadays and they agreed that animal-based collagen would harm the environment. They also agreed that the halal-compliant process would not harm the environment, and the production of the recombinant CLP would not harm the environment because it was produced in a lab where no animals were involved. It appears that the respondents are aware that the products are safe to consume if the manufacturers use halal-compliant production methods. This is because the authorities did not indiscriminately declare any procedure to be halal compliant (Arif & Sidek, 2015; Muflih & Juliana, 2020).

Most respondents expressed concern about the hygienic and quality aspects of the development of the recombinant CLP, regarding both quality and halal risk. They also concurred that they are concerned about whether the process and standards for developing CLP comply with Shariah, as well as about the final product containing the recombinant CLP.

However, they agreed that the recombinant CLP will be of high quality because it goes through thorough research prior to its development. The respondents acknowledge that following Shariah-compliant processing guidelines will result in high-quality end goods (Arif & Sidek, 2015; Muflih & Juliana, 2020; Mustaffa et al., 2017; Yuswan et al., 2021).

Meanwhile, for financial risk, the respondents agreed that animal-based collagen was expensive, and they assumed the product containing the recombinant CLP would be cheaper because it is locally produced since the Malaysian halal research institution developed the recombinant CLP without any import sources.

Somehow, respondents decided to spend their money to purchase the product containing the recombinant CLP. The noteworthy finding suggests that consumers' perceptions of risk have an impact on their choice to buy or not to buy recombinant CLP-based products. Similarly, the previous study on mobile payment also reported

that the financial risk is the strongest factor that influences consumers' behaviour toward using mobile payments (Yang et al., 2015).

6.10.2.4 Consumers' Trust Influences Their Purchase Intention on the Recombinant CLP.

The results of the investigation demonstrated a significant correlation between consumers' trust and their intention to purchase a product containing a recombinant CLP ($\beta = 0.149$, $t\text{-value} = 3.171$, $p\text{-value} = 0.001$). Trust is recognised as a major driver of customers' satisfaction and desired behavioural outcomes (Al-Ansi et al., 2019).

The significant result is consistent with previous studies, such as the study on the intention to recommend halal food. The study reported that consumers' trust has a positive impact on the consumers' intention to recommend halal food (Al-Ansi et al., 2019). Aside from that, the study on the willingness to buy perishable food products also supported the significant influence of trust on consumers' willingness to buy (Konuk, 2018).

Apparently, consumers are willing to rely on institutions such as JAKIM and halal research institutions to decide on the management of technology, the environment, medicine, or other realms of public health and safety (Siegrist et al., 2000). The study aimed to examine the relationship between consumers' trust and their acceptance, intention to buy, willingness to buy, or behavioural intention. It was performed in various technologies because it is imperative to gain social trust before commercialising new technology (Lusk et al., 2014).

For this construct, most respondents said they trusted the halal institution and the Islam Department, known as JAKIM (Jabatan Kemajuan Islam Malaysia), which was authorised by the Malaysian government. In fact, JAKIM has strict and complex procedures prior to certifying a product as halal (Mustaffa et al., 2017).

Respondents' responses have a positive impact on their intention to buy the product that contains the recombinant CLP. The supported result suggests that there shouldn't be any issues when introducing the CLP recombinant product to customers, which is why more research is necessary after the final items are released.

6.10.3 Research Objective 4: The Mediating Role of Risk Perception and Attitude on the relationship between predictor variables and consumers' purchase intention

Under research objective four, four hypotheses were put forth to test the mediating roles. The results' presentation was segregated into two; (1) the mediating role of attitude, and (2) the mediating role of risk perception. The following hypotheses were put up for this study objective after the findings showed that only three hypotheses were significant.

6.10.3.1 The Mediating Role of Attitude.

From the findings, the study discovered that attitude significantly ($\beta = 0.080$, t -value = 3.865, $p < 0.001$) mediates the relationship between religiosity and respondents' purchase intention of the products containing the recombinant CLP. It appears that religiosity was not directly influenced by the purchase intention rather, the relationship was mediated by the respondent's attitude.

The result can be supported by a previous study, which studies the mediating role of attitude towards halal products (Garg & Joshi, 2018). The study inferred that the religiosity was not significantly related to the purchase intention, but the relationship between religiosity and purchase intention of the halal products was mediated by the attitude towards the halal products (Garg & Joshi, 2018).

In another study, attitude also mediates the relationship between religiosity and the willingness to pay for halal transportation (Ngah et al., 2020). In addition, the

relationship between religiosity and the intention to purchase halal food by the millennial generation was also mediated by the consumers' attitude (Setiawati et al., 2019).

Apparently, several studies discovered that religiosity did not significantly influence the consumers' purchase intention on halal products but, their relationship was significantly mediated by the consumers' attitude (Garg & Joshi, 2018; Ngah et al., 2020; Nora & Minarti, 2017; Setiawati et al., 2019).

6.10.3.2 The Mediating Role of Risk Perception.

Three hypotheses were proposed for the mediating role of risk perception as listed below:

H10: Risk perception mediates the relationship between attitude and purchase intention.

H11: Risk Perception mediates the relationship between religiosity and purchase intention.

H12: Risk Perception mediates the relationship between trust and purchase intention.

Two of these hypotheses were significant (H10 and H12). The results suggested that the association between attitude and purchase intention is mediated risk perception ($\beta = 0.262$, $t\text{-value} = 7.241$, $p < 0.001$). Somehow, the finding could not be corroborated by previous research since there was no current literature on the mediating role of risk perception on the relationship between attitude and intention behaviour.

Nevertheless, a number of research have found that risk perception plays a mediation role in the relationship between consumers' behaviour and other variables (Sozer, 2019; Sulaiman et al., 2018). For instance, the risk perception variable significantly mediated the risk communication and preventive behaviour during the pandemic outbreak in 2019 (Heydari et al., 2021).

Concurrently, another hypothesis test revealed that the relationship between customers' trust and their intention to purchase is significantly mediated by their perception of risk ($\beta = 0.135$, $t\text{-value} = 5.420$, $p < 0.001$). The literature on the risk perception mediates the relationship between trust and purchase intention is lacking.

Nevertheless, because the association between risk perception and trust could be interchangeable according to the study's objective, there was a study that discovered that trust mediates the relationship between perceived benefit and risks perception of a technology (Nancy Chen, 2015; Siegrist et al., 2007). The relationship between risk perception and trust is interchangeable, which means that trust could be the dependent variable on risk perception (Siegrist et al., 2007; Yeni et al., 2021) or risk perception could be the dependent variable for trust (Al-Ansi et al., 2019; Nancy Chen, 2015; Olya & Al-ansi, 2018).

In any case, it is evident that risk perception may operate as mediator in the interaction between factors and consumers behaviour. According to another study, risk perception significantly mediates the relationship between financial literacy and investors' decision-making (Waheed et al., 2020). The mediating effect of risk perception is highlighted in this study, despite the fact that the research objectives and variables differ.

Furthermore, risk perception also significantly mediated the relationship between word of mouth from artificial intelligence and consumers' purchase behaviour (Zhang et al., 2022). Risk perception could also directly and indirectly influence the intention behaviour of tourists (Adam et al., 2022; Yazid et al., 2018; Zhu & Deng, 2020).

6.10.4 Research Objective 5: To examine the moderating effect of knowledge on the relationship between predictor variables and consumers' purchase intention

Four hypotheses were constructed to investigate the moderating effect of knowledge. However, none of the variables yield insignificant outcomes. Even so, the discussion regarding the research objectives were as follows.

6.10.4.1 Knowledge Moderates the Relationship between Predictor Variables and Consumers' Purchase Intention.

It was hypothesised that the relationship between the predictor variables and the consumers' purchase intention would be moderated by the consumers' knowledge. Four conjectures were put out as follows:

H13: Knowledge moderates the relationship between attitude and purchase intention on the recombinant CLP.

H14: Knowledge moderates the relationship between religiosity and purchase intention on the recombinant CLP.

H15: Knowledge moderates the relationship between trust and purchase intention on the recombinant CLP.

H16: Knowledge moderates the relationship between risk perception and purchase intention on the recombinant CLP.

The hypothesis of this study is that the association between the predictors and the consumers' intention to buy the products containing the recombinant CLP would be moderated by their level of understanding about collagen. This is because information is seen as one of the key elements that influences how customers behave (Ghali, 2019; Megido et al., 2016; Siegrist & Hartmann, 2020a).

Consumers typically respond to risks based on their present understanding, which is subjective and may or may not be true (Leung & Cai, 2021). In their study, for

example, Kim and Bonn (2015) found that knowledge modifies environmental factors and purchase intention; the items in their environmental factor were somewhat similar to the items in the risk perception construct in this study's investigation (Kim & Bonn, 2015).

Knowledge is assumed to have a moderating role because it could strengthen the relationship between religiosity factors and consumers' purchase intention (Baron & Kenny, 1986). Hence, knowledge may moderate by strengthening the relationship between consumers' attitudes on the recombinant CLP and their purchase intention.

Aside from that, the relationship between consumers' trust and their purchase intention, as well as the relationship between consumers' risk perception and their purchase intention could be moderated by their knowledge of collagen. It was similar to a previous study that discovered the moderating role of knowledge on the relationship between consumers' trust and their intention to purchase organic drinks (Kim & Bonn, 2015).

However, those hypotheses were not supported by the empirical result of this study. Regardless, the simple slope from the result could show a slight effect of the existence of knowledge as a moderator of the relationships. Even though the hypotheses are not supported by the empirical result, the existence of knowledge as a moderating role does increase the percentage of R^2 , which is the coefficient of determination.

Thus, knowledge does play a moderating effect in the relationship between predictor variables and purchase intention, as indicated by the R^2 statistics, which evaluated the model's quality. According to a study, individuals increased use of precautions during the 2019 disease outbreak was influenced by their knowledge of the virus (Iorfa et al., 2020; Zhong et al., 2021).

However, the slope further shows the moderation analysis result, which indicates that consumers' knowledge has no moderating effect on the relationship between attitude and purchase intention, nor on the association between religious

variables and purchase intention. This is probably because respondents were informed and aware that the recombinant CLP is laboratory-produced, hence not an organic product material. In fact, knowledge was shown to significantly moderated the relationship between attitude and consumers' purchase intention on the organic foods on the one hand (Shaharudin et al., 2010).

On the other hand, as the findings revealed, consumers' knowledge somewhat moderated the relationship between their intention to purchase and their risk perception. This finding can be corroborated by another study that discovered the individuals' perception of risk was significantly influence by their knowledge and understanding about viruses, leading them to take more precaution (Iorfa et al., 2020; Zhong et al., 2021). Consumers who are better informed about collagen in general perceive more risks, thus more likely to purchase products containing the recombinant CLP. This concept aligns with the prospect theory, where consumers behave according to their evaluation of the risk, and outcomes (Camerer, 2005; D. Chen & Liang, 2006; Kahneman et al., 1982; Tversky & Kahneman, 1989; Zhang et al., 2017).

Meanwhile, in the relationship between trust and consumers' knowledge, higher knowledge will cause consumers to have higher trust on JAKIM and other halal research institutions. Subsequently, they may have higher interest to buy a product containing the recombinant CLP.

Slovic (1987) contended that an individual may assume himself/herself was the experiments of the authority and manufacturers of the new technology since he/she has little knowledge. However, if they were properly informed and acquires higher knowledge, he/she will know that new technologies will likely benefit them (Slovic, 1987; Slovic et al., 1982).

Both risk and trust variables could be considered complementary and should be surveyed together in the case of consumers' acceptance of new technologies (Connor & Siegrist, 2010; Siegrist, 2000; Siegrist & Hartmann, 2020b, 2020a). It asserted that

consumers' knowledge has impact on determining the consumers' level of risk perception and trust (Hakim et al., 2020).

In conclusion, even though knowledge as the moderating role was tested and found not significant, knowledge is still deemed as important variable that influences the consumers' intention behaviour (Connor & Siegrist, 2010; Frewer et al., 1994; Hakim et al., 2020; Kim & Bonn, 2015; Siyal et al., 2021; Suki, 2016; Tuu & Olsen, 2012; Wang et al., 2019; Wang & Hazen, 2016; Zhong et al., 2021).

The claim is supported by an empirical result of Duasa et al.'s study, in which Duasa and colleagues reported that consumers with high education levels would opt for the product containing recombinant CLP if it is assured as halal collagen (Duasa, Burhanuddin, et al., 2022; Duasa, Zainan Nazri, et al., 2023). Hence, this supports the conclusion that knowledge could be a factor that influences purchase intention. Moreover, a study has reported that low level of education and knowledge would influence consumers' perception on the intention to purchase organic foods (Wang et al., 2019).

6.11 SUMMARY

To summarise, this chapter explained in detail the analysis of the quantitative data collected from the survey. It purportedly tested the hypotheses constructed for the study. The analysis was carried out in two-stages SEM, where the first stage involved the assessment of the measurement model for all latent variables. Meanwhile, the structural model was analysed in second stage to test the hypotheses. The structural model was divided into three parts of which the first part tested the direct hypotheses, second part tested the mediating role, and the third part tested the moderating effect. The summary of findings was listed in table 7.47, where among all sixteen (16) hypothesis, five (5) direct hypotheses were supported, three (3) mediator hypotheses were supported, while the moderating effect hypotheses were not supported.

CHAPTER SEVEN

CONCLUSION, IMPLICATION, LIMITATION, AND FUTURE RESEARCH

7.1 INTRODUCTION

This chapter discusses the results of both qualitative and quantitative data collection. The discussion starts by briefly explaining the purpose of the study and its objectives. The discussion is segregated based on research questions, and each question consists of the proposed hypotheses. Later, the discussion continues to discuss the research implications, which will be sorted into three perspectives: theoretical, practical, and policy implications. The limitations of the study will be described later followed by the recommendations for future research.

7.2 CONCLUSION

This study focuses on the development of recombinant collagen-like protein (CLP), of which both experts, and consumers' perceptions have been taken into consideration. For the experts, the interview was conducted physically, and the questions were asked to fulfil the themes of the studies. Since the study on the perception of recombinant CLP is lacking, especially when the purpose of the development was halal thus, the interview questions focused on the suitability and viability of recombinant CLP if it were to alternate the animal-based collagen. Meanwhile, on the consumers' side, the study focused on consumers' risk perception as well as their intention to purchase on the product based on recombinant CLP. Another endogenous variable which it examined how consumers would act if the product were made of recombinant CLP. Nevertheless, the main focus in consumers' perception was how they perceived the risks of the development CLP.

The results from the analysis are used to uphold the following research objective:

1. To explore the experts' opinions on the issues with the collagen, suitability, and viability of the recombinant CLP development as an alternative to halal collagen.
2. To investigate consumers' perception of risk regarding the development of recombinant CLP.
3. To investigate consumers' purchase intention for the product based on recombinant CLP.
4. To examine the mediating role of attitude towards the relationship between religiosity and consumers' purchase intention on recombinant CLP.
5. To examine the mediating role of risk perception on the relationship between attitude, religiosity, and trust with consumers' purchase intention on recombinant CLP.
6. To explore the moderating role of consumers' knowledge on the relationship among predictors variables with consumers' purchase intention on the recombinant CLP.
7. To recommend a policy on halal consumptions.

The data collection was performed in two parts, namely, interview and survey questions. Prior to the final survey, content validity and pilot surveys were conducted to check for the reliability and validity of the questionnaires.

7.3 RESEARCH IMPLICATION

The implications of the outcome of the research would apply on a theoretical and practical basis as well as to the policy.

7.3.1 Theoretical Implications

Theoretically, this study contributes to the literature on behavioural economics and consumer behaviour through the adoption of prospect theory and risk perception framework.

The results expand on the use of the risk perception and prospect theory. The significant relationship between risk perception and intention behaviour has reinforced the applicability of the risk perception framework.

Aside from that, the findings indicate that even though respondents acknowledge that the recombinant CLP carries a number of risks, they would still consume the product containing the recombinant CLP if they were worried about the animal-based collagen products' halal status. These results are consistent with the prospect theory idea, which holds that consumers become risk-seeking in the development of the recombinant CLP but still, would choose it over animal-based collagen.

Past literatures offer differing approaches to the risk perception framework, where most of them looked into the relationship between risk perception and trust (Al-Ansi et al., 2019; Hakim et al., 2020; Hu et al., 2020; Nancy Chen, 2015; Siegrist, 2000). The direction of the relationship between trust and risk perception is interchangeable. Some of the studies reported that risk perception significantly influences trust (Al-Ansi et al., 2019), where the study discovered that trust is increased once the respondents evaluate a combination of risks.

Meanwhile, research indicates that trust has a major impact on how individuals perceive risk (Hu et al., 2020; Nancy Chen, 2015; Ross et al., 2014). The results of this study also showed a substantial relationship between trust and risk perception, which may be evidence that trust significantly affects risk perception.

The findings of this research also support the seminal work by Slovic (1987) on the examination of risk perception by the public and the authorities on the introduction of a new potential hazard, such as food preservatives, microwave ovens, and several

others (Slovic, 1987). This study conducted interviews among experts in halal, food safety and hazards, as well as the industry players regarding their perception of the development of the recombinant CLP. Risk perception was not specifically asked during the interviews, but participants were asked whether the recombinant CLP is safe to produce to public.

The findings from the interviews were among the experts, is viewed the development of the recombinant CLP as safe according to their knowledge and expertise. Nonetheless, consumers who are also the public have different perceptions, and they perceive a higher risk in the development of the recombinant CLP. Hence, it is consistent with the seminal work by Slovic (1987).

The findings of this study also further enhance Bauer's (1960) work on perceived risk in consumer behaviour (Bauer, 1960). In this study, whether respondents intend to purchase the product containing the recombinant CLP or not, they would face the consequences.

7.3.2 Practical Implications

In terms of implications for practice, the study would convince the industrial players of the potential of the products containing the recombinant CLP to stay in the market longer. It is apparent from the interview conducted with the industry player, who is the director of Superfood Sdn. Bhd. He agreed that the recombinant CLP is suitable to be produced in Malaysia. Moreover, collagen that processed through a recombinant process may have a unique selling proposition that can increase its value compared to natural collagen sources.

Besides, the cost to produce the recombinant CLP is minimal (Awang et al., 2021; Salleh et al., 2021), thus attracting entrepreneurs to alternate animal-based collagen with the recombinant CLP. Meanwhile, based on the responses of the

consumers, they agreed that they would be willing to alternate animal-based collagen with the recombinant CLP for halal purposes.

Moreover, based on the findings, even though consumers perceived higher risk in the development of the recombinant CLP, they still agreed to choose the recombinant CLP over animal-based collagen. Therefore, it gives assurance to the entrepreneurs in producing the products containing the recombinant CLP. Besides, the provision of the halal certification by the authorities would guarantee a place for the entrepreneurs. This is in lieu of the Shariah-compliant process of the end-product, and not on the recombinant CLP as a halal raw material.

Aside from that, the recombinant CLP could contribute to halal pharmaceutical companies, as proposed by Salleh et al. (2023). They proposed a halal recombinant of CLP to be one of the main ingredients in wound healing medications (Salleh et al., 2023). In addition, the recombinant CLP has been presented to have faster wound healing ability compared to medication without collagen (An et al., 2014).

Therefore, the introduction of the recombinant CLP to the industry could contribute to the halal industry. Moreover, Malaysia has a team of experts in the halal industry, such as three of the interviewees (E01, E02, E04) are halal experts aside from being an academician. Hence, it should be fully utilised. Besides, the Prime Minister of Malaysia has mentioned that the halal industry in Malaysia is authorised under the government with many experts, whereas other countries are still in a nascent stage and seeking help from each other to strengthen their halal industry, which contribute millions of ringgits to the country's economy (Bernama, 2023).

Since the recombinant CLP is generated with less natural resource consumption and may multiply exponentially through recombinant technology, its development could also contribute to environmental sustainability (An et al., 2014; Awang et al., 2021; Ramshaw et al., 2019; Salleh et al., 2021). The implications may also extend to new insights and abilities, particularly in the field of food engineering, to produce halal collagen for use in supplements and cosmetics, among other applications. By producing

the product at a significantly reduced cost, consumers will be able to purchase it at a reasonable price.

7.3.3 Policy Implications

The findings of the study also contribute to the Government and policy makers. Policy is the principle of actions made referring to various research and current conditions. In a study conducted by Slovic and colleagues on why they should study risk perception, they aimed for several purposes, and one of them was to aid the policymakers by improving the communication between them and the public or consumers (Slovic et al., 1982). The public was always concerned about their health and environmental risks on various occasions, for example, the intention to recommend halal products and services (Olya & Al-ansi, 2018).

The halal status has always an issue among Muslim consumers, especially collagen and gelatine (Batu et al., 2015). Because halal is compulsory and deemed important to the public, the halal research institute has been established in public universities such as the International Institute of Halal Research and Training (INHART) under the International Islamic University Malaysia (IIUM). Other than that, the University Putra Malaysia also has its Halal Products Research Institute, and the University Malaya has the UM Halal Research Centre. The research on the recombinant CLP was also conducted under the Halal Research and Institute in an attempt to boost the halal industry (Salleh et al., 2023).

The issues in relation to collagen and the development of the recombinant CLP were discussed and explained in Chapter 2 (2.8). Nonetheless, the Government ought to impose enforcement on business owners and the public. Furthermore, it was clear that from the analysis and discussion that consumers perceived a significant risk associated with the recombinant CLP. Therefore, with support from the Government, consumers' anxiety may be reduced, and producers may be persuaded to develop and market the recombinant CLP.

Moreover, the recombinant CLP has been conducted in a variety of scientific fields during the past thirty years (Aly et al., 2022; An et al., 2014; Awang et al., 2021; Chunlin et al., 2004; Fertala, 2020; Gameil et al., 2023; Meganathan et al., 2022; Olsen et al., 2003; Ramshaw et al., 2019; Salleh et al., 2023; Wenbo et al., 2022; Yang et al., 2021). Nonetheless, it is still in its infancy in the business context (Lauret, 2023).

