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Summary report of and papers presented at the tenth session of the

WORKING PARTY ON FISH TECHNOLOGY AND MARKETING

Colombo, Sri Lanka, 4-7 June 1996

Food and Agriculture Organization of the United Nations

ASIA-PACIFIC FISHERY COMMISSION

SUMMARY REPORT OF AND PAPERS PRESENTED AT THE

TENTH SESSION OF THE WORKING PARTY ON FISH TECHNOLOGY AND MARKETING

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FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
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ABSTRACT

This publication contains a summary report of the tenth session of the APFIC Working Party on Fish Technology and Marketing held in Colombo, Sri Lanka, from 4 to 7 June 1996. It is supplemented by the 46 papers presented and discussed at the session. The proceedings are divided into five sections. The first section contains papers on public health and fish microbiology; the second on the quality and storage of fish and fishery products; the third covers the subject of fish lipids and the fourth product development, particularly from low-valued species. The final section contains five papers of general interest.

CONTENTS

	Page
SUMMARY REPORT OF THE TENTH SESSION OF THE APFIC WORKING PARTY ON FISH TECHNOLOGY AND MARKETING	1
APPENDIX A - List of Participants	5
PAPERS PRESENTED AT THE SESSION	
SECTION I - MICROBIOLOGY	
Polymerase chain reaction based methods for rapid detection of pathogenic *Vibrio* spp. in seafoods by I. Karunasagar, G. Sugumar, B.B. Nayak and I. Karunasagar	11
Studies on phage pattern, antibiotic sensitivity and enterotoxigenicity of *Staphylococcus aureus* strains isolated from fish and factory workers by S. Sanjeev, J. Stephen and K. Gopakumar	17
Prevalence of pathogenic vibrios in coastal waters and fishes of Cochin (India) by N. Thampuran, P.K. Surendran and K. Gopakumar	25
Evaluation of microbiological quality of coastal water taken from several landing sites along the North Java coastal area by Sunarya, Kukuh S. Achmad, Budi Susilowati and Tri Pratiwi	35
Antibacterial potential of lactic acid bacteria isolated from fermented fish products in Thailand by P.K. Ben Embarek, Ch. Wedell-Neergaard, O. Kongpun and H.H. Huss	39
Occurrence of *Clostridium botulinum* in farmed fish and shrimp in India by K.V. Lalitha and K. Gopakumar	43
SECTION II - QUALITY AND STORAGE	
Quality evaluation of iced stored major carps using k-value and fish tester (vi) readings by P.T. Lakshmanan and K. Gopakumar	55
Melanosis inhibition in shrimp treated with metabisulphite and "ever fresh" held under different storage conditions by S. Luckman, T.S.G. Fonseka and U. Edirisinghe	65
Post-harvest technology of Nile tilapia in Indonesia: a review by G. Irianto and H.E. Irianto	71
Ice storage studies of the stomatopod, *Oratosquilla nepa* by T. Rajeswary and M. Shahul Hameed	85

Page

Studies on quality changes of Skipjack (*Katsuwonis pelamis*) and Trevally (*Carangoides fulvoguttatus*) during frozen storage at -18°C
by C.V.L. Jayasinghe, V. Jayaweera and A. Bamunuarachchi 91

Study of quality grading system in salted fish trade by wholesalers in Jakarta
by N. Retnowati, Y.N. Fawzya and Suparno 99

Quality grading of salted fish and its effect on pricing of the product at production centers
by N. Retnowati, M. Saleh and Suparno 111

Effect of icing of raw material on the quality of dried smoked sand sea cucumber (*Holothuria scabra*)
by Yunizal, Tazwir, S. Nasran and Murdinah 119

N-nitroso compounds and bacteria related to the formation of nitrosamine in Thai salted fish
by M. Sangjindavong 125

Histamine in Maldive Fish
by S. Gunaratne, U. Samarajeewa, T.S.G. Fonseka and I.V. Ranjani 131

Detection of adulteration of cooked fish flesh by immunological methods
by R. Peranginangin, F.G. Winarno, M.B. Malole, D. Fardiaz and S. Fardiaz 139

Anaesthetization of lobster by a direct cooling technique for live transport in a dry pack system
by T.D. Suryaningrum, Suparno, S. Wibowo, M.D. Erlina 149

