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## PROCESSING AND VALUE ADDITION OF FISHERY PRODUCTS

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February 2022, Myanmar

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## Introduction

The training manual on processing and value addition of fishery products is for fishery operators and their families in rural areas to increase their daily income and to improve the living standard by enabling them to change the fishery production and processing practices from indigenous local knowledge to proper understanding on safe and quality production and to be able to produce the value-added fishery products.

### Objective of the training

- To enable the fishery operators to implement Good Manufacturing Practices (GMP) and Sanitation Standard Operation Procedures (SSOP) in fish and shrimp handling, preserving and storage.
- To improve personal hygiene of workers and cleaning and sanitation of the workplaces.
- To enable the operators to produce safe and good quality traditional fishery products (e.g., fish paste, dry fish, fish sauce, and fermented fish etc.)
- To improve quality and to increase benefit in fish and shrimp icing business by using ice properly
- To promote the proper usage of permitted chemicals approved by Department of Fisheries (color, odor, preservative)
- To better understand the compliance of laws and directives enforced by Department of Fisheries for small and medium fishery enterprises
- To gain better job opportunities for rural communities
- To be able to develop small scale business
- To improve livelihood standard of the rural fishery communities and increase daily income
- To be able to produce local fish and shrimp products that meet the needs of export quality and safety.

## Chapter (1)

### Four rules in fishery sector (Time, Temperature, Technology, and Hygiene)

#### Objective

- To follow and implement the safety and quality requirements of fishery products.

#### Four rules to follow for processing of fishery products

- 1) **Time** – Process the fishery products as quickly as possible in a short period of time
- 2) **Temperature** – Keep fish and shrimp at low temperature by using sufficient ice
- 3) **Technology** – Operate the fishery business with knowledge and technology
- 4) **Hygiene** – Keep the utensils used in fishery processing and the processing environment clean

#### Five keys in all sectors of food business operation

- 1) Water must be potable.
- 2) Hands must be clean.
- 3) Food or food products must be clean.
- 4) Restrooms must be clean.
- 5) Working environment must be clean.



Figure 1: Hygiene and temperature control at a fish processing plant (Source: frontiermyanmar.net)

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## Chapter (2)

### Personal hygiene of workers, cleanliness, and sanitation of workplace

#### Objective

- To sensitize food safety and food hygiene for the fishery workers involved in handling and processing
- To improve hygiene condition of production and processing workplace

#### Uniform and personal protective equipment (PPE) for workers

- Appropriate clothing such as blouse, longyi, trousers (short/three quarter/long).
- Clean and neat headpieces and hats.
- Long rubber gloves or disposable plastic gloves must be provided to the workers to handle ice and gutting fish.
- Face masks must be used to prevent dirt and contaminants from mouth and nose.
- Plastic or vinyl apron or chest cover must be used to prevent the worker's body from water, blood, and strain.
- Long boots must be worn in cold storage or in wet and dirty work environment especially during rainy season.

#### Forbidden work behaviors for workers

- Betel chewing and spitting in workplace.
- Nail biting, nose picking, head scratching, shouting, and speaking loudly, fixing longyi frequently, touching objects unnecessarily, coughing or sneezing right onto the food or food products

#### Facilities and infrastructure of fish processing factory

- Processing factory must be sufficiently spacious.
- Free from water lodging, dust, odor, and smoke.
- Keep mice, slugs, snails, frog, birds, cats, and dogs out of factory surrounding.
- Wall, floor, and ceiling must be easy for washing with water and enough exposure to sunlight for quick drying.
- Availability of water for hand washing, footbath, and cleaning facilities.
- Workplace must not be near the toilet, waste bin, and temporary waste disposal areas.
- Systematic wastewater drainage.
- Fence must be in place to prevent the entry of chickens, ducks, pig, frogs, or mice.



- Pesticide, lime powder and detergent must be provided.
- Washing and brushing with soap must be performed before and after the working schedules or whenever it is required.

### **Toilet and cleaning facilities**

#### **a) For fish and shrimp processing factory**

- Toilet and cleaning facilities must be sufficient for the staff members and workers.
- Availability of water must be sufficient.
- Water taps used in processing plant must be hands free.
- Disposable paper/tissue and hot air hand dryer must be provided.
- Footbath must be installed, and chlorine must be used for disinfection.
- Chlorine powder, lime powder and detergent liquid/powder must be available for sanitation.

#### **b) For fish and shrimp processing businesses**

- Toilet and cleaning facilities must be sufficient for staff members and workers.
- Water availability must be sufficient.
- **Cups must be with handle.**
- Disposable paper/tissue must be provided. Cloth used for hand drying must be washed daily.
- Chlorine powder, lime powder and detergent liquid/powder must be provided for sanitation.

### **Systematic hand washing method for food and food product handlers**

- Wet hands with clean water.
- Rub hands thoroughly with soap.
- Rinse hands with clean water.
- Use chlorine (20-25 ppm) to disinfect hands.
- Dry hands with clean cloth.

### **Daily cleaning and sanitation procedure at workplace**

- Sweep debris and dirt and dispose the waste regularly.
- Use both hot and cold water to easily remove grease. Use soap and brush until the grease is clean.
- Wash with clean water.

- Choose the variety of suitable sanitizers, adjust the concentration and spray the place that is already washed with clean water and soap. Then, wait for 15-20 min after spraying with sanitizer.
- Rinse the place with clean water again.
- Let the sanitized surface clean and dry by means of sundry or airdry.

