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PREPARATION OF THIS DOCUMENT

The publication contains the report of and the technical contributions made to the APFIC Symposium on Fish Utilization in the Asia-Pacific Region held in Beijing, People's Republic of China, from 24 to 24 September 1998, in conjunction with the 26th Session of APFIC. The papers have been edited by D.G. James, Technical Secretary of the Symposium.

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ABSTRACT

The publication contains the report of and the papers presented at the APFIC Symposium on Fish Utilization in the Asia-Pacific Region, held in Beijing, People's Republic of China, 24-26 September 1998. The contributions are divided into four groups. The first group contains papers related to technical approaches to fish utilization in low-cost products, particularly for poor consumers. The second concentrates on processes for full utilization of aquatic resources for food, feed and other purposes, while the third is centered on the safety and quality assurance of fish and fishery products from the region. The final section collects miscellaneous topics of interest to the region.

Distribution:

Participants at the Symposium
Members of the Asia-Pacific Fishery Commission
FAO Fisheries Department
FAO Regional Fishery Officers

CONTENTS

	Page
REPORT OF THE APFIC SYMPOSIUM ON FISH UTILIZATION AND MARKETING	1
APPENDIX A – List of Participants	8
PAPERS PRESENTED AT THE SESSION	
SECTION I - PRODUCTS	
Technological approaches to utilizing bycatch in low-cost products for human consumption by Yu Swee Yean	13-28
Utilization of bycatches and low-value fish in India by K. Gopakumar	29-48
Utilization of trawl bycatch in Southeast Asia by Tan Sen Min	49-51
The microbiology of low-salt fermented fish products by Christine Paludan-Müller	52-60
Traditional fermented fish products in Indonesia by Hari Eko Irianto and Giyatmi Irianto	67-75
Market potential of processed Tasmanian jack mackerel (*Trachurus declivis*) for human consumption by Jaquie Edwards and F. Kow	76-83
Maximizing utilization of low-value fish for a better future – using black tilapia as the model by Jamilah Bakar and A. Yusoff	84-90
A study on the fish price and consumption of fish in the nine cities of Fujian Province of China in 1997 by Qiu Chengyu	91-93
Preparation and storage studies of Squilla pickle by R. Tanuja and M. Shahul Hameed	94-100
Preparation and properties of functional protein concentrate from tuna (*Euthynnus affinis*) by V. Muraleedharan and K. Gopakumar	101-106
Use of soybean flour in fish sausage processing by Yusro Nuri Fawzya, Sugiyono, Ijah Muljanah and Hari Eko Irianto	107-113
Studies on the extraction of fish protein concentrate (FPC) by solvent extraction by Li Laihao, Chen Peiji, Li Liudong, Wan Daogong	114-118

	Page
Processing of fish flour from croacker (*Pseudociena amoyensis*) by Yusro Nuri Fawzyq, Dwiyitno, Hari Eko Irianto and R. Peranginangin	119-124
The utilization of fish protein and oil from anchovy (*Engraulis japonicus*) for human consumption by Changhu Xue, Yang Liu, C. Wang and X. Chen	125-130
Utilization of fish waste for production of fish silage powder and its application as feed for chicken and fish culture by N. Djazuli, Sunarya and Dwi Budiyanto	131-134
Utilization of fresh water catla (*Catla catla*) for preparation of myofibrillar protein concentrate by T.V. Sankar and A. Ramachandran	135-140
SECTION II - PROCESSES	
Control of salting schedule and its effect on the quality and storage life of cured fish by K.P.Anthony, V. Muraleedharan, Jose Joseph and K. Gopakumar	141-148
Changes in tissue proteinase activity of Indian mackerel upon curing in brine and salt by Jose Leema, P. Seema Nair and M.R. Raghunath	149-155
Processing and frozen storage characteristics of ray fillets by A. Ramachandran and T.V. Sankar	156-162
Effect of Indian gooseberry (*Phyllanthus emblica*) on fish oil antioxidation by E.M.R.K.B. Edirisinghe, W.M.K. Perera and A. Bamunuarachchi	163-171
Fatty acid composition of some small pelagic fishes in Sri Lanka by E.M.R.K.B. Edirisinghe, W.M.K. Perera and A. Bamunuarachchi	172-181
Influence of extraction methods on quality of shark liver oils by C.V.L. Jayasinghe, W.M.K. Perera and A. Bamunuarachchi	182-188
Assessment of nutritional value of processed shark fins in different species by C.V.L. Jayasinghe, M.K. Perera, R. Samaradivakara and S.P. Jayasooriya	189-197
Studies on the extraction of phospholipide from mussel by Hong Lin, Changhu Xue, Weifeng Lou and Xiubai Chen	198-200
Regular changes of free amino acid and taurine during oyster freshness preservation by Wu Chengye	201-205

