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**CONSUMER MARKET RESEARCH FOR OPTIMIZATION OF  
AN EXTRUDED SNACK PRODUCT AND PROCESS  
FOR THE INDONESIAN MARKET**

**A THESIS  
PRESENTED IN PARTIAL FULFILMENT  
OF THE REQUIREMENTS FOR THE DEGREE OF  
MASTER OF TECHNOLOGY IN FOOD TECHNOLOGY  
AT MASSEY UNIVERSITY - NEW ZEALAND**



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1996**

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## ABSTRACT

i

A coextruded snack based on corn, defatted soya flour and Indonesian ingredients (rice and/or tapioca) was developed for Indonesian consumers, particularly to fit into the young adult niche market. Market and consumer research was carried out through collecting primary and secondary data and the results were utilized in the formulation of the extruded snack. Information about the snack market situation in Indonesia and consumer attitude towards extruded snack products indicated that there is an opportunity for success for a new-western style snack (extruded snack) in Indonesia and the key for success are product awareness and product attributes, notably crispiness and flavour.

The snack base was manufactured using a co-rotating and intermeshing twin screw extruder (Clextral BC-21) with a constant feed rate and optimized by changing ingredients and extrusion conditions set by a constrained mixture design scheme (Echip computer software). The effect of the extrusion conditions and ingredients on the functional, physical properties of the snack product was also studied in this project. The product cost was also optimized with a constraint of no more than Rp. 4000 per kg (NZ\$ 2.70) finish snack product.

The study on the extrudate properties showed that an increase in rice flour increased moisture content (MC), Water Absorption Index (WAI), Nitrogen Solubility Index (NSI) and Breaking Strength (BS), while an increase in soya reduced the protein solubility and the extrudate became brownish. Consumer acceptability was mainly affected by the rice content, soya content and temperature in the last section (T4).

Specific Mechanical Energy (SME), an extrusion parameter, was calculated directly through torque measurements. Higher SME indicated higher energy used in the extrusion process, thus more starch degradation and protein denaturation occurred, producing extrudates with lower BS. Sensory evaluation showed that snacks with lower BS (a crispier product), higher  $L^*$  and  $b^*$  colour (light brownish yellow colour) had a higher acceptance.

The most preferred snack base was made from 28% defatted soya flour, 12% rice flour, 59.6% corn grits and 0.4% baking soda. These ingredients were processed in a twin screw extruder with a feed rate of 4.47 kg/hr. The four barrel temperature zones were set at 40°C, 80°C, 115°C and 140°C, respectively and 150 ml/hr of water was pumped to the barrel. The screw speed was set at 300 rpm. The snack acceptance was improved by coating the samples with flavours and the most preferred flavour determined by a sensory panel was a spicy flavour (Ethican - QZ 02346; Quest International).

The optimum product formulation was then tested in a larger scale consumer test in Indonesia. The results from the final product testing showed that the developed snack was accepted by the target consumers. However some improvements of the product in terms of oil content and product stickiness in the mouth are still necessary. The developed product had a better acceptance over the snacks already in the market in terms of nutritional image, crispiness, product appearance and main ingredients.

In addition a feasibility study on snack production in a single screw extruder was carried out and functional and physical properties of the resulting extrudates were compared with those produced using the twin screw extruder. The comparison of WAI, Glass transition temperature (T<sub>g</sub>), NSI and BS of snacks manufactured using a single (Lalesse, Universal single screw extruder) and a twin screw extruder (Clextral BC21) showed that the extent of molecules degradation was lower in the single screw extruder than in the twin screw extruder. Sensory properties also indicated that the twin screw extrudate was crispier and suited to the consumers' preference than the single screw extrudate.

The developed product could be produced commercially either using a twin screw extruder or a single screw extruder, depending on the available equipment, although it was recognized that the snack manufactured using the twin screw extruder had a higher preference compared to those produced using the single screw extruder.

**DEDICATION**

to my parent, Mr. and Mrs. Harminto,  
my sister and brothers, Daili, Ibnu and Ardian  
for their understanding and encouragement throughout my course.

*Make the best use of your possessions and capabilities to gain your goal;  
and accept the limits of the situation.*

*It is THE WAY IT IS, therefore LET IT GO.*

## ACKNOWLEDGEMENTS

iv

I would like to express my deepest gratitude to my chief supervisor, Dr. Osvaldo H Campanella and my second supervisor, Ms. Carol Pound for their valuable guidance, advice and encouragement provided throughout the project.