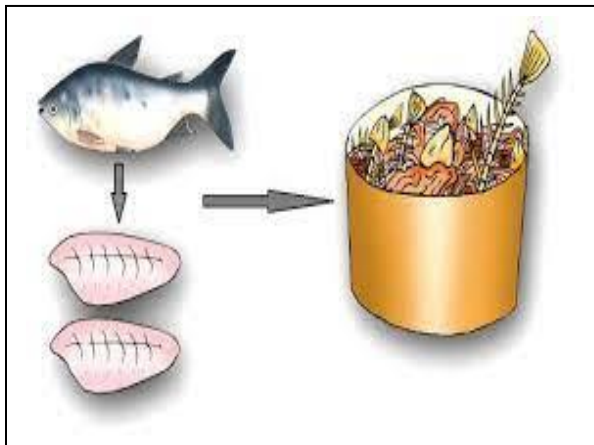


Figure 2: Personal hygiene and sanitation at workplace (Sources: [www.shweyamone.com](http://www.shweyamone.com) & Google images)



## Chapter (3)

### Nutritional composition of the fish and shrimp

#### Objective

- To increase knowledge on importance of nutrients in fish and shrimp for the longevity and wellbeing of the consumers
- To promote fish consumption throughout the lifetime according to the saying “Eat fish, live longer”.

*Table 1: Body structure and nutritional composition of a fish*

No.	Nutrient type	Approximated nutrient composition (%)	Body part of fish	Contribution to well-being
1	Water content	Water content (70-80)	Entire body except in fat and bone	Essential for living organism
2	Protein	Protein (15-20)	Muscles, Viscera	Growth and energy
3	Fat	Fatty acid, Glyceride (5-6)	Belly, Intestine, Belly fat, Roe	Energy
4	Calcium	Mineral (ash) (2-3)	Skull, Dorsal fin, Scale	Supportive for body system
5	Carbohydrate	Carbohydrate (sugar) (1)	Flesh, Soft bones	Energy
6	Fiber	Fiber (1)	Fillet, Joint cartilage	Help digestive system
7	Vitamins	Vitamin A, B, C, D, E, K (traces)	Contain in whole fish, Roe	Supportive for fish health

#### (100g of fish/shrimp contains 80 calories energy)

All the seven nutrients mentioned in above table can be found in crab, fish and shrimp. In addition, lysine (food digestion) and Taurine (intelligence booster) can also be found in fishery products. Percentage of nutritional composition differs depending on the type of fish.

## Chapter (4)

### Characteristics of fresh fish and shrimp

#### Objective

- To earn profit from decent pricing of the fish and shrimp products based on their freshness characteristics during logistics transportation and trading.

#### 4.1. External features of the fish

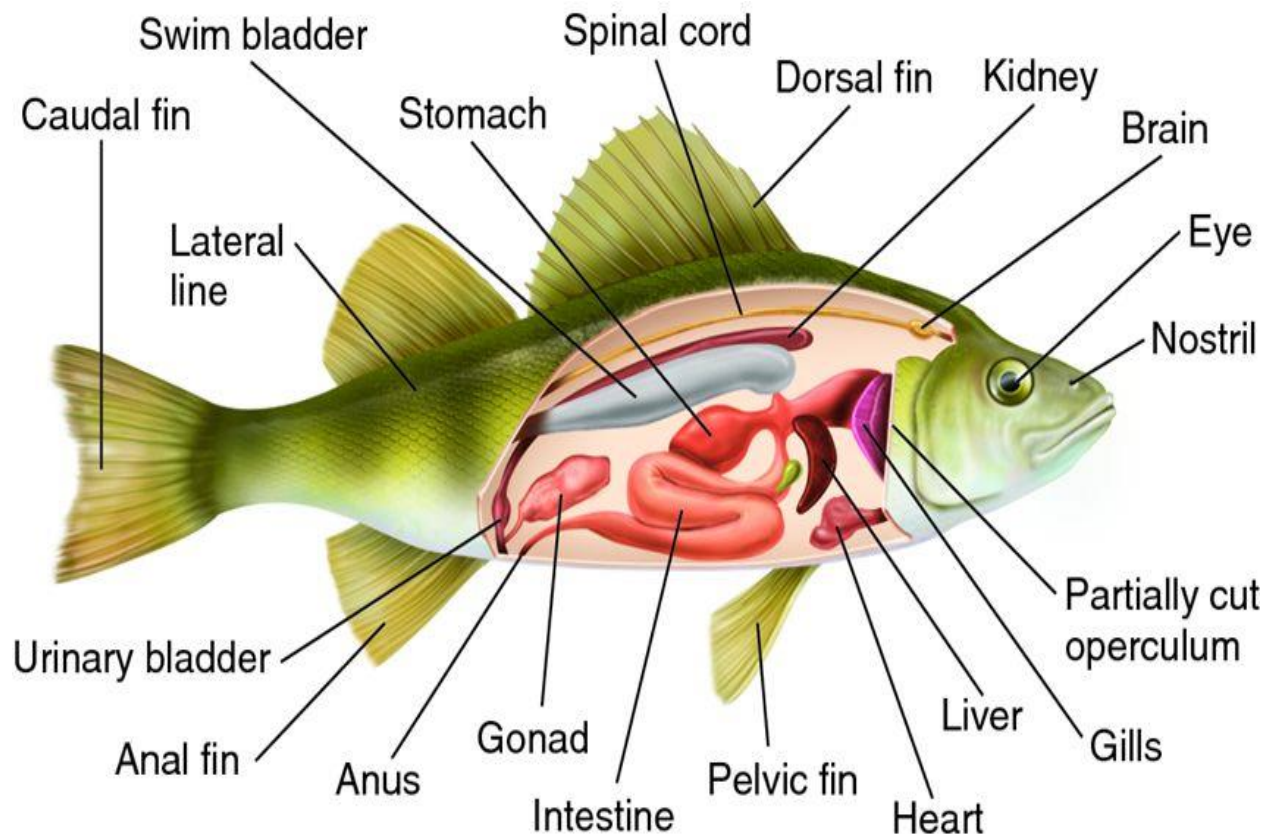


Figure 3: Generalized body plan of a bony fish (Source: biology-forum.com)