SECTION III - FISH LIPIDS

Nutritional significance of dietary fish lipids and proteins in patients with cardiovascular problems
by K. Devadasan and K. Gopakumar 155

Fatty acid composition of 32 species of low value fishes from Indian waters
by P.S. Reena, P.G. Viswanathan Nair, K. Devadasan and K. Gopakumar 167

Changes in sardine lipids during brining
by T.V. Sankar, P.D. Antony and K. Gopakumar 177

Efficacy of butylated hydroxy toluene to suppress oxidative rancidity in the squalene of crude liver oil of deep sea shark (*Centrophorus squamosus*)
by Yunizal, J. Basmal and M. Noor 183

Further studies of the effect of Indian gooseberry (*Phynanthus emblica*) extract on the preservation of fish oil
by E.M.R.K.B. Edirisinghe, A. Bamunuarachchi, V. Jayaweera and R. Samaradiwakara 189

Studies on the effect of some plant component extracts on the preservation of fish oils
by E.M.R.K.B. Edirisinghe, A. Bamunuarachchi, V. Jayaweera and R. Samaradiwakara 199

Page

The effect of natural and artificial antioxidants on shark (*Carcharhinus falciformis*) liver oil during storage
by C.V.L. Jayasinghe, A. Bamunuarachchi and M.U. Jayasekara 207

The variation of fat content and fatty acid profile of black tiger shrimp (*Penaeus monodon* Fab) taken from several different habitats
by Sunarya, Nurjanah, Nurlela and Patawi 215

Omega-3 fatty acids from the heads and eye sockets of bigeye (*Thunnus obesus*) and yellowfin (*Thunnus albacores*) tuna
by E.B. Panggat and L.C. Rivas 223

Utilization of fish oil in beef and chicken sausage processing
by H.E. Irianto, Y.N. Fawzya and N. Retnowati 235

SECTION IV - PRODUCT DEVELOPMENT

Hydrolysis and functional properties of proteins from *L. subviridis*
by S.Y. Yu and R. Ahmad 247

Development of fishburgers from *S. leptolepis, A. monoceros* and *A. nobilis*
by S.Y. Yu and W.M. Siah 257

Quality of extruded food product made from corn, rice and fish flour mixture
by Y.N. Fawzya, M. Rufina, Sugiyono and H.E. Irianto 265

Quality evaluation of bread fortified with surimi and surimi flour during storage
by Y.N. Fawzya, Suparno, I. Muljanah and R. Peranginangin 271

Use of fish protein concentrate from *Muraenosox talabon* for bread enrichment
by Y.N. Fawzya, Suparno, Sugiyono and R. Peranginangin 279

Use of protein concentrate from recovered fish meat for extruded food products
by Murdinah, Suparno, M. Saleh and A. Setyani 287

Utilization of shark cartilage for preparation of fish glue
by Murdinah, Suparno, N. Indriati and N. Haq 293

Storage behaviour of semi-dried dhoma cake in different relative humidities
by A. Ramachandran and T.V. Sankar 299

Production of gelatin from fish skin
by W. Klaypradit and W. Worawattanamateekul 307

Suitability of trawl by catch for surimi preparation
by V. Muraleedharan and K. Gopakumar 315

A comparative study between machine peeled and hand peeled shrimp
by A. Ramachandran and M. Shahul Hameed 321

Page

Introduction of a new smoking technique in Andhra Pradesh
by V. Salagramma 329

Some bio-chemical changes of fermented fish (Jaadi) during bio-preservation
by P. Jayasinghe, T.S.G. Fonseka and A. Bamunuarachchi 335

SECTION V - GENERAL

Quantitative data on post harvest fish losses using informal data collection techniques
by A. Ward 345

Possible control strategy for the control of insect infestation in traditionally processed fish in the tropics
by C. Johnson and J. Esser 357

Development of a microbial insecticide for use against the dipteran pests of traditionally processed fish
by C. Johnson and A. Bishop 359

The ODA Post-harvest fisheries project's role in working with small-scale fishing communities in the post-harvest sub-sector
by D. King and V. Salagrama 365

Status of post-harvest fisheries technology in Vietnam and proposals for development
by N. V. Ngoan 371

UTILIZATION OF FISH OIL IN BEEF AND CHICKEN SAUSAGE PROCESSING

by

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ABSTRACT

A study on the utilization of fish oil in the processing of beef and chicken sausage was carried out. The levels of addition of fish oil were 0, 3, 5 and 7%. The sausages were analyzed chemically, microbiologically and organoleptically to determine their acceptability and storage stability. Results of sensory evaluation showed insignificant score differences among the products and this indicates that the fish oil addition up to 7% in the beef and chicken sausage production is acceptable. Acceptability of beef and chicken sausages reduced sharply after 4 and 8 day chill storage, respectively.