Page

SECTION III - QUALITY ASSURANCE

Fish inspection and control systems in the Asia-Pacific Region 206-237
by Sirilak Suwanrangsi

Histamine in tuna in the Pacific Island Region 238-248
by A. Chamberlain

Histamine producing *Micrococcus* and *Flavobacterium* spp. from fish 249-253
by S. Gunaratne, U. Samarajeewa, T.S.G. Fonseka, I.V. Ranjani and K.S. Seetha

Incidence of salmonella in fishery products 254-262
by Sirilak Suwanrangsi, K. Srimanobhas and S. Keerativiriyaporn

Distribution of *Clostridium botulinum* in cured fishery products 263-269
by K.V. Lalitha and K. Gopakumar

Incidence of *Listeria* in fish and seafood in Indonesia 270-276
by Muntiningsih and Sunarya

Analysis of paralytic shellfish poison (PSP) using mouse bio-assay to support the Indonesian shellfish sanitation program by Sunarya and K. S. Ahmad 277-281

Study of a Hazard Analysis Critical Point system related to the processing of fish and meat products by N.P. Edirisinghe, T.S.G. Fonseka and S. Jayaratne 282-294

Quality determination of comercially frozen prawns using nucleotide-based products, sensory assessment and texture measurements by P.T. Lakshmanan, P.D. Antony and K. Gopakumar 295-306

Overview of a simple, systems based approach to the reduction of blowfly infestation of cured fish by Claire Johnson and John Easer 307-310

SECTION IV - MANAGEMENT

Studies on the organizational structure, leadership styles and communication in the seafood industry in Kerala (India) with respect to their applicability for introducing total quality management by S. Shassi and A. Ramachandran 311-317

Inland fisheries and aquaculture for food security in Sri Lanka 318-323
by J.M.P.K. Jayasinghe

TRADITIONAL FERMENTED FISH PRODUCTS IN INDONESIA

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ABSTRACT

Fermented fish products have an important role in stimulating appetite by providing unique aromas and flavours. Many kinds of fermented fish products can be found in various parts of Indonesia. Raw materials include whole fish, comminuted fish and viscera from marine and fresh water fishes. The products are peda, jambal roti, kecap ikan, terasi, ikan takai, bekasang, bekasam, naniura, picungan, and cincaluk.

INTRODUCTION

Traditional processing makes a significant contribution to fish preservation in Indonesia as about 50 percent of the total marine catch is processed and traditional methods account for more than 40 percent of that.

One of the traditional fish processing methods is fermentation and many kinds of fermented fish products can be found in parts of Indonesia. Those products are able to provide specific unique characteristics. In fermented processing, there is a transformation of organic substances into simpler compounds either by the action of micro-organisms or by the action of enzymes from the fish (Beddows, 1985). At the same time, the fish odour of the starting material is changed to the flavour and aromas of certain foods (Bukholder *et al.*, 1968). Enzymes are most significant in changing the texture and producing some of the flavour but micro-organisms aid in the development of aroma and flavour (Beddows, 1985).

Consumption of fermented fish products in Indonesia is mainly to introduce specific flavours which encourage the appetite. The many fermented fish products available in Indonesia provide many different flavours which meet various consumer appetites. Unfortunately, most of the fermented products are only available locally. Thus, a fermented product in one province will be very difficult to find in other provinces.