Authorities such as the *Jabatan Kemajuan Islam Malaysia* (JAKIM) should first recognise the recombinant process to develop the collagen as an alternative to animal-based collagen and give the affirmation on the halal status of the CLP. Besides, the cost of producing the recombinant CLP is also less expensive, the Government should provide a grant to the manufacturers to produce the recombinant CLP. Additionally, with the minimum cost of production, the final products containing the recombinant CLP can be sold at minimum price.

Apart from that, the production of the recombinant CLP may help to sustain the environmental and further benefit consumers. Hence, the Ministry of Health can promote the benefit of the recombinant CLP to the public, considering the risk perceived by the public. Given that many firms promote Environment, Social, and Governance (ESG) in their non-financial investments, the Government should likewise assist the development of the recombinant CLP as an inclusion in ESG investments.

The potential contribution of the recombinant CLP development to Gross Domestic Products (GDP) stems from its local production. As such, the Government may also offer some form of support such as financial assistance or grants application to the producers of this collagen since it has the potential to boost both the economy and the general people's wellbeing.

Furthermore, Malaysia is currently leading the global halal industry (Matrade, 2024), while also developed in halal pharmaceutical industry (MIDA, 2023). Under the jurisdiction of JAKIM, Malaysia has gone a long way with several key players such as Duopharma Biotech, Pharmaniaga, and Ain Medicare (MIDA, 2023). Therefore, the

recombinant CLP as vegetarian and halal collagen could also contribute in sustaining the Malaysia's place as a top country in global halal industry.

Moreover, recombinant CLP, which is now developed as vegetarian and halal collagen, has the potential to maintain both Malaysia's position as the world's largest exporter of halal goods and the integrity of JAKIM's halal certification. This is particularly important given that other non-Muslim nations are currently vying for the top spot in the global halal market (The Nation, 2024).

7.4 LIMITATION OF THE STUDY

The limitation of a study typically involves potential weaknesses that were unable to be controlled by the study (Theofanidis & Fountouki, 2018). This study also has its own limitations including lack literatures about the integration of prospect theory and risk perceptions in consumer behaviour on medicine, nutraceuticals, and cosmetics products. meanwhile, the interviewee selection is also one of the limitations.

To note, most of the interviewees were among academicians, and the study only managed to secure one entrepreneur, who is the director of a company, and one science officer who is directly involved in halal certification. Moreover, the interview session with the entrepreneur took a while to conduct. Other entrepreneurs approached either did not respond or refused to be interviewed.

Another limitation was securing the required respondents. Some of the potential respondents approached either ignored the researcher's message, did not answer the questionnaire, which they initially agreed to, or did not answer altogether. Moreover, many male respondents refused to spend their time to answer the survey. Thus, the data obtained more female respondents than male respondents.

Aside from that, the items for religious variable were only five and it might be the reason of insignificant result. Even though the items were constructed after referring

to previous studies but, more items might be required to achieve significant result for this study.

Moreover, the moderating role of knowledge also considered as limitation for this study. Despite the fact that the objective was created after referring to several pieces of literature but, the result yields an insignificant outcome. Therefore, the knowledge might be having a direct relationship with the purchase intention instead of having a role as moderator.

7.5 RECOMMENDATIONS FOR FUTURE RESEARCH

Based on the limitations mentioned above, this research proved several recommendations for future research as follows:

- Prospect theory and risk perception framework should be applied to other context of the study related to collagen for example, supplement drinks, gelatine consumers' goods, cosmetics, and so on, to examine how the consumers perceive the risk of these products and would purchase the products even if they perceive high risk.
- Focus groups involving consumers who come from a variety of educational and socioeconomic backgrounds might be conducted for future research. This might combine different perspectives, which would encourage businesses to launch a product with a CLP recombinant.
- In future studies, religious factors can be segregated into intrinsic and extrinsic religiosity and identify if these factors could influence the consumers' purchase intention on products containing recombinant CLP.
- The construct knowledge as a moderator should be studied further together with the risk and trust effect on consumers' behavioural intention. This is because, logically, knowledge will influence consumers' decision making. Also, the construct can be assumed to have a direct effect on risk perception, trust, and consumers' behavioural intention.

- One possible way to further this research would be to concentrate on a particular target population, such as diabetes patients who have wounds, as the recombinant CLP has the potential to be an effective medicine for wound healing. However, this continuance needs to be carried out with the healthcare centre's approval and help.

7.6 CHAPTER SUMMARY

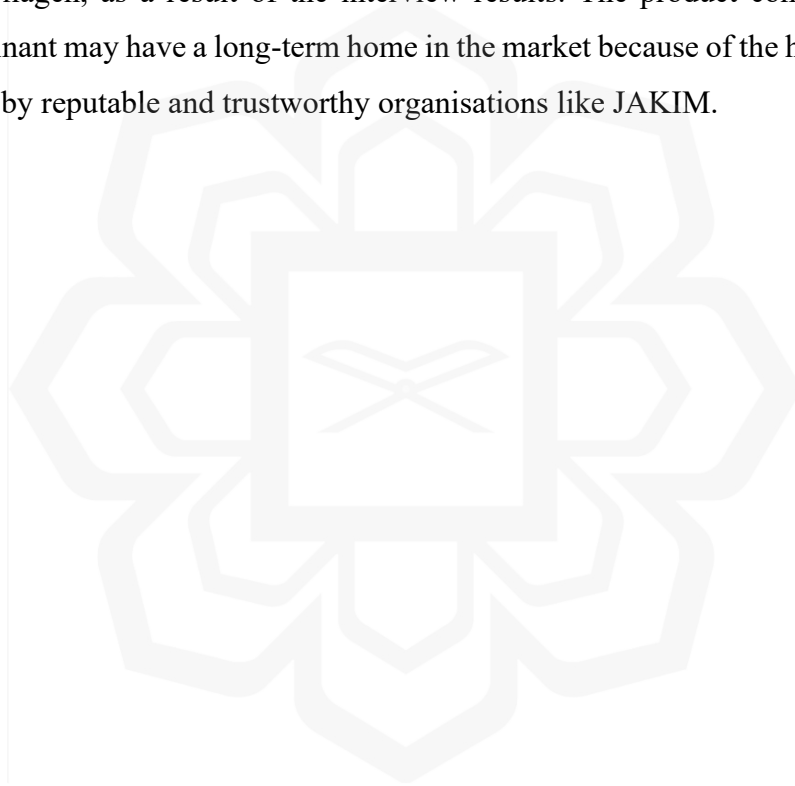
As the previous chapter's discussion has demonstrated, previous research in other fields of technology, including genetically modified crops, genome editing on crops, nanotechnology, and other food technology, supports the findings of this study. The results also matched those of the acceptability analysis of the recombinant CLP from earlier research conducted by Duasa and colleague. The present study is different from the previous one in that it is centred around the risk perception framework and prospect theory. Prospect theory was regarded as an important instrument for studying how consumers made decisions in the actual world and how they were heuristically appraised. In light of this, this study investigates the moderating effect of knowledge on consumers' purchase intentions.

The empirical data validated eight of the sixteen (16) hypotheses, and even though the moderating role showed minor results, they could serve as a baseline for more research. Nevertheless, when it came to mediating the association between the predictors and the purchase intention of the consumers, risk perception emerged as a key mediator.

Numerous research have indicated that attitude is an important variable; hence, this study's results are consistent with those of previous investigations. It also shows that attitude considerably mediates the relationship between religious elements and customers' purchase intentions. Numerous research on food technology and nuclear disasters have identified the trust variable, and it is obvious that trust affects consumers' intentions to make purchases.

This study also investigates the relationship between the variable trust and the risk perception constructs, which have been reported frequently in previous research on the recombinant CLP development. Eventually, the findings were consistent with a number of earlier research projects.

More significantly, this research may provide confidence that recombinant CLP will be used in the market for vegetarian and halal collagen goods. Most experts agreed to produce a recombinant form of CLP as an alternative to animal-based collagen, or halal collagen, as a result of the interview results. The product containing the CLP recombinant may have a long-term home in the market because of the halal certification granted by reputable and trustworthy organisations like JAKIM.



BIBLIOGRAPHY

- 360 Market Updates. (2020). *Global collagen peptides market size manufacturers, supply chain, sales channels and clients, 2020-2026*. <https://www.360marketupdates.com/global-collagen-peptides-market-15947720>
- Abd Samad, N. S., Amid, A., & Jimat, D. N. (2017). Protease purification from *Bacillus amyloliquefaciens* B7 using Aqueous Two-Phase System (ATPS). *International Food Research Journal*, 24.
- Abdul Jabar, N. A. (2011). *Extraction of collagen from fish waste and determination of its physico-chemical characteristics*. Universiti Teknologi MARA. [http://ir.uitm.edu.my/id/eprint/4654/1/TD_NURUL ASYIRAF ABDUL JABAR 11_5 1.pdf](http://ir.uitm.edu.my/id/eprint/4654/1/TD_NURUL%20ASYIRAF%20ABDUL%20JABAR%2011_5%201.pdf)
- Abedin, M. Z., Karim, A. A., Ahmed, F., Latiff, A. A., Gan, C., Che Ghazali, F., & Islam Sarker, M. Z. (2013). Isolation and characterization of pepsin-solubilized collagen from the integument of sea cucumber (*Stichopus vastus*). *Journal of the Science of Food and Agriculture*, 93(5), 1083–1088.
- Abedinia, A., Ariffin, F., Huda, N., & Nafchi, A. M. (2017). Extraction and characterization of gelatin from the feet of Pekin duck (*Anas platyrhynchos domestica*) as affected by acid, alkaline, and enzyme pretreatment. *International Journal of Biological Macromolecules*, 98, 586–594.
- Adam, M., Ibrahim, M., Idris, S., Saputra, J., & Putra, T. (2022). An investigation of e-marketing and its effect on the consumer buying decision during COVID-19 pandemic in Aceh Province, Indonesia: A mediating role of perceived risk. *International Journal of Data and Network Science*, 6(1), 115–126.
- Adonis, L., Basu, D., & Luiz, J. (2015). The role of prospect theory in screening behavior decision-making in a health-insured population of south africa. *Journal of Psychology and Psychotherapy*, 5(5).
- Afthanorhan, W. (2014). Hierarchical component using reflective-formative measurement model in partial least square structural equation modeling (Pls-Sem). *International Journal of Mathematics*, 2(2), 33–49.

- Ag Majid, D. K. Z., Abdul Hanan, S., & Hassan, H. (2021). A mediator of consumers' willingness to pay for halal logistics. *British Food Journal*, 123(3), 910–925.
- Agarwal, R., & Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage. *MIS Quarterly*, 665–694.
- Aguinis, H., Beaty, J. C., Boik, R. J., & Pierce, C. A. (2005). Effect size and power in assessing moderating effects of categorical variables using multiple regression: a 30-year review. *Journal of Applied Psychology*, 90(1), 94.
- Ahlin, E. M. (2019). *Semi-structured interviews with expert practitioners: Their validity and significant contribution to translational research*.
- Ahmed, M. A., Al-Kahtani, H. A., Jaswir, I., AbuTarboush, H., & Ismail, E. A. (2020). Extraction and characterization of gelatin from camel skin (potential halal gelatin) and production of gelatin nanoparticles. *Saudi Journal of Biological Sciences*, 27(6), 1596–1601.
- Ahmed, Z., Rasool, S., Saleem, Q., Khan, M. A., & Kanwal, S. (2022). Mediating role of risk perception between behavioral biases and investor's investment decisions. *Sage Open*, 12(2), 21582440221097390.
- Ahuja, T., Dhakray, V., Mittal, M., Khanna, P., Yadav, B., & Jain, M. (2012). Role of collagen in the periodontal ligament-A Review. *The Internet Journal of Microbiology*, 10(1).
- Aiken, L. S., West, S. G., & Reno, R. R. (1991). *Multiple regression: Testing and interpreting interactions*. sage.
- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior. In *Action control: From cognition to behavior* (pp. 11–39). Springer.
- Ajzen, I. (1989). Attitude structure and behavior. *Attitude Structure and Function*, 241, 274.
- Ajzen, I. (2020). The theory of planned behavior: Frequently asked questions. *Human Behavior and Emerging Technologies*, 2(4), 314–324.

- Ajzen, I., Fishbein, M., Lohmann, S., & Albarracín, D. (2018). The influence of attitudes on behavior. *The Handbook of Attitudes*, 197–255.
- Al-Ansi, A., Olya, H. G. T., & Han, H. (2019). Effect of general risk on trust, satisfaction, and recommendation intention for halal food. *International Journal of Hospitality Management*, 83, 210–219.
- Alavi, M., & Leidner, D. E. (2001). Knowledge management and knowledge management systems: Conceptual foundations and research issues. *MIS Quarterly*, 107–136.
- Al-Bakri, Z. M. (2023). *Status Halal Gelatin*. Makanan Dan Minuman. <https://maktabahalbakri.com/1259-status-halal-gelatin/>
- Alden, D. L., Stayman, D. M., & Hoyer, W. D. (1994). Evaluation strategies of American and Thai consumers. *Psychology & Marketing*, 11(2), 145–161.
- Al-Hassan, A. A. (2020). Gelatin from camel skins: Extraction and characterizations. *Food Hydrocolloids*, 101, 105457.
- Ali, Q., Salman, A., Yaacob, H., & Parveen, S. (2019). Financial cost and social influence: factors affecting the adoption of halal cosmetics in Malaysia. *Academy of Entrepreneurship Journal*, 25(2), 1–17.
- Alipal, J., Pu'ad, N. A. S. M., Lee, T. C., Nayan, N. H. M., Sahari, N., Basri, H., Idris, M. I., & Abdullah, H. Z. (2021). A review of gelatin: Properties, sources, process, applications, and commercialisation. *Materials Today: Proceedings*, 42, 240–250.
- Allais, M. (1953). Le comportement de l'homme rationnel devant le risque: critique des postulats et axiomes de l'école américaine. *Econometrica: Journal of the Econometric Society*, 503–546.
- Aly, N., Benoit, E., Chaubard, J.-L., Chintalapudi, K., Choung, S., de Leeuw, M., Diaz, M., Dueppen, D., Ferraro, B., & Fischetti, V. (2022). Cosmetic Potential of a Recombinant 50 kDa Protein. *Cosmetics*, 9(1), 8.
- Ambali, A. R., & Bakar, A. N. (2013). Halāl food and products in Malaysia: People's awareness and policy implications. *Intellectual Discourse*, 21(1).

- An, B., Kaplan, D. L., & Brodsky, B. (2014). Engineered recombinant bacterial collagen as an alternative collagen-based biomaterial for tissue engineering. *Frontiers in Chemistry*, 2, 40.
- Anderson, J. C., & Narus, J. A. (1998). Business marketing: understand what customers value. *Harvard Business Review*, 76, 53–67.
- Annunziata, A., & Vecchio, R. (2013). Consumer perception of functional foods: A conjoint analysis with probiotics. *Food Quality and Preference*, 28(1), 348–355.
- Ansari, Z. A. (2014). The relationship between religiosity and new product adoption among Muslim consumers. *International Journal of Management Sciences*, 2(6), 249–259.
- Anunciato, T. P., & da Rocha Filho, P. A. (2012). Carotenoids and polyphenols in nutricosmetics, nutraceuticals, and cosmeceuticals. *Journal of Cosmetic Dermatology*, 11(1), 51–54.
- Ardoin, R., & Prinyawiwatkul, W. (2020). Product appropriateness, willingness to try and perceived risks of foods containing insect protein powder: A survey of US consumers. *International Journal of Food Science & Technology*, 55(9), 3215–3226.
- Arif, S., & Sidek, S. (2015). Application of halalan tayyiban in the standard reference for determining Malaysian halal food. *Asian Social Science*, 11(17), 116.
- Artigas, E. M., Yrigoyen, C. C., Moraga, E. T., & Villalón, C. B. (2017). Determinants of trust towards tourist destinations. *Journal of Destination Marketing & Management*, 6(4), 327–334.
- Ashoer, M., & Said, S. (2016). The impact of perceived risk on consumer purchase intention in Indonesia; a social commerce study. *Proceeding of the International Conference on Accounting, Management, Economics and Social Sciences*, 1–13.
- Asnawi, N., Sukoco, B. M., & Fanani, M. A. (2018). Halal products consumption in international chain restaurants among global Moslem consumers. *International Journal of Emerging Markets*.

- Avila Rodríguez, M. I., Rodriguez Barroso, L. G., & Sánchez, M. L. (2018). Collagen: A review on its sources and potential cosmetic applications. *Journal of Cosmetic Dermatology*, *17*(1), 20–26.
- Awang, N. A., Amid, A., & Arshad, Z. I. (2021). Purification of Recombinant Collagen-Like Protein (CLP) from *Rhodopseudomonas Palustris* Expressed in *Escherichia Coli* System Using Aqueous Two-Phase System (ATPS). *Rhodopseudomonas Palustris*.
- Awang, N. A., Amid, A., & Arshad, Z. I. (2023). *Rhodopseudomonas Palustris* Collagen-Like Recombinant Protein Purification Using an Aqueous Two-Phase System. *IIUM Engineering Journal*, *24*(1), 40–56.
- Awang, N. A., Amida, A., & Arshadb, Z. I. (2020). Method for purification of collagen: A systematic review. *AsPac J. Mol. Biol. Biotechnol.*, *28*(3), 99–112.
- Axinn, W. G. (1991). The influence of interviewer sex on responses to sensitive questions in Nepal. *Social Science Research*, *20*(3), 303–318.
- Axinn, W. G., & Pearce, L. D. (2006). *Mixed method data collection strategies*. Cambridge University Press.
- Azam, M. S. E., & Abdullah, M. A. (2020). Global halal industry: realities and opportunities. *IJIBE (International Journal of Islamic Business Ethics)*, *5*(1), 47–59.
- Baazeem, T., Mortimer, G., & Neale, L. (2016). Conceptualising the relationship between shopper religiosity, perceived risk and the role of moral potency. *Journal of Consumer Behaviour*, *15*(5), 440–448.
- Bae, S. Y., & Chang, P.-J. (2021). The effect of coronavirus disease-19 (COVID-19) risk perception on behavioural intention towards ‘untact’ tourism in South Korea during the first wave of the pandemic (March 2020). *Current Issues in Tourism*, *24*(7), 1017–1035.
- Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, *16*(1), 74–94.

- Bahmanziari, T., & Odom, M. D. (2015). Prospect theory and risky choice in the ecommerce setting: Evidence of a framing effect. *Academy of Accounting and Financial Studies Journal*, 19(1), 85.
- Baillon, A., Bleichrodt, H., & Spinu, V. (2020). Searching for the reference point. *Management Science*, 66(1), 93–112.
- Bainbridge, S. (2022). *What is Vegan Collagen Made From?*
- Baker, A., Bittner, T., Makrigeorgis, C., Johnson, G., & Haefner, J. (2010). Teaching prospect theory with the deal or No deal game show. *Teaching Statistics*, 32(3), 81–87.
- Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, 51(6), 1173.
- Bashir, A. M. (2020). Awareness of purchasing halal food among non-Muslim consumers: An explorative study with reference to Cape Town of South Africa. *Journal of Islamic Marketing*, 11(6), 1295–1311.
- Battour, M., Salaheldeen, M., & Mady, K. (2021). Exploring innovative marketing opportunities for Halal entrepreneurs in hospitality and tourism industry. *SHS Web of Conferences*, 124, 10001.
- Batu, A., Regenstein, J. M., & Dogan, I. S. (2015). Gelatin Issues in Halal Food Processing for Muslim Societies. *Electronic Turkish Studies*, 10(14).
- Bauer, R. A. (1960). Consumer behavior as risk taking. *Proceedings of the 43rd National Conference of the American Marketing Association, June 15, 16, 17, Chicago, Illinois, 1960*.
- Bauer, R. A. (1967). Consumer behavior as risk taking. *Marketing: Critical Perspectives on Business and Management*, 13–21.
- Becker, J.-M., Cheah, J.-H., Gholamzade, R., Ringle, C. M., & Sarstedt, M. (2023). PLS-SEM's most wanted guidance. *International Journal of Contemporary Hospitality Management*, 35(1), 321–346.

- Becker, J.-M., Klein, K., & Wetzels, M. (2012). Hierarchical latent variable models in PLS-SEM: guidelines for using reflective-formative type models. *Long Range Planning*, 45(5–6), 359–394.
- Bergstra, A. D., Brunekreef, B., & Burdorf, A. (2018). The mediating role of risk perception in the association between industry-related air pollution and health. *PLoS One*, 13(5), e0196783.
- Bernamea. (2023). Malaysia perlu memanfaatkan kepakaran dalam industri halal - PM. *Astro Awani*. <https://www.astroawani.com/berita-malaysia/malaysia-perlu-manfaatkan-kepakaran-dalam-industri-halal-pm-433282>
- Bettman, J. R., & Park, C. W. (1980). Effects of prior knowledge and experience and phase of the choice process on consumer decision processes: A protocol analysis. *Journal of Consumer Research*, 7(3), 234–248.
- Binlath, T., Thammanichanon, P., Rittipakorn, P., Thinsathid, N., & Jitprasertwong, P. (2022). Collagen-based biomaterials in periodontal regeneration: Current applications and future perspectives of plant-based collagen. *Biomimetics*, 7(2), 34.
- Blomqvist, K. (1998). The many faces of trust <http://www.sciencedirect.com/science/article/pii/S0956522197846441>. *As Assessed on October, 7, 2011*.
- Bodas, M., Peleg, K., Stolero, N., & Adini, B. (2022). Risk Perception of Natural and Human-Made Disasters—Cross Sectional Study in Eight Countries in Europe and Beyond. *Frontiers in Public Health*, 10, 825985.
- Bonne, K., & Verbeke, W. (2006). Muslim consumer's motivations towards meat consumption in Belgium: qualitative exploratory insights from means-end chain analysis. *Anthropology of Food*, 1(5).
- Bonne, K., & Verbeke, W. (2008). Religious values informing halal meat production and the control and delivery of halal credence quality. *Agriculture and Human Values*, 25, 35–47.
- Bonne, K., Vermeir, I., Bergeaud-Blackler, F., & Verbeke, W. (2007). Determinants of halal meat consumption in France. *British Food Journal*.