INTRODUCTION

Recently, fish oil has received wide attention from researchers and the public, due to its therapeutic benefits. Fish oil contains considerable amounts of omega-3 poly-unsaturated fatty acids (PUFA). Dietary intake of omega-3 PUFA has been linked with blood cell anti-aggregation and reduced risk of coronary heart disease (Hearn *et al.*, 1987). Fishy odour and taste are the main problems encountered in fish oil consumption (Irianto, 1992). By adding food products, those undesirable properties of fish oil are expected to be hidden.

This study investigated the possibility of the use of fish oil in sausage manufacture. Sausage is an emulsion product that is an emulsion of oil phase into water phase with protein as emulsifier. Sausages encountered in the Indonesian market are beef, chicken and pork sausages. However, this study concentrated to beef and chicken sausages dominating the market. Vegetable oil and margarine are normally used for sausage production in Indonesia. Both of them were then replaced by fish oil in this study. The aim of the study was to investigate the optimum addition level of fish oil that produced the acceptable products.

MATERIALS AND METHODS

Materials

Sardine oil used was supplied by PT Indo Bali, Negara, Bali. The oil that was a-by-product of fish meal processing was refined using a method developed by Pudjiati (1995) as shown in Appendix 1. Free fatty acid value of refined fish oil was 0.14 % (oleic acid).

Beef and chicken used for the raw material of the sausages were purchased from a Supermarket in Jakarta.

Methods

Sausages were processed by applying a method previously used by Irianto (1993) as in Appendix 2, but fish oil was used instead of vegetable oil. The fish oil levels added were 0, 3, 5 and 7%. Sausages were then stored at chill temperature (+5°C) and withdrawn every two days during a 10-day storage period.

Analyses

Free fatty acid (FFA) value of refined fish oil was determined (Fernandez, 1986). Sausages were analyzed organoleptically, chemically and physically as follows:

Organoleptic analyses:	preference test (see Appendix 3 for score sheet).
Chemical analyses:	moisture content (AOAC, 1984) and thiobarbituric acid value/TBA value (Lemon, 1975).
Physical analyses:	folding test (Nasran and Tambunan, 1974).

RESULTS AND DISCUSSION

Product Acceptability

Acceptability scores of the evaluated sensory properties of sausages can be seen in Table 1. In terms of appearance, colour and texture scores, the product showed an insignificant acceptability difference. However, odour and taste acceptabilities were significantly affected by the level of addition of fish oil. Odour and taste acceptability scores decreased with increase of fish oil. This was more obvious in beef sausage than in chicken sausage. Undesirable odour remaining in fish oil was probably the main cause of this occurrence as the fish oil was not deodorized during alkali refining.

Table 1

Sensory acceptability score of beef and chicken sausage

Sausage	Fish Oil Level (%)	Score				
		Appearance	Colour	Odour	Taste	Texture
Beef	0	4.8	4.2	5.0	5.3	4.4
	3	4.7	4.1	4.8	4.9	4.2
	5	4.5	4.3	4.5	4.7	4.0
	7	4.8	4.3	4.2	4.3	4.4
Chicken	0	5.1	5.2	5.1	5.0	5.1
	3	4.8	4.8	4.9	4.4	5.0
	5	4.8	4.8	4.7	4.1	5.5
	7	4.7	4.7	4.5	4.1	5.1

Changes in Sausages During Chill Storage

Organoleptic Changes

Preference scores of panellists to organoleptic properties of the product can be seen in Tables 2, 3, 4, 5 and 6.

Appearance

Preference score of appearance for both sausages decreased during 10 days chilling storage (Table 2). The decrease in beef sausage was sharper than in chicken sausage. The appearance of chicken sausage was still acceptable until 6 days storage and then rejected at the eighth day of storage. However, the appearance of beef sausage was rejected after 4 days storage. The addition of fish oil did not induce significant difference of appearance score among the sausage during storage.