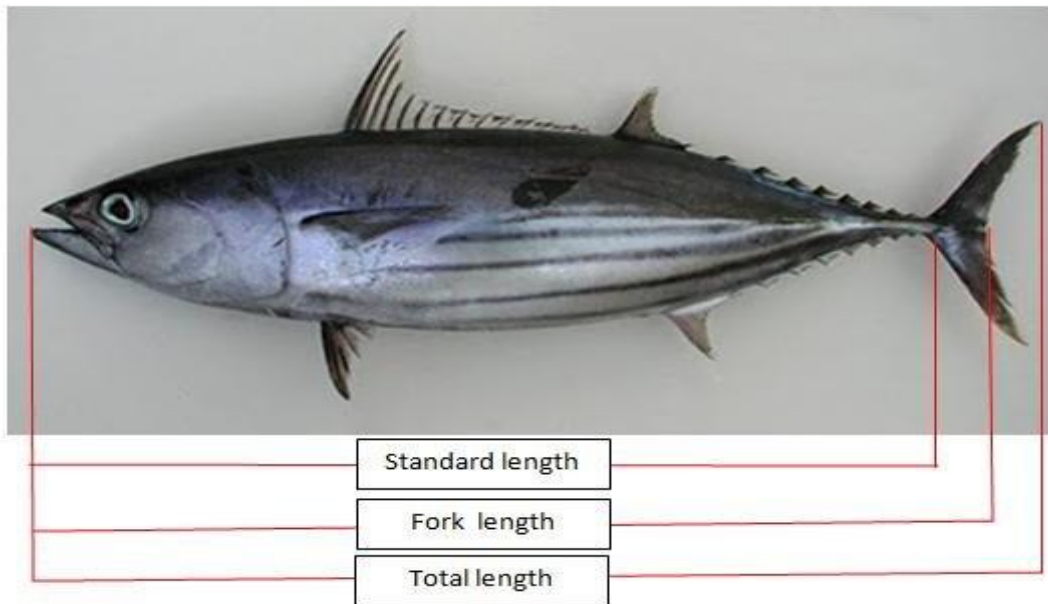


Figure 4: Fish length measurement (Source: Alauddin Riyadi, 2019)

**Standard Length (SL):** The body length of a fish from the tip of its nose to end of its last vertebrae.

**Fork Length (FL):** The length of a fish from the tip of its nose to the middle caudal fin rays.

**Total Length (TL):** The length of a fish from the tip of its nose to the end of the longer lobe of its caudal fin.

## 4.2. Freshness characteristic of the fish

- The body is firm and has a specific consistency and appearance. When pressed it should bounce back.
- Scale or skin has a naturally metallic glow and must be tightly attached to the body.
- No damage or injury on dorsal fin, pelvic fin and tail.
- Body is covered with thin layer of slime.
- No blood leakage from gills.
- Eyes should be bulging in eye sacs.
- Clear, plump, and shiny eyes.
- Pupil velvet black and cornea transparent.
- Gills with red filaments.
- Gills and filaments are covered with thin layer of slime.
- Gills and filaments have no bad odor.

- Gill and filaments are neither greasy nor rough in texture.
- Fillet is firm, and when pressed, it should bounce back.
- No foul smell of rotten fish.
- Flesh is moist, firm, elastic, and has a fresh appearance.
- No sign of red flesh due to blood leak into the flesh.
- Belly flesh is not too soft
- No sign of injured skin.
- Smell is nice, briny, and fresh.
- Shape of internal entrails remain unchanged.
- No smell and blood from internal entrails.
- Texture of flesh is not too soft and not badly frayed when cut.



Figure 5: Fresh fish and shrimp (Source: Myanmar Digital News)

## Chapter (5)

### Quality assessment methods for fish and shrimp

#### Objective

- To understand the quality assessment methods for fish and shrimp

#### Methods used for assessing freshness characteristics of fish and shrimp

1. Organoleptic test – assessment of appearance, texture, color, smell, and taste by using eye, nose, hand, tongue, and common sense.
2. Bio-chemical test – nutritional analysis in laboratory.
3. Bacteriological test -microbiological analysis in laboratory.
4. Freshness test by using instruments – Use of thermometer and fish freshness meter (Torrymeter).