This project was financially sponsored by NZ Seed Bank Ltd. and Quest International Australasia Ltd., I express my sincere appreciation for their assistance. Special thanks are extended to Mr. Bill J Torrey, Mr. Robert Coulson, Mr. Jonathan Cameron and Ms. Judy Newell for their help and understanding.

I wish to thank Mr. W H Jones, Dr. Ajay Shah, Mr. Patrick Li, Mr. Wally Ostrowskyj, Mr. Karl Zuber for their assistance in the extrusion process; Mr. Peter Nuboer, Mr. Kelvin Hawkes, Ir. FX Eko Sudarminto for their useful consumer information.

I would also like to thank the Flavour and ingredient companies; Quest International, NZ Ltd., Bush Boake Allen, NZ Ltd., Haarmann & Reimer NZ, and NZ Dairy Board, NZ who provided flavouring samples in this project.

Many people in New Zealand and in Indonesia have contributed their cooperations either directly or indirectly during this study, I would like to thank to them, in particular to :

- The staff of Department of Food Technology, Massey University, especially Mr. Garry Radford, Mr. Alistair Young, Mr. Byron McKillop, Ms. Liza Duizer, Ms. Lynley Drummond, Mr. Mike Sahayam, Ms. June Latham and Mr. Steve Glassgow.
- The staff and students of Faculty Science and Technology, University of Western Sydney for their assistance during the single screw extrusion trials, especially to Assc.Prof. Jim Hourigan and Mr. John Connaughton.
- The staff and students of University of Widya Kartika and University of 17 Agustus, Surabaya for their help and cooperation during the research in Indonesia, especially Dr. J. Soewono, Ms. L. Birowo, Ir. I.G.A. Ari Agung.
- Indonesia consumers who participated in the product testing.
- My fellow graduates and friends in Palmerston North, Surabaya and Sydney, especially Ms. Saw Sze Chia, Ms. B. Noppon, Ir. T. Simatupang, Dr. S. Govindasamy, Ir. Pt A Ariyanti, Ms. Indrijati and Ms. Saw Peck Cheng.

## TABLE OF CONTENTS

<b>ABSTRACT</b> .....	i
<b>ACKNOWLEDGEMENT</b> .....	iv
<b>TABLE OF CONTENTS</b> .....	v
<b>LIST OF TABLES</b> .....	xiii
<b>LIST OF FIGURES</b> .....	xvii
<b>LIST OF APPENDICES</b> .....	xix
<b>SYMBOLES AND ABBREVIATIONS</b> .....	xxii
<b>PUBLICATION</b> .....	xxiii
<b>CHAPTER 1            INTRODUCTION</b> .....	1
1.1    Product development .....	1
1.2    Consumer involvement in the product development process ...	2
1.3    Why an extruded snack was selected as the prototype product for the indonesian market .....	5
1.4    Aim and objectives .....	6
1.5    Project constraints .....	7
1.6    Project strategy .....	8
<b>CHAPTER 2            LITERATURE REVIEW</b> .....	10
2.1    Extrusion .....	10
2.1.1    Definition .....	10
2.1.2    Extruder design .....	11
2.1.2.1          Single screw extruder .....	13

2.1.2.2	Twin screw extruder . . . . .	15
2.1.3	Application . . . . .	16
2.2	The functional properties of raw materials used in extrusion cooking for the manufacture of a snack product . . . . .	18
2.2.1	Structure forming agents . . . . .	20
2.2.2	Dispersion agents or fillers . . . . .	21
2.2.3	Plasticisers and lubricants . . . . .	22
2.2.4	Nucleants for gas bubble formation . . . . .	23
2.2.5	Flavouring agents . . . . .	24
2.2.6	Colouring agents . . . . .	25
2.3	Raw material properties changes during extrusion process for an expanded snack . . . . .	26
2.3.1	Starch degradation . . . . .	26
2.3.2	Protein denaturation . . . . .	29
2.3.3	Protein-carbohydrate interaction in the extrusion process . . . . .	31
2.3.4	Rheology properties . . . . .	32
2.3.5	Specific Mechanical Energy . . . . .	33
2.4	Extrudate properties assessment . . . . .	34
2.4.1	Water Absorption Index (WAI) and Water Solubility Index (WSI) . . . . .	34
2.4.2	Nitrogen Solubility Index (NSI) . . . . .	36
2.4.3	Glass transition temperature (Tg) . . . . .	36
2.4.4	Texture measurement . . . . .	37
2.4.5	Colour measurement . . . . .	38
2.5	CONSUMER AND MARKET RESEARCH . . . . .	39
2.5.1	Data collection in market and consumer research . . . . .	40
2.5.1.1	Research objectives . . . . .	40
2.5.1.2	Types of data collection . . . . .	40
2.5.1.3	Research implementation . . . . .	42
2.5.1.4	Data interpretation . . . . .	42
2.5.2	Product attributes and product position in the market . . . . .	43