Table 2

Acceptability changes of appearance score of beef and chicken sausages during chill storage

Sausage	Fish Oil Level (%)	Storage Period (days)					
		0	2	4	6	8	10
Beef	0	4.8	4.4	4.4	1.8	3.0	2.2
	3	4.7	4.4	3.8	2.4	2.5	2.9
	5	4.5	4.2	3.2	2.3	2.0	2.6
	7	4.8	3.9	3.6	2.4	2.3	3.0
Chicken	0	5.1	5.4	5.5	4.5	4.4	3.9
	3	4.8	5.5	5.3	5.1	4.2	3.6
	5	4.8	5.7	5.2	4.7	3.8	3.6
	7	4.7	5.8	5.2	4.8	3.7	3.8

Colour

Colour of chicken sausage was more acceptable than beef sausage (colour of chicken sausage was whiter than that of beef sausage). That colour difference was probably mainly due to natural property difference of meat used as raw materials, particularly pigment compounds. Acceptability score of sausage colour reduced with storage period (Table 3). Score reduction rate in beef sausage was higher than in chicken sausage. Fish oil addition did not significantly influence colour acceptability of sausages. Colour of beef and chicken sausages was rejected by panellists after 4 and 8 days storage, respectively.

Table 3

Colour acceptability scores of beef and chicken sausages during chill storage

Sausage	Fish Oil Level (%)	Storage Period (days)					
		0	2	4	6	8	10
Beef	0	4.2	4.5	3.9	1.8	2.3	2.0
	3	4.1	4.5	3.6	2.4	2.5	2.3
	5	4.3	4.3	3.2	2.3	2.0	2.7
	7	4.3	4.2	3.6	2.4	2.3	2.8
Chicken	0	5.2	5.7	5.8	5.1	4.3	3.8
	3	4.8	5.5	5.7	5.2	4.3	3.6
	5	4.8	5.6	5.8	4.9	3.7	3.6
	7	4.7	5.6	5.7	5.2	3.8	3.8

Odour

Odour acceptability scores of beef and chicken sausages were different, with beef sausage tending to be lower than chicken sausage. The scores reduced during storage and reduction rate in beef sausage was higher than found in chicken sausage (Table 4). Rejection was probably caused by oxidation and protein decomposition processes producing undesirable odour. In terms of the odour, all beef sausages fortified with fish oil were rejected after 4 days storage. The odour of chicken sausages fortified with both 5 and 7% fish oil was rejected after 6 days storage, but that of sausage fortified with 3% fish oil was rejected after 8 days storage. Fish oil addition levels affected the odour acceptability of sausages during storage. The more fish oil added, the lower odour acceptability .

Taste

As for odour, the taste acceptabilities of beef and chicken sausages were different. The taste acceptability score of chicken sausages was significantly higher than that of beef sausages. The scores of all products decreased during storage (Table 5). In term of taste, all beef sausages were rejected after 4 days storage and all chicken sausages were rejected after 8 days storage.

Table 4

Changes of odour acceptability score of beef and chicken sausages during chill storage

Sausage	Fish Oil Level (%)	Storage Period (days)					
		0	2	4	6	8	10
Beef	0	5.0	5.2	4.8	2.0	3.3	1.2
	3	4.8	5.5	3.6	2.4	2.3	2.0
	5	4.5	4.6	3.3	2.4	2.3	2.0
	7	4.2	4.4	3.4	2.0	2.3	1.6
Chicken	0	5.1	5.7	5.7	4.2	3.7	3.0
	3	4.9	5.4	5.2	4.6	3.6	3.2
	5	4.7	5.3	5.2	3.8	2.8	2.8
	7	4.6	5.1	4.8	3.9	2.7	2.2

Table 5

Changes of taste acceptability score of beef and chicken sausages during chill storage

Sausage	Fish Oil Level (%)	Storage Period (days)					
		0	2	4	6	8	10
Beef	0	5.3	5.1	3.8	1.5	2.3	1.6
	3	4.9	4.8	3.1	1.7	2.0	1.1
	5	4.7	4.3	3.3	1.7	2.0	1.0
	7	4.3	4.0	2.8	1.7	2.0	1.1
Chicken	0	5.0	6.1	5.7	4.2	3.6	2.8
	3	4.4	5.5	5.5	4.7	3.7	3.1
	5	4.1	5.4	5.5	4.0	2.7	2.6
	7	4.4	5.4	5.0	4.2	2.6	2.4

Fish oil addition levels did not show any effects on the taste acceptability of beef sausage, but significant effect was found in chicken sausage. The more fish oil added into chicken sausage, the lower taste acceptability score of the product. Those effects were obvious in chicken sausage after 8 days storage.

