Development of Fish Processing Technology in Relation to Quality Management in Indonesia

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Abstract

1. *The fishery industry in Indonesia comprise domestic-based traditional fish products factories and export-oriented companies. The traditional processing units are usually operated by small to medium-scale processors while the export-oriented products are mostly operated by means of advanced technology.*
2. *The traditional processing units are predominantly engaged in fish curing such as salting and drying, smoking, steaming/boiling and fermentation, whereas modernised industries usually produce products for export purposes, including handling of live and fresh or chilled shrimp and other fish products and frozen, canning factories, etc.*
3. *The fish inspection and quality control programme includes the development of a standardization system, inspection of production facilities in terms of Good Handling, and/or Manufacturing and Hygienic Practices and inspection of product quality.*
4. *The inspection and quality control policy consists of compulsory and supervisory approaches. The compulsory programme was manifested with certifications of a) GMP, which includes sanitary and hygienic status of plant; b) competence provided to in-plant processing technologist and quality control supervisors; c) quality or health for exported product and d) letter of origin/ quality for products transported and distributed inter-provincially.*
5. *The application of quality management in the fishery industry, whether they are traditional or more modern and whether their products are for domestic or export markets, are all at different states of development. The processing plants are classified according to the degree of compliance for meeting prerequisite conditions. The plant must achieve at least "C+" rating to pass the inspection; those which fall under plant-rating of "C-" and D are considered to be in non-compliance and will go through the supervisory programme to correct deficiencies within a specified period.*
6. *For the past five years, an Integrated Quality Management Programme (IQMP) based on HACCP concept adopted from the Canadian QMP, has been exercised by those fishery industries which meet the acceptable prerequisite conditions.*

Introduction

Fisheries play an important role in contributing to socio-economic development in Indonesia. Fishery is considered as one of the important commodities and it also provides employment opportunities and generates foreign exchange. Fish has also traditionally been one of the sources of animal protein in the Indonesian diet.

The processing industry comprise mainly domestic-based traditional fish products factories and export-oriented fish processing plants. The traditional fish products, which are commonly operated by small to medium-scale processors, mostly cater to the needs of the domestic market, whereas some larger-scale factories process for export purposes. The traditional processing units, are predominantly engaged in fish curing, such as salting/drying, smoking, steaming/ boiling and fermentation, the operation of which varies from home to medium-scale factories.

The export-oriented industries include handling of live, fresh and chilled shrimp and other products such as finfish, seaweed, jellyfish and value-added products. The products are usually destined for a large number of countries, mainly Japan, our neighbouring countries, Australia, European Union, United States of America, and Canada

1. Fisheries Resources

Indonesia is an archipelago, 70% of which comprise marine waters with a potential yield of 6.6 million tonnes. The level of exploitation of such marine fisheries resources was indicated in 1994 to be still at a low level, probably at about 30%. This means that a great deal of potential resources remain unexploited.

The areas of potential freshwater culture cover 180,000 hectares and the yield could be expected to reach some 675,000 tonnes. From areas of brackish water ranging from 420,000 to 840,000 hectares, production of 761,000 to 1,155,200 tonnes could be expected, if semi- to fully intensive culture

is applied.

2. Fisheries production

During 1989 - 1993 total fish production increased from 3,036,268 tonnes in 1989, 76% of which being marine products, to 4,013,831 tonnes in 1994, an increase of approximately 6% each year.

Indonesia is now in the third year of its Sixth Five-Year Development Plan (1994-1999). The current plan is still geared towards promoting income for fishermen and fish farmers: providing employment opportunities, optimising utilization of production and increasing consumption of fish.

Fish production is projected to reach 4,587,000 tonnes in 1996, an average increase of about 5% per year.

3. Export of fishery products

Export of fishery products increased from 228,590 tonnes in 1989 to 545,371 tonnes in 1994, an increase of 9.7% per year, while value is projected to US$2,134 million in 1998. This represents an average increase of 9.7% per year.