2.5.3	Sensory techniques . . . . .	43
2.5.3.1	Techniques for measuring sensory response . . . . .	44
2.5.3.2	Consumer panel . . . . .	45
2.5.3.3	Environment . . . . .	46
2.5.3.4	Correlation between sensory evaluation with objective measurements . . . . .	47
2.6	Product optimization . . . . .	48
2.6.1	Linear programming . . . . .	50
2.6.1.1	Definition and application of linear programming in product optimization . . .	50
2.6.1.2	The structure of linear programming in formulation . . . . .	50
2.6.2	Mixture experimental design . . . . .	51
2.6.2.1	General mixture experiment . . . . .	51
2.6.2.2	Structure of mixture experimental design . . . . .	52
2.6.3	Echip experimental design program . . . . .	52

### **CHAPTER 3            PRELIMINARY STUDY OF SNACK DEVELOPMENT . . . . .**

3.1	Snack market situation . . . . .	54
3.1.1	Trend of snack market in the world . . . . .	54
3.1.2	Snack market in Indonesia . . . . .	57
3.2	Consumer study for expanded snacks . . . . .	65
3.2.1	Aim of the consumer study . . . . .	65
3.2.2	Focus group and consumer study evaluation . . . . .	66
3.2.3	Consumer attitude towards an expanded snack . . . . .	67
3.2.4	Important product attributes of an extruded snack . . . . .	69
3.2.4.1	Important product attributes considered when purchase an extruded snack . . . . .	70

3.2.4.2	Important product attributes considered when an extruded snack is consumed . . .	73
3.2.5	Product concept testing for extruded snack . . . . .	76
3.2.5.1	Participants' attitudes towards raw materials . . . . .	76
3.2.5.2	Buying attitudes towards product concept . . . . .	79
3.3	Conclusion of the preliminary study . . . . .	80
<b>CHAPTER 4</b>	<b>MATERIALS AND METHODS . . . . .</b>	<b>81</b>
4.1	Materials . . . . .	81
4.1.1	Raw materials . . . . .	81
4.1.2	Flavour ingredients . . . . .	81
4.1.3	Ingredient mixture preparation . . . . .	82
4.1.4	Storage of extrudates before analysis . . . . .	82
4.2	Extruder operation . . . . .	82
4.2.1	Twin screw extruder . . . . .	82
4.2.2	Single screw extruder . . . . .	84
4.3	Methods . . . . .	86
4.3.1	Raw materials . . . . .	86
4.3.1.1	Particle size distribution . . . . .	86
4.3.1.2	Moisture content . . . . .	86
4.3.1.3	Water absorption index and water solubility index . . . . .	87
4.3.1.4	Nitrogen solubility index . . . . .	88
4.3.2	Extrudates . . . . .	90
4.3.2.1	Functional properties analysis . . . . .	90
4.3.2.1.1	Moisture content . . . . .	90
4.3.2.1.2	Water absorption index and water solubility index . . . . .	91
4.3.2.1.3	Nitrogen solubility index . . . . .	91
4.3.2.1.4	Glass transition temperature . . . . .	91

4.3.2.2	Physical properties	92
4.3.2.2.1	Colour measurement	92
4.3.2.2.2	Texture measurement	93
4.4	Sensory evaluation	94
4.4.1	Panellists	94
4.4.1.1	Flavour screening	95
4.4.1.2	Formulation development	95
4.4.1.3	Final consumer test	96
4.4.2	Testing environment	96
4.4.3	Line scale acceptability test	96
4.4.4	Hedonic preference test	97
4.4.5	Ranking test	98
4.4.6	<i>Just right</i> scales test	98
4.5	Calculation of specific mechanical energy	99
4.6	Cost optimization	101
4.7	Data processing method	104