Texture

Texture acceptability score during storage showed a decreasing trend which was faster in beef than in chicken sausage. Flesh structure differences of raw material may have induced texture acceptability differences of the product.

Fish oil addition level insignificantly affected sausage texture. Comparison between beef sausage with and without fish oil addition indicated that the fish oil addition reduced texture acceptability of beef sausage during storage. However, this was not noted in chicken sausage.

Table 6

Changes of texture acceptability score of beef and chicken sausages during chill storage

Sausage	Fish Oil Level (%)	Storage Period (days)					
		0	2	4	6	8	10
Beef	0	4.4	4.0	3.8	2.1	3.5	2.6
	3	4.2	4.0	3.2	2.5	2.3	1.3
	5	4.0	3.9	3.1	2.8	3.0	2.0
	7	4.4	3.6	3.2	2.7	2.5	1.9
Chicken	0	5.1	5.3	5.2	5.2	5.1	3.9
	3	5.0	5.6	5.5	5.5	4.9	3.8
	5	5.5	5.9	5.7	4.9	4.4	3.7
	7	5.1	6.1	5.7	5.1	4.6	3.5

Chemical Changes

Moisture Content

Fish oil addition and storage period did not induce any significant effect on moisture content of both beef and chicken sausages. The former indication was supported by the fact that fish oil addition level did not cause moisture content differences among the sausages. The latter by the fact that the moisture contents of sausages were relatively constant during storage.

Table 7

Changes of moisture content of beef and chicken sausages during chill storage (% w.b.)

Sausage	Fish Oil Level (%)	Storage Period (days)					
		0	2	4	6	8	10
Beef	0	71.05	71.49	71.72	71.13	71.95	71.00
	3	72.03	73.66	71.69	72.98	72.52	72.53
	5	70.08	70.55	71.61	72.17	70.82	70.68
	7	69.32	69.78	71.60	68.73	69.06	71.26
Chicken	0	72.20	70.15	70.52	70.69	68.21	70.55
	3	69.91	70.05	70.23	70.54	68.96	69.02
	5	71.35	69.83	68.61	69.95	70.05	69.50
	7	70.68	68.44	68.18	68.44	68.87	68.23

Thiobarbituric Acid (TBA) Value

TBA values of sausages increased during storage, except for beef sausage. TBA values of beef sausage with added fish oil increased up to the sixth day of storage, but then decreased. The decrease of TBA value was probably due to the reaction between malonaldehyde and amino acids, peptides and other compounds resulted from protein decomposition (Kwon *et al.*, 1965; Finley, 1985). Malonaldehyde may undergo aldol reactions producing a polymer mixture (O'Brien, 1987).

Fish oil addition resulted in sausages with higher TBA increase during storage compared to sausages without fish oil addition. Results also showed that the higher the fish oil addition level, the higher were the TBA values of the sausages at the end of storage.

Table 8

Changes of TBA values of beef and chicken sausages during chill storage (μmol/kg)

Sausage	Fish Oil Level (%)	Storage Period (days)					
		0	2	4	6	8	10
Beef	0	0.51	0.34	2.59	2.52	4.09	4.33
	3	1.00	2.22	2.65	7.94	4.52	3.67
	5	1.53	4.49	5.62	8.50	4.31	5.82
	7	1.97	3.54	3.98	3.77	5.07	9.45
Chicken	0	0.07	0.13	0.30	1.40	0.30	1.38
	3	1.02	1.33	1.00	1.93	2.98	2.42
	5	1.00	2.22	1.57	2.27	0.57	3.09
	7	0.76	1.88	1.18	1.64	2.02	2.10

Folding Test Value Changes

Chicken sausage had a higher folding test value than beef sausage. The amount of fish oil added did not significantly affect folding values of the sausage. These values decreased during storage, but the decrease in chicken sausage was lower than in beef sausage.