During this period, the main species exported were shrimp, tuna and skipjack. In 1993, the export of shrimp contributed 58.3%, tuna-like species 14.2% and others included froglegs, seaweed, crabs, etc. accounted for 27.5%.

4. Fish consumption

Fish was estimated to provide about 60% of the domestic animal protein supply. The average annual per capita consumption of fish has been demonstrating a general increase in recent years although the level is still below the national recommendation of 26.55 kg per capita per year. The average consumption of fish currently reaches 19.14 kg per capita per year.

Status of Fishery Post-harvest Technology

1. Development of fish and fishery products

Of the total fish production 54% was distributed fresh in 1994 and the rest were processed products as seen in Table 1.

The traditional processing factories, comprising over 4721 units, engage in salting, drying, steaming, boiling, smoking and fermentation. They are mostly operated by small-scale processors to cater for the domestic market, while a number of medium and larger-scale factories are found which are also oriented for export market.

The export-oriented processing plants comprise over 220 freezing and 20 canning factories.

Those industrial processing plants target their products mainly for export markets. The main export commodities include shrimp, tuna, froglegs, sardine, seaweed, anchovies and jelly fish. High market value species such as red snapper, tilapia, pomfret, crab, sand goby, snail, etc. are also exported.

The main species marketed include tiger shrimp (*Penaeus monodon*), white shrimp (*Penaeus marguiensis*), pink shrimp (*Metapenaeopsis* spp.), flower shrimp (*Metapenaeopsis* spp.), *kuruma ebi* (*Penaeus japonicus*), freshwater shrimp (*Macrobrachium rosenbergii*) and lobster (*Panulirus* spp.).

Shrimp are presented to the market, either alive, fresh (chilled), frozen or dried. Product forms include headless shell-on (HL), head-on (HO) peeled and deveined (PD), peeled undeveined (PUD), peeled tail-on (PTO), individually quick frozen (IQF) and block frozen according to the requirements of the intended market.

Tuna include big-eye (*Thunnus obsus*), albacore (*Thunnus alelunga*), yellowfin (*Thunnus albacore*), bluefin (*Thunnus thynnus*), and Skipjack (*Katsuwonus pelamis*). They are marketed either fresh, frozen, canned or smoked and dried for domestic and export markets.

Bullfrog (*Rana catesbiana*) and Stone frog (*Rana macrodon*) and green frog (*Rana rana*) are usually marketed alive. These species are also marketed as individually quick frozen (IQF) froglegs.

Other fishery commodities of potential economic importance include :

- Sardine (*Sardinella longiceps*) is normally canned or prepared for fish meal.
- Seaweed: species like *Sargossum* spp., *Euchema spinosum*, *Gelidium* spp., *Gracilaria* spp. and *Hypnea* spp. are processed into dried agar (sheet, powder) and jelly.
- Anchovies from the *Stolephorus* species are processed into a variety of products such as chilled, dried, dried salted or unsalted.
- Dried jelly fish and sea-cucumber are prepared for domestic and export market.
- Other species of potential market value such as grouper, red snapper, pomfret, crab, sand goby, tilapia, eels (*Anguila anguila, A. bicolor*) can be marketed fresh, frozen, lives, canned, dried or smoked.
- Other value-added products include fish nugget, shark fin (dried, frozen), fish steak, *sushi ebi*, tuna steak, tuna ham are also developed.

2. Development of Quality Management Measures

The concept of quality assurance in terms of providing safety of fish and fishery products was developed by means of preventing food borne hazards through inspection and quality control.

Historically, the Indonesian fish inspection and quality control policy was launched in 1975; the Fish Inspection and Quality Control Programme was based on the Health and Hygiene Acts of 1960 and 1962. Since then, the Directorate-General of Fisheries has administered the inspection and quality control programme. The programme includes development of a Standardization system and of inspection of production facilities in terms of Good Manufacturing Practices (GMP) and the testing of product quality.