This paper mainly addresses fermented fish products found in Indonesia. Due to lack of scientific information about most of the products, the paper emphasizes processing technologies, which are traditionally employed by processors.

PRODUCT TYPES

Based on the information which has been compiled, Indonesian fermented fish can be divided in several ways, such as in terms of raw materials, fermentation types and final product forms.

a. Raw Materials

1. fresh water fish: bekasam
2. marine fish:
   2.1. whole gutted fish: peda, jambal roti, ikan tukai, cincaluk, picungan, and naniura
   2.2. pounded fish/shrimp: terasi
   2.3. visceral: bekasang

b. Types of Fermentation

1. fish and salt fermentation: peda, jambal roti, ikan tukai, bekasang, terasi, and kecap ikan
2. fish, carbohydrate and salt fermentation: bekasam, cincaluk, naniura, and picungan

c. Final Product Forms

1. dried fish: peda, jambal roti, and ikan tukai
2. moist fish: bekasam, naniura, and picungan
3. lumped pounded fish/shrimp: terasi
4. liquid/semi-liquid: kecap ikan, bekasang, and cincaluk.

FERMENTED FISH PRODUCTS

Peda

Peda is mainly found in Java. This product is processed using mackerel (*Rastrelliger neglectus*) as raw material. Fresh water fish processed into peda did not result in products with similar quality (Sukarsa, 1979). Nutritional quality of peda can be seen in Table 1.

Table 1. Nutritional quality of Peda.

Parameter	Amount in 100 g sample
Moisture content (g)	46
Energy (Calorie)	156
Protein content (g)	28
Fat content (g)	4
Ca (mg)	174
P (mg)	316
Fe (mg)	3.1
Vitamin A (IU)	110
Vitamin B1 (mg)	trace
Vitamin C (mg)	trace

Source: Soedarmo and Sediaoetama (1977)

The basic method of peda processing is a salting process with two steps. The first salting step takes several weeks to develop its characteristic flavour and texture, and this is followed by a maturation phase. Salting is carried out using a 1:3 salt to fish ratio. Fish and salt are arranged in layers alternately in a salting tank. By the end of the process, the fish are soaked in saturated brine pickle with coarse salt remaining at the bottom and the top covering the fish. This salting process normally takes 3 days. Maturation is performed by mixing the fish and salt thoroughly. The amount of salt used is a one third of fish weight. During maturation, the fish are kept in bamboo baskets, the process taking around 1-2 weeks (Rahayu, 1992). Better products can be obtained by using eviscerated fish (Hanafiah, 1987) and without salt addition in the second fermentation (Hanafiah, 1987; Irianto, 1990; Irianto and Brooks, 1994).

Investigations conducted by Nur and Sjahri (1979) indicate that fish viscera and vacuum encourage the fermentation process. Use of a starter made from matured peda has a similar effect to fish viscera. Sjachri and Nur (1979) improved pedah quality by introducing antifungals and antioxidants during processing.

Microbiological studies on peda conducted by Hanaflah (1987) revealed Gram-positive cocci predominated and some were identified as lactic acid bacteria. Isolation of halo-tolerant bacteria from peda by Suwandi (1988) concluded that bacterial growth in peda was characterized as Gram positive cocci, which were non-motile, aerobes or facultative aerobes, catalase positive, non-indole producers and oxidase negative. They can utilize citrate as the only carbon source, ferment glucose and show proteolytic activity. Some of them are able to reduce nitrate. These bacteria can be classified as mesophiles and require a pH of 6-8. They show variations in salt tolerance and can be divided on the basis of salt tolerance as weak, moderate and halotolerant bacteria. Idawati (1996) showed that lactic acid bacteria isolated from peda were homo-fermentative and hetero-fermentative *Lactobacillus* sp., *Leuconostoc* sp., and *Streptococcus* sp.

Jambal Roti

Jambal roti is processed from marine catfish (*Arius thalassinus*). Production centres in Java are Pekalongan, Cilacap, Cirebon and Pangandaran. Basically, processing methods applied in all production places are the same, but each location has their own specific ways to process jambal roti.