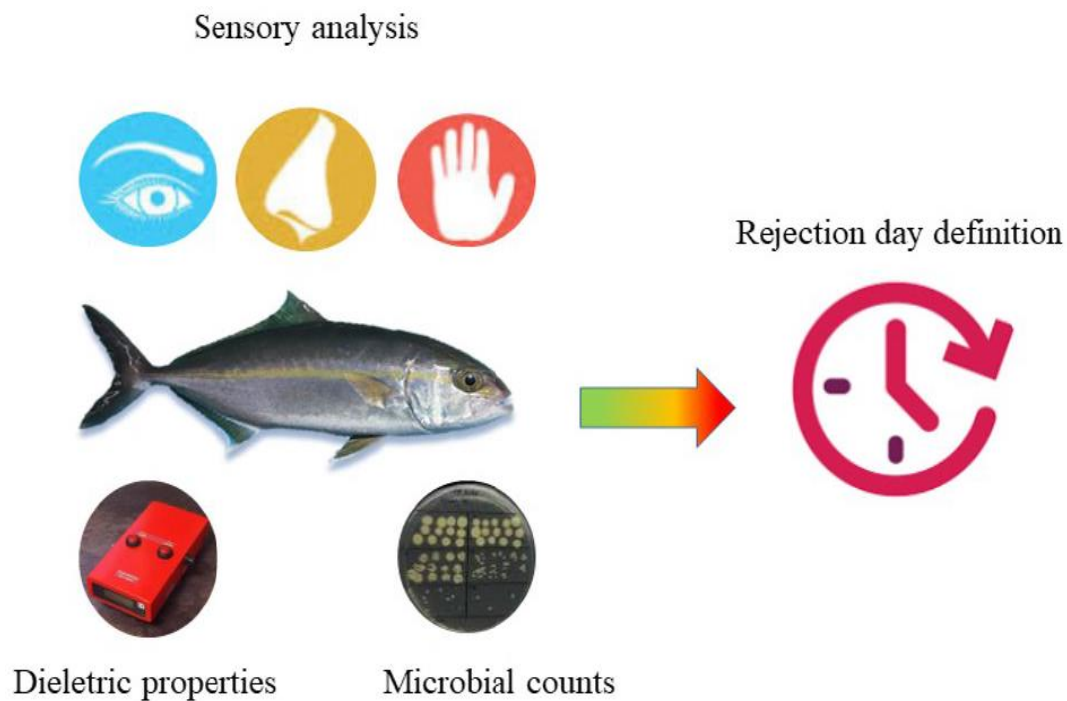


Figure 6: Freshness assessment and shelf-life prediction (Source: Jorge Freitas, 2019)

## Chapter (6)

# Prevention of raw fish and shrimp from spoilage (Icing fish and dipping fish in chilled water)

### Objective

- To understand the reasons of fish and shrimp spoilage
- To be able to implement prevention and control measures for fish and shrimp quality degradation
- To earn benefits by minimizing the spoilage of fish and shrimp

### Spoilage of fish and shrimp raw materials

#### 6.1. Enzymatic degradation/Autolysis

- Gastric juice (mild acid)
- Flesh of the fish becomes stiff or soften.
- Belly cracks in fish due to enzymatic degradation.
- Black spot formation in shrimp due to enzymatic degradation.
- Combination of hemolymph and oxygen from air

**Notes:** Enzymatic degradation in shrimp can cause Black spot/Melanosis.  
Enzymatic degradation in fish can cause belly rupture.

### Prevention

- Chill the fish in airtight insulated box.
- Degutting and removing gills in fish.
- Remove head in shrimp.

#### 6.2. Bacterial Spoilage

- Cannot see with naked eyes.
- Can be seen only by microscope.
- Foul smell in fish and shrimp due to bacterial spoilage.
- Bacteria size –1 micrometer (1/1000 mm). Varies in shape ranging from rod-shape, spherical, ovoid, spiral, or grape-shaped.
- Single cell organisms, multiply asexually by means of binary fission.



At 25-30°C, under normal room temperature before chilling the fishery products, bacteria can multiply double in every 15 mins means four times at every hour during the logarithmic growth phase.

At cold temperature after icing the products, bacteria can multiply once in every 30 mins, whilst the products are stored at -18°C, bacteria multiply once in every 12 hours.

Technically, there are three types of microbes in fishery sector.

- Harmful microbes
- Beneficial microbes
- Spoilage microbes for fishery products

### Prevention

- Chill the products in insulated airtight box.
- Degut and remove gills in fish.
- Remove heads in shrimps.

### 6.3. Oxidation and Rancidity

- Fats in fish/shrimp are unsaturated fats.
- Rancidity happens when fat is exposed to heat, light, or oxygen over a period of time.
- To reduce the fat contents, it is necessary to degut and to remove entrails and belly portion of the fish.
- Chemicals can be used to prevent from fat oxidation and oxidative rancidity.
- Fish and shrimp can be prevented from rancidity by keeping them under airtight condition and storage away from light and heat.
- Fish rich in fatty acid should not be used to make dry fish and salted fish.
- When rancidity happens, color of the fish change from dark yellow to brown and release bad smell. Texture of the flesh change and flavor becomes bitter.
- To prevent fat oxidative spoilage
  - Degut
  - Remove viscera for fish, and
  - Remove head for shrimp.

**Fats in fish/shrimp+ oxygen in air = Fat oxidation (Rancidity)**

- Raw material (Shark catfish)
- Most common in finished products (Fish paste, dry fish etc.).

**Prevention**

- Remove belly portion of raw fish.
- Pack the final products in cool, dry, and airtight condition.

**6.4. Extrinsic factors for fish and shrimp spoilage**

- High processing room temperature.
- Delay processing time.
- Rough handling of fish and shrimp.
- Poor fishing technique.
- Less ice usage.
- Different fishing season. (Summer, rainy season, and winter)
- Difference type and size of fish storage container.

**6.5. Characteristic of fish and shrimp spoilage**

- Change in color.
- Foul smell.
- Bad taste.
- Texture become soften.
- Slimier and produce more mucus.
- Reduced weight.
- Damage physical appearance.

**6.6. Storing fishery products at low temperature to prevent spoilage**

**(a) Icing/Chilling of fish and shrimp**

- Insulated plastic ice box should be chosen as a container for fishery products.
- Plastic tray can also be used to carry fish with ice.
- When fishery products are mixed with ice, use 1:1 ratio (1 x Weight of fish: 1 x Weight of Ice) and lay the products on the tray with drain hole at the bottom.