3. Current Legislation and Jurisdiction

a. Government Regulation no. 15/1991 issued on March 1, 1991 laying down the Indonesian National Standardization (INS).
b. Presidential Decree No. 19/1991 issued on March 1, 1991 setting forth the formulation, application and control of the Indonesian National Standard.
c. Presidential Decree No. 2/1990 issued on May 28, 1990 setting forth the Quality Control and Inspection of fresh and frozen seafood products.
d. A Memorandum of Understanding between Ministers of Agriculture, of Health, and of Trade, issued on May 28, 1990 setting forth the implementation of Inspection and Quality Control of fresh and frozen fish and fishery products.
e. An implementation decree issued by the Minister of Health no. 397/Men.Kes/SK/VIII/1990 dated August 24, 1990 setting forth regulation on additives permissible for use in handling and processing of fish and fishery products.
f. Presidential Decree No. 47/1986 issued on September 17, 1986 setting forth the Improvement of Post-Harvest Technology of Agricultural Product.
g. Ministry of Agriculture decree no. 303/Kpts./OT.210/4/1994 setting forth the development of quality management system of agricultural products.
h. Ministry of Agriculture decree No. 304/Kpts./OT.210/4/1994 setting forth the development of Standardization and Accreditation System for Agricultural Products.

4. Fish Inspection and Quality Control Programme.

The fish inspection and quality control policy was strategically taken through compulsory and supervisory approaches. The compulsory regulation was manifested with providing certifications, namely:
a. certification of Good Manufacturing Practices (GMP) which include sanitary and hygienic means.
b. certification of competence provided to the in-plant processing technologist and quality control supervisors.
c. certification of quality for exported products.
d. Letter of Origin/Quality for products transported inter-provincially.

Good Manufacturing Practices, including sanitary and hygienic compliances, need to be met by producers or processors as a prerequisite requirement for qualifying the plant to be registered as an approved establishment.

The inspector will verify whether or not the processing facilities meet the requirements of sanitation and hygiene assessment of the plant, and the operational aspects of their handling and processing. The inspection and certification guidelines were adopted from the "Codes of Practices" prepared by FAO/WHO Codex Alimentarius Committee for Fish and Fishery Products and other GMPs used by other countries (US, Canada, etc).

The certificate of GMP/sanitation will only be issued by the Director-General of Fisheries if the processing facilities pass the prescribed assessment of sanitation, hygiene and operational aspects of handling and processing. Otherwise, the plant will be categorised as non-compliant and will have to go through the supervisory programme for improvement before being re-assessed for registration as an approved establishment.

The application of quality management at fishery plants, whether they are traditionally or modernistically operated and whether their products are for domestic consumption or export purposes, are at different stages of development.

The processing plants are classified according to the degree of compliance of the prerequisite requirement. The processing plant must achieve at least "C+" grade to pass the inspection. Those which fall under grade "C-" and D are considered to be in non-compliance and will be supervised to correct the deficiencies within a specified period.

Most processing plants have employed a technologist-supervisor and a quality controller, each holding a certificate of competence issued by the Directorate-General of Fisheries through participation at formal and informal training on the subject of Fish Processing Technology and Quality Management System based on HACCP concept.

The final product will be sampled and tested by the inspectors engaged at the Laboratory of Fish Inspection and Quality Control (LFIQC) prior to exportation. Certificates will be issued if the products comply with the standard requirements of importing countries.

In addition, fish and fishery products transported and marketed inter-provincially or regionally should obtained a Letter of Origin from the local authority/LFIQC.

Development of HACCP-Based Integrated Quality Management Program (IQMP) in Fish Industries

1. Implementation of HACCP-based Quality Management system in developed countries

The international market for fish and fishery products is becoming more competitive in this globalization era. This is partly due to :

- growing concern over consumer protection which is based on food quality and safety with the developed countries leading the way to a tightening of requirements of importing countries;
- environmental issues which have forced producing countries into a difficult position and which have been used by some developing countries to protect their own interests.