- Boran, G., & Regenstein, J. M. (2010). Fish gelatin. *Advances in Food and Nutrition Research*, 60, 119–143.
- Borumand, M., & Sibilla, S. (2014). Daily consumption of the collagen supplement Pure Gold Collagen® reduces visible signs of aging. *Clinical Interventions in Aging*, 9, 1747.
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101.
- Briliana, V., & Mursito, N. (2017). Exploring antecedents and consequences of Indonesian Muslim youths' attitude towards halal cosmetic products: A case study in Jakarta. *Asia Pacific Management Review*, 22(4), 176–184.
- Bronfman, N. C., & Vázquez, E. L. (2011). A cross-cultural study of perceived benefit versus risk as mediators in the trust-acceptance relationship. *Risk Analysis: An International Journal*, 31(12), 1919–1934.
- Browne, R. H. (1995). On the use of a pilot sample for sample size determination. *Statistics in Medicine*, 14(17), 1933–1940.
- Bukhari, S. N. Z., Isa, S. M., & Nee, G. Y. (2020). Halal vaccination purchase intention: A comparative study between Muslim consumers in Malaysia and Pakistan. *Journal of Islamic Marketing*.
- Çabuk, S., Tanrikulu, C., & Gelibolu, L. (2014). Understanding organic food consumption: attitude as a mediator. *International Journal of Consumer Studies*, 38(4), 337–345.
- Cain, M. K., Zhang, Z., & Yuan, K.-H. (2017). Univariate and multivariate skewness and kurtosis for measuring nonnormality: Prevalence, influence and estimation. *Behavior Research Methods*, 49, 1716–1735.
- Camerer, C. (2005). Three cheers—psychological, theoretical, empirical—for loss aversion. *Journal of Marketing Research*, 42(2), 129–133.
- Campos, L. D., de Almeida Pereira, A. T. S., & Cazarin, C. B. B. (2023). The collagen market and knowledge, attitudes, and practices of Brazilian consumers regarding collagen ingestion. *Food Research International*, 170, 112951.

- Campuzano, S., & Pelling, A. E. (2019). Scaffolds for 3D cell culture and cellular agriculture applications derived from non-animal sources. *Frontiers in Sustainable Food Systems*, 3, 38.
- Cao, C., Xiao, Z., Ge, C., & Wu, Y. (2021). Animal by-products collagen and derived peptide, as important components of innovative sustainable food systems—A comprehensive review. *Critical Reviews in Food Science and Nutrition*, 1–25.
- Carmines, E. G., & Zeller, R. A. (1979). *Reliability and validity assessment*. Sage publications.
- Chakka, A. K., Muhammed, A., Sakhare, P. Z., & Bhaskar, N. (2017). Poultry processing waste as an alternative source for mammalian gelatin: Extraction and characterization of gelatin from chicken feet using food grade acids. *Waste and Biomass Valorization*, 8(8), 2583–2593.
- Chattopadhyay, S., & Raines, R. T. (2014). Collagen-based biomaterials for wound healing. *Biopolymers*, 101(8), 821–833.
- Chen, D., & Liang, H. (2006). *Shaping consumer perception to motivate online shopping: a prospect theory perspective*.
- Chen, K., & Deng, T. (2016). Research on the green purchase intentions from the perspective of product knowledge. *Sustainability*, 8(9), 943.
- Chin, P. N., Isa, S. M., & Alodin, Y. (2020). The impact of endorser and brand credibility on consumers' purchase intention: the mediating effect of attitude towards brand and brand credibility. *Journal of Marketing Communications*, 26(8), 896–912.
- Chin, W. W. (1998). Commentary: Issues and opinion on structural equation modelling. In *MIS quarterly* (pp. vii–xvi). JSTOR.
- Chin, W. W. (2009). How to write up and report PLS analyses. In *Handbook of partial least squares: Concepts, methods and applications* (pp. 655–690). Springer.
- Chiu, C., Wang, E. T. G., Fang, Y., & Huang, H. (2014). Understanding customers' repeat purchase intentions in B2C e-commerce: the roles of utilitarian value, hedonic value and perceived risk. *Information Systems Journal*, 24(1), 85–114.

- Choi, E., & Lee, K. C. (2019). Effect of trust in domain-specific information of safety, brand loyalty, and perceived value for cosmetics on purchase intentions in mobile e-commerce context. *Sustainability*, *11*(22), 6257.
- Choi, J., Lee, A., & Ok, C. (2013). The effects of consumers' perceived risk and benefit on attitude and behavioral intention: A study of street food. *Journal of Travel & Tourism Marketing*, *30*(3), 222–237.
- Chunlin, Y., J, H. P., A, B. J., Minna, N., Juliana, B., James, T., Robert, S., & W, P. J. (2004). The application of recombinant human collagen in tissue engineering. *BioDrugs*, *18*(2), 103–119.
- Clark, K. L., Sebastianelli, W., Flechsenhar, K. R., Aukermann, D. F., Meza, F., Millard, R. L., Deitch, J. R., Sherbondy, P. S., & Albert, A. (2008). 24-Week study on the use of collagen hydrolysate as a dietary supplement in athletes with activity-related joint pain. *Current Medical Research and Opinion*, *24*(5), 1485–1496.
- Cobern, W., & Adams, B. (2020). When interviewing: how many is enough? *International Journal of Assessment Tools in Education*, *7*(1), 73–79.
- Cochran, W. G. (1977). *Sampling Techniques*. Wiley. *New York*, 413.
- Coderoni, S., & Perito, M. A. (2021). Approaches for reducing wastes in the agricultural sector. An analysis of Millennials' willingness to buy food with upcycled ingredients. *Waste Management*, *126*, 283–290.
- Cohen, J. (1992a). A power primer. *Psychological Bulletin*, *112*(1), 155.
- Cohen, J. (1992b). Statistical power analysis. *Current Directions in Psychological Science*, *1*(3), 98–101.
- Coleman, W., Warren, W. E., & Huston, R. (1994). *Factors Influencing the Choice of a New Dental Service Provider*.
- Comrey, A. L., & Lee, H. B. (2013). *A first course in factor analysis*. Psychology press.
- Connor, M., & Siegrist, M. (2010). Factors influencing people's acceptance of gene technology: The role of knowledge, health expectations, naturalness, and social trust. *Science Communication*, *32*(4), 514–538.

- Coppola, D., Oliviero, M., Vitale, G. A., Lauritano, C., D'Ambra, I., Iannace, S., & de Pascale, D. (2020). Marine collagen from alternative and sustainable sources: Extraction, processing and applications. *Marine Drugs*, 18(4), 214.
- Cotton, R. T. (2000). Management of subglottic stenosis. *Otolaryngologic Clinics of North America*, 33(1), 111–130.
- Cox, A. D., Cox, D., & Zimet, G. (2006). Understanding consumer responses to product risk information. *Journal of Marketing*, 70(1), 79–91.
- Creswell, J. D., & John, W. (2018). *Creswell, Research Design. Qualitative, Quantitative, and Mixed Methods Approaches*. Fifth. London.
- Creswell, J. W., Shope, R., Plano Clark, V. L., & Green, D. O. (2006). How interpretive qualitative research extends mixed methods research. *Research in the Schools*, 13(1), 1–11.
- Cui, Y., & Yang, H. (2017). Dissecting genomic imprinting and genetic conflict from a game theory prospective: Comment on: “Epigenetic game theory: How to compute the epigenetic control of maternal-to-zygotic transition” by Qian Wang et al. *Physics of Life Reviews*, 20, 161–163.
- Dal, S., Çavuşoğlu, S. B., & Karaman, Ö. (2017). The effect of Word of Mouth (WOM) communication on the fitness center participants’ decision making process about nutritional supplements purchase. *International Journal of Social Sciences and Education Research*, 3(2), 456–466.
- Dave, D., Liu, Y., Clark, L., Dave, N., Trenholm, S., & Westcott, J. (2019). Availability of marine collagen from Newfoundland fisheries and aquaculture waste resources. *Bioresource Technology Reports*, 7, 100271.
- Davis, L. L. (1992). Instrument review: Getting the most from a panel of experts. *Applied Nursing Research*, 5(4), 194–197.
- Davison-Kotler, E., Marshall, W. S., & García-Gareta, E. (2019). Sources of collagen for biomaterials in skin wound healing. *Bioengineering*, 6(3), 56.
- de Albuquerque Wanderley, M. C., Neto, J. M. W. D., Albuquerque, W. W. C., Marques, D. de A. V., de Albuquerque Lima, C., da Cruz Silvério, S. I., de Lima Filho, J. L., Teixeira, J. A. C., & Porto, A. L. F. (2017). Purification and

- characterization of a collagenase from *Penicillium* sp. UCP 1286 by polyethylene glycol-phosphate aqueous two-phase system. *Protein Expression and Purification*, 133, 8–14.
- De Canio, F., & Martinelli, E. (2021). EU quality label vs organic food products: A multigroup structural equation modelling to assess consumers' intention to buy in light of sustainable motives. *Food Research International*, 139, 109846.
- De Jong, N., Ocke, M. C., Branderhorst, H. A. C., & Friele, R. (2003). Demographic and lifestyle characteristics of functional food consumers and dietary supplement users. *British Journal of Nutrition*, 89(2), 273–281.
- De Vaus, D. (2001). Research design in social research. *Research Design in Social Research*, 1–296.
- Deal, C. L., & Moskowitz, R. W. (1999). Nutraceuticals as therapeutic agents in osteoarthritis: the role of glucosamine, chondroitin sulfate, and collagen hydrolysate. *Rheumatic Disease Clinics of North America*, 25(2), 379–395.
- Delener, N. (1994). Religious contrasts in consumer decision behaviour patterns: their dimensions and marketing implications. *European Journal of Marketing*, 28(5), 36–53.
- Demirhan, Y., Ulca, P., & Senyuva, H. Z. (2012). Detection of porcine DNA in gelatine and gelatine-containing processed food products—Halal/Kosher authentication. *Meat Science*, 90(3), 686–689.
- Deng, Z., & Liu, S. (2017). Understanding consumer health information-seeking behavior from the perspective of the risk perception attitude framework and social support in mobile social media websites. *International Journal of Medical Informatics*, 105, 98–109.
- DeVellis, R. F., Lewis, M. A., & Sterba, K. R. (2003). Interpersonal emotional processes in adjustment to chronic illness. *Social Psychological Foundations of Health and Illness*, 256–287.
- DeVellis, R. F., & Thorpe, C. T. (2021). *Scale development: Theory and applications*. Sage publications.

- Dhami, S., & Al-Nowaihi, A. (2007). Why do people pay taxes? Prospect theory versus expected utility theory. *Journal of Economic Behavior & Organization*, 64(1), 171–192.
- Di Vita, G., Blanc, S., Mancuso, T., Massaglia, S., La Via, G., & D'Amico, M. (2019). Harmful compounds and willingness to buy for reduced-additives salami. An outlook on Italian consumers. *International Journal of Environmental Research and Public Health*, 16(14), 2605.
- Diamantopoulos, A., & Siguaw, J. A. (2006). Formative versus reflective indicators in organizational measure development: A comparison and empirical illustration. *British Journal of Management*, 17(4), 263–282.
- Diogo, G. S., Pirraco, R. P., Reis, R. L., & Silva, T. H. (2023). From Its Nature to Its Function: Marine-Collagen-Based-Biomaterials for Hard Tissue Applications. *Tissue Engineering Part B: Reviews*.
- Dörnyei, Z., & Taguchi, T. (2009). *Questionnaires in second language research: Construction, administration, and processing*. Routledge.
- DOSM. (2023). *MyCensus2020*. Population and Housing Census. <https://www.dosm.gov.my/portal-main/release-content/mycensus--population-well-being-fitness>
- Douglass, R. B., Fishbein, M., & Ajzen, I. (1977). Belief, attitude, intention, and behavior: An introduction to theory and research. *Philosophy and Rhetoric*, 10(2).
- Dowling, G. R., & Staelin, R. (1994). A model of perceived risk and intended risk-handling activity. *Journal of Consumer Research*, 21(1), 119–134.
- Druică, E., Ianole-Călin, R., Băicuș, C., & Dinescu, R. (2021). Determinants of Satisfaction with Services, and Trust in the Information Received in Community Pharmacies: A Comparative Analysis to Foster Pharmaceutical Care Adoption. *Healthcare*, 9(5), 562.
- Dryhurst, S., Schneider, C. R., Kerr, J., Freeman, A. L. J., Recchia, G., Van Der Bles, A. M., Spiegelhalter, D., & Van Der Linden, S. (2020). Risk perceptions of COVID-19 around the world. *Journal of Risk Research*, 23(7–8), 994–1006.

- Duasa, J., Burhanuddin, N., & Hidayah, N. (2022). Collagen Products: Issue of Halalness and the Consumers' Tendency of Acceptance. *Journal of Contemporary Islamic Studies* 2, 8(Special Issue).
- Duasa, J., & Husin, A. M. (2020). The likelihood of Choosing Alternative Source of Collagen among Consumers: Logistic Regression Approach. *Journal of Social Science and Humanities*, 3(1), 7–13.
- Duasa, J., Husin, A. M., Thaker, M. A. M. T., & Rahman, M. P. (2021). An alternative source of collagen for Muslim consumers: halal and environmental concerns. *Journal of Islamic Marketing*.
- Duasa, J., Mohamed Noor, S. F., Mohd Thas Thaker, M. A., & Rahman, M. P. (2020). The recombinant Collagen-like protein as animal-based Collagen substitution: a qualitative study. *Journal of Contemporary Islamic Studies*, 6(2).
- Duasa, J., Radzman, N. A. M., & Thaker, M. A. M. T. (2023). Assessing Malaysian Firms' Intention to Use Recombinant Collagen-Like Protein in Collagen Products. *IOP Conference Series: Earth and Environmental Science*, 1165(1), 12008.
- Duasa, J., Thaker, M. A. M. T., & Mohd-Radzman, N. A. (2022). Collagen Products Sourced from Recombinant Collagen-Like Protein: Acceptance Analysis. *Global Business and Management Research*, 14(4s), 101–118.
- Duasa, J., Zainan Nazri, N. J., & Fatah Yasin, R. F. (2023). Recombinant collagen-like protein: ethical policy and consumers' likelihood to consume. *Journal of Islamic Accounting and Business Research*.
- Dybka, K., & Walczak, P. (2009). Collagen hydrolysates as a new diet supplement. *Food Chemistry and Biotechnology*, 73(1058), 83–92.
- Ellsberg, D. (1961). Risk, ambiguity, and the Savage axioms. *The Quarterly Journal of Economics*, 643–669.
- El-Masri, M. M., Mowbray, F. I., Fox-Wasylyshyn, S. M., & Kanters, D. (2021). Multivariate outliers: A conceptual and practical overview for the nurse and health researcher. *Canadian Journal of Nursing Research*, 53(3), 316–321.

- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics*, 5(1), 1–4.
- Fadzlillah, N. A., Sukri, S. J. M., Othman, R., Rohman, A., & Jubri, M. M. (2022). Concept and Guidelines of Consuming Halal-Tayyiban Food from Islamic and Health Perspectives: A Meaningful Lesson from COVID-19 Outbreak. *International Journal of Asian Social Science*, 12(5), 169–182.
- Faria-Silva, C., Ascenso, A., Costa, A. M., Marto, J., Carvalheiro, M., Ribeiro, H. M., & Simões, S. (2020). Feeding the skin: A new trend in food and cosmetics convergence. *Trends in Food Science & Technology*, 95, 21–32.
- Farquhar, P. H. (1994). Strategic challenges for branding. *Marketing Management*, 3(2), 8.
- Faul, F., Erdfelder, E., Buchner, A., & Lang, A.-G. (2009). Statistical power analyses using G* Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, 41(4), 1149–1160.
- Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39(2), 175–191.
- Feetham, H. J., Jeong, H. S., McKesey, J., Wickless, H., & Jacobe, H. (2018). Skin care and cosmeceuticals: Attitudes and trends among trainees and educators. *Journal of Cosmetic Dermatology*, 17(2), 220–226.
- Felician, F. F., Xia, C., Qi, W., & Xu, H. (2018). Collagen from marine biological sources and medical applications. *Chemistry & Biodiversity*, 15(5), e1700557.
- Fertala, A. (2020). Three decades of research on recombinant collagens: reinventing the wheel or developing new biomedical products? *Bioengineering*, 7(4), 155.
- Field, A., & Miles, J. (2010). *Discovering statistics using SAS*. Sage.
- Fishbein, M., & Ajzen, I. (1977). Belief, attitude, intention, and behavior: An introduction to theory and research. *Philosophy and Rhetoric*, 10(2).

- Fishbein, M., & Ajzen, I. (2011). *Predicting and changing behavior: The reasoned action approach*. Psychology press.
- Fornell, C., & Larcker, D. F. (1981). *Structural equation models with unobservable variables and measurement error: Algebra and statistics*. Sage Publications Sage CA: Los Angeles, CA.
- Franke, G., & Sarstedt, M. (2019). Heuristics versus statistics in discriminant validity testing: a comparison of four procedures. *Internet Research*, 29(3), 430–447.
- Frewer, L. J. (2017). Consumer acceptance and rejection of emerging agrifood technologies and their applications. *European Review of Agricultural Economics*, 44(4), 683–704.
- Frewer, L. J., Shepherd, R., & Sparks, P. (1994). Biotechnology and food production: knowledge and perceived risk. *British Food Journal*.
- Fuller, C. M., Simmering, M. J., Atinc, G., Atinc, Y., & Babin, B. J. (2016). Common methods variance detection in business research. *Journal of Business Research*, 69(8), 3192–3198.
- Gable, R. K., & Wolf, M. B. (2012). *Instrument development in the affective domain: Measuring attitudes and values in corporate and school settings* (Vol. 36). Springer Science & Business Media.
- Gameil, A. H. M., Yusof, F., Azmi, A. S., & Puad, N. I. M. (2023). Modelling of e.coli Growth, Glucose Consumption, and Recombinant of Collagen-Like Protein Formation Kinetics. *IIUM Engineering Congress Proceedings*, 1(1), 74–78.
- Garg, P., & Joshi, R. (2018). Purchase intention of “Halal” brands in India: the mediating effect of attitude. *Journal of Islamic Marketing*.
- Gelatine Manufacturers of Europe. (2023). *Premium raw materials and gentle processing*. <https://www.gelatine.org/en/collagen-peptides/manufacturing.html>
- Gerber, P. J., Steinfeld, H., Henderson, B., Mottet, A., Opio, C., Dijkman, J., Falcucci, A., & Tempio, G. (2013). *Tackling climate change through livestock: a global assessment of emissions and mitigation opportunities*. Food and Agriculture Organization of the United Nations (FAO).

- Ghali, Z. (2019). Motives of willingness to buy organic food under the moderating role of consumer awareness. *Journal of Scientific Research and Reports*, 1–11.
- Ghali-Zinoubi, Z., & Toukabri, M. (2019). The antecedents of the consumer purchase intention: Sensitivity to price and involvement in organic product: Moderating role of product regional identity. *Trends in Food Science & Technology*, 90, 175–179.
- Global Market Insight. (2022). *Collagen supplement market*. https://www.gminsights.com/industry-analysis/collagen-supplement-market?gclid=CjwKCAiAzp6eBhByEiwA_gGq5Ea5Hc17_sILExE-hFqCmxNXW35CLILPcbB-nW2jZFIM731bmhNCahoCBdAQAvD_BwE
- Global Market Insights. (2023). *Collagen Market By Product (Gelatin, Peptides), By Source (Bovine, Porcine, Marine), By Dosage Form (Powder, Liquid, Capsule), By Application (Food, Healthcare, Nutraceuticals, Personal care & cosmetics) & Global Forecast, 2023 - 2032*. Collagen Market. <https://www.gminsights.com/industry-analysis/collagen-market>
- Gómez-Guillén, M. C., Giménez, B., López-Caballero, M. E. al, & Montero, M. P. (2011). Functional and bioactive properties of collagen and gelatin from alternative sources: A review. *Food Hydrocolloids*, 25(8), 1813–1827.
- Gorgieva, S., & Kokol, V. (2011). Collagen-vs. gelatine-based biomaterials and their biocompatibility: review and perspectives. *Biomaterials Applications for Nanomedicine*, 2, 17–52.
- Grand View Research. (2021). *Collagen Market Size, Share & Trend Analysis Report By Source, By Product, By Application, By Region, and Segment Forecast, 2021-2028*. <https://www.grandviewresearch.com/industry-analysis/collagen-market>
- Grealish, D. (2004). Pre-testing questionnaires: the New Zealand experience. *Conference on Questionnaire Evaluation Standards-QUEST 2003*, 9, 37–42.
- Grewal, D., Gotlieb, J., & Marmorstein, H. (1994). The moderating effects of message framing and source credibility on the price-perceived risk relationship. *Journal of Consumer Research*, 21(1), 145–153.
- Grimm, P. (2010). Pretesting a questionnaire. *Wiley International Encyclopedia of Marketing*.