<b>CHAPTER 5</b>	<b>STUDY OF PROPERTIES OF THE EXTRUDED SNACK BASE MANUFACTURED USING A TWIN SCREW EXTRUDER</b>	<b>106</b>
5.1	Introduction	106
5.2	Preliminary product cost optimization	107
5.3	Experimental design for the extruded snack base formulation	108
5.4	Analysis of raw materials and extrudate	111
5.4.1	Raw materials	111
5.4.2	Extrudates	112
5.4.2.1	Functional properties analysis	112
5.4.2.2	Physical properties analysis	112
5.4.2.3	Acceptability test	112
5.4.2.4	Specific mechanical energy	115
5.5	Results: effect of ingredients and process conditions on the extrudate characteristics	115

5.5.1	Functional properties . . . . .	115
5.5.1.1	Moisture Content (MC) . . . . .	115
5.5.1.2	Water Absorption Index (WAI) . . . . .	118
5.5.1.3	Water solubility index (WSI) . . . . .	119
5.5.1.4	Nitrogen solubility index (NSI) . . . . .	121
5.5.2	Specific mechanical energy (SME) . . . . .	122
5.5.3	Physical properties . . . . .	124
5.5.3.1	Breaking strength . . . . .	124
5.5.3.2	Colour measurement . . . . .	124
5.5	Acceptability . . . . .	125
5.6	The relationship between specific mechanical energy and extrudate physicochemical properties . . . . .	126
5.7	Correlation between consumer acceptability and extrudate physical characteristics . . . . .	133
5.8	Conclusion . . . . .	136
<b>CHAPTER 6</b>	<b>EXTRUDED SNACK FORMULATION . . . . .</b>	<b>138</b>
6.1	Snack base formulation . . . . .	139
6.1.1	Introduction . . . . .	139
6.1.2	Method in obtaining the snack base formulation . . . . .	139
6.1.3	The optimum snack base formulation . . . . .	139
6.2	Flavour coating formulation . . . . .	141
6.2.1	Aim . . . . .	142
6.2.2	Flavour development procedures . . . . .	142
6.2.2.1	Sample preparation . . . . .	143
6.2.2.2	Flavour screening method . . . . .	146
6.3	Flavour development results . . . . .	149
6.3.1	First flavour screening . . . . .	149
6.3.2	Second flavour screening . . . . .	149
6.3.3	Third flavour screening . . . . .	152
6.4	Conclusion . . . . .	156

<b>CHAPTER 7</b>	<b>FINAL CONSUMER PRODUCT TESTING</b>	157
7.1.	Aim of final consumer product testing	157
7.2.	Procedure in testing the snack	157
7.2.1	Selection of consumers and testing venue	157
7.2.2	Sample preparation	158
7.2.3	Questionnaire	158
7.2.4	Data processing and analysis of results	160
7.3	Evaluation of the extruded snack concept by consumers in Indonesia	160
7.3.1	Acceptance of soy as an ingredient	161
7.3.2	Frequency of snack consumption	161
7.3.3	Consumer expectation of extruded snack characteristics	162
7.4	Consumer acceptability of the new extrudate snack	166
7.5	Comparison with other commercial products	168
7.6	Consumer purchase intention	170
7.7	Price and packet size of the new extrudate snack	171
7.8	Conclusion	173
<b>CHAPTER 8</b>	<b>COMPARISON BETWEEN SINGLE AND TWIN SCREW EXTRUDERS FOR THE MANUFACTURE OF THE SNACK PRODUCT</b>	175
8.1	Introduction	175
8.2	Single screw extrudate study	176
8.2.1	Experimental conditions used on the single screw extruder	176
8.2.2	Extrudates analysis	177
8.2.2.1	Functional and physical properties analysis	177
8.2.2.2	Sensory evaluation	177