- As prawn is an expensive product, use (1: 1.5) ratio (1 x Weight of prawn: 1.5 x Weight of ice).
- Thick layer of ice should be laid at the bottom of tray or ice box. Place the fish/ shrimp layer and ice layer alternatively and cover with thick layer of ice on the top of the product to prevent the heat conduction from outer surface of the tray. (More ice should be added on top and bottom layers)
- A quick drop in temperature can be resulted by letting the cold water from upper tray flow through drain hole over the bottom fish tray.
- However, it is likely to happen that bacteria from the upper trays can transmit to the bottom trays.
- When the drain hole is at the side of the tray, neither quick cooling effect for bottom tray nor bacteria transmission to the bottom tray will be resulted.
- The ratio of fish and ice should be adjusted depending on the distance and duration of the transportation, seasonal temperature change, insulation capacity of the container, and capacity of fish storage condition to prevent from exposure to light and air.

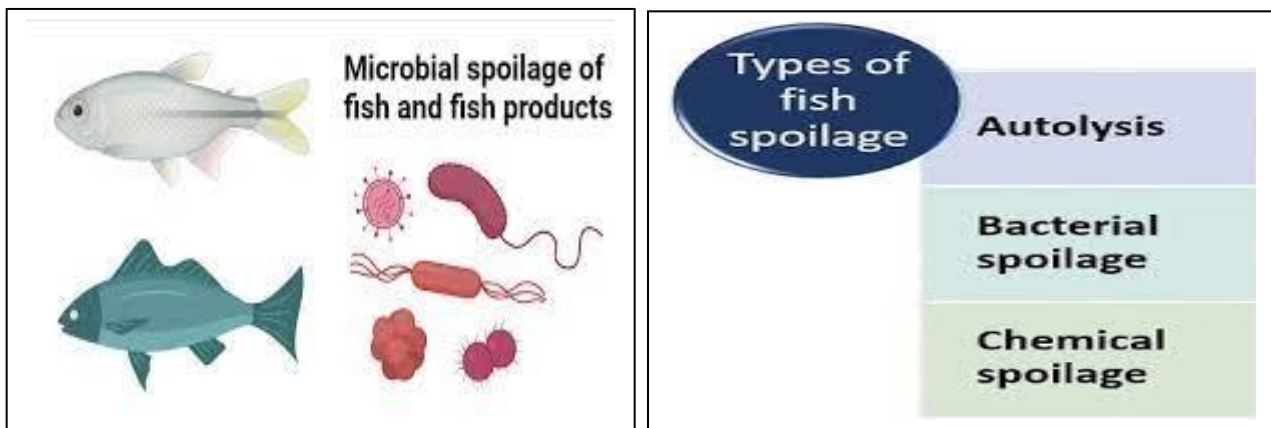


Figure 7: Spoilage of fishery product (Source: [www.biologynotes.com](http://www.biologynotes.com))

## 6.7. Systematic icing/chilling technique

1. Use of clean ice



2. Laying the fish in order during icing



3. Thick layer of ice at the bottom



4. Layering of fish and ice in layer



5. Use of insulated box



Figure 8: Icing fish (Sources: Google images)

## Chapter (7)

### Advantages and disadvantages of using ice

#### Objective

- To understand the benefits and importance of using ice to prevent fish and shrimp spoilage.

#### Advantages of using ice

- Brighter color in fish and shrimp.
- Enhance flavor and odor in fish and shrimp.
- Maintain weight of raw materials.
- Enhance quality of final products.
- Better price due to better in quality.

#### Disadvantages of using ice

- More costly for buying ice.
- Longer duration.
- Longer working time.
- Damage in fish/shrimp.
- More susceptible to spoilage if the ice is unclean.
- More costly for insulated box and utensils.

**TIPS: Remove belly portion in fish when ice is used & use extra ice for shrimp.**



*Figure 9: Icing fish to protect spoilage*

## Chapter (8)

### Usage of Chemical (Color, Odor, and Preservative)

#### Objective

- To understand the safe use of chemicals according to the permitted limit directed by Department of Fisheries and Food and Drug Administration Department
- To improve consumer awareness on adverse human health effect of non-permitted chemicals and dyes.

#### Usage of Chemicals (preservatives, dyes)

- Sodium nitrate/nitrite is used in production of dry fish, fermented fish, and salted fish. Dyes are also used in raw fish, dry fish, dry shrimp, and fish paste.
- Sulphite is used in shrimp to prevent black spot formation. It is necessary to understand and follow the manufacturer's instruction not to exceed the maximum residue limit.
- 0.01% sodium benzoate is used to prevent food safety hazard such as mold that is commonly found in dried fish and shrimp.
- Vinegar for sour taste, saccharine and artificial sugar such as power sugar for sweet flavor, monosodium glutamate for meat and vegetable are commonly used to enhance flavor.
- It is necessary to use and follow the list of permitted chemicals set out by Codex Alimentarius Commission (CAC) of Food and Agriculture Organization.
- Both for local market and export market, it is an obligation to follow the list of permitted chemicals stated in the directives issued by Department of Fisheries.

#### Formalin cannot be used in processing of fishery products.

- Pest control chemicals used for terminating fly, maggot, or cockroach, cannot be used in fish and food processing.
- Alum is frequently used to increase clarity of water and it is sometimes used for fish/shrimp. Use of alum in small amount is not critical.
- It is not appropriate to use indigo as dye to change the color of freshwater lobster to bluish green.