- Guenther, P., Guenther, M., Ringle, C. M., Zaefarian, G., & Cartwright, S. (2023). Improving PLS-SEM use for business marketing research. *Industrial Marketing Management, 111*, 127–142.
- Gupta, C., & Prakash, D. (2015). Nutraceuticals for geriatrics. *Journal of Traditional and Complementary Medicine, 5*(1), 5–14.
- Gursoy, D., Chi, C. G., & Chi, O. H. (2021). Effects of COVID 19 pandemic on restaurant and hotel customers' sentiments towards dining out, traveling to a destination and staying at hotels. *Journal of Hospitality, 3*(1), 1–17.
- Hair Joe F, J., Sarstedt, M., Matthews, L. M., & Ringle, C. M. (2016). Identifying and treating unobserved heterogeneity with FIMIX-PLS: part I–method. *European Business Review, 28*(1), 63–76.
- Hair, J., & Alamer, A. (2022). Partial Least Squares Structural Equation Modeling (PLS-SEM) in second language and education research: Guidelines using an applied example. *Research Methods in Applied Linguistics, 1*(3), 100027.
- Hair, J. F. (2009). *Multivariate data analysis*.
- Hair, J. F., Money, A. H., Samouel, P., & Page, M. (2007). Research methods for business. *Education+ Training*.
- Hair, J. F., Ortinau, D. J., & Harrison, D. E. (2010). *Essentials of marketing research* (Vol. 2). McGraw-Hill/Irwin New York, NY.
- Hair, J. F., Ringle, C. M., Gudergan, S. P., Fischer, A., Nitzl, C., & Menictas, C. (2019). Partial least squares structural equation modeling-based discrete choice modeling: an illustration in modeling retailer choice. *Business Research, 12*(1), 115–142.
- Hair, J. F., Ringle, C. M., & Sarstedt, M. (2011). PLS-SEM: Indeed a silver bullet. *Journal of Marketing Theory and Practice, 19*(2), 139–152.
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*.
- Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2021). *A primer on partial least squares structural equation modeling (PLS-SEM)*. Sage publications.

- Hair Jr, J. F., Hult, G. T. M., Ringle, C. M., Sarstedt, M., Danks, N. P., & Ray, S. (2021). *Partial Least Squares Structural Equation Modeling (PLS-SEM) Using R: A Workbook*. Springer Nature.
- Hair Jr, J. F., Sarstedt, M., Ringle, C. M., & Gudergan, S. P. (2017). *Advanced issues in partial least squares structural equation modeling*. saGe publications.
- Hakim, M. P., Zanetta, L. D., de Oliveira, J. M., & da Cunha, D. T. (2020). The mandatory labeling of genetically modified foods in Brazil: Consumer's knowledge, trust, and risk perception. *Food Research International*, *132*, 109053.
- Han, J., Wang, Q.-L., Ye, S.-X., Chai, J., & Lai, K. K. (2016). Selecting medical service scheme: A novel method based on prospect theory. *Filomat*, *30*(15), 4049–4058.
- Hashim, P., Ridzwan, M. M. S., Bakar, J., & Hashim, M. D. (2015). Collagen in food and beverage industries. *International Food Research Journal*, *22*(1), 1.
- Hauser, M., Nussbeck, F. W., & Jonas, K. (2013). The impact of food-related values on food purchase behavior and the mediating role of attitudes: A swiss study. *Psychology & Marketing*, *30*(9), 765–778.
- Healio. (2023). *The Immune System*. Hematology/ Oncology. <https://www.healio.com/hematology-oncology/learn-immuno-oncology/the-immune-system/adaptive-immunity-humoral-and-cellular-immunity>
- Helson, H. (1964). *Adaptation-level theory: An experimental and systematic approach to behavior*.
- Hennink, M., & Kaiser, B. N. (2022). Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social Science & Medicine*, *292*, 114523.
- Henseler, J., & Chin, W. W. (2010). A comparison of approaches for the analysis of interaction effects between latent variables using partial least squares path modeling. *Structural Equation Modeling*, *17*(1), 82–109.
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, *43*, 115–135.

- Henseler, J., Ringle, C. M., & Sinkovics, R. R. (2009). The use of partial least squares path modeling in international marketing. In *New challenges to international marketing* (Vol. 20, pp. 277–319). Emerald Group Publishing Limited.
- Heydari, S. T., Zarei, L., Sadati, A. K., Moradi, N., Akbari, M., Mehralian, G., & Lankarani, K. B. (2021). The effect of risk communication on preventive and protective Behaviours during the COVID-19 outbreak: mediating role of risk perception. *BMC Public Health*, *21*(1), 1–11.
- Ho, S., & Ng, V. (1994). Customers' risk perceptions of electronic payment systems. *International Journal of Bank Marketing*.
- Hoeksma, D. L., Gerritzen, M. A., Lokhorst, A. M., & Poortvliet, P. M. (2017). An extended theory of planned behavior to predict consumers' willingness to buy mobile slaughter unit meat. *Meat Science*, *128*, 15–23.
- Hörtenhuber, S. J., Seiringer, M., Theurl, M. C., Größbacher, V., Piringer, G., Kral, I., & Zollitsch, W. J. (2022). Implementing an appropriate metric for the assessment of greenhouse gas emissions from livestock production: a national case study. *Animal*, *16*(10), 100638.
- Hsiuying, W. (2021). A review of the effects of collagen treatment in clinical studies. *Polymers*, *13*(22), 3868.
- Hu, L., Liu, R., Zhang, W., & Zhang, T. (2020). The effects of epistemic trust and social trust on public acceptance of genetically modified food: an empirical study from China. *International Journal of Environmental Research and Public Health*, *17*(20), 7700.
- Huei-Shan, L., Pi-Chuan, S., Tzong-Shyuan, C., & Ying-Jie, J. (2015). The effects of avatar on trust and purchase intention of female online consumer: Consumer knowledge as a moderator. *International Journal of Electronic Commerce Studies*, *6*(1), 99–118.
- Hult, G. T. M., Hair Jr, J. F., Proksch, D., Sarstedt, M., Pinkwart, A., & Ringle, C. M. (2018). Addressing endogeneity in international marketing applications of partial least squares structural equation modeling. *Journal of International Marketing*, *26*(3), 1–21.

- Hussain, I., Rahman, S. U., Zaheer, A., & Saleem, S. (2016). Integrating factors influencing consumers' halal products purchase: Application of theory of reasoned action. *Journal of International Food & Agribusiness Marketing*, 28(1), 35–58.
- In, J. (2017). Introduction of a pilot study. *Korean Journal of Anesthesiology*, 70(6), 601–605.
- Indriani, I. A. D., Rahayu, M., & Hadiwidjojo, D. (2019). The influence of environmental knowledge on green purchase intention the role of attitude as mediating variable. *International Journal of Multicultural and Multireligious Understanding*, 6(2), 627–635.
- Iorfa, S. K., Ottu, I. F. A., Oguntayo, R., Ayandele, O., Kolawole, S. O., Gandi, J. C., Dangiwa, A. L., & Olapegba, P. O. (2020). COVID-19 knowledge, risk perception, and precautionary behavior among Nigerians: a moderated mediation approach. *Frontiers in Psychology*, 11, 3292.
- Iranmanesh, M., Mirzaei, M., Hosseini, S. M. P., & Zailani, S. (2019). Muslims' willingness to pay for certified halal food: an extension of the theory of planned behaviour. *Journal of Islamic Marketing*.
- Ishii, T., & Araki, M. (2016). Consumer acceptance of food crops developed by genome editing. *Plant Cell Reports*, 35(7), 1507–1518.
- Islamic Tourism Centre. (2021). *Malaysia - The world's leading Halal hub*. Tourists.
- Jakobsen, M., & Jensen, R. (2015). Common method bias in public management studies. *International Public Management Journal*, 18(1), 3–30.
- Jamal, A. (2003). Marketing in a multicultural world: The interplay of marketing, ethnicity and consumption. *European Journal of Marketing*.
- Jamaludin, M. A., Zaki, N. N. M., Ramli, M. A., Hashim, D. M., & Rahman, S. A. (2011). Istihalah: analysis on the utilization of gelatin in food products. *2nd International Conference on Humanities, Historical and Social Sciences, IPEDR*, 17, 174–178.
- Jarvis, C. B., MacKenzie, S. B., & Podsakoff, P. M. (2003). A critical review of construct indicators and measurement model misspecification in marketing and consumer research. *Journal of Consumer Research*, 30(2), 199–218.

- Jasper, C. R., & Ouellette, S. J. (1994). Consumers' perception of risk and the purchase of apparel from catalogs. *Journal of Direct Marketing*, 8(2), 23–36.
- Jin, W.-G., Pei, J., Du, Y.-N., Pan, J., Gao, R., Chen, D.-J., Wu, H.-T., & Zhu, B.-W. (2019). Characterization and functional properties of gelatin extracted from Chinese giant salamander (*Andrias davidianus*) skin. *Journal of Aquatic Food Product Technology*, 28(8), 861–876.
- Johnson, B. R., Jang, S. J., Larson, D. B., & De Li, S. (2001). Does adolescent religious commitment matter? A reexamination of the effects of religiosity on delinquency. *Journal of Research in Crime and Delinquency*, 38(1), 22–44.
- Kahneman, D. (1979). Prospect theory: An analysis of decisions under risk. *Econometrica*, 47, 278.
- Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgment under uncertainty: Heuristics and biases*. Cambridge university press.
- Kee, H. W., & Knox, R. E. (1970). Conceptual and methodological considerations in the study of trust and suspicion. *Journal of Conflict Resolution*, 14(3), 357–366.
- Kertzer, D. I., & Fricke, T. (1997). *Anthropological demography: Toward a new synthesis*. University of Chicago Press.
- Khalek, A. A. (2014). Young consumers' attitude towards halal food outlets and JAKIM's halal certification in Malaysia. *Procedia-Social and Behavioral Sciences*, 121, 26–34.
- Khurana, A., Kumar, V. V. R., & Sidhpuria, M. (2020). A study on the adoption of electric vehicles in India: the mediating role of attitude. *Vision*, 24(1), 23–34.
- Kim, H., & Bonn, M. A. (2015). The moderating effects of overall and organic wine knowledge on consumer behavioral intention. *Scandinavian Journal of Hospitality and Tourism*, 15(3), 295–310.
- Kinateder, M. T., Kuligowski, E. D., Reneke, P. A., & Peacock, R. D. (2015). Risk perception in fire evacuation behavior revisited: definitions, related concepts, and empirical evidence. *Fire Science Reviews*, 4(1), 1–26.

- Kock, N. (2014). Advanced mediating effects tests, multi-group analyses, and measurement model assessments in PLS-based SEM. *International Journal of E-Collaboration (Ijec)*, 10(1), 1–13.
- Kock, N., & Hadaya, P. (2018). Minimum sample size estimation in PLS-SEM: The inverse square root and gamma-exponential methods. *Information Systems Journal*, 28(1), 227–261.
- Kock, N., & Lynn, G. (2012). Lateral collinearity and misleading results in variance-based SEM: An illustration and recommendations. *Journal of the Association for Information Systems*, 13(7).
- Konuk, F. A. (2018). The role of risk aversion and brand-related factors in predicting consumers' willingness to buy expiration date-based priced perishable food products. *Food Research International*, 112, 312–318.
- Kostyk, A., Niculescu, M., & Leonhardt, J. M. (2017). Less is more: Online consumer ratings' format affects purchase intentions and processing. *Journal of Consumer Behaviour*, 16(5), 434–441.
- Koththagoda, K. C., & Herath, H. (2018). Factors influencing online purchasing intention: The mediation role of consumer attitude. *Journal of Marketing and Consumer Research*, 42(2003), 66–74.
- Kraus, A., Annunziata, A., & Vecchio, R. (2017). Sociodemographic factors differentiating the consumer and the motivations for functional food consumption. *Journal of the American College of Nutrition*, 36(2), 116–126.
- Krishnan, S., & Perumal, P. (2013). Preparation and biomedical characterization of jellyfish (*Chrysaora Quinquecirrha*) collagen from southeast coast of India. *Int. J. Pharm. Pharm. Sci*, 5(3), 698–701.
- Kuang, L., Burgess, B., Cuite, C. L., Tepper, B. J., & Hallman, W. K. (2020). Sensory acceptability and willingness to buy foods presented as having benefits achieved through the use of nanotechnology. *Food Quality and Preference*, 83, 103922.
- Kumar, A., Elavarasan, K., Hanjabam, M. D., Binsi, P. K., Mohan, C. O., Zynudheen, A. A., & Kumar, A. (2019). Marine collagen peptide as a fortificant for biscuit: Effects on biscuit attributes. *Lwt*, 109, 450–456.

- Kumosa, L. S., Zetterberg, V., & Schouenborg, J. (2018). Gelatin promotes rapid restoration of the blood brain barrier after acute brain injury. *Acta Biomaterialia*, *65*, 137–149.
- Kwon, I. G., & Suh, T. (2005). Trust, commitment and relationships in supply chain management: a path analysis. *Supply Chain Management: An International Journal*.
- Lauret, C. (2023). *Rejuvenating and Regenerating the Skin with Biodegradable Polymers*. Health Care. <https://healthcare.evonik.com/en/news-and-events/blog/rejuvenating-and-regenerating-the-skin-with-biodegradable-polymers-206857.html>
- Lazaroiu, G., Andronie, M., Uță, C., & Hurloiu, I. (2019). Trust management in organic agriculture: Sustainable consumption behavior, environmentally conscious purchase intention, and healthy food choices. *Frontiers in Public Health*, *340*.
- Lederman, N. G., & Lederman, J. S. (2015). What is a theoretical framework? A practical answer. In *Journal of Science Teacher Education* (Vol. 26, Issue 7, pp. 593–597). Taylor & Francis.
- Lee, C., & Hallak, R. (2018). Investigating the moderating role of education on a structural model of restaurant performance using multi-group PLS-SEM analysis. *Journal of Business Research*, *88*, 298–305.
- León-López, A., Morales-Peñaloza, A., Martínez-Juárez, V. M., Vargas-Torres, A., Zeugolis, D. I., & Aguirre-Álvarez, G. (2019). Hydrolyzed collagen—Sources and applications. *Molecules*, *24*(22), 4031.
- Lestari, W., Octavianti, F., Jaswir, I., & Hendri, R. (2019). Plant-Based Substitutes for Gelatin. In *Contemporary Management and Science Issues in the Halal Industry* (pp. 319–322). Springer.
- Leung, X. Y., & Cai, R. (2021). How pandemic severity moderates digital food ordering risks during COVID-19: An application of prospect theory and risk perception framework. *Journal of Hospitality and Tourism Management*, *47*, 497–505.
- Levin, K. A. (2006). Study design III: Cross-sectional studies. *Evidence-Based Dentistry*, *7*(1), 24–25.

- Levy, J. S. (1992). An introduction to prospect theory. *Political Psychology*, 171–186.
- Li, Z., Sha, Y., Song, X., Yang, K., ZHao, K., Jiang, Z., & Zhang, Q. (2020). Impact of risk perception on customer purchase behavior: a meta-analysis. *Journal of Business & Industrial Marketing*, 35(1), 76–96.
- Liao, S.-H., Hu, D.-C., Chung, Y.-C., & Huang, A.-P. (2021). Risk and opportunity for online purchase intention—A moderated mediation model investigation. *Telematics and Informatics*, 62, 101621.
- Lim, X. J., Radzol, A. M., Cheah, J., & Wong, M. W. (2017). The impact of social media influencers on purchase intention and the mediation effect of customer attitude. *Asian Journal of Business Research*, 7(2), 19–36.
- Lim, Y.-S., Ok, Y.-J., Hwang, S.-Y., Kwak, J.-Y., & Yoon, S. (2019). Marine collagen as a promising biomaterial for biomedical applications. *Marine Drugs*, 17(8), 467.
- Liobikienė, G., & Juknys, R. (2016). The role of values, environmental risk perception, awareness of consequences, and willingness to assume responsibility for environmentally-friendly behaviour: The Lithuanian case. *Journal of Cleaner Production*, 112, 3413–3422.
- Liu, D., Nikoo, M., Boran, G., Zhou, P., & Regenstein, J. M. (2015). Collagen and gelatin. *Annual Review of Food Science and Technology*, 6, 527–557.
- Liu, S., Liu, X., & Qin, J. (2017). Three-way group decisions based on prospect theory. *Journal of the Operational Research Society*, 1–11.
- Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, 127(2), 267.
- López-Bonilla, L. M., & López-Bonilla, J. M. (2017). Explaining the discrepancy in the mediating role of attitude in the TAM. *British Journal of Educational Technology*, 48(4), 940–949.
- Lowry, P. B., & Gaskin, J. (2014). Partial least squares (PLS) structural equation modeling (SEM) for building and testing behavioral causal theory: When to choose it and how to use it. *IEEE Transactions on Professional Communication*, 57(2), 123–146.

- Lu, H., Hsu, C., & Hsu, H. (2005). An empirical study of the effect of perceived risk upon intention to use online applications. *Information Management & Computer Security*.
- Lude, M., & Prüggl, R. (2019). Risky decisions and the family firm bias: An experimental study based on prospect theory. *Entrepreneurship Theory and Practice*, 43(2), 386–408.
- Luo, J., Ma, B., Zhao, Y., & Chen, T. (2018). Evolution model of health food safety risk based on prospect theory. *Journal of Healthcare Engineering*, 2018.
- Lusk, J. L., Roosen, J., & Bieberstein, A. (2014). *Consumer acceptance of new food technologies: causes and roots of controversies*.
- Lv, L.-C., Huang, Q.-Y., Ding, W., Xiao, X.-H., Zhang, H.-Y., & Xiong, L.-X. (2019). Fish gelatin: The novel potential applications. *Journal of Functional Foods*, 63, 103581.
- Lynn, M. R. (1986). Determination and quantification of content validity. *Nursing Research*, 35(6), 382–386.
- Ma, R. (2016). *Extraction and Characterization of Acetic Acid-Soluble Collagen Papain-Soluble Collagen Hydrolysate from Poultry Eggshell Membrane*.
- MacEwan, M. R., Kovacs, T., Osburn, J., & Ray, W. Z. (2018). Comparative analysis of a fully-synthetic nanofabricated dura substitute and bovine collagen dura substitute in a large animal model of dural repair. *Interdisciplinary Neurosurgery*, 13, 145–150.
- MacKenzie, S. B., & Podsakoff, P. M. (2012). Common method bias in marketing: Causes, mechanisms, and procedural remedies. *Journal of Retailing*, 88(4), 542–555.
- Maesele, P. A., & Schuurman, D. (2008). Biotechnology and the popular press in Northern Belgium: A case study of hegemonic media discourses and the interpretive struggle. *Science Communication*, 29(4), 435–471.
- Mahboob, S., Haider, S., Sultana, S., Al-Ghanim, K., Al-Misned, F., Al-Balawi, H., & Ahmad, Z. (2014). Isolation and characterisation of collagen from the waste

- material of two important freshwater fish species. *Journal of Animal and Plant Sciences*, 24(6), 1802–1810.
- Mahbubi, A., Uchiyama, T., & Hatanaka, K. (2019). Capturing consumer value and clustering customer preferences in the Indonesian halal beef market. *Meat Science*, 156, 23–32.
- Mahesh, L., Kurtzman, G. M., & Shukla, S. (2015). Regeneration in Periodontics: Collagen-A Review of Its Properties and Applications in Dentistry. *Compendium of Continuing Education in Dentistry (Jamesburg, NJ: 1995)*, 36(5), 358.
- Mai, L.-W. (2001). Effective risk relievers for dimensional perceived risks on mail-order purchase: a case study on specialty foods in the UK. *Journal of Food Products Marketing*, 7(1–2), 35–52.
- Malfait, F. (2015). *SP0134 Heritable Collagen Disorders*. BMJ Publishing Group Ltd.
- Mallet, M.-A., Kwateng, K. O., & Nuertey, D. (2022). Can trust moderate the relationship between supplier–buyer relationship and supply chain sustainability? *International Journal of Pharmaceutical and Healthcare Marketing*.
- Mancuso, T., Baldi, L., & Gasco, L. (2016). An empirical study on consumer acceptance of farmed fish fed on insect meals: the Italian case. *Aquaculture International*, 24(5), 1489–1507.
- Marino, H., Caputo, V., & Consiglio, V. (1961). The use of patient’s own auricular cartilage to repair deficiency of the tracheal wall. *Plastic and Reconstructive Surgery*, 28(6), 696.
- Market Study Report. (2020). *Global Marine Collagen Market Research Report 2020*. https://www.marketstudyreport.com/reports/global-marine-collagen-market-research-report-2020?gclid=CjwKCAjwryUBhBSEiwAGN5OCEELh3zm0kZF0ojCb64xtoPMC0CoBJReTQBtpsaiWMiLfuaGuIFx5RoCytUQAvD_BwE
- Markets and Markets. (2022). *Collagen Market by Product Type*. <https://www.marketsandmarkets.com/Market-Reports/collagen-market-220005202.html>

- Markets and Markets. (2024). *Collagen Market by Product Type, Applications (Nutritional Products, Food & Beverages Products, Pharmaceuticals Products, Cosmetics & Personal care Products, Textile), Sources, Form, Type, Extraction process, and Region - Global Forecast to 2030*. Collagen Market. <https://www.marketsandmarkets.com/Market-Reports/collagen-market-220005202.html>
- Mason, C., & Dunnill, P. (2008). *A brief definition of regenerative medicine*.
- Matmaroh, K., Benjakul, S., Prodpran, T., Encarnacion, A. B., & Kishimura, H. (2011). Characteristics of acid soluble collagen and pepsin soluble collagen from scale of spotted golden goatfish (*Parupeneus heptacanthus*). *Food Chemistry*, 129(3), 1179–1186.
- Matrade. (2024). *Halal Industry. Nation Branding*. <https://www.matrade.gov.my/en/nation-branding/halal-industry>
- Matthews, L. M., Sarstedt, M., Hair, J. F., & Ringle, C. M. (2016). Identifying and treating unobserved heterogeneity with FIMIX-PLS: Part II—A case study. *European Business Review*, 28(2), 208–224.
- Medline Plus. (2020). *Systematic lupus erythematosus*. <https://medlineplus.gov/ency/article/000435.htm>
- Medline Plus. (2022). *Amino Acids. Medical Encyclopedia*. <https://medlineplus.gov/ency/article/002222.htm>
- Meganathan, I., Pachaiyappan, M., Aarthy, M., Radhakrishnan, J., Mukherjee, S., Shanmugam, G., You, J., & Ayyadurai, N. (2022). Recombinant and genetic code expanded collagen-like protein as a tailorable biomaterial. *Materials Horizons*, 9(11), 2698–2721.
- Megido, R. C., Gierts, C., Blecker, C., Brostaux, Y., Haubruge, É., Alabi, T., & Francis, F. (2016). Consumer acceptance of insect-based alternative meat products in Western countries. *Food Quality and Preference*, 52, 237–243.
- MIDA. (2023). *Malaysia leads global halal pharmaceutical industry*. <https://www.mida.gov.my/mida-news/malaysia-leads-global-halal-pharmaceutical-industry/>

- Minakuchi, Y., Takeshita, F., Kosaka, N., Sasaki, H., Yamamoto, Y., Kouno, M., Honma, K., Nagahara, S., Hanai, K., & Sano, A. (2004). Atelocollagen-mediated synthetic small interfering RNA delivery for effective gene silencing in vitro and in vivo. *Nucleic Acids Research*, 32(13), e109–e109.
- Mirabi, V., Akbariyeh, H., & Tahmasebifard, H. (2015). A study of factors affecting on customers purchase intention. *Journal of Multidisciplinary Engineering Science and Technology (JMEST)*, 2(1).
- Mitchell, V. (1999). Consumer perceived risk: conceptualisations and models. *European Journal of Marketing*.
- Mohd Dzin, N. H., & Lay, Y. F. (2021). Validity and reliability of adapted self-efficacy scales in Malaysian context using PLS-SEM approach. *Education Sciences*, 11(11), 676.
- MOHE. (2022). *Laporan Kajian Pengesahan Gradual 2021*. https://great.mohe.gov.my/penerbitan/LAPORAN_KAJIAN_PENGESANAN_GRADUAN_2022.pdf
- Mortimer, G., Fazal-e-Hasan, S. M., Grimmer, M., & Grimmer, L. (2020). Explaining the impact of consumer religiosity, perceived risk and moral potency on purchase intentions. *Journal of Retailing and Consumer Services*, 55, 102115.
- Mou, J., Shin, D.-H., & Cohen, J. F. (2017). Trust and risk in consumer acceptance of e-services. *Electronic Commerce Research*, 17(2), 255–288.
- Muflih, M., & Juliana, J. (2020). Halal-labeled food shopping behavior: the role of spirituality, image, trust, and satisfaction. *Journal of Islamic Marketing*.
- Mukhtar, A., & Butt, M. M. (2012). Intention to choose Halal products: the role of religiosity. *Journal of Islamic Marketing*.
- Mustaffa, K. A., Borhan, J. T., & Nor, M. R. M. (2017). Manual prosedur pensijilan halal Malaysia sebagai suatu aplikasi memenuhi keperluan konsep halalan tayyiban: suatu analisis. *Online Journal of Research in Islamic Studies*, 4(1), 1–16.