In the processing method employed by processors in Cirebon, the fish are first beheaded and eviscerated. They are then washed and soaked in fresh water for 24 hours. After draining, the fish are arranged in a basin. Each layer of fish is sprinkled with salt and the bellies are also filled with salt. Total amount of salt used for salting is 30-35% of fish weigh and the salting process takes around 24 hours. After salting, the fish are freed from excessive salt and washed. Clean fish are soaked in fresh water for 15-20 minutes and subsequently split into butterfly form. The split fish is sun dried for 3-5 days (Burhanuddin *et al.*, 1987).

Fish which has been iced usually produces a worse quality product than fish without icing. Nuraniekmah (1996) investigated a new method for processing jambal roti from iced fish by soaking the fish in warmer water to bring the temperature back to normal before processing. The higher the water temperature, the shorter the soaking period will be. Soaking the fish at 40°C needs 60 minutes to reach normal temperature.

Erwan (1992) developed a modified method of jambal roti processing by soaking the fish in 30% coconut sugar solution before salting. He also found that 20% of fish weight was enough for salting. Proximate composition, salt content and pH of jambal roti noted by Nuraniekmah (1996) can be seen in Table 2.

Table 2. Proximate composition, salt content and pH of jambal roti.

Parameter	
Moisture content (%)	49.27 - 49.68
Protein content (%)	54.17 - 61.86
Fat content (%)	0.69 - 1.19
Ash content (%)	34.93 - 38.80
Salt content (%)	7.38 - 8.53
pH	6.57 - 6.91

Source: Nuraniekmah (1996)

Terasi

Terasi is consumed in small quantities as a flavour. The product is not only for local consumption, but is also exported, mainly to the Netherlands and Suriname, in powder form. Terasi is usually made from planktonic shrimp "rebon" (*Atyas* sp. or *Mycis* sp.) (Budhyatni *et al.*, 1982). Terasi processors can be found in Java and Sumatera islands. According to Yunizal (1998) terasi can be processed in two ways, i.e. (1) with salt only and (2) with salt and other ingredients.

In the processing of terasi with salt only, firstly rebon is washed, drained and dried, until half dried. During drying, impurities, such as small fish, mussel shells and coral, are removed. After that, semi dried rebon is sifted to separate sand and other undesirable materials. The rebon is then left overnight at ambient temperature and pounded the next day. During the first pounding, salt is added (around half of the total salt required during processing). Total amount of salt used in terasi processing is 2-5% of rebon weight which should be added as solution. Pounded rebon is sun dried and subsequently kept in a container at ambient temperature for 2-3 days. The stored rebon is then pounded for a second time, while the remaining salt is added. After that, the pounded rebon is sun dried and kept at ambient temperature for 2-3 days until soft. It is then ground by many passes through a meat grinder until fine. Fine rebon is formed in cubes or cylinders of 1 kg weight and subsequently fermented for a week or more at ambient temperature (Yunizal, 1998). Proximate composition and important mineral contents of this type of terasi can be seen in Table 3.

Table 3. Proximate composition, energy, and mineral contents of terasi.

Parameter	Amount in 100 g sample
Moisture content (g)	40
Energy (Calories)	174
Protein content (g)	30
Fat content (g)	3.5
Ca (mg)	100
P (mg)	250
Fe (mg)	3.1

Source: Soedarmo and Sediaoetama (1977)

Processing method of terasi with salt and other ingredients is similar to the processing method of terasi with salt only. Specifically, in the second pounding, the salt solution is mixed with coconut sugar and tamarind prior to be added to rebon. For 10 kg fresh rebon, 200g and 250g respectively of tamarind and coconut sugar are used. The additional ingredients accelerate the fermentation process (Yunizal, 1998).

Budhyatni *et al.* (1982) investigated micro-organisms in terasi powder during ambient storage. Results showed that the number of *Lactobacillus* sp was constant during storage. Pathogenic bacteria: *Staphylococcus* sp., *Bacillus* sp., and *Proteus* sp. were present, but *Salmonella* sp., *Clostridium* sp., *Vibrio* sp. and *E. coli* were absent.