#### Usage of Chemicals (preservatives and dyes)

- Preservatives are used for prolonged shelf-life, and dyes are for enhancing color. Formalin, or formaldehyde is used in fish and shrimp to improve quality after catching.



Permitted and non-permitted chemicals in fish and shrimp processing.

No.	Fishery products	Chemical used	Allowable limits	Potential health risk
1	Croaker fish	Textile dye – yellow color	Not permitted	Cancer
	Squid	Formalin	Not permitted	Cancer
	Shrimp	Sodium metabisulphite	25-50 mg per 60 tickles (25-50 ppm)	Cancer if permitted limit is exceeded
2	Various dried fish and dried shrimp	Fly/maggot killer Alum Polyphosphates Antioxidant Boric acid Propionic acid Benzoic acid Sodium nitrate/nitrite	Not permitted	Cancer
3	Fermented fish and shrimp	Sodium nitrate/nitrite Dyes (textile dyes)	Not permitted	Cancer
4	Fish paste, shrimp paste and fish sauce	Dyes Formalin	Not permitted	Cancer

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## Chapter (9)

### Basic food packaging techniques

#### Objective

To get better benefits from improved quality and shelf life of fishery products and attracts customer's trust by using systematic packaging techniques of fish and shrimp products.

#### Basic food packaging techniques

The quality of fish and shrimp raw materials or products also depend on the quality of packaging. Quality of raw materials and final products decrease due to poor quality of packaging material and could also pose food safety risk. (For e.g., molding due to damage in packaging material)

In wholesale markets, fish paste, and dried fish products are sold in Penan bag, fish and shrimp paste are piled in plastic tray for selling, bowl or bottle, fish sauces are sold in big plastic containers.

In retail markets, products are packed with plastic bag, plastic box, plastic tray, polystyrene box to get more attractive. Fish paste and dried fish products in some supermarkets, are packed in vacuum packaging for better quality and longer shelf life.

#### Types of packaging materials

- Green leaves (e.g., banana leaves and Taung Zun leaves)
- Paper (sheet, bag), Plastic
- Poly styrene (PS) box
- Polyethylene (PE) based bag, box, cup, basket, mesh, bowl, barrel, bucket, insulated fish box.
- Glass-based bottle and cup, Bamboo and cane-based basket, mesh, screen.
- Tin-based bucket and barrel, Wooden box, barrel, pine box.
- Hessian bag.

#### Characteristic of good packaging materials

- Must be durable to protect leakage of products.
- Must have protection from mold, bacteria, fly and bugs.
- Must have protection from dehydration.
- Must be able to maintain the product's original odor, flavor, and texture.
- Must be able to maintain the product's shelf life.

- Must be attractive.
- Must be able to provide the products' information and label completely.



Figure 10: Various types of fishery product packaging (Source: Google images)

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## Chapter (10)

### Traditional fish products processing (Fish paste, Dried fish, Salted fish, and Pickled fish)

#### Objective

- To be able to produce safe and quality traditional fishery products. (e.g., Fish paste, dried fish, salted fish, and fermented fish).
- To be able produce safe and quality fish and shrimp products from local consumption to export oriented production.

#### Processing flow chart and formulas for traditional fishery products

##### 10.1. Dried fish

Dried fish is one of the popular foods not only in Myanmar but also in other countries. The taste of dried fish is unique. It can be consumed either sprinkling with edible oil after roasting or by cooking or frying. Although the basis techniques of dried fish production are similar in principles, not all production methods are identically the same depending on the species and size of the fish. Dried fish is one of the main dishes for rural areas and fish deficient areas such as upper Myanmar. One of the main quality concerns for dried fish is molding. Dried fish can get molding easily if moisture content exceeds 40% in dried fish and because of poor sanitation and packaging quality. Quality can be improved, and shelf life can be prolonged when vacuum packaging technique is used.

Different varieties and sizes of dried fish products such as small whole fish, medium-sized fish, and fish fillets, fish slices can be found in market. Depending on the shape of the products, manufacturing techniques are slightly different, however, the basic principles is the same. Molding in dried fish can be prevented by using 0.1% (1g/1kg) Sodium Benzoate. Previously, 0.025% (250 mg/kg) Sodium nitrate can be used for better color and stiffness of dried fish. Now, Sodium Benzoate for use in fishery product is no longer permitted by Department of Fisheries.

#### Raw materials used

- Freshwater fish or saltwater fish
- Striped snakehead, banded snakehead, king fish, mackerel, lizard fish, sole fish, pomfret, butter catfish, ribbon fish, striped catfish, silver barb, climbing perch, catfish, the gangetic

mystus, shark, murrel, croaker, anchovy, bream, threadfin, Bombay duck, lotia, lesser spiny eel, tank goby

### Notes to enhance quality

- Good quality freshwater and saltwater fish should be selected.
- Moisture content should not exceed 40% and 30-35% is the optimum. Molding may occur when the moisture content exceeds 40%. Crispiness in dry fish flesh could result when the moisture content is less than 30%.
- Oily fish should not be used to make dried fish as it can become rancid, change in color, and develop bitter taste.
- Strips of dried fish should not be too thick as it will be difficult for evaporation, and it may delay in fish drying.
- Drying process for fish can also be slow when there is high humidity. (e.g., in raining season)
- Employee, workplace, and facilities used must be clean and hygienic.
- Pests (fly, mouse, dog, cat etc.) must be prevented and controlled.

### Remark

- Maggots can be bred in dried fish when flies are not controlled during drying. Flies can be prevented by maintaining the clean environment and by using solar tent dryer for fish drying.
- For salting, two thirds of raw salt and one third of fine salt (table salt) should be used.
- When impure salt is used, variation in color and flavor can happen.