- Nagai, T., Izumi, M., & Ishii, M. (2004). Fish scale collagen. Preparation and partial characterization. *International Journal of Food Science & Technology*, 39(3), 239–244.
- Nakamura, T., Teramachi, M., Sekine, T., Kawanami, R., Fukuda, S., Yoshitani, M., Toba, T., Ueda, H., Hori, Y., & Inoue, M. (2000). *Artificial trachea and long term follow-up in carinal reconstruction in dogs* (pp. 718–724). SAGE Publications Sage UK: London, England.
- Nalinanon, S., Benjakul, S., Visessanguan, W., & Kishimura, H. (2007). Use of pepsin for collagen extraction from the skin of bigeye snapper (*Priacanthus tayenus*). *Food Chemistry*, 104(2), 593–601.
- Nancy Chen, N. (2015). Predicting Vaccination Intention and Benefit and Risk Perceptions: The Incorporation of Affect, Trust, and Television Influence in a Dual-Mode Model. *Risk Analysis*, 35(7), 1268–1280.
- Neuman, W. L. (2011). *Social Research Methods: Qualitative and Quantitative Approaches*. Pearson.
- Newaz, F. T., Fam, K.-S., & Sharma, R. R. (2016). Muslim religiosity and purchase intention of different categories of Islamic financial products. *Journal of Financial Services Marketing*, 21(2), 141–152.
- Ngah, A. H., Gabarre, S., Eneizan, B., & Asri, N. (2020). Mediated and moderated model of the willingness to pay for halal transportation. *Journal of Islamic Marketing*.
- Nik Muhammad, N. A., Huda, N., Karim, A. A., & Mohammadi Nafchi, A. (2018). Effects of acid type extraction on characterization and sensory profile of duck feet gelatin: towards finding bovine gelatin alternative. *Journal of Food Measurement and Characterization*, 12(1), 480–486.
- Nitzl, C., Roldan, J. L., & Cepeda, G. (2016). Mediation analysis in partial least squares path modeling: Helping researchers discuss more sophisticated models. *Industrial Management & Data Systems*, 116(9), 1849–1864.

- Nora, L., & Minarti, N. S. (2017). The role of religiosity, lifestyle, attitude as determinant purchase intention. *Proceedings of The 2th International Multidisciplinary Conference 2016*, 1(1).
- Nunnally, B., & Bernstein, I. (1994). *Psychometric Theory*. New York: Oxford Univer. Press.
- Ochiya, T., Nagahara, S., Sano, A., Itoh, H., & Terada, M. (2001). Biomaterials for gene delivery atelocollagen-mediated controlled release of molecular medicines. *Current Gene Therapy*, 1(1), 31–52.
- Ogbeibu, S., Emelifeonwu, J., Pereira, V., Oseghale, R., Gaskin, J., Sivarajah, U., & Gunasekaran, A. (2023). Demystifying the roles of organisational smart technology, artificial intelligence, robotics and algorithms capability: A strategy for green human resource management and environmental sustainability. *Business Strategy and the Environment*.
- Okazaki, E., & Osako, K. (2014). Isolation and characterization of acid-soluble collagen from the scales of marine fishes from Japan and Vietnam. *Food Chemistry*, 149, 264–270.
- Ollerenshaw, J. A., & Creswell, J. W. (2002). Narrative research: A comparison of two restorying data analysis approaches. *Qualitative Inquiry*, 8(3), 329–347.
- Olsen, D., Yang, C., Bodo, M., Chang, R., Leigh, S., Baez, J., Carmichael, D., Perälä, M., Hämäläinen, E.-R., & Jarvinen, M. (2003). Recombinant collagen and gelatin for drug delivery. *Advanced Drug Delivery Reviews*, 55(12), 1547–1567.
- Olya, H. G. T., & Al-ansi, A. (2018). Risk assessment of halal products and services: Implication for tourism industry. *Tourism Management*, 65, 279–291.
- Olya, H. G. T., & Altinay, L. (2016). Asymmetric modeling of intention to purchase tourism weather insurance and loyalty. *Journal of Business Research*, 69(8), 2791–2800.
- Olya, H. G. T., & Han, H. (2020). Antecedents of space traveler behavioral intention. *Journal of Travel Research*, 59(3), 528–544.
- Omar, S. N., Omar, S. R., Mohd Rodzi, S. N. A., Chek Talib, N. A., & Mohd Noor, N. H. (2019). Factors Affecting Customer's Intention towards Purchasing Halal

- Collagen Beauty Drinks in Malaysia: a Structural Equation Modelling. *Journal of Entrepreneurship and Business*, 7(2), 70–82.
- Omori, K., Nakamura, T., Kanemaru, S., Asato, R., Yamashita, M., Tanaka, S., Magrufov, A., Ito, J., & Shimizu, Y. (2005). Regenerative medicine of the trachea: the first human case. *Annals of Otology, Rhinology & Laryngology*, 114(6), 429–433.
- Onel, N., & Mukherjee, A. (2016). Consumer knowledge in pro-environmental behavior: An exploration of its antecedents and consequences. *World Journal of Science, Technology and Sustainable Development*, 13(4), 328–352.
- Oslan, S. N. H., Li, C. X., Shapawi, R., Mokhtar, R. A. M., Noordin, W. N. M., & Huda, N. (2022). Extraction and Characterization of Bioactive Fish By-Product Collagen as Promising for Potential Wound Healing Agent in Pharmaceutical Applications: Current Trend and Future Perspective. *International Journal of Food Science*, 2022.
- Pacheco, L. M., Alves, M. F. R., & Liboni, L. B. (2018). Green absorptive capacity: A mediation-moderation model of knowledge for innovation. *Business Strategy and the Environment*, 27(8), 1502–1513.
- Pallant, J. (2001). SPSS survival manual. In *Chicago/Illinois USA: SPSS Inc/223.wackerdrive/*. <https://doi.org/10.4324/9781003117407>
- Pandey, S. K. (2018). A prospect theory application to understand tourism in terror infested destinations. *International Journal of Knowledge Management in Tourism and Hospitality*, 2(1), 87–103.
- Parenteau-Bareil, R., Gauvin, R., & Berthod, F. (2010). Collagen-based biomaterials for tissue engineering applications. *Materials*, 3(3), 1863–1887.
- Park, C. W., Mothersbaugh, D. L., & Feick, L. (1994). Consumer knowledge assessment. *Journal of Consumer Research*, 21(1), 71–82.
- Parsons, J. T., Siegel, A. W., & Cousins, J. H. (1997). Late adolescent risk-taking: Effects of perceived benefits and perceived risks on behavioral intentions and behavioral change. *Journal of Adolescence*, 20(4), 381–392.

- Pawelec, K. M., Best, S. M., & Cameron, R. E. (2016). Collagen: a network for regenerative medicine. *Journal of Materials Chemistry B*, 4(40), 6484–6496.
- Pelaez, A., Chen, C.-W., & Chen, Y. X. (2019). Effects of perceived risk on intention to purchase: A meta-analysis. *Journal of Computer Information Systems*, 59(1), 73–84.
- Peralta, E. (2018). Overview of topical hemostatic agents and tissue adhesives. *UpToDate. Waltham (MA): UpToDate.*
- Piha, S., Pohjanheimo, T., Lähteenmäki-Uutela, A., Křečková, Z., & Otterbring, T. (2018). The effects of consumer knowledge on the willingness to buy insect food: An exploratory cross-regional study in Northern and Central Europe. *Food Quality and Preference*, 70, 1–10.
- Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., & Podsakoff, N. P. (2003). Common method biases in behavioral research: a critical review of the literature and recommended remedies. *Journal of Applied Psychology*, 88(5), 879.
- Podsakoff, P. M., MacKenzie, S. B., & Podsakoff, N. P. (2012). Sources of method bias in social science research and recommendations on how to control it. *Annual Review of Psychology*, 63, 539–569.
- Polit, D. F., & Beck, C. T. (2006). The content validity index: are you sure you know what's being reported? Critique and recommendations. *Research in Nursing & Health*, 29(5), 489–497.
- Pongluxna, N. (2017). *Factors influencing purchase intention toward dietary collagen in Bangkok, Thailand.*
- Pop, R.-A., Hlédik, E., & Dabija, D.-C. (2023). Predicting consumers' purchase intention through fast fashion mobile apps: The mediating role of attitude and the moderating role of COVID-19. *Technological Forecasting and Social Change*, 186, 122111.
- Porrall, C. C., & Levy-Mangin, J.-P. (2016). Food private label brands: the role of consumer trust on loyalty and purchase intention. *British Food Journal*.

- Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods, Instruments, & Computers*, 36, 717–731.
- Presser, S., & Blair, J. (1994). Survey pretesting: Do different methods produce different results? *Sociological Methodology*, 73–104.
- Pullman, M., & Wu, Z. (2012). *Food supply chain management: Economic, social and environmental perspectives*. Routledge.
- Puto, C. P. (1987). The framing of buying decisions. *Journal of Consumer Research*, 14(3), 301–315.
- Radhakrishnan, R., Ghosh, P., & Selvakumar, T. A. (2020). Poultry spent wastes: an emerging trend in collagen mining. *Adv Tissue Eng Regen Med Open Access*, 6(2), 26–35.
- Rahi, S. (2018). *Research Design and Methods*. CreateSpace Independent Publishing Platform CA.
- Rahman, M. A. (2019). Collagen of extracellular matrix from marine invertebrates and its medical applications. *Marine Drugs*, 17(2), 118.
- Rahman, R. A., Zahari, M. S. M., Hanafiah, M. H., & Mamat, M. N. (2021). Effect of Halal Food Knowledge and Trust on Muslim Consumer Purchase Behavior of Syubhah Semi-Processed Food Products. *Journal of Food Products Marketing*, 27(6), 319–330.
- Raithel, S., Sarstedt, M., Scharf, S., & Schwaiger, M. (2012). On the value relevance of customer satisfaction. Multiple drivers and multiple markets. *Journal of the Academy of Marketing Science*, 40, 509–525.
- Raman, M., & Gopakumar, K. (2018). Fish collagen and its applications in food and pharmaceutical industry: A review. *EC Nutrition*, 13(12), 752–767.
- Ramayah, T., Cheah, J., Chuah, F., Ting, H., & Memon, M. A. (2018). Partial least squares structural equation modeling (PLS-SEM) using smartPLS 3.0. *An Updated Guide and Practical Guide to Statistical Analysis*.

- Ramshaw, J. A. M., Werkmeister, J. A., & Glattauer, V. (2019). Recent progress with recombinant collagens produced in *Escherichia coli*. *Current Opinion in Biomedical Engineering*, *10*, 149–155.
- Rao, A. R., & Monroe, K. B. (1988). The moderating effect of prior knowledge on cue utilization in product evaluations. *Journal of Consumer Research*, *15*(2), 253–264.
- Rasiel, E. B., Weinfurt, K. P., & Schulman, K. A. (2005). Can prospect theory explain risk-seeking behavior by terminally ill patients? *Medical Decision Making*, *25*(6), 609–613.
- Rather, J. A., Akhter, N., Ashraf, Q. S., Mir, S. A., Makroo, H. A., Majid, D., Barba, F. J., Khaneghah, A. M., & Dar, B. N. (2022). A comprehensive review on gelatin: Understanding impact of the sources, extraction methods, and modifications on potential packaging applications. *Food Packaging and Shelf Life*, *34*, 100945.
- Ricard-Blum, S. (2011). The collagen family. *Cold Spring Harbor Perspectives in Biology*, *3*(1), a004978.
- Ringle, C. M., Sarstedt, M., & Straub, D. W. (2012). Editor's comments: a critical look at the use of PLS-SEM in "MIS Quarterly". *MIS Quarterly*, iii–xiv.
- Ringle, C. M., Wende, S., & Becker, J.-M. (2024). *Finite Mixture Partial Least Squares (FIMIX-PLS)*. SmartPLS. <https://www.smartpls.com>
- Rizkitysha, T. L., & Hananto, A. (2020). Do knowledge, perceived usefulness of halal label and religiosity affect attitude and intention to buy halal-labeled detergent? *Journal of Islamic Marketing*.
- Robinson, O. C. (2014). Sampling in interview-based qualitative research: A theoretical and practical guide. *Qualitative Research in Psychology*, *11*(1), 25–41.
- Rodríguez-Ardura, I., & Meseguer-Artola, A. (2020). How to prevent, detect and control common method variance in electronic commerce research. In *Journal of theoretical and applied electronic commerce research* (Vol. 15, Issue 2, pp. 1–5). Multidisciplinary Digital Publishing Institute.
- Rosa, F., Nassivera, F., & Iseppi, L. (2018). *Sunflower oil innovation, claim assessment and consumer motivations to accept this food*.

- Roselli, L., Cicia, G., Cavallo, C., Del Giudice, T., Carlucci, D., Clodoveo, M. L., & De Gennaro, B. C. (2018). Consumers' willingness to buy innovative traditional food products: The case of extra-virgin olive oil extracted by ultrasound. *Food Research International*, *108*, 482–490.
- Ross, V. L., Fielding, K. S., & Louis, W. R. (2014). Social trust, risk perceptions and public acceptance of recycled water: Testing a social-psychological model. *Journal of Environmental Management*, *137*, 61–68.
- Rousseau, D. M., Sitkin, S. B., Burt, R. S., & Camerer, C. (1998). Not so different after all: A cross-discipline view of trust. *Academy of Management Review*, *23*(3), 393–404.
- Ruan, Y., Li, Q., & Xu, X. (2016). What makes social shopping? re-examining the effects of multi-attributes utility, trust and relationship on social shopping intention. *Proceedings of the 18th Annual International Conference on Electronic Commerce: E-Commerce in Smart Connected World*, 1–8.
- Ruggeri, K., Alí, S., Berge, M. L., Bertoldo, G., Bjørndal, L. D., Cortijos-Bernabeu, A., Davison, C., Demić, E., Esteban-Serna, C., & Friedemann, M. (2020). Replicating patterns of prospect theory for decision under risk. *Nature Human Behaviour*, *4*(6), 622–633.
- Saari, U. A., Damberg, S., Frömbling, L., & Ringle, C. M. (2021). Sustainable consumption behavior of Europeans: The influence of environmental knowledge and risk perception on environmental concern and behavioral intention. *Ecological Economics*, *189*, 107155.
- Sahid, N. A., Hayati, F., Rao, C. V., Ramely, R., Sani, I., Dzulkarnaen, A., Zakaria, Z., Hassan, S., Zahari, A., & Ali, A. A. (2018). Snakehead consumption enhances wound healing? From tradition to modern clinical practice: A prospective randomized controlled trial. *Evidence-Based Complementary and Alternative Medicine*, 2018.
- Salam, M. T., Muhamad, N., & Leong, V. S. (2018). Measuring religiosity among Muslim consumers: observations and recommendations. *Journal of Islamic Marketing*, *10*(2), 633–652.

- Salleh, F. (2023a). *Cloning, Purification and Characterization of Collagen-Like Protein from Methylobacteria sp. 4-46 as Alternative for Halal Pharmaceutical Application*. International Islamic University Malaysia.
- Salleh, F. (2023b). *Cloning, Purification and Characterization of Collagen-Like Protein from Methylobacteria sp 4-46 as Alternative to Non-Halal Collagen*.
- Salleh, F., Amid, A., & Nordin, N. F. H. (2021). Cloning, expression and purification of collagen-like protein from Methylobacteria SP. 4-46 as alternative substance for collagen-based industries. *Virtual International Halal Science Conference 2021*.
- Salleh, F., Amid, A., & Nordin, N. F. H. (2023). A Potential Halal Collagen-like Protein (RecCLPM-46) Exhibits Wound Healing Properties for Halal Pharmaceutical Industry. *AIJR Abstracts*, 231–235.
- Salvatore, L., Gallo, N., Natali, M. L., Campa, L., Lunetti, P., Madaghiele, M., Blasi, F. S., Corallo, A., Capobianco, L., & Sannino, A. (2020). Marine collagen and its derivatives: Versatile and sustainable bio-resources for healthcare. *Materials Science and Engineering: C*, 113, 110963.
- Samaranayaka, A. G. P., & Li-Chan, E. C. Y. (2011). Food-derived peptidic antioxidants: A review of their production, assessment, and potential applications. *Journal of Functional Foods*, 3(4), 229–254.
- Sánchez-Cañizares, S. M., Cabeza-Ramírez, L. J., Muñoz-Fernández, G., & Fuentes-García, F. J. (2021). Impact of the perceived risk from Covid-19 on intention to travel. *Current Issues in Tourism*, 24(7), 970–984.
- Sandhu, S. V, Gupta, S., Bansal, H., & Singla, K. (2012). Collagen in health and disease. *J Orofac Res*, 2(3), 153–159.
- Sarker, S., Bose, T. K., Palit, M., & Haque, E. (2013). Influence of personality in buying consumer goods-a comparative study between neo-Freudian theories and trait theory based on Khulna region. *International Journal of Business and Economics Research*, 2(3), 41–58.
- Sarstedt, M., Hair, J. F., Pick, M., Liengaard, B. D., Radomir, L., & Ringle, C. M. (2022). Progress in partial least squares structural equation modeling use in marketing research in the last decade. *Psychology & Marketing*, 39(5), 1035–1064.

- Sarstedt, M., Hair Jr, J. F., Cheah, J.-H., Becker, J.-M., & Ringle, C. M. (2019). How to specify, estimate, and validate higher-order constructs in PLS-SEM. *Australasian Marketing Journal*, 27(3), 197–211.
- Sarstedt, M., Ringle, C. M., Cheah, J.-H., Ting, H., Moisescu, O. I., & Radomir, L. (2020). Structural model robustness checks in PLS-SEM. *Tourism Economics*, 26(4), 531–554.
- Sarstedt, M., Ringle, C. M., & Hair, J. F. (2017a). Partial least squares structural equation modeling. *Handbook of Market Research*, 26(1), 1–40.
- Sarstedt, M., Ringle, C. M., & Hair, J. F. (2017b). Treating unobserved heterogeneity in PLS-SEM: A multi-method approach. *Partial Least Squares Path Modeling: Basic Concepts, Methodological Issues and Applications*, 197–217.
- Schmidt, M. M., Dornelles, R. C. P., Mello, R. O., Kubota, E. H., Mazutti, M. A., Kempka, A. P., & Demiate, I. M. (2016). Collagen extraction process. *International Food Research Journal*, 23(3), 913–922.
- Sebora, T. C., & Cornwall, J. R. (1995). Expected utility theory vs. prospect theory: Implications for strategic decision makers. *Journal of Managerial Issues*, 41–61.
- Sekaran, U., & Bougie, R. (2016). *Research methods for business: A skill building approach*. John Wiley & Sons.
- Selina Wamucii. (2022). *Export market prices for Malaysia sea cucumber*. Malaysia Sea Cucumber Prices. <https://www.selinawamucii.com/insights/prices/malaysia/sea-cucumber/#:~:text=Malaysia sea cucumber wholesale price,is MYR 53.25 per kg.>
- Setiawati, L. M., Chairy, C., & Syahrivar, J. (2019). Factors affecting the intention to buy halal food by the millennial generation: The mediating role of attitude. *DeReMa (Development Research of Management): Jurnal Manajemen*, 14(2), 175–188.
- Sezonov, G., Joseleau-Petit, D., & d'Ari, R. (2007). Escherichia coli physiology in Luria-Bertani broth. *Journal of Bacteriology*, 189(23), 8746–8749.
- Shabbir, M. S. (2010). The relationship between religiosity and new product adoption. *Journal of Islamic Marketing*.