Table 9

Changes of folding value of beef and chicken sausages during chill storage

Sausage	Fish Oil Level (%)	Storage Period (days)					
		0	2	4	6	8	10
Beef	0	B	B	B	C	C	D
	3	B	B	C	C	C	D
	5	B	B	C	C	C	D
	7	B	B	C	C	C	D
Chicken	0	B	A	A	B	B	B
	3	B	A	A	B	B	B
	5	B	A	A	B	B	B
	7	B	A	A	B	B	B

CONCLUSIONS

Results of sensory evaluation indicated that fish oil addition up to 7% produced acceptable beef and chicken sausages.

This study showed that acceptability score differences for appearance, colour and texture among the products were insignificantly different. However, fish oil addition affected odour and taste acceptabilities. Acceptability of beef and chicken sausages reduced sharply after 4 and 8 days chill storage, respectively.

REFERENCES

AOAC. 1984. Official methods of analysis of the association of analytical chemists, AOAC Inc., Virginia.

Fardiaz, S. 1985. Food Microbiology. Laboratory Guide, Faculty of Agriculture Technology, Bogor Agricultural University, Bogor (In Indonesian).

Fernandez, C.C. 1986. Refinement of fish oil for human consumption: engineering investigation, Ph.D. Dissertation, University of Washington, Seattle.

Finley, J.W. 1985. Environmental effects on protein quality. In: Chemical changes in food during processing (Eds. T.Richardson and J.W.Finley), The AVI publishing Co.Inc., Westport, Connecticut.

Hearn, T.L., S.A. Sgoutas, J.A. Hearn and D.S. Sgoutas. 1987. Polyunsaturated fatty acids and fat in fish flesh for selecting species for health benefits, J.Food Sci 52: 1209-12.

Irianto, H.E. 1992. Fish oil: refining, stability and its use in canned fish for the Indonesian market, Ph.D. Thesis, Massey University, New Zealand.

Irianto, H.E. 1993. Processing of shark sausage. In: Compilation of the results of fishery post-harvest research (Eds. Suparno, S.Nasran and E. Setiabudi). Center Research Institute for Fisheries, Jakarta, p.252-3 (In Indonesian).

Kwon, T.W., Menzel, D.B. and H.S. Olcott. 1965. Reactivity of malonaldehyde with food constituents, J. Food Sci. 30: 808-13.

Lemon, D.W. 1975. An improved TBA test for rancidity. New series circular No.51, Halifax Laboratory. Fisheries and Marine Service, Halifax, Nova Scotia.

Nasran, S. and P.R. Tambunan. 1974. Preliminary study on the utilization of trash fish. In: Report of Fishery Technology Report No.2, Research Institute for Fishery Technology, Jakarta (In Indonesian).

O'Brien, P.J. 1987. Oxidation of lipids in biological membranes and intracellular consequences, In: Autoxidation of unsaturated lipids (Eds. H.W.S. Chan), Academic Press, London, p.233-80.

Pudjiati, S.N. 1995. Effects of neutralization temperature and time on the quality and stability of sardine oil, Sarjana Thesis, Faculty of Fisheries, Bogor Agricultural University, Bogor (in Indonesian)

Appendix 1

Fish oil refining (Pudjiati, 1995)

Fish Oil

↓

Degumming

(8% NaCl, 70°C, 15 minutes)

↓

Neutralization

1N NaOH, 60-80°C, 30 minutes

↓

Centrifuge ----------> Soap

20°C, 10,000 rpm, 15 minutes

↓

Washing with warm water

↓

Centrifuge----------> Water + Remaining soap

20°C, 10,000 rpm, 15 minutes

↓

Bleaching

6% Bentonite, 60°C, 20 minutes

↓

Centrifuge----------> Used Bentonite

20°C, 10,000 rpm, 15 minutes

↓

REFINED OIL

Appendix 2
Sausage processing

Beef/Chicken

↓

Mincing

↓

Mixing with:
- Salt 2.5%
- Pepper 0.5%
- Fine sugar
- MSG 0.75%
- Condiment * 2%
- Tapioca 15%
- Vegetable/Fish oil

↓

Stuffing into casing

↓

Boiling

↓

Cooling

↓

SAUSAGE

* Condiment consisted of shallot, garlic and ginger at ratio of 15:3:1

Appendix 3

Score sheet for preference test

No :
Date :
Panellist :

	Sample Code				
Parameter	A	B	C	D	E
Appearance Colour Odour Taste Texture					

Hedonic Scale:

(1) strongly disliked
(2) disliked
(3) slightly disliked
(4) not sure
(5) Slightly liked
(6) liked
(7) strongly liked