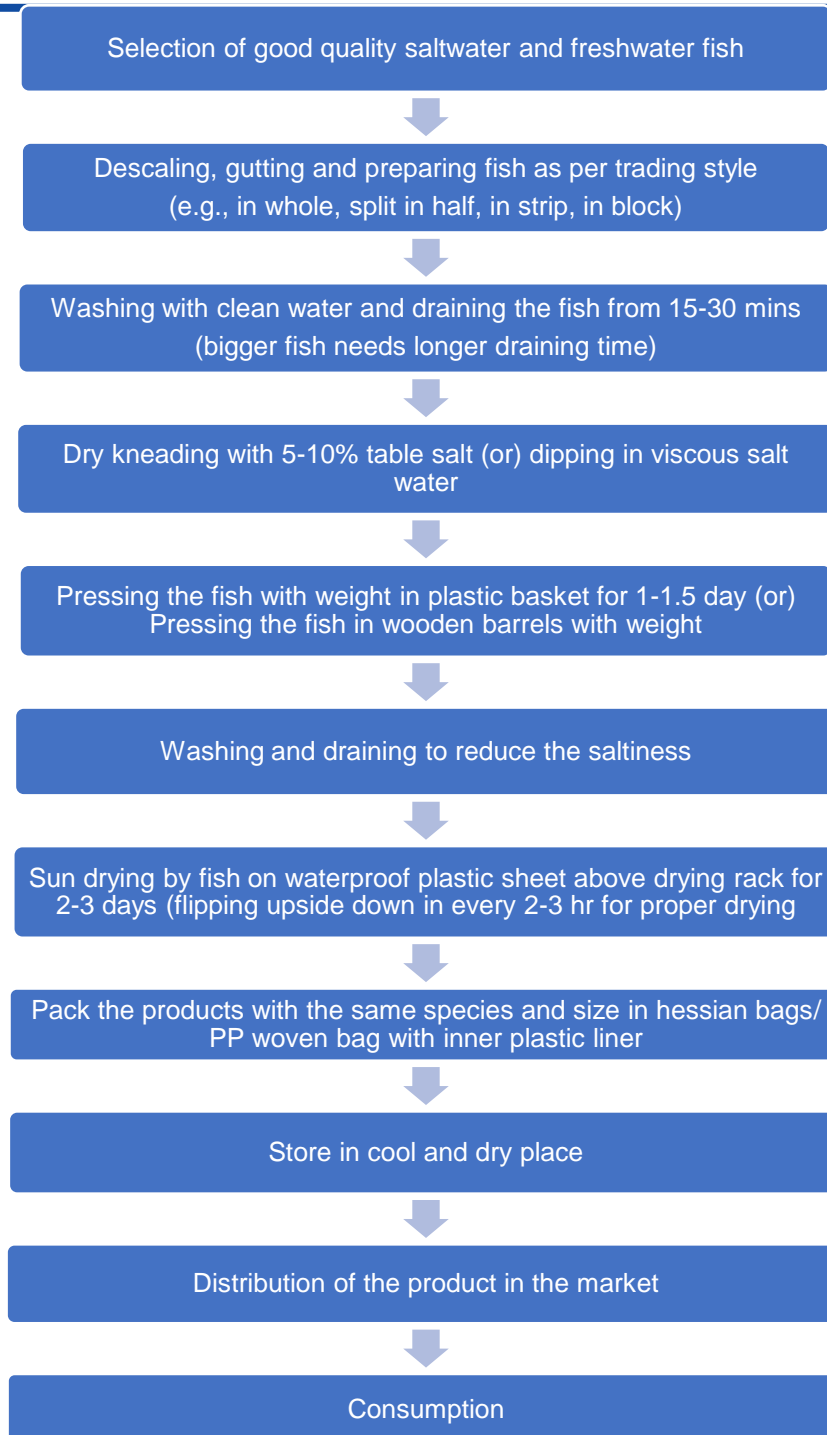


Figure 11: Flow diagram of dried fish production

Remark: The productivity ratio for dried fish is 25-35 %.



## 10.2. Production of Salted Fish



Figure 12: Flow diagram for salted fish (Nga Pi Kaung) production

### Raw materials used

- Striped snakehead, wallago, hilsa, Mrigal, Yellow croaker, Rohu, Carp, Striped cat fish, Pangush, Smelt, Tilapia, Large-eyed mullet, Sword fish



Figure 14: Dry fish production in Myanmar (Source: [www.mmmtimes.com](http://www.mmmtimes.com) & [www.alamy.com](http://www.alamy.com))



Figure 13: Salted fish in Myanmar (Source: [www.mmlazp.blogspot.com](http://www.mmlazp.blogspot.com))

### 10.3. Fish paste

Since a long time ago, fish paste has been one of the traditional foods consumed by many people not only in rural area but in urban communities also in Myanmar. Fish paste is a type of food produced by preserving fish for consumption.

Fish paste is an essential ingredient used in many Myanmar cuisines because of its salty and sweetened flavor although it is less popular in western countries for its potent smell. Fish paste contains protein and vitamin D. Fish paste is one of the marine products which can be produced not only for domestic scale but also for commercial scale.

Fish paste can be classified into 2 types – fish paste made from whole fish (Yaekyo ngapi) and fish paste made from small prawns (Seinza ngapi and Hmyin ngapi). Seinza ngapi and Hmyin ngapi can be made with tiny shrimps from Ayeyarwady Region and Tanintharyi Region.