- Shah, S. S. H., Aziz, J., Jaffari, A. R., Waris, S., Ejaz, W., Fatima, M., & Sherazi, S. K. (2012). The impact of brands on consumer purchase intentions. *Asian Journal of Business Management*, 4(2), 105–110.
- Shaharudin, M. R., Pani, J. J., Mansor, S. W., Elias, S. J., & Sadek, D. M. (2010). Purchase intention of organic food in Kedah, Malaysia; A religious overview. *International Journal of Marketing Studies*, 2(1), 96.
- Shalaby, M., Agwa, M., Saeed, H., Khedr, S. M., Morsy, O., & El-Demellawy, M. A. (2020). Fish scale collagen preparation, characterization and its application in wound healing. *Journal of Polymers and the Environment*, 28, 166–178.
- Shan, L. C., Henchion, M., De Brún, A., Murrin, C., Wall, P. G., & Monahan, F. J. (2017). Factors that predict consumer acceptance of enriched processed meats. *Meat Science*, 133, 185–193.
- Shariff, A. M. (2023). *Young Muslims' Debt Behavior: Between the Influence of Western Materialism, Islamic Religiosity and the Bridging Role of Islamic Banking and Finance*. International Islamic University Malaysia.
- Shmueli, G., Sarstedt, M., Hair, J. F., Cheah, J.-H., Ting, H., Vaithilingam, S., & Ringle, C. M. (2019). Predictive model assessment in PLS-SEM: guidelines for using PLSpredict. *European Journal of Marketing*, 53(11), 2322–2347.
- Shoseyov, O., Posen, Y., & Grynspan, F. (2014). Human collagen produced in plants: more than just another molecule. *Bioengineered*, 5(1), 49–52.
- Sidek, N. A., Latif, M. S. A., & Zin, M. Z. M. (2024). Factors Shaping the Preference for Halal Beauty Supplements among the Younger Generation. *International Journal of Academic Research in Business and Social Sciences*, 14(4), 524–545.
- Siegrist, M. (1999). A causal model explaining the perception and acceptance of gene technology. *Journal of Applied Social Psychology*, 29(10), 2093–2106.
- Siegrist, M. (2000). The influence of trust and perceptions of risks and benefits on the acceptance of gene technology. *Risk Analysis*, 20(2), 195–204.
- Siegrist, M. (2008). Factors influencing public acceptance of innovative food technologies and products. *Trends in Food Science & Technology*, 19(11), 603–608.

- Siegrist, M. (2021). Trust and risk perception: A critical review of the literature. *Risk Analysis*, 41(3), 480–490.
- Siegrist, M., Cousin, M.-E., Kastenholz, H., & Wiek, A. (2007). Public acceptance of nanotechnology foods and food packaging: The influence of affect and trust. *Appetite*, 49(2), 459–466.
- Siegrist, M., Cvetkovich, G., & Roth, C. (2000). Salient value similarity, social trust, and risk/benefit perception. *Risk Analysis*, 20(3), 353–362.
- Siegrist, M., & Hartmann, C. (2020a). Consumer acceptance of novel food technologies. *Nature Food*, 1(6), 343–350.
- Siegrist, M., & Hartmann, C. (2020b). Perceived naturalness, disgust, trust and food neophobia as predictors of cultured meat acceptance in ten countries. *Appetite*, 155, 104814.
- Siegrist, M., Luchsinger, L., & Bearth, A. (2021). The impact of trust and risk perception on the acceptance of measures to reduce COVID-19 cases. *Risk Analysis*, 41(5), 787–800.
- Siegrist, M., Shi, J., Giusto, A., & Hartmann, C. (2015). Worlds apart. Consumer acceptance of functional foods and beverages in Germany and China. *Appetite*, 92, 87–93.
- Silvipriya, K. S., Kumar, K. K., Bhat, A. R., Kumar, B. D., John, A., & Lakshmanan, P. (2015). Collagen: Animal sources and biomedical application. *Journal of Applied Pharmaceutical Science*, 5(3), 123–127.
- Siyal, S., Ahmed, M. J., Ahmad, R., Khan, B. S., & Xin, C. (2021). Factors influencing green purchase intention: Moderating role of green brand knowledge. *International Journal of Environmental Research and Public Health*, 18(20), 10762.
- Slovic, P. (1987). Perception of risk. *Science*, 236(4799), 280–285.
- Slovic, P., Fischhoff, B., & Lichtenstein, S. (1982). Why study risk perception? *Risk Analysis*, 2(2), 83–93.

- Slovic, P., & Lichtenstein, S. (1983). Preference reversals: A broader perspective. *The American Economic Review*, 73(4), 596–605.
- Slovic, P., & Peters, E. (2006). Risk perception and affect. *Current Directions in Psychological Science*, 15(6), 322–325.
- Song, E., Kim, S. Y., Chun, T., Byun, H.-J., & Lee, Y. M. (2006). Collagen scaffolds derived from a marine source and their biocompatibility. *Biomaterials*, 27(15), 2951–2961.
- Song, Y., Guo, S., & Zhang, M. (2019). Assessing customers' perceived value of the anti-haze cosmetics under haze pollution. *Science of the Total Environment*, 685, 753–762.
- Sood, A., Granick, M. S., & Tomaselli, N. L. (2014). Wound dressings and comparative effectiveness data. *Advances in Wound Care*, 3(8), 511–529.
- Sozer, E. G. (2019). The effect of dynamic pricing on holiday purchase intentions: moderated mediation role of perceived risk. *Advances in Hospitality and Tourism Research (AHTR)*, 7(1), 57–84.
- Statista. (2022). *Share of Malaysian Population in 2020, by religion*. <https://www.statista.com/statistics/594657/religious-affiliation-in-malaysia/>
- Stone, H., FitzGibbon, L., Millan, E., & Murayama, K. (2022). Curious to eat insects? Curiosity as a Key Predictor of Willingness to try novel food. *Appetite*, 168, 105790.
- Streukens, S., & Leroi-Werelds, S. (2016). Bootstrapping and PLS-SEM: A step-by-step guide to get more out of your bootstrap results. *European Management Journal*, 34(6), 618–632.
- Subhan, F., Ikram, M., Shehzad, A., & Ghafoor, A. (2015). Marine collagen: An emerging player in biomedical applications. *Journal of Food Science and Technology*, 52(8), 4703–4707.
- Sugibayashi, K., Yusuf, E., Todo, H., Dahlizar, S., Sakdiset, P., Arce Jr, F., & See, G. L. (2019). Halal Cosmetics: A Review on Ingredients, Production, and Testing Methods. *Cosmetics*, 6(3), 37.

- Sugiura, H., Yunoki, S., Kondo, E., Ikoma, T., Tanaka, J., & Yasuda, K. (2009). In vivo biological responses and bioresorption of tilapia scale collagen as a potential biomaterial. *Journal of Biomaterials Science, Polymer Edition*, 20(10), 1353–1368.
- Suki, N. M. (2016). Green product purchase intention: impact of green brands, attitude, and knowledge. *British Food Journal*.
- Sulaiman, Y., Mat, N. K. N., & Ghani, N. H. A. (2018). The antecedents of halal consumption pattern: the mediating role of muslim lifestyle, risk perception and trust. *International Journal of Engineering & Technology*, 7(4.38), 1006–1011.
- Sullivan, G. M., & Feinn, R. (2012). Using effect size—or why the P value is not enough. *Journal of Graduate Medical Education*, 4(3), 279–282.
- Sultana, S., Ali, M. E., & Ahamad, M. N. U. (2018a). 11.1 Overview of gelatin and collagen. *Preparation and Processing of Religious and Cultural Foods*, 215.
- Sultana, S., Ali, M. E., & Ahamad, M. N. U. (2018b). Gelatine, collagen, and single cell proteins as a natural and newly emerging food ingredients. In *Preparation and processing of religious and cultural foods* (pp. 215–239). Elsevier.
- Susanti, E., Lutfiana, N., & Retnosari, R. (2019). Screening of proteolytic bacteria from tauco Surabaya based on pathogenicity and selectivity of its protease on milky fish (*Chanos chanos*) scales for healthy and halal collagen production. *IOP Conference Series: Materials Science and Engineering*, 509(1), 12044. <https://doi.org/10.1088/1757-899X/509/1/012044>
- Svensson, G., Ferro, C., Høgevoid, N., Padin, C., Varela, J. C. S., & Sarstedt, M. (2018). Framing the triple bottom line approach: Direct and mediation effects between economic, social and environmental elements. *Journal of Cleaner Production*, 197, 972–991.
- Tada, Y., Takezawa, T., Tani, A., Nakamura, T., & Omori, K. (2012). Collagen vitrigel scaffold for regenerative medicine of the trachea: Experimental study and quantitative evaluation. *Acta Oto-Laryngologica*, 132(4), 447–452.

- Taherdoost, H. (2016a). Sampling methods in research methodology; how to choose a sampling technique for research. *How to Choose a Sampling Technique for Research (April 10, 2016)*.
- Taherdoost, H. (2016b). Validity and reliability of the research instrument; how to test the validation of a questionnaire/survey in a research. *How to Test the Validation of a Questionnaire/Survey in a Research (August 10, 2016)*.
- Taherdoost, H. (2019). What is the best response scale for survey and questionnaire design; review of different lengths of rating scale/attitude scale/Likert scale. *Hamed Taherdoost*, 1–10.
- Tan, C. C., Karim, A. A., Latiff, A. A., Gan, C. Y., & Ghazali, F. C. (2013). Extraction and characterization of pepsin-solubilized collagen from the body wall of crown-of-thorns Starfish (*Acanthaster planci*). *International Food Research Journal*, 20(6), 3013.
- Tan, H. S. G., van den Berg, E., & Stieger, M. (2016). The influence of product preparation, familiarity and individual traits on the consumer acceptance of insects as food. *Food Quality and Preference*, 52, 222–231.
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53.
- Teare, M. D., Dimairo, M., Shephard, N., Hayman, A., Whitehead, A., & Walters, S. J. (2014). Sample size requirements to estimate key design parameters from external pilot randomised controlled trials: a simulation study. *Trials*, 15(1), 1–13. <https://link.springer.com/article/10.1186/1745-6215-15-264>
- Tehseen, S., Ramayah, T., & Sajilan, S. (2017). Testing and controlling for common method variance: A review of available methods. *Journal of Management Sciences*, 4(2), 142–168.
- Teixeira, C., Ferraz, R., Prudêncio, C., & Gomes, P. (2018). Collagen-like materials for tissue regeneration and repair. In *Peptides and Proteins as Biomaterials for Tissue Regeneration and Repair* (pp. 283–307). Elsevier.
- Terwel, B. W., Harinck, F., Ellemers, N., & Daamen, D. D. L. (2009). Competence-based and integrity-based trust as predictors of acceptance of carbon dioxide

- capture and storage (CCS). *Risk Analysis: An International Journal*, 29(8), 1129–1140.
- The Nation. (2024, September 7). Fast-growing Thai halal industry poised for big leap in 2025. *Business*. <https://www.nationthailand.com/business/economy/40041263>
- Theofanidis, D., & Fountouki, A. (2018). Limitations and delimitations in the research process. *Perioperative Nursing-Quarterly Scientific, Online Official Journal of GORNA*, 7(3 September-December 2018), 155–163.
- Tieman, M., Ghazali, M. C., & Van Der Vorst, J. G. A. J. (2013). Consumer perception on halal meat logistics. *British Food Journal*, 115(8), 1112–1129.
- Treadwell, J. R., & Lenert, L. A. (1999). Health values and prospect theory. *Medical Decision Making*, 19(3), 344–352.
- Tsujikawa, N., Tsuchida, S., & Shiotani, T. (2016). Changes in the factors influencing public acceptance of nuclear power generation in Japan since the 2011 Fukushima Daiichi nuclear disaster. *Risk Analysis*, 36(1), 98–113.
- Tumkur, M. (2010). Reaching billions of Muslim shoppers. *Media*, 14.
- Tuu, H. H., & Olsen, S. O. (2012). Certainty, risk and knowledge in the satisfaction-purchase intention relationship in a new product experiment. *Asia Pacific Journal of Marketing and Logistics*.
- Tversky, A., & Fox, C. R. (1995). Weighing risk and uncertainty. *Psychological Review*, 102(2), 269.
- Tversky, A., & Kahneman, D. (1985). *The framing of decisions and the psychology of choice*. Springer.
- Tversky, A., & Kahneman, D. (1989). Rational choice and the framing of decisions. In *Multiple criteria decision making and risk analysis using microcomputers* (pp. 81–126). Springer.
- Tversky, A., & Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty*, 5(4), 297–323.

- Urbach, N., & Ahlemann, F. (2010). Structural equation modeling in information systems research using partial least squares. *Journal of Information Technology Theory and Application (JITTA)*, 11(2), 2.
- U.S National Library of Medicine. (2016). *Stickler Syndrome*. <https://ghr.nlm.nih.gov/condition/stickler-syndrome>
- Vaismoradi, M., Turunen, H., & Bondas, T. (2013). Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. *Nursing & Health Sciences*, 15(3), 398–405.
- Van der Linden, S. (2014). On the relationship between personal experience, affect and risk perception: The case of climate change. *European Journal of Social Psychology*, 44(5), 430–440.
- Van der Linden, S. (2017). Determinants and measurement of climate change risk perception, worry, and concern. *The Oxford Encyclopedia of Climate Change Communication*. Oxford University Press, Oxford, UK.
- van Witteloostuijn, A., Eden, L., & Chang, S.-J. (2020). Common method variance in international business research: Further reflections. *Research Methods in International Business*, 409–413.
- Vanany, I., Soon, J. M., Maryani, A., & Wibawa, B. M. (2019). Determinants of halal-food consumption in Indonesia. *Journal of Islamic Marketing*.
- Van't Riet, J., Cox, A. D., Cox, D., Zimet, G. D., De Bruijn, G.-J., Van den Putte, B., De Vries, H., Werrij, M. Q., & Ruiter, R. A. C. (2014). Does perceived risk influence the effects of message framing? A new investigation of a widely held notion. *Psychology & Health*, 29(8), 933–949.
- VanVoorhis, C. R. W., & Morgan, B. L. (2007). Understanding power and rules of thumb for determining sample sizes. *Tutorials in Quantitative Methods for Psychology*, 3(2), 43–50.
- Visschers, V. H. M., Keller, C., & Siegrist, M. (2011). Climate change benefits and energy supply benefits as determinants of acceptance of nuclear power stations: Investigating an explanatory model. *Energy Policy*, 39(6), 3621–3629.

- Vizano, N. A., Fittria, A., Nuryansah, M., Muqtada, M. R., Farhan, M., & Purwanto, A. (2020). Halal Medicine Purchase Intention among South East Asian Consumers. *European Journal of Molecular & Clinical Medicine*, 7(7), 58–77.
- Waheed, H., Ahmed, Z., Saleem, Q., Din, S. M. U., & Ahmed, B. (2020). The mediating role of risk perception in the relationship between financial literacy and investment decision. *International Journal of Innovation, Creativity and Change*, 14(4), 112–131.
- Wang, J., Tao, J., & Chu, M. (2020). Behind the label: Chinese consumers' trust in food certification and the effect of perceived quality on purchase intention. *Food Control*, 108, 106825.
- Wang, S., Wang, J., Lin, S., & Li, J. (2019). Public perceptions and acceptance of nuclear energy in China: The role of public knowledge, perceived benefit, perceived risk and public engagement. *Energy Policy*, 126, 352–360.
- Wang, T., Gu, Q., Zhao, J., Mei, J., Shao, M., Pan, Y., Zhang, J., Wu, H., Zhang, Z., & Liu, F. (2015). Calcium alginate enhances wound healing by up-regulating the ratio of collagen types I/III in diabetic rats. *International Journal of Clinical and Experimental Pathology*, 8(6), 6636.
- Wang, T., Lew, J., Premkumar, J., Poh, C. L., & Naing, M. W. (2017). Production of recombinant collagen: state of the art and challenges. *Engineering Biology*, 1(1), 18–23.
- Wang, X., Pacho, F., Liu, J., & Kajungiro, R. (2019). Factors influencing organic food purchase intention in developing countries and the moderating role of knowledge. *Sustainability*, 11(1), 209.
- Wang, Y., Gu, J., Wang, S., & Wang, J. (2019). Understanding consumers' willingness to use ride-sharing services: The roles of perceived value and perceived risk. *Transportation Research Part C: Emerging Technologies*, 105, 504–519.
- Wang, Y., & Hazen, B. T. (2016). Consumer product knowledge and intention to purchase remanufactured products. *International Journal of Production Economics*, 181, 460–469.

- Wardana, L. W., Narmaditya, B. S., Wibowo, A., Mahendra, A. M., Wibowo, N. A., Harwida, G., & Rohman, A. N. (2020). The impact of entrepreneurship education and students' entrepreneurial mindset: the mediating role of attitude and self-efficacy. *Heliyon*, 6(9).
- Weber, E. U., Anderson, C. J., & Birnbaum, M. H. (1992). A theory of perceived risk and attractiveness. *Organizational Behavior and Human Decision Processes*, 52(3), 492–523.
- Weber, E. U., Blais, A., & Betz, N. E. (2002). A domain-specific risk-attitude scale: Measuring risk perceptions and risk behaviors. *Journal of Behavioral Decision Making*, 15(4), 263–290.
- Weber, E. U., & Johnson, E. J. (2009). Decisions under uncertainty: Psychological, economic, and neuroeconomic explanations of risk preference. In *Neuroeconomics* (pp. 127–144). Elsevier.
- Wenbo, L., Hai, L., Peng, Z., Lina, X., Jie, L., Zehua, W., Shan, J., XinLi, S., Yinghui, L., & Gang, D. (2022). A regulatory perspective on recombinant collagen-based medical devices. *Bioactive Materials*, 12, 198–202.
- Westhoek, H., Lesschen, J. P., Rood, T., Wagner, S., De Marco, A., Murphy-Bokern, D., Leip, A., van Grinsven, H., Sutton, M. A., & Oenema, O. (2014). Food choices, health and environment: Effects of cutting Europe's meat and dairy intake. *Global Environmental Change*, 26, 196–205.
- Wilkinson, N., & Klaes, M. (2017). *An introduction to behavioral economics*. Bloomsbury Publishing.
- Worthington Jr, E. L., Wade, N. G., Hight, T. L., Ripley, J. S., McCullough, M. E., Berry, J. W., Schmitt, M. M., Berry, J. T., Bursley, K. H., & O'Connor, L. (2003). The Religious Commitment Inventory--10: Development, refinement, and validation of a brief scale for research and counseling. *Journal of Counseling Psychology*, 50(1), 84.
- Wu, L., Zhong, Y., Shan, L., & Qin, W. (2013). Public risk perception of food additives and food scares. The case in Suzhou, China. *Appetite*, 70, 90–98.

- Wu, R., Wu, C., Liu, D., Yang, X., Huang, J., Zhang, J., Liao, B., & He, H. (2018). Antioxidant and anti-freezing peptides from salmon collagen hydrolysate prepared by bacterial extracellular protease. *Food Chemistry*, *248*, 346–352.
- Xiao, Q., Liu, H., & Feldman, M. W. (2017). How does trust affect acceptance of a nuclear power plant (NPP): A survey among people living with Qinshan NPP in China. *Plos One*, *12*(11), e0187941.
- Xu, C., Yu, Z., Inouye, M., Brodsky, B., & Mirochnitchenko, O. (2010). Expanding the family of collagen proteins: recombinant bacterial collagens of varying composition form triple-helices of similar stability. *Biomacromolecules*, *11*(2), 348–356.
- Yaacob, T. Z., Jaafar, H. S., & Rahman, F. A. (2016). AN OVERVIEW OF HALAL FOOD PRODUCT CONTAMINATION RISKS DURING TRANSPORTATION. *Science International*, *28*(3).
- Yan, T., Kreuter, F., & Tourangeau, R. (2012). Evaluating survey questions: A comparison of methods. *Journal of Official Statistics*, *28*(4), 503.
- Yang, F., Tan, J., & Peng, L. (2020). The effect of risk perception on the willingness to purchase hazard insurance—A case study in the Three Gorges Reservoir region, China. *International Journal of Disaster Risk Reduction*, *45*, 101379.
- Yang, J., Sarathy, R., & Lee, J. (2016). The effect of product review balance and volume on online Shoppers' risk perception and purchase intention. *Decision Support Systems*, *89*, 66–76.
- Yang, Y., Campbell, R. A., & M, E. N. (2021). Recombinant human collagen/chitosan-based soft hydrogels as biomaterials for soft tissue engineering. *Materials Science and Engineering: C*, *121*, 111846.
- Yang, Y., Liu, Y., Li, H., & Yu, B. (2015). Understanding perceived risks in mobile payment acceptance. *Industrial Management & Data Systems*.
- Yao, H., Chen, Y., Chen, Y., & Zhu, X. (2019). Mediating role of risk perception of trust and contract enforcement in the construction industry. *Journal of Construction Engineering and Management*, *145*(2), 4018130.