Kecap Ikan

Kecap ikan (fish sauce) is not really popular in Indonesia due to strong competition from soy sauce, but is well recognized in West Kalimantan Province (Mulyokusumo, 1974). In East Java, kecap ikan is processed from oil sardine (*Sardinella lemuru*) (Putro, 1993).

Kecap ikan is traditionally produced by fermentation using high salt concentrations. Generally fermentation takes a long time to complete (Supamo and Silowati, 1982).

In the processing of kecap ikan described by Putro (1993), fish are firstly washed and minced. Minced fish are mixed with salt (25-30% of fish weight) and allowed to ferment for 10-12 months. The fermented mixture is then filtered and finally brown sugar and spices are added. Results of chemical analysis of commercial kecap ikan can be seen in,Table 4.

Table 4. Chemical composition of kecap ikan.

Parameter	Kecap Ikan A	Kecap Ikan B
Moisture content (%)	66.67	76.89
Ash content (%)	23.5	21.95
Salt content (%)	21.16	11.60
Protein content (%)	10.17	10.51
Fat content (%)	0.50	0.70
Carbohydrate content (%)	1.50	0.30
Energy (calories/g)	5.41	5.24

Source: Poernomo et al. (1984)

Idawati (1996) produced kecap ikan from the brine waste of salting peda. The brine waste was fermented for a month. Identification of lactic acid bacteria isolated from that kecap ikan revealed that bacteria involved in the fermentation of kecap ikan were homo fermentative *Lactobacillus* sp, *Pediococcus* sp and *Streptococcus* sp.

Kumalaningsih (1986) studied the improvement of fish sauce quality by introducing bromeline and papain to prepare fish hydrolysate as well as the use of *Brevibacterium linens* and *Micrococcus* sp. According to the formation of amino-N, the incorporation of *Brevibacterium linens* strain C and *Micrococcus* were considered to be promising.

Ikan Tukai

Ikan tukai is a traditional fermented fish product which is only found in West Sumatera. Ikan tukai is also called *lauak tukai* or *ikan sambal lado*, and is mostly processed from barracuda (*Sphyraena* sp.).

The traditional processing method of ikan tukai is unique. Barracuda is washed and soaked in 20% brine for around two hours. After draining, the fish are dried for a day. Dried fish are then wrapped with taro leaves. The wrapped fish are kept underground for two days to allow fermentation and then sun dried until dry. Chemical characteristics of commercial ikan tukai can be seen in Table 5.

Table 5. Results of chemical analyses of ikan tukai.

Analyses	
Moisture content (%)	51.01
Salt content (%)	5.05
pH	6.93
TVN (mg/100g)	113.22
VRS (meq/g)	40.97

Source: Effendi (1995)

Effendi (1995) processed ikan tukai using a modified method, in which fermentation and drying were carried out in vacuum incubator and oven respectively. His microbiological studies concluded that bacteria

having a significant role in the fermentation process of ikan tukai were *Micrococcus* sp., *Pediococcus* sp., *Lactobacillus* sp, *Pseudomonas* sp and *Staphylococcus* sp.

Bekasang

Bekasang is a traditional product in North Sulawesi and the Moluccas and is processed from the viscera of skipjack (*Katsuwonus pelamis*), which is waste from *cakalang fufu* (smoked skipjack) processing in North Sulawesi and *cakalang asar* (smoked skipjack) processing in the Moluccas.

Processing methods of bekasang employed by processors in Manado-North Sulawesi are as follows. Skipjack viscera obtained from cakalang fufu processors is washed and mixed with salt at a ratio of 2.5:1. The mixture of viscera and salt is kept for a week to allow fermentation. After fermentation ceases, the fermented viscera are boiled for 2 hours and filtered using gauze. The filtrate is bottled and ready to sell (Wudianto *et al.*, 1996).

Subroto *et al.* (1984) introduced a mincing treatment to viscera before mixing with salt, this resulted in better quality bekasang. Setiabudi *et al.* (1985) investigated salt levels in bekasang processing by varying salt addition from 10 to 20%. Conclusions from the results were that the higher salt addition, the better bekasang quality obtained. Comparison of protein content and pH of experimental bekasang with commercial bekasang can be seen Table 6.