8.3	Result: single screw extrudate characteristics . . . . .	178
8.3.1	Effect of feed moisture and feed rate on single screw extrudate characteristics . . . . .	181
8.3.2	Relationship between Specific Mechanical Energy (SME), Glass Transition Temperature (Tg) and Breaking Strength (BS) . . . . .	182
8.4	Comparison of extrudate characteristics produced with single and twin screw extruders . . . . .	184
8.5	Comparison of product preference between single screw and twin screw extrudates . . . . .	187
8.6	Conclusion . . . . .	191
 <b>CHAPTER 9            O V E R A L L   D I S C U S S I O N   A N D</b>		
	<b>RECOMMENDATIONS . . . . .</b>	<b>193</b>
9.1	Introduction . . . . .	193
9.2	Overall discussion and conclusions . . . . .	193
9.2.1	Market opportunity for extruded snack in Indonesia . .	193
9.2.2	Application of a Design Experimental Software (Echip) in this study . . . . .	194
9.2.3	Selection of extrusion cooking as an alternative process for snack manufacture . . . . .	195
9.2.4	Feasibility of In-house testing in extruded snack development . . . . .	196
9.2.5	The use of consumer (untrained) panellists over trained panellists in this study . . . . .	197
9.2	Recommendations for further study . . . . .	198
 <b>REFERENCES . . . . .</b>		<b>200</b>
 <b>APPENDICES . . . . .</b>		<b>213</b>

## LIST OF TABLES

Table 1.1	Systematic development process . . . . .	2
Table 1.2	Consumer panel involvement in the product development process . . . . .	5
Table 2.1	Extrusion process application . . . . .	17
Table 2.2	Raw materials commonly used to produce extruded snacks . . .	19
Table 2.3	Advantages and disadvantages of central location and in-house test environment . . . . .	47
Table 3.1	Extruded snack available in the Surabaya market . . . . .	60
Table 3.2	Modern snacks available in Surabaya. Classified according to brand, flavour, suppliers, size and consumer price. December 1995 . . . . .	62
Table 3.3	Frequency of consumption of corn extruded snack . . . . .	67
Table 3.4	Types of preferable flavour . . . . .	69
Table 3.5	Important product attributes when purchase an extruded snack . . . . .	70
Table 3.6	Degree of importance on each characteristic when purchase an extruded snack . . . . .	71
Table 3.7	Important product attributes when an extruded snack is consumed . . . . .	73
Table 3.8	Product attributes when snack is consumed ranked by the degree of importance . . . . .	74

Table 3.9	Extruded snack product concept . . . . .	76
Table 3.10	Preference to include soya bean as an ingredient of an extruded snack . . . . .	77
Table 3.11	Preference of samples and raw materials estimated by the participants . . . . .	78
Table 3.12	Willingness to buy the new product . . . . .	79
Table 4.1	Seven point verbal hedonic scale . . . . .	97
Table 4.2	Example of a <i>just right</i> scale . . . . .	99
Table 4.3	Cost of ingredients used in the snack formulation . . . . .	102
Table 4.4	Decision variables in the snack base formulation . . . . .	103
Table 5.1	Model for cost minimization . . . . .	107
Table 5.2	Solution on cost minimization model using linear programming	108
Table 5.3	Raw materials used in the study . . . . .	109
Table 5.4	Transformation of mixture variables percentages into ratios . .	110
Table 5.5	Variables used in the experimental design . . . . .	110
Table 5.6	Equation coefficient and variables which affected the extrudate's moisture content (MC) . . . . .	116
Table 5.7	Equation of coefficient and variables which affected the extrudate's water solubility index (WSI) . . . . .	119
Table 5.8	Coefficient of the model and variables which affected the extrudate's nitrogen solubility index (NSI) . . . . .	121

Table 5.9	Variables and coefficient equation which affected the SME . . .	123
Table 6.1	The most acceptable snack base formulation and process . . . . .	141
Table 6.2	Flavour samples used in the flavour development . . . . .	144
Table 6.3	The adjustment of flavouring agent for the snack formulation and the total product cost . . . . .	145
Table 6.4	Flavour grouping and order of preference . . . . .	150
Table 6.5	The product preference on each flavour group . . . . .	154
Table 6.6	Ranking preference test among corn, savory, barbecue and spicy flavours . . . . .	156
Table 7.1	Frequency of any snack products consumption by extruded snack eater and non extruded snack eater . . . . .	162
Table 7.2	Favourable characteristics expected by consumers . . . . .	164
Table 7.3.	Snacks existing in the Indonesian market ranked by order of preference . . . . .	165
Table 7.4	Unfavourable characteristics found by consumers on snacks currently in the market . . . . .	166
Table 7.5	Developed snack acceptability tested by itself . . . . .	167
Table 7.6	Results of the blind test to determine the snack preference . . .	169
Table 7.7	Buying frequency for the new product . . . . .	170
Table 7.8	Price recommendation from consumers who answered that they would buy the product, when compared with similar product's price that they are currently purchasing . . . . .	172