- Yazid, A. S., Yusof, M. Y. M., Rashid, N., Ghazali, P. L., Salleh, F., Mahmud, M. S., & Mahmood, S. (2018). A mediating effect of risk perception on factors influencing tourist intention to travel: A conceptual framework. *International Journal of Academic Research in Business and Social Sciences*, 8(11), 1246–1255.
- Yeni, Y., Pujani, V., & Syahrul, L. (2021). Customers' Intention to Recommend Takeaway Food during COVID-19 Pandemic. *Quality Innovation Prosperity/Kvalita Inovacia Prosperita*, 25(3).
- Yoon, V. Y., Hostler, R. E., Guo, Z., & Guimaraes, T. (2013). Assessing the moderating effect of consumer product knowledge and online shopping experience on using recommendation agents for customer loyalty. *Decision Support Systems*, 55(4), 883–893.
- Young, D. L., Goodie, A. S., Hall, D. B., & Wu, E. (2012). Decision making under time pressure, modeled in a prospect theory framework. *Organizational Behavior and Human Decision Processes*, 118(2), 179–188.
- Yu, Z., An, B., Ramshaw, J. A. M., & Brodsky, B. (2014). Bacterial collagen-like proteins that form triple-helical structures. *Journal of Structural Biology*, 186(3), 451–461.
- Yunus, N. S. N. M., Rashid, W. E. W., Ariffin, N. M., & Rashid, N. M. (2014). Muslim's purchase intention towards non-Muslim's Halal packaged food manufacturer. *Procedia-Social and Behavioral Sciences*, 130, 145–154.
- Yusoff, F. A. M., Yusof, R. N. R., & Hussin, S. R. (2015). Halal Food Supply Chain Knowledge and Purchase Intention. *International Journal of Economics & Management*, 9.
- Yuswan, M. H., Jalil, N. H. A., Mohamad, H., Keso, S., Mohamad, N. A., Yusoff, T. S. T. M., Ismail, N. F., Manaf, Y. N. A., Hashim, A. M., & Desa, M. N. M. (2021). Hydroxyproline determination for initial detection of halal-critical food ingredients (gelatin and collagen). *Food Chemistry*, 337, 127762.
- Zhang, B., Fu, Z., Huang, J., Wang, J., Xu, S., & Zhang, L. (2018). Consumers' perceptions, purchase intention, and willingness to pay a premium price for safe vegetables: a case study of Beijing, China. *Journal of Cleaner Production*, 197, 1498–1507.

- Zhang, M., Li, L., & Bai, J. (2020). Consumer acceptance of cultured meat in urban areas of three cities in China. *Food Control*, *118*, 107390.
- Zhang, M., Zhu, M., Liu, X., & Yang, J. (2017). Why should I pay for e-books? An empirical study to investigate Chinese readers' purchase behavioural intention in the mobile era. *The Electronic Library*, *35*(3), 472–493.
- Zhang, W., Sun, L., Wang, X., & Wu, A. (2022). The influence of AI word-of-mouth system on consumers' purchase behaviour: The mediating effect of risk perception. *Systems Research and Behavioral Science*, *39*(3), 516–530.
- Zhang, Y., Jing, L., Bai, Q., Shao, W., Feng, Y., Yin, S., & Zhang, M. (2018). Application of an integrated framework to examine Chinese consumers' purchase intention toward genetically modified food. *Food Quality and Preference*, *65*, 118–128.
- Zhang, Z., Li, G., & Shi, B. I. (2006). Physicochemical properties of collagen, gelatin and collagen hydrolysate derived from bovine limed split wastes. *Journal-Society of Leather Technologists and Chemists*, *90*(1), 23.
- Zhao, S., & Yue, C. (2020). Risk preferences of commodity crop producers and specialty crop producers: An application of prospect theory. *Agricultural Economics*, *51*(3), 359–372.
- Zhao, X., Lynch Jr, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. *Journal of Consumer Research*, *37*(2), 197–206.
- Zhong, Y., Liu, W., Lee, T.-Y., Zhao, H., & Ji, J. (2021). Risk perception, knowledge, information sources and emotional states among COVID-19 patients in Wuhan, China. *Nursing Outlook*, *69*(1), 13–21.
- Zhou, P., & Regenstein, J. M. (2005). Effects of alkaline and acid pretreatments on Alaska pollock skin gelatin extraction. *Journal of Food Science*, *70*(6), c392–c396.
- Zhou, T., Wang, N., Xue, Y., Ding, T., Liu, X., Mo, X., & Sun, J. (2015). Development of biomimetic tilapia collagen nanofibers for skin regeneration through inducing keratinocytes differentiation and collagen synthesis of dermal fibroblasts. *ACS Applied Materials & Interfaces*, *7*(5), 3253–3262.

- Zhu, H., & Deng, F. (2020). How to influence rural tourism intention by risk knowledge during COVID-19 containment in China: Mediating role of risk perception and attitude. *International Journal of Environmental Research and Public Health*, *17*(10), 3514.
- Zhu, P., Wang, Z., Li, X., Liu, Y.-H., & Zhu, X. (2020). Understanding promotion framing effect on purchase intention of elderly mobile app consumers. *Electronic Commerce Research and Applications*, *44*, 101010.
- Zhu, W., Yao, N., Ma, B., & Wang, F. (2018). Consumers' risk perception, information seeking, and intention to purchase genetically modified food: An empirical study in China. *British Food Journal*, *120*(9), 2182–2194.
- Zikmund, W. G., Babin, B. J., Carr, J. C., & Griffin, M. (2013). *Business research methods*. Cengage learning.
- Zin, Z. M., Sarbon, N. M., Zainol, M. K., Jaafar, S. N., Shukri, M. M., & Rahman, A. H. A. (2021). Halal and Non-Halal Gelatine as a Potential Animal By-Products in Food Systems: Prospects and Challenges for Muslim Community. *First International Conference on Science, Technology, Engineering and Industrial Revolution (ICSTEIR 2020)*, 530–540.
- Zohrabi, M. (2013). Mixed method research: Instruments, validity, reliability and reporting findings. *Theory and Practice in Language Studies*, *3*(2), 254.
- Zolkepli, I. A., Omar, A., Ab Rahim, N. H., Tahir, S. N. K. M., & Tiwari, V. (2023). Social Media Advertising, Celebrity Endorsement, And Electronic Word-of-Mouth Effect on Health Supplement Purchasing Behaviour. *Asian Journal of Research in Business and Management*, *4*(4), 185–199.
- Zulfakar, M. H., Anuar, M. M., & Ab Talib, M. S. (2014). Conceptual framework on halal food supply chain integrity enhancement. *Procedia-Social and Behavioral Sciences*, *121*, 58–67.

APPENDIX A: Interview questions



THE EXPERTS' PERCEPTION OF THE RECOMBINANT COLLAGEN-LIKE PROTEIN AS HALAL COLLAGEN

Assalamualaikum wbt,

Dear Prof/ Assoc. Prof/ Dr/ Sir/ Madam

I am Siti Fatimah Mohamed Noor, a PhD candidate of International Islamic University Malaysia (IIUM). I am intending to do research related to recombinant collagen-like protein as vegetarian and halal collagen.

The International Institute for Halal Research and Training (INHART) IIUM, Gombak has developed a vegetarian collagen, or the recombinant collagen-like protein with the assurance that no halal issue in its development. The collagen, namely Collagen-Like Protein (CLP) was developed using the sequence of protein genes named *Methylobacteria sp 4-46*. These genes were processed and transformed into *e.coli*, where *e.coli* is grown and fed with vegetarian and halal source of media thus, the halal issues are guaranteed.

I wish to acquire your perceptions based on your experience and expertise in related to the field. Your response and assistance to provide me with the information is highly appreciated.

Yours sincerely,

Siti Fatimah Mohamed Noor

PhD Economics Candidate at Kulliyah of Economics and Management Science, IIUM

Email: siti.fatimah256@yahoo.com

1. Information on the collagen

- a. Do you know what collagen is? Could you explain collagen from your understanding?
- b. Could you please explain the usage or benefit of collagen?
- c. Could you explain what the sources of collagen are?
- d. What are the debatable issues pertaining to these sources if any? Do you know why a particular group of people does not prefer animal-based collagen?

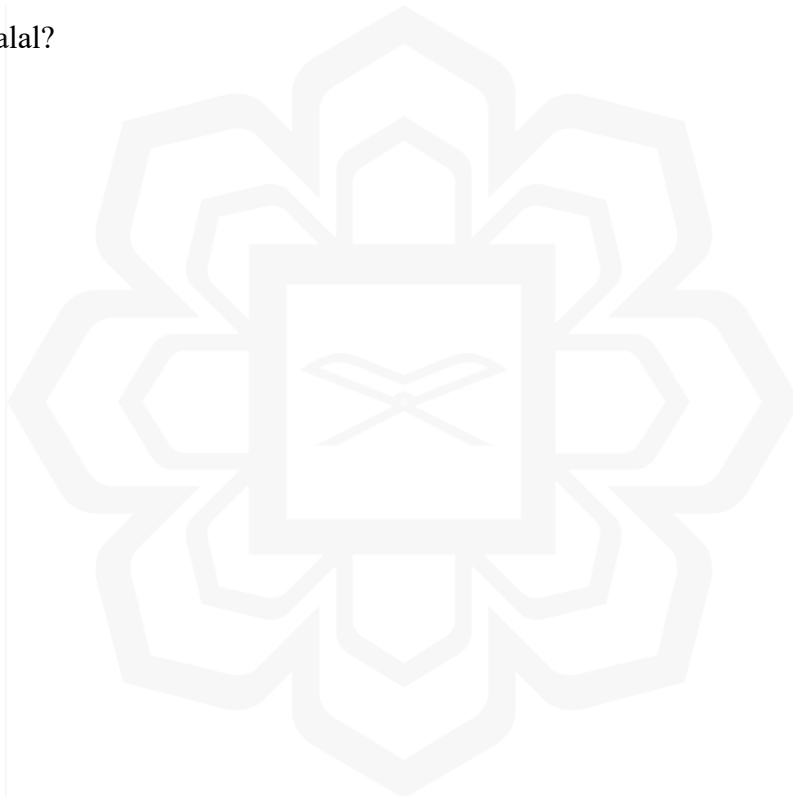
2. Information on the suitability of collagen

- a. A new source of collagen extraction that is based on bacteria has been discovered. Are you aware of this?
- b. What do you think of this new source in terms of its suitability?
- c. Do you think bacteria-based collagen is suitable for use in lab experiments only, or is it suitable for mass production? Could you explain the reason?
- d. Do you think bacteria-based collagen is suitable and safe for public to use? May I know why?
- e. Could you explain if the bacteria-based collagen is suitable to be produced in Malaysia?
- f. Do you think bacteria-based collagen is halal? Why?
- g. What do you think of the prospects of bacteria-based collagen in Malaysia?

3. Information on the viability of collagen

- a. Would you provide your opinions on whether producers or manufacturers are interested in producing collagen that is based on bacteria?
- b. Do you think producers or manufacturers are interested in investigating in the production of collagen-based on bacteria? Why do you think so?
- c. Is bacteria-based collagen profitable to manufacturers? Why?
- d. Will bacteria-based collagen boost production and increase the demand for collagen-based products? Why do you think so?
- e. Will the bacteria-based collagen industry stay in the economy longer?
- f. From your understanding, what is/are the factor(s) that can make a company remain relevant?
- g. In Malaysia, is halal certification important? Why?
- h. Will halal certification guarantee the company's place in the industry? Why do you think so?

- i. Some collagen products in Malaysia state the ingredients come from natural ingredients without halal certification. It is safe for Muslim consumers to ingest that product.
- j. Could you explain why collagen is considered well-accepted among Muslims in Malaysia nowadays?
- k. If this product complies with the halal requirement, are you there to consumer this product from bacteria?
- l. Could you provide your knowledge on collagen-like protein?
- m. Are you aware of collagen-like proteins as new things? Could you provide your thoughts about the collagen-like protein being a new thing?
- n. As a Muslim, would you consume this product if it is commercialised and certified as halal?



APPENDIX B: Content validation



CONTENT VALIDITY

AN ANALYSIS ON THE INTENTION TO PURCHASE OF HALAL COLLAGEN IN MALAYSIA

Assalamualaikum wbt,

Dear Prof/ Assoc. Prof/ Dr/ Sir/ Madam

I am Siti Fatimah Mohamed Noor, a PhD student of the International Islamic University Malaysia. I am currently constructing a survey instrument to observe the consumers' intention to purchase the product contain recombinant of collagen-like protein (CLP) as alternative to animal-based collagen.

The International Institute of Halal Research and Training (INHART) IIUM, Gombak has developed a vegetarian collagen or, the recombinant of collagen-like protein with the assurance that no halal issue in its development. The collagen, namely Collagen-Like Protein (CLP) was developed using the sequence of genes named *Methylobacteria sp 4-46*. These genes were grown in lab and fed with vegetarian-based nutrients thus, the halal issues are guaranteed. CLP can be incorporated in wound healing application such as skin grafting, collagen scaffold, wound dressing, and others. However, the CLP produced would have the same characteristic as the commercialized collagen.

Prior conducting the survey, I wish to acquire your expert opinion on the questionnaire items which I have constructed based on the literatures and findings conducted earlier. For your information, this study adopt and adapt the prospect theory by Kahneman and Tversky and take into consideration the previous studies related to the theory.

Kindly find the attached expert assessment form to be filled in.

Your kind cooperation and assistance in completing the form is highly appreciated.

Thank you,

Researcher: Siti Fatimah binti Mohamed Noor
Supervisor: Dr. Mohamed Asmy bin Mohd Thas Thaker
Co-Supervisor: Prof. Dr. Jarita binti Duasa
Kulliyah of Economics and Management Sciences
International Islamic University Malaysia (IIUM)
53100 Gombak, Selangor
Mobile no: 013-5121419
E-mail: sfmn.256@gmail.com

Name of expert:

Designation:

Date:



Instruction: The section below is divided into few variables; *knowledge, attitude, religiosity, risk perception, trust, and consumers' acceptance as well as their intention to purchase the product contain recombinant of collagen-like protein*. Please tick (/) the appropriate column to indicate your opinion on the suitability of the item in measuring the proposed construct on a scale of 1 (clearly representative), 2 (somewhat representative), and 3 (not representative). Your comment on the item also would be highly appreciated.

Variables	Operational definition	Questionnaires item development	Response category	Expert Assessment [please tick (/)]			Comments
				Clearly representative 1	Somewhat representative 2	Not representative 3	
Knowledge	Refers to the general knowledge consumers had on the collagen that already in the market and the Collagen-Like Protein (CLP) that is still under development	1. Generally, I know collagen and its benefit on me.	1 = Strongly Disagree				
		2. I know there were halal and non-halal collagen.	7 = Strongly Agree				
		3. I find it quite hard to determine whether the collagen product is halal or not.					
		4. To my knowledge, Collagen-Like Protein is different with animal-based collagen.					
		5. I know that Collagen-Like Protein can be an alternative to					

		animal-based collagen					
		6.I acknowledge that the halal institute will focus on research and strengthen the halal industry					
Variables	Operational definition	Questionnaires item development	Response category	Expert Assessment [please tick (/)]			Comments
				Clearly representative 1	Somewhat representative 2	Not representative 3	
Attitude	Refers to the respondents' evaluation of the recombinant of CLP	1.I think the production of recombinant of CLP is a great idea	1 = Strongly Disagree				
		2.I think the recombinant of CLP would have better wound healing ability	7 = Strongly Agree				
		3.I feel that recombinant of CLP would have better skin aging ability					
		4.Recombinant of CLP will also be					

		preferred by non-Muslim consumers					
		5.I think the recombinant of CLP would have sustain the environment					
		6.I think the recombinant of CLP would improve the health condition of the consumers					

Variables	Operational definition	Questionnaires item development	Response category	Expert Assessment [please tick (/)]			Comments
				Clearly representative 1	Somewhat representative 2	Not representative 3	
Religiosity	How people act to the recombinant of CLP based on the religious beliefs, values, and practices	1.The belief I have on my religion leading the way I live	1 = Strongly Disagree				
		2.I am very meticulous prior consuming a product because of my religious belief	7 = Strongly Agree				
		3.My religious belief influences the choice on my daily consumption					

		4.I often study about my religious teaching					
		5.I would be happy when there are products that prioritise halal regulations					

Variables	Operational definition	Questionnaires item development	Response category	Expert Assessment [please tick (/)]			Comments
				Clearly representative 1	Somewhat representative 2	Not representative 3	
Risk Perception	1. Perceived risk on health It refers to the consumers' perception on risk of recombinant of CLP on his/her health	1.The information about the recombinant of CLP made me feel concern on its effect on my health after consuming it.	1 = Strongly Disagree 7 = Strongly Agree				
		2.Consuming recombinant of CLP might cause sickness					
		3.Recombinant of CLP might be hazardous					
		4.Recombinant of CLP might cause one to have chronic illness					

	<p>2. Perceived risk on social It refers to how consumers perceive risk on his/her family and friends on consuming recombinant of CLP</p>	1.I worried if my family might get sick after consume recombinant of CLP	1 = Strongly Disagree				
		2.My family might did not agree with recombinant of CLP development	7 = Strongly Agree				
		3.I worried my peers might got sick after consume recombinant of CLP					
		4.My peers might have negative perception on recombinant of CLP					
	<p>3. Perceived risk on environment It refers to how consumers perceive risk on environmental results from recombinant of CLP</p>	1.I am worried about the environmental problems occurred these days	1 = Strongly Disagree				
		2.I am concern about the impact of the production on the environment when the product contains animal-based collagen	7 = Strongly Agree				

		3.I believe halal production will not give the negative impact on the environment				
		4.I think the recombinant of CLP will not harm the environment because it was grown in lab by the Halal institute				
	4. Perceived risk on quality and halal Refers to how consumers made decision considering the uncertainty on the quality and halal status of the recombinant of CLP	1.I am concern on the hygiene of the recombinant of CLP	1 = Strongly Disagree			
		2.I am concern on the quality of the recombinant of CLP	7 = Strongly Agree			
		3.I am concern whether recombinant of CLP follows the halal requirement to be halal collagen				
		4.I am concern on the physical product of the recombinant of CLP				

		5.A product contain Collagen-Like Protein will have a good quality because researchers have done thorough studies to produce it					
	5. Perceived risk on financial Refers to how consumers decided to act on the recombinant of CLP considering the risk and uncertainty regarding his/her financial condition	1. The animal-based collagen products in the current market are expensive	1 = Strongly Disagree				
		2. I assume the production on the collagen product contain recombinant of CLP will be cheaper because it will not involve the animals	7 = Strongly Agree				
		3. I assume the products contain recombinant of CLP would be cheaper because it is local product					
		4. I would spend my money on the product contain recombinant of CLP because it is					

		not involving animal-based collagen and I know collagen has many benefit					
--	--	--	--	--	--	--	--

Variables	Operational definition	Questionnaires item development	Response category	Expert Assessment [please tick (/)]			Comments
				Clearly representative 1	Somewhat representative 2	Not representative 3	
Trust	Refers to the intention to accept the vulnerability based on positive expectations of the intentions of another	1. I am literally trusting the Halal Agency in Malaysia	1 = Strongly Disagree				
		2. I am more convinced when I saw Halal Logo from Malaysian Halal Agency	7 = Strongly Agree				
		3. I trust the halal from other countries affirmed by Malaysian Halal Agency					
		4. I trust that Halal research institute produce a halal collagen					
		5. I am convinced to consume the product					

		contained recombinant of CLP					
--	--	------------------------------	--	--	--	--	--

Variables	Operational definition	Questionnaires item development	Response category	Expert Assessment [please tick (/)]			Comments
				Clearly representative 1	Somewhat representative 2	Not representative 3	
Intention behaviour	This is the decision that consumers will show whether they accept the product contain the recombinant of CLP in the market and intend to purchase them	1. I accept the development of Collagen-Like Protein	1 = Strongly Disagree				
		2. If I found the product based on Collagen-Like Protein, I would certainly buy it	7 = Strongly Agree				
		3. I would substitute the animal-based collagen with Collagen-Like Protein if I were too anxious on the halal status of the product contain animal-based collagen					
		4. I would prefer the Collagen-Like Protein product even if the price is more expensive					

		than animal-based product					
--	--	---------------------------	--	--	--	--	--



APPENDIX C: Survey questionnaire



الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
وَتَبَرَّسْتِي: اِسْلَامًا اِنْتَابَارًا يَجْنِبًا مِلْسِنًا

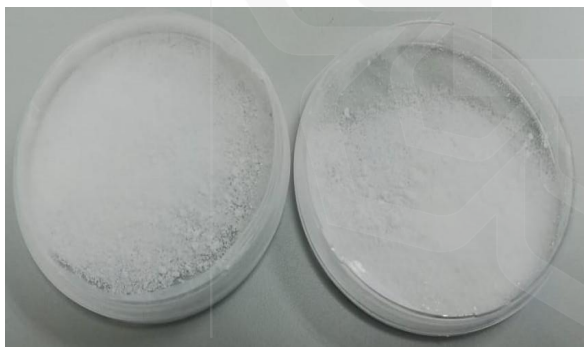
The Analysis of Consumers' Purchase Intention on the Recombinant of Collagen-Like Protein as Halal Collagen in Malaysia

Analisis Keinginan Membeli Pengguna terhadap Recombinant of Collagen-Like Protein sebagai Kolagen Halal di Malaysia

Dear Sir/Madam, Brother/Sister,

Assalamualaikum warahmatullahi wabarakatuh,

I am Siti Fatimah binti Mohamed Noor, a PhD candidate under Kulliyah of Economics and Management Sciences, IIUM. I will be conducting a survey on consumers' purchase intention on an input product namely recombinant of collagen-like protein. A halal research institute under IIUM Gombak has developed a vegetarian collagen through a process known as recombinant of with it was grown in lab with the purpose of developing a halal compliance raw collagen.



Raw recombinant of CLP

We know collagen commonly derived from animals, especially pig or cow. Therefore, this vegetarian collagen was developed using a sequence of genes and they were grown and fed with vegetarian-based nutrients; hence the halal status of this raw vegetarian collagen is guaranteed. The collagen-like protein can be incorporated in wound healing applications, tissue engineering, as well as cosmetic products. It has similar characteristics and nutrients to the animal-based collagen, which has been in the current market but, its better because it is vegetarian and halal compliance.

The collagen-like protein is an input product and will be concocted with other materials to produce the final output products. Moreover, the production of collagen-like protein will be safe to the environment since no animals involved in its production. Thereby, this survey will determine the consumers' acceptance and whether the consumers intend to buy the product contain collagen-like protein.

Your response is highly appreciated and will remain anonymous. The information will be used for academic purpose only. In case you have any inquiries, kindly contact me and my supervisor at the following contact information.