The challenges above have been addressed by both government and private sector. As far as quality and safety is concerned, the fish and fishery industries inevitably have to keep pace with the current requirements imposed by the importing countries.

While the formal procedures for seafood quality assurance is now widely recognised under the GATT/WTO and Codex Alimentarius, the potential importing countries, namely EU (European Union), USA, Canada, Japan etc. have the expectation that producing countries will implement their fish inspection and quality control programmes, in terms of quality management, equivalent to the system applied in their own countries.

The Fish Inspection and Quality Control Systems of such major importing countries regulate the implementation of HACCP-based quality assurance programmes.

a. EU's HACCP-based own-check system

EU Council Directives nos. 91/492/EEC, 91/493/EEC, 92/48/EEC and 96/340/EC or so-called "EU's own-check system" rules, lay down the health conditions for the production and placing in the market of fish and fishery products for distribution and consumption to the EU.

The Directives require that all levels of operation must be regulated from the environment where products are harvested, fishing vessels, factory vessels, fish landing and auction halls, storages and transportation facilities. EU-version Health Certificate is required for all exported products certifying that those have been handled, prepared or processed, identified, stored and transported under conditions at least equivalent to those laid down in the Directives.

The EU Commission Decision no. 95/34/EC of 16 February 1995 amending no. 94/324/EC of May 1994, endorsed 152 processing plants to export fish and fishery products from Indonesia to EU countries. The approved establishments are recognised to be in compliance with the Council Directives no. 94/492/EEC; 91/493/EEC and 92/48/EEC.

b. US FDA-HACCP Mandatory Inspection

The HACCP programme became a law on 17 December 1995 and was stipulated in the 21 CFR part 123. The regulation will effectively be implemented by 18 December 1997. There are about 30 processors at the moment who have exported regularly to the USA.

c. Canadian HACCP-based Quality Management Programme

QMP follows HACCP fairly closely. It also includes all those 7 principles in different forms.

Canadian Federal Regulation stipulates that to facilitate entry of products into Canada, or in any case, producers wish to comply with "prefered status", the QMP shall be consequently implemented.

Based on the MOU established between the government of Canada and the exporting countries, fish processors of the producing countries who wish to possess "prefered status" should meet standardised prerequisite requirement before adhering to the Canadian QMP and have in place a QMP-equivalent quality control programme approved by the Department of Fishery and Oceanography (DFO) as the Canadian Competent Authority.

The plant facilities are inspected and rated by the DFO according to the compliance requirement for an in-plant QMP as described in the Canadian Fish Inspection Regulation.

Different programmes are used to describe such quality management systems, namely HACCP programme applied in the USA, own-check in UE and QMP in Canada. Regardless of which system is

applied, the objectives are the same and the method are equivalent to the 7 principles.

2. Development of HACCP-based IQMP in Indonesian Fish Industries

In the development of the fishery industry a strategic policy is taken through an agribusiness development approach. The development of each sub-system of the agribusiness system from pre-harvest through post-harvest up to marketing is made with good management in all aspects of the production chain in mind. The objective is aimed to maximize the utilization of resources by minimizing losses and to maintain the safety of seafood produced.

In terms of export market development, both government and private sector have positioned themselves to harmonise the quality assurance system by developing for the past five years a HACCP-based quality management system. This is the so-called "Integrated Quality Management Programme (IQMP)" in the fishery industry. It is an approach to encompass the complete system of production system, the development of which is adopted from the Canadian QMP. The development of this IQMP is aimed not only to improve quality and safety, but also to improve the Indonesian product reputation in the international market, as well as to establish a self-regulatory quality control system in the fishery industry.