Table 7.9	Packet size recommended by the consumers who were willing to buy the product, in comparison with similar product packets that they are currently purchasing . . . . .	173
Table 8.1	Ingredients for formulation 5 (consumer test formulation) . . .	176
Table 8.2	Different extrudate texture . . . . .	178
Table 8.3	Analysis on functional and physical properties of single screw extrudate . . . . .	179
Table 8.4	F-values to study the effect of variables (ingredients moisture and feed rate) on the physical and functional properties of extrudates using ANOVA . . . . .	180
Table 8.5	Snack characteristics produced on single screw and twin screw extruders . . . . .	185
Table 8.6	Comparison snack preference and crispiness between single screw and twin screw extrudates . . . . .	188
Table 8.7	Relationship between degree of crispiness ( <i>just right</i> test) and texture preference (hedonic test) for snacks produced with the single screw extruder . . . . .	190
Table 8.8	Relationship between degree of crispiness ( <i>just right</i> test) and texture preference (hedonic test) for snacks produced with the twin screw extruder . . . . .	190
Table A4.1	Preliminary trials . . . . .	222
Table A4.2	Size distribution of corn meal used in preliminary trials . . . . .	224
Table A4.3	Analysis of extrudates produced during the preliminary trials .	226

## LIST OF FIGURES

Figure 1.1	Schematic diagram of the project strategy . . . . .	9
Figure 3.1	Snack consumption per capita and per year in various countries. 1993 . . . . .	55
Figure 3.2	Stages of maturity for snack food markets in several countries in 1993 . . . . .	55
Figure 3.3	Several commercial snack products available in the market . . .	64
Figure 4.1	Twin screw extruder (Cleextral BC-21, France) . . . . .	83
Figure 4.2	Schematic diagram of the screw configuration used in the snack development . . . . .	84
Figure 4.3	Lalesse universal single screw extruder (87-780) . . . . .	85
Figure 4.4	A typical curve of obtained during DSC measurements . . . . .	92
Figure 4.5	Chisel probe for testing extrudate samples . . . . .	94
Figure 5.1	Samples delivered to the panellist . . . . .	114
Figure 5.2	Trend of the relationship between breaking strength and specific mechanical energy . . . . .	127
Figure 5.3	Trend of the relationship between Tg and SME . . . . .	128
Figure 5.4	Trend of the relationship between Tg and SME for selected formulations . . . . .	129
Figure 5.5	Trend of the relationship between WAI and SME . . . . .	130
Figure 5.6	Trend of the relationship between WSI and SME . . . . .	131

Figure 5.7	Trend of the relationship between NSI and SME . . . . .	131
Figure 5.8	Examples of trend on a single formulation . . . . .	132
Figure 5.9	Relationship between consumer acceptability and extrudate breaking strength . . . . .	134
Figure 5.10	Correlation between consumer acceptability and colour measurements . . . . .	135
Figure 6.1	Stages on the extruded snack formulation . . . . .	138
Figure 6.2	Acceptability of the snack base . . . . .	140
Figure 6.3	Flavour screening stages . . . . .	147
Figure 6.4	Six different flavoured snack samples . . . . .	153
Figure 7.1	Samples evaluated in the first section of the final product testing . . . . .	159
Figure 8.1	Correlation between breaking strength (BS) and SME . . . . .	183
Figure 8.2	Correlation between Tg and SME . . . . .	183
Figure 8.3	Correlation between BS and Tg . . . . .	184
Figure 8.4	Samples manufactured using twin screw extruder (1) and single screw extruder (2) . . . . .	188
Figure A4.1	Diagram of extrudate's structure . . . . .	224