Table 6. Protein content and pH of experimental and commercial bekasang.

Samples of Bekasang	Protein content %)	pH
Experimental bekasang:		
- from minced viscera	37.95	5.65
- from whole viscera	36.52	5.72
Commercial bekasang	22.37	5.77

Source: Subroto et al. (1984)

Bekasam

Bekasam is a fermented fish product processed from fresh water fish which can be found in South Sumatera and Central Kalimantan. Bekasam is served by mixing with chilli and sugar. In bekasam processing, inspite of the salt addition, carbohydrate sources are also incorporated to stimulate the growth of lactic acid bacteria by decomposing into simpler compounds. Carbohydrate sources used are cooked rice, roasted rice and sticky rice Murtini (1992).

Processing of bekasam from common carp (*Cyprinus carpio* Linn) was described by Murtini (1992). Firstly, the fish are beheaded, descaled and eviscerated. They are then cut into butterfly forms and washed. Washed fish are eventually soaked in 16% brine solution for 48 hours prevented from floating by weights. The fish are then drained and cooked rice and sticky rice, up to 50% and 25% of fish weight respectively, are added. Finally the mixture of fish and rice is sealed in plastic jars and allowed to ferment for a week or more. Proximate composition and salt content of common carp bekasam are shown in Table 7.

Table 7. Proximate composition and salt content of common carp bekasam.

Parameter	
Moisture content (%)	66.95
Ash content (%)	5.76
Protein content (%)	4.81
Fat content (%)	14.95
Salt content (%)	5.72

Source: Murtini (1992)

In order to improve bekasam quality, Murtini *et al.* (1997) added the liquids of cabbage and Chinese leaf pickles as lactic acid bacteria sources into spotted gouramy bekasam. Sensory evaluation indicated that the best bekasam was produced by the addition of Chinese leaf pickle. All bekasam in this study was organo leptically still acceptable after 8-weeks storage.

A similar product called *Naniura* is found in Riau and North Sumatera provinces. In naniura processing, the fish are firstly soaked in lemon juice or 25% acetic acid solution for three hours. After that, ground boiled rice is added and the fish is then packed and allowed to ferment.

Another similar product to bekasam is *Picungan* which can be found in West Java. This product is processed using marine fish. Picungan seeds are used as a carbohydrate source. The seeds are cut into small pieces before mixing with fish and salt.

Cincaluk

Cincaluk is a traditional fermented fish product from Riau Province. This product is usually processed from rebon.

There is no prescribed method to process cincaluk. In a method employed by processors in Bengkalis, fresh shrimp are mixed with boiled rice and salt in a pan. For 1 kg shrimp, the rice added is around 200-300g, while salt is approximately 300g. The pan is then sealed with the lid to avoid air entry and kept for 4 days until liquid release. After that the mixture is put into bottles and eventually sealed tightly. Proximate composition and other chemical properties of cincaluk processed using this method can be seen in Table 8.

Another method to process cincaluk is by mixing shrimp with tapioca flour, salt and sugar at the ratio of 20:1:1:1. In its processing, shrimp are descaled and then washed. Tapioca flour is dissolved in water, gelatinized and allowed to cool. Shrimp are then mixed thoroughly with salt, sugar and gelatinized tapioca flour. The mixture is filled to washed bottles and sealed firmly and fermented at ambient temperature for 1-2 weeks.

Table 8. Proximate composition and other chemical properties of cincaluk.

Parameter	
Moisture content (%)	69.76
Ash content (%)	12.43
Protein content (%)	16.23
Fat content (%)	1.57
Salt content (%)	10.11
Lactic acid content (%)	2.34
pH	4.82

CONCLUSIONS

Indonesian fermented fish products vary in form, raw material and fermentation type. Most of them have not been studied in detail, thus scientific information relating to those products is difficult to find. More studies identify lactic acid bacteria involved in the fermentation which suggests improved product quality can be achieved by using selected lactic acid bacteria.

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