To enhance the implementation of a self-regulatory quality control system in the fishery industry, prerequisite requirements on Good Handling/ Manufacturing Practices (GHP/GMP) and hygienic practices have also been developed as an integral part of the quality management function, the activity of which is manifested in the HACCP-based IQMP.

To achieve the above objectives, development programmes have been carried out to strengthen the government and private sector institutions by providing transfer of technology on the application of HACCP-based IQMP.

Training have been provided to :

a. Senior fish inspectors who were trained as trainers (TOT). The training was conducted overseas as well as in-country.
b. Management personnel were also briefed on the concept of HACCP-based IQMP.
c. Fish inspectors engaged at the provincial and district levels and industry personnel (QA/QC) were trained in the IQMP-concept and an IQMP-Manual preparation.
d. Further training to both government and private personnel on the inspection system of IQMP implementation.

In exercising the implementation of IQMP procedure in the selected factories :

a. The inspectors were trained to conduct preliminary assessment on sanitation and hygiene and GMP as a prerequisite requirement of the plants for further training of application of IQMP.

   The plant should meet the requirement of GMP including the sanitation and hygienic practices.

   The inspection training provides the trainees with a detailed sanitation and hygienic assessment of the establishment and the operational aspects of the handling and processing techniques.

   - Assessment of processing facilities
     - Environment / infrastructure
     - Building / construction
     - Production appliances and equipment
     - Transportation of product
     - Sanitary and hygienic procedures
   - Assessment of material, handling and processing
     - Raw material
     - Water and ice quality
     - Additives
     - Packaging
     - Storage of raw materials, water, ice, end products, hazardous material and containers
     - Transportation and distribution
   - Assessment of other components involved in the quality management program
     - Facilities
     - Material and final product
     - Employees
     - Waste products

b. Training on preparation of IQMP-manual based on the 7 principles of HACCP

   To harmonize the program, all plants were trained in the development of in plant IQMP, adopted from Canadian QMP, which apply the rules on an approach to the identification of the hazards at their 12 generic CCPs, namely :

   - Incoming shrimp/fish
   - Packaging material
   - Other ingredients
   - Chemicals
   - Labelling
   - Construction / equipment
   - Operation / sanitation
   - Process control
   - Cold storage
   - Final product
   - Recall

   At each CCP the plant must :

- identify the standard that is being applied to ensure compliance with requirement
- identify the monitoring procedures and inspection frequencies that the standard is being met during production.
- identify the reporting mechanism that will be used at each CCP to document the results of the inspections (record keeping).
- to develop corrective action plans that will be followed, if and when the standard is not being met.

c. Exercising for validation, audit and verification of IQMP plan.

The training for both inspectors as well as plant-auditors to conduct the external and internal control measures, respectively, of the quality management function include :

- Validation of the written IQMP to ensure that the documented standards meet the minimum requirement
- Audit of the IQMP application in order to confirm that the written IQMP is being followed in the plant
- Verification that the processor's records are accurate.

d. Supervising the trial/implementation of IQMP.

The implementation of HACCP-based inspection programme requires :

- utilisation of skilled and experienced fields inspectors and in-plant QA/QC personnel
- upgrading of fishermen's knowledge
- enhanced awareness and understanding of processors with regard to the task of inspectors.
- development of sufficient facilities and equipment for fish landing, fishing vessels, fish auctions, and laboratories.

A significant output of the development of HACCP-based IQMP, an MOU on inspection of raw frozen shrimp between Department of Fisheries and Oceans (DFO) Canada and Directorate-General of Fisheries (DGF) Indonesia was materialized to facilitate the flow of trade shrimp products between Indonesia and Canada.

Moreover, according to the EU's Commission Decision number 95/34/EC of 16 February 1995 amending number 94/324/EC of May 1994, 152 processing plants have been endorsed to export fish and fishery product to EU member countries. The approved establishments are recognised to be in compliance with the Council Directives numbers 94/492/EEC; 91/493/EEC and 92/48/EEC.