## LIST OF APPENDICES

Appendix 3.1 Questionnaire format used in the focus group discussion. Preliminary consumer study of expanded snack . . . . .	213
Appendix 3.2 Important characteristics considered when purchasing an extruded snack . . . . .	217
Appendix 3.3 Important characteristics considered when consuming an extruded snack . . . . .	218
Appendix 3.4 Familiarity with corn snacks . . . . .	219
Appendix 3.5 Occasions to consume the snack product . . . . .	220
Appendix 4.1 Preliminary production trials . . . . .	221
Appendix 5.1 Experimental conditions for the 31 trials (based on the experimental design) . . . . .	228
Appendix 5.2 Ingredients particle size distribution . . . . .	230
Appendix 5.3 Analysis of functional properties of ingredients mixtures . . . .	231
Appendix 5.4 Format of general testing information and questionnaire sheet . . . . .	232
Appendix 5.5 Randomized samples code for acceptability test . . . . .	233
Appendix 5.6 Ratio on line scale acceptability test for snack base formulation . . . . .	235
Appendix 5.7 Extrudate functional and physical properties analysis . . . . .	238

Appendix 5.8 Coefficients of estimated quadratic models for the following parameters: moisture content (MC), water absorption index (WAI), water solubility index (WSI) and nitrogen solubility index (NSI) . . . . .	240
Appendix 5.9 Coefficients of estimated quadratic models for the following parameters: breaking strength (BS), $L^*$ colour, $a^*$ colour, $b^*$ colour, $\Delta E^*$ colour and acceptability (accept.) . . . . .	241
Appendix 6.1 Analysis of variance (ANOVA) and Tukey's honestly significant different test used for the snack basic formulation acceptability . . . . .	242
Appendix 6.2 Cost of snack extrudate for each formulation . . . . .	243
Appendix 6.3 Ranking test questionnaire used in the second stage of flavour screening . . . . .	244
Appendix 6.4 Questionnaire for the preference product test used in the flavour development . . . . .	245
Appendix 6.5 Questionnaire for the ranking test used in the flavour development . . . . .	246
Appendix 6.6 Calculation of product cost . . . . .	247
Appendix 6.7 Results of preference ranking test on each flavour group . . . . .	250
Appendix 6.8 Re-evaluation test for the chicken and barbecue flavours . . . . .	251
Appendix 6.9 Panellists' responds for each sample . . . . .	252
Appendix 6.10 Analysis of variance and Tukey's honestly significant different test for each product attribute . . . . .	255
Appendix 7.1 Questionnaire form for final consumer product testing written in Bahasa Indonesia . . . . .	258

Appendix 7.2 Questionnaire form for final consumer product testing written in English . . . . .	263
Appendix 7.3 Summary of results from the final product testing . . . . .	268
Appendix 8.1 Ingredients for formulation 5 and processing conditions used on the single screw extruder experiment . . . . .	276
Appendix 8.2 Formulation 5 manufactured using the twin screw extruder at different process conditions . . . . .	277
Appendix 8.3 Format of questionnaire for sensory evaluation . . . . .	278
Appendix 8.4 Panellists' respond on sensory evaluation between twin screw extruder and single screw extruder . . . . .	279
Appendix 8.5 Relationship between degree of crispiness ( <i>just right</i> test) versus texture preference (hedonic test) on single screw and on twin screw extruders . . . . .	280

## SYMBOLS AND ABBREVIATIONS

TSE	:	Twin Screw Extruder
SSE	:	Single Screw Extruder
RSE	:	Reverse Screw Element
T1	:	Temperature at the first zone in the twin screw extruder
T2	:	Temperature at the second zone in the twin screw extruder
T3	:	Temperature at the third zone in the twin screw extruder
T4	:	Temperature at the forth/last zone in the twin screw extruder
MC	:	Moisture Content
w/w	:	Weight per weight basis
wwb	:	Weight by wet basis
WAI	:	Water Absorption Index
WSI	:	Water Solubility Index
NSI	:	Nitrogen Solubility Index
Tg	:	Glass transition temperature
BS	:	Breaking Strength
SME	:	Specific Mechanical Energy

All other abbreviations are standard chemical, mathematical or country symbols.

**PUBLICATION**

**Indrawati, Y., Pound, C. and Campanella, O.H. (1996)** Extruded snack development. A study of the correlation between its physical properties and consumer acceptability. *Southern Connection - Joint conference of the New Zealand Institute of Food Science & Technology (NZIFST) and the New Zealand Biotechnology Association (NZBA)*. Lincoln University. New Zealand.