*Tuan/Puan, Saudara/Saudari yang dihormati,
Assalamualaikum warahmatullahi wabarakatuh,*

Saya Siti Fatimah binti Mohamed Noor, pelajar Doktor Falsafah di bawah Kulliyah Ekonomi dan Sains Pengurusan, Universiti Islam Antarabangsa, Malaysia dengan rendah hati memohon tuan/puan, saudara/saudari menyertai survei ini. Survei ini adalah untuk melihat niat membeli pengguna ke atas produk yang mengandungi bahan mentah Recombinant Collagen. Recombinant Collagen adalah kolagen sayuran yang dicipta dan dibesarkan oleh salah satu pusat penyelidikan halal Malaysia yang bertempat di Universiti Islam Antarabangsa, Gombak.

Institusi penyelidikan halal dibawah penyeliaan penyelidik UIA telah mencipta kolagen sayuran melalui proses yang dinamakan sebagai recombinant dengan tujuan utama untuk mencipta kolagen yang dijamin halal. Kebiasaannya, kolagen yang dipasarkan adalah berasal dari binatang, dan biasanya dari khinzir atau lembu dan status halal adalah diragui. Oleh itu, kolagen sayuran ini dicipta oleh penyelidik dengan menggunakan jujukan gen yang dibesarkan dan diberi nutrient yang berasaskan sayuran.

Recombinant Collagen ini boleh diaplikasikan di dalam perubatan seperti penyembuhan luka dalam, bidang perubatan dan pembedahan. Kolagen yang dihasilkan secara recombinant ini juga telah diuji dan selamat untuk barangan kosmetik. Ini kerana kolagen yang dihasilkan mempunyai karakter, kelebihan serta nutrien yang sama seperti kolagen yang diekstrak daripada haiwan. Lebih utama, recombinant collagen ini adalah kolagen sayuran dan dijamin bersih dan halal. Kolagen ini akan diproses bersama-sama bahan yang lain untuk menghasilkan output atau produk akhir yang akan dipasarkan.

Tambahan lagi, penghasilan recombinant collagen adalah selamat dan tidak akan memberi impak yang buruk kepada persekitaran dan ekosistem kerana ianya tidak melibatkan haiwan. Oleh itu, kajian ini diadakan untuk melihat penerimaan pengguna serta adakah pengguna mempunyai keinginan dan niat untuk membeli produk yang mengandungi kolagen sayuran yang dihasilkan secara recombinant. Respon anda adalah dihargai dan akan kekal dirahsiakan. Informasi yang diberikan hanya digunakan untuk tujuan kajian akademik sahaja. Sekiranya anda mempunyai sebarang pertanyaan, boleh hubungi saya pada alamat dan nombor yang tertera di bawah.

Thank You,
Terima Kasih,
Siti Fatimah binti Mohamed Noor
PhD Candidate
Kulliyah of Economics and Management Science, IIUM
013-5121419
siti.fatimah256@yahoo.com

Dr Mohamed Asmy bin Mohd Thas Thaker
 Supervisor,
 Kulliyah of Economics and Management Sciences, IIUM
 013-3904299
asmy@iium.edu.my

Instructions: Please answer all questions below. Kindly tick (/) your answer
Arahan: Sila jawab semua soalan dibawah. Tandakan (/) jawapan anda

<p>Gender (<i>Jantina</i>):</p> <p><input type="radio"/> Male (<i>Lelaki</i>)</p> <p><input type="radio"/> Female (<i>Perempuan</i>)</p> <p>Age (<i>Umur</i>):</p> <p><input type="radio"/> below 20 years old</p> <p><input type="radio"/> 20 – 29 years old</p> <p><input type="radio"/> 30 – 39 years old</p> <p><input type="radio"/> 40 – 49 years</p> <p><input type="radio"/> 50 years old and above</p> <p>Education (<i>Pendidikan</i>)</p> <p><input type="radio"/> Primary school (<i>sekolah rendah</i>)</p> <p><input type="radio"/> Secondary school (<i>sekolah menengah</i>)</p> <p><input type="radio"/> Diploma/ Pre-University (<i>Diploma/ Pra-Universiti</i>)</p> <p><input type="radio"/> Degree (<i>Ijazah Sarjana</i>)</p> <p><input type="radio"/> Postgraduate (<i>Pasca-Sarjana</i>)</p> <p>Employment (<i>Pekerjaan</i>)</p> <p><input type="radio"/> Private (<i>Swasta</i>)</p> <p><input type="radio"/> Government services (<i>Kakitangan kerajaan</i>)</p> <p><input type="radio"/> Self-employed/ Business (<i>Bekerja sendiri/ berniaga</i>)</p> <p><input type="radio"/> Pensioners (<i>Pesara</i>)</p> <p><input type="radio"/> Students (<i>Pelajar</i>)</p> <p><input type="radio"/> Housewife (<i>Surirumah</i>)</p>	<p>Race</p> <p><input type="radio"/> Malay (<i>Melayu</i>)</p> <p><input type="radio"/> Chinese (<i>Cina</i>)</p> <p><input type="radio"/> Indian (<i>India</i>)</p> <p><input type="radio"/> Others (<i>lain-lain</i>): _____</p> <p>Health Status (<i>Status Kesihatan</i>)</p> <p><input type="radio"/> Good – Rarely get sick (eg: flu or fever). <i>Baik - Jarang berjangkit dengan penyakit berjangkit (demam dan selsema)</i></p> <p><input type="radio"/> Average – often get sick (eg: flu or fever). <i>Biasa – Mudah berjangkit dengan penyakit berjangkit (demam dan selsema)</i></p> <p><input type="radio"/> Poor – have chronic illness (eg: diabetes, hypertension and others). <i>Teruk – Mempunyai penyakit kronik seperti kencing manis, darah tinggi, buah pinggang, dan sebagainya</i></p> <p>Do you know collagen? (<i>Adakah anda kenal kolagen?</i>)</p> <p><input type="radio"/> Yes (<i>Ya</i>)</p> <p><input type="radio"/> No (<i>Tidak</i>)</p>
--	--

Kindly read each descriptive statement carefully and indicate your choice by circling the appropriate number (on a 7-point scale given below), that is, the number that **best describe how you feel about the statement.**

1	2	3	4	5	6	7
Strongly Disagree (Sangat tidak bersetuju)	Disagree (Tidak bersetuju)	Slightly Disagree (Sedikit tidak bersetuju)	Neither Agree nor Disagree (Samada setuju atau tidak bersetuju)	Slightly Agree (Sedikit bersetuju)	Agree (Bersetuju)	Strongly Agree (Sangat bersetuju)

SECTION A: FACTORS INFLUENCING CONSUMERS' PURCHASE INTENTION

SEKSYEN A: FAKTOR-FAKTOR YANG MEMPENGARUHI KEINGINAN MEMBELI PENGGUNA

Knowledge refers to the general information you had on the collagen, which you can found in any stores and also the information you may had on the collagen-like protein.

Pengetahuan disini merujuk kepada pengetahuan umum anda terhadap kolagen yang terdapat di pasaran sekarang serta informasi yang anda tahu terhadap collagen-like protein.

Knowledge (Pengetahuan)							
I find it quite hard to determine whether the collagen product is halal or not. <i>Saya merasakan sangat susah untuk menentukan adakah produk yang mengandungi kolagen halal atau tidak</i>	1	2	3	4	5	6	7
To my knowledge, Collagen-Like Protein is different from animal-based collagen. <i>Berdasarkan pengetahuan saya, Collagen-Like Protein berbeza dengan kolagen yang berasaskan haiwan</i>	1	2	3	4	5	6	7
I know that Collagen-Like Protein can be an alternative to the animal-based collagen. <i>Saya tahu Collagen-Like Protein boleh menjadi alternatif atau pengganti kepada kolagen yang berasaskan haiwan</i>	1	2	3	4	5	6	7
I am aware of the pro and contra between Collagen-Like Protein and animal-based collagen. <i>Saya sedar terdapat pro dan kontra antara Collagen-Like Protein dan kolagen yang berasaskan haiwan</i>	1	2	3	4	5	6	7
I acknowledged that the Halal Research Institutions in Malaysia (eg: JAKIM,	1	2	3	4	5	6	7

INHART etc) will focus on research and strengthen the halal industry. <i>Saya akui bahawa institut penyelidikan halal di Malaysia memfokuskan kepada penyelidikan untuk mengukuhkan industri halal.</i>							
--	--	--	--	--	--	--	--

Attitude refers to your evaluation on the recombinant of collagen-like protein.

Sikap disini merujuk kepada pendapat anda terhadap kolagen yang dihasilkan melalui proses rekombinan

Attitude (Sikap)							
I think the Collagen-Like Protein would have better wound healing ability. <i>Pada pendapat saya, Collagen-Like Protein boleh menyembuhkan luka dalam dengan lebih berkesan</i>	1	2	3	4	5	6	7
I feel that the Collagen-Like Protein has better ability to reduce skin aging. <i>Saya merasakan Collagen-Like Protein lebih baik dalam merawat penuaan kulit</i>	1	2	3	4	5	6	7
The Collagen-Like Protein will also be preferred by non-Muslim consumers. <i>Collagen-Like Protein akan lebih disukai oleh pengguna bukan Islam</i>	1	2	3	4	5	6	7
I think the Collagen-Like Protein in general would improve the health condition of the consumers. <i>Saya merasakan Collagen-Like Protein secara umumnya akan menambahbaik kesihatan pengguna</i>	1	2	3	4	5	6	7
I think the Collagen-Like Protein causing harm to the environmental. <i>Saya merasakan Collagen-Like Protein akan merosakkan alam sekitar</i>	1	2	3	4	5	6	7
I think the production of Collagen-Like Protein is a bad idea. <i>Pada pendapat saya, pengeluaran Collagen-Like Protein adalah idea yang buruk.</i>	1	2	3	4	5	6	7
I would choose Collagen-Like Protein product relative to animal-based collagen. <i>Saya akan lebih memilih produk yang mengandungi Collagen-Like Protein berbanding kolagen yang berasaskan haiwan</i>	1	2	3	4	5	6	7

Religiosity refers to how people act to the recombinant of CLP based on the religious beliefs, values, and practices.

Keagamaan disini merujuk kepada bagaimana sikap seseorang terhadap Collagen-Like Protein berdasarkan kepercayaan dan amalan agama mereka.

Religiosity (Keagamaan)							
The belief I have on my religion leads the way I live. <i>Kepercayaan saya terhadap agama saya memimpin cara kehidupan saya.</i>	1	2	3	4	5	6	7
I am very meticulous before consuming a product because of my religious belief. <i>Saya sangat teliti sebelum menggunakan sesuatu produk kerana kepercayaan agama saya.</i>	1	2	3	4	5	6	7
My religious belief does not influence the choice on my daily consumption. <i>Kepercayaan agama saya tidak mempengaruhi pemilihan alat-alatan penggunaan harian saya.</i>	1	2	3	4	5	6	7
I rarely study about my religious teaching. <i>Saya jarang mendalami pembelajaran dan pengajaran berkaitan agama saya.</i>	1	2	3	4	5	6	7
I would be happy when there are products that prioritise halal compliant. <i>Saya akan gembira apabila terdapat produk yang mengutamakan halal.</i>	1	2	3	4	5	6	7

Perceived risk refers to the uncertainty involved in making decision, and the consequences of taking action. Questions regarding perceived risk will be divided into:

Persepsi risiko disini merujuk kepada ketidakpastian yang terlibat didalam membuat keputusan serta, akibat daripada tindakan yang dibuat. Soalan berkenaan persepsi risiko akan dibahagikan kepada jenis-jenis risiko seperti berikut:

Perceived risk on health (Persepsi risiko terhadap kesihatan)							
I am very concern on how the Collagen-Like Protein affect my health upon consuming the product. <i>Saya sangat kluatir bagaimana Collagen-Like Protein memberi kesan kepada kesihatan saya ketika menggunakan produk tersebut.</i>	1	2	3	4	5	6	7
Consuming Collagen-Like Protein might cause sickness.	1	2	3	4	5	6	7

<i>Menggunakan Collagen-Like Protein mungkin akan menyebabkan saya sakit.</i>							
Collagen-Like Protein might NOT cause any hazardous to my health such as skin irritation or after-affect. <i>Produk yang mengandung Collagen-Like Protein mungkin TIDAK memberi keburukan selepas penggunaan</i>	1	2	3	4	5	6	7
Collagen-Like Protein might give better effect on wound healing compared to medication without collagen. <i>Collagen-Like Protein mungkin akan memberi kesan yang lebih baik untuk penyembuhan luka dalam berbanding ubatan yang tidak mengandungi kolagen.</i>	1	2	3	4	5	6	7
Collagen-Like Protein might cause one to have chronic illness. <i>Collagen-Like Protein mungkin akan menyebabkan pengguna mendapat penyakit kronik.</i>	1	2	3	4	5	6	7
Perceived risk on social (<i>Persepsi risiko terhadap sosial</i>)							
I worried if my family might get sick after consuming the Collagen-Like Protein. <i>Saya bimbang sekiranya keluarga saya mendapat sakit selepas menggunakan Collagen-Like Protein</i>	1	2	3	4	5	6	7
My family and friends might have different views regarding Collagen-Like Protein. <i>Keluarga dan rakan-rakan saya mungkin mempunyai pendapat yang berbeza berkaitan Collagen-Like Protein.</i>	1	2	3	4	5	6	7
I think I would suggest the Collagen-Like Protein to my family and friends. <i>Saya akan mencadangkan Collagen-Like Protein kepada keluarga dan rakan-rakan saya.</i>	1	2	3	4	5	6	7
I think I would encourage the society to use the product contain Collagen-Like Protein <i>Saya akan menggalakkan orang-orang di sekitar saya menggunakan produk yang mengandungi Collagen-Like Protein.</i>	1	2	3	4	5	6	7

Perceived risk on environment (<i>Persepsi risiko terhadap alam sekitar</i>)							
I am worried about the environmental problems occurred these days. <i>Saya khawatir terhadap masalah alam sekitar yang berlaku pada masa sekarang.</i>	1	2	3	4	5	6	7
I think the animal-based collagen production give the negative impact the environment. <i>Saya berpendapat bahawa penghasilan kolagen yang berasaskan haiwan memberi kesan negatif kepada alam sekitar</i>	1	2	3	4	5	6	7
I believe halal compliant processes and procedures will not give negative impact on the environment. <i>Saya percaya proses dan prosedur yang patuh halal tidak akan memberi kesan negatif terhadap alam sekitar</i>	1	2	3	4	5	6	7
I think the Collagen-Like Protein will not harm the environment because it was grown in research lab. <i>Saya berpendapat bahawa Collagen-Like Protein tidak akan merosakkan alam sekitar kerana ianya dihasilkan di dalam makmal.</i>	1	2	3	4	5	6	7
Perceived risk on quality and halal (<i>Persepsi risiko terhadap kualiti dan halal</i>)							
I am concern on the hygiene aspect of the Collagen-Like Protein. <i>Saya prihatin terhadap aspek kebersihan Collagen-Like Protein.</i>	1	2	3	4	5	6	7
I am concern on the quality of the products contain Collagen-Like Protein. <i>Saya prihatin terhadap kualiti produk yang mengandungi Collagen-Like Protein.</i>	1	2	3	4	5	6	7
I am concern whether Collagen-Like Protein follows the halal requirement and guidelines. <i>Saya khawatir samada Collagen-Like Protein memenuhi keperluan dan garis panduan yang disahkan halal</i>	1	2	3	4	5	6	7
I am concern on the condition of the end-product contain Collagen-Like Protein. <i>Saya khawatir terhadap keadaan produk pasaran yang mengandungi Collagen-Like Protein.</i>	1	2	3	4	5	6	7

A product contain Collagen-Like Protein will have a good quality because researchers must have done thorough studies to produce it. <i>Produk yang mengandungi Collagen-Like Protein akan mempunyai kualiti yang bagus kerana penyelidik semestinya membuat kajian yang menyeluruh untuk menghasilkannya.</i>	1	2	3	4	5	6	7
Perceived risk on financial (Persepsi risiko terhadap kewangan)							
The animal-based collagen products in the market are currently expensive. <i>Harga kolagen yang berasaskan binatang yang dijual di pasaran sekarang adalah lebih mahal.</i>	1	2	3	4	5	6	7
I believe the production of Collagen-Like Protein will be cheaper because it will not involve the animals. <i>Saya percaya penghasilan Collagen-Like Protein adalah lebih murah kerana ianya tidak melibatkan binatang.</i>	1	2	3	4	5	6	7
I think the products contain Collagen-Like Protein would be cheaper because it is locally produced. <i>Saya berpendapatan bahawa produk yang mengandungi Collagen-Like Protein adalah lebih murah kerana ianya adalah produk local.</i>	1	2	3	4	5	6	7
I will spend my money on the products contain Collagen-Like Protein if it is not expensive. <i>Saya akan berbelanja keatas produk yang mengandungi Collagen-Like Protein sekiranya ia tidak mahal.</i>	1	2	3	4	5	6	7

Trust is referred to your willingness to be vulnerable to the actions of a party based on your positive expectations on the behaviour of another.

Kepercayaan atau Amanah merujuk kepada keinginan untuk menerima sebarang tindakan dari pihak tertentu berdasarkan sangkaan positif terhadap pihak tersebut.

Trust							
I am literally trusting the Halal Agency (eg: JAKIM) in Malaysia. <i>Saya benar-benar mempercayai Agensi Halal (contoh: JAKIM) di Malaysia.</i>	1	2	3	4	5	6	7

I am more convinced when I saw the certified Halal Logo from Malaysian Halal Agency. <i>Saya berasa lebih yakin apabila saya melihat logo halal yang disahkan oleh Agensi Halal Malaysia (Contoh: JAKIM).</i>	1	2	3	4	5	6	7
I trust the halal certification from other countries affirmed by Malaysian Halal Agency. <i>Saya percaya sijil halal daripada negara lain yang telah disahkan oleh Agensi Halal Malaysia (Contoh: JAKIM).</i>	1	2	3	4	5	6	7
I doubt Halal research institute in Malaysia producing halal collagen. <i>Saya meragui institut penyelidikan halal di Malaysia dalam menghasilkan kolagen halal.</i>	1	2	3	4	5	6	7
I will not consume the product contained the Collagen-Like Protein if it did not certify as halal. <i>Saya tidak akan menggunakan produk yang mengandungi Collagen-Like Protein sekiranya ia tidak disahkan halal.</i>	1	2	3	4	5	6	7

SECTION B: THIS SECTION CONSISTS OF QUESTIONS THAT WILL DETERMINE YOUR DECISION IF YOU ACCEPT THE PRODUCT CONTAIN THE RECOMBINANT OF COLLAGEN-LIKE PROTEIN IN THE MARKET AND INTEND TO PURCHASE THOSE PRODUCT. KINDLY TICK YOUR ANSWER.

SEKSYEN B: SEKSYEN INI MENGANDUNGI SOALAN-SOALAN YANG AKAN MENENTUKAN KEPUTUSAN ANDA SAMADA ANDA MENERIMA PRODUK YANG MENGANDUNGI COLLAGEN-LIKE PROTEIN DIPASARKAN DAN BERKEINGINAN UNTUK MEMBELI PRODUK TERSEBUT. Sila tandakan (/) jawapan anda.

I have no problems with the development of Collagen-Like Protein <i>Saya tiada masalah dengan penciptaan Collagen-Like Protein.</i>	1	2	3	4	5	6	7
I would substitute the animal-based collagen with Collagen-Like Protein if I were too anxious on the halal status of the product contain animal-based collagen. <i>Saya akan menggantikan kolagen yang berasaskan haiwan dengan Collagen-Like Protein jika saya terlalu bimbang tentang status halal produk yang mengandungi kolagen yang berasaskan haiwan.</i>	1	2	3	4	5	6	7

<p>I would prefer the Collagen-Like Protein product even if the price is more expensive than animal-based product.</p> <p><i>Saya lebih suka produk yang mengandung Collgen-Like Protein walaupun harganya lebih mahal daripada produk yang berasaskan haiwan.</i></p>	1	2	3	4	5	6	7
--	---	---	---	---	---	---	---



APPENDIX C: Result for all indicator before deletion

First Order Constructs	Items	Loadings	CR	AVE	α
Purchase Intention DV_PInt	PI1	0.865	0.856	0.666	0.745
	PI2	0.870			
	PI3	0.702			
Attitude IV1_ATT	ATT1	0.772	0.871	0.497	0.827
	ATT2	0.770			
	ATT3	0.497			
	ATT4	0.818			
	ATT5	0.676			
	ATT6	0.705			
	ATT7	0.649			
Religiosity IV2_REL	REL1	0.847	0.893	0.627	0.849
	REL2	0.865			
	REL3	0.729			
	REL4	0.700			
	REL5	0.803			
Trust IV3_TRUST	TR1	0.866	0.876	0.589	0.849
	TR2	0.870			
	TR3	0.754			
	TR4	0.693			
	TR5	0.624			
Perceived Risk on Health IV4a_HR	HR1	0.313	0.818	0.492	0.724
	HR2	0.710			
	HR3	0.775			
	HR4	0.819			
	HR5	0.765			
Perceived Risk on Social IV4b_SR	SR1	0.598	0.834	0.570	0.732
	SR2	0.516			
	SR3	0.909			
	SR4	0.911			
Perceived Risk on Environmental IV4c_ER	ER1	0.717	0.848	0.583	0.762
	ER2	0.718			
	ER3	0.794			
	ER4	0.818			
Perceived Risk on Quality and Halal IV4d_QHR	QHR1	0.817	0.878	0.592	0.828
	QHR2	0.850			
	QHR3	0.657			
	QHR4	0.711			
	QHR5	0.797			
Perceived Risk on Financial IV4e_FR	FR1	0.687	0.880	0.650	0.819
	FR2	0.848			
	FR3	0.861			
	FR4	0.816			

	KN1	0.510			
	KN2	0.779			
Knowledge	KN3	0.823	0.849	0.534	0.777
MV_KN	KN4	0.746			
	KN5	0.755			