Table 1. Distribution of fish and fisheries products in 1994.

Distribution	Weight (tonnes)	%
Freshly Consumed	1,675,372	54.39
Traditionally processed		
- dried / salted	778,093	25.26
- boiled / steamed	173,948	5.66
- cured / fermented		
* shrimp paste	21,122	0.68
* cured	10,374	0.34
* fish sauce	2,345	0.08
- smoked	62,891	2.04
- other preserved product	34,360	1.11
Frozen	262,168	8.52
Canned	26,626	0.86
Fish Meal	32,869	1.06

Source : Central Bureau of Statistics, Indonesia

Table 2. Fish and fishery products of market importance.

No.	Resources	Species	Processing	Form of product	Country of destination
1.	**Shrimp :**				
	Tiger	*Penaeus monodon*	Fresh / chilled Block frozen IQF	Raw/cooked, chilled shrimp Head on, shell on (HO) Headless, shell on (HL) Peeled, deveined (PD) Peeled, undeveined (PUD) Peeled, tail on (PTO) *Sushi ebi* Butterfly Shrimp ring Live	Japan, Singapore, Hong Kong, USA, Europe, Canada, Australia
	White	*Penaeus merguiensis*	Block Frozen IQF	Peeled, undeveined (PUD) Canned, peeled	- ditto -
	Pink	*Metapenaeus* spp.	Block frozen Canned IQF	Peeled, undeveined (PUD) Cocktail *Ebi*	- ditto -
	Flower	*Metapenaeopsis* spp.	Block frozen IQF Canned Dried		- ditto -

No.	Resource	Species	Processing	Form of product	Country of destination
1.	*Kuruma* Lobster	*Penaeus japonicus* *Panulirus* spp.	Live Live Chilled Frozen IQF	Dry packed Dry / wet packed Head on Headless	- ditto - - ditto -
2.	**Tuna :** Big eye Albacore Yellowfin Bluefin Skipjack	 *Thunnus obesus* *Thunnus alalunga* *Thunnus albacares* *Thunnus thynnus* *Katsuwomus pelamis*	 Fresh Frozen Canned Smoked	 Whole Whole, loin, chunk Chunk in brine oil Solid in brine oil Tuna in dressing sauce *Kastuobushi*	 Japan, Thailand, USA, Singapore
3.	**Frogleg :** Bullfrog Stonefrog Greenfrog	 *Rana catesbiana* *Rana makrodon* *Rana rana*	 Live Block frozen IQF	 Froglegs	 Singapore, Europe, Korea
4.	**Sardine :** Balinese sardine	 *Sardinella longiceps*	 Canned	 Solid in tomato sauce Solid in oil	 Domestic
5.	**Seaweed :** Brown Red	 *Sargassum* spp. *Eucheuma spinosum* *Gelidium* spp. *Gracilaria* spp. *Hypnea* spp.	 Dried Agar Jelly		 Japan, Denmark, Germany
6.	**Anchovies**	*Stolephorus commersonii*	Chilled, dried Dried unsalted/ Dried salted	Whole	Japan, Singapore
7.	**Others :** Grouper Red snapper Pomfret Crab Sand goby Snail Tilapia Marine catfish	 *Epinephelus merra* *Lutjanus sanguineus* *Pampus argenteus* *Formio niger* *Achatina* *Tilapia* *Arius thalassinus*	 Fresh, frozen Salted, dried Fresh, frozen Salted, dried Fresh frozen Live Canned Live, canned Frozen Dried, salted	 Whole, gutted, fillet Whole, gutted, fillet Whole, gutted, fillet Whole, gutted, fillet Whole Whole Meat only Fillet, gutted Fillet, gutted	 Singapore, Hong Kong Singapore, USA, Hong Kong Europe, USA, Malaysia, Saudi-Arabia