Yaekyo ngapi is the essential product in rural areas of Myanmar where there are plenty of fish and it can be made either with freshwater fish or low-price saltwater fish, can be made with whole fish with no waste and easy processing steps.

The use of salt in making fish paste and shrimp paste is to reduce the water content of the fish and shrimp, for firming of the flesh, and for preservation and adding flavor.

#### Raw materials used

Striped snakehead, Climbing perch, Fresh water herring, striped dwarf catfish, Flounder fish, Nga Pu Lway, Croaker, Ribbon fish, Flat fish, Nga Phyin Tha Lat, and Nga Mye Tan Thwe.



Figure 15: Fish paste (Nga Pi) in Myanmar (Sources: Google images)

## 10.4. Production of fish paste (Yaykyo Ngapi)

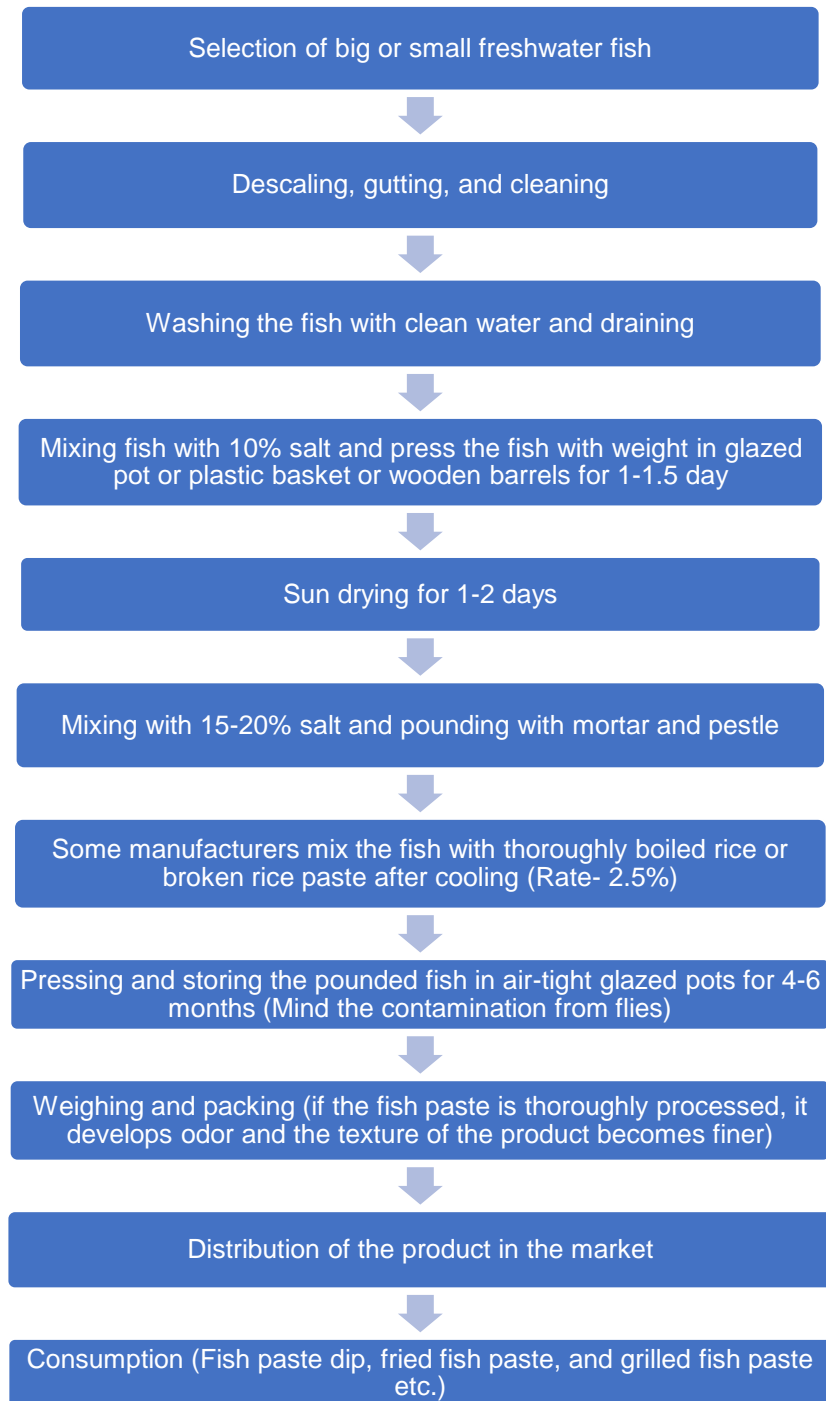


Figure 16: Flow diagram for production of fish paste (Yaykyo Ngapi)

### Raw materials used

Snakehead, Gourami, Climbing perch, Freshwater herrings, Striped dwarf catfish, Flounder fish, Ngar Pu Lway, Ribbon fish, Croaker, Flat fish, Ngar Phyin Tha Lat, and Ngar Mye Tan Thwe.

### Remark

- Store the fish paste in the pot
- Cover the fish paste pot with 1% salt in thick layer.
- Then, cover the salt coated pot with leaves such as bamboo leaves, Taung Zun leaves, banana leaves or with In Phat,
- Press firmly with bamboo stick on top of the fish paste pot.
- To prevent maggot infestation, cover the pot with Desmodium leaves on top of the fish paste before closing the pot with lid.
- Total product yield ratio for Yaekyo Ngapi is 65-75%.



Figure 17: Yaykyo Ngapi sold at a market in Myanmar (Source: [www.locotabi.jp](http://www.locotabi.jp))

## 10.5. Production of pickled fish (Small whole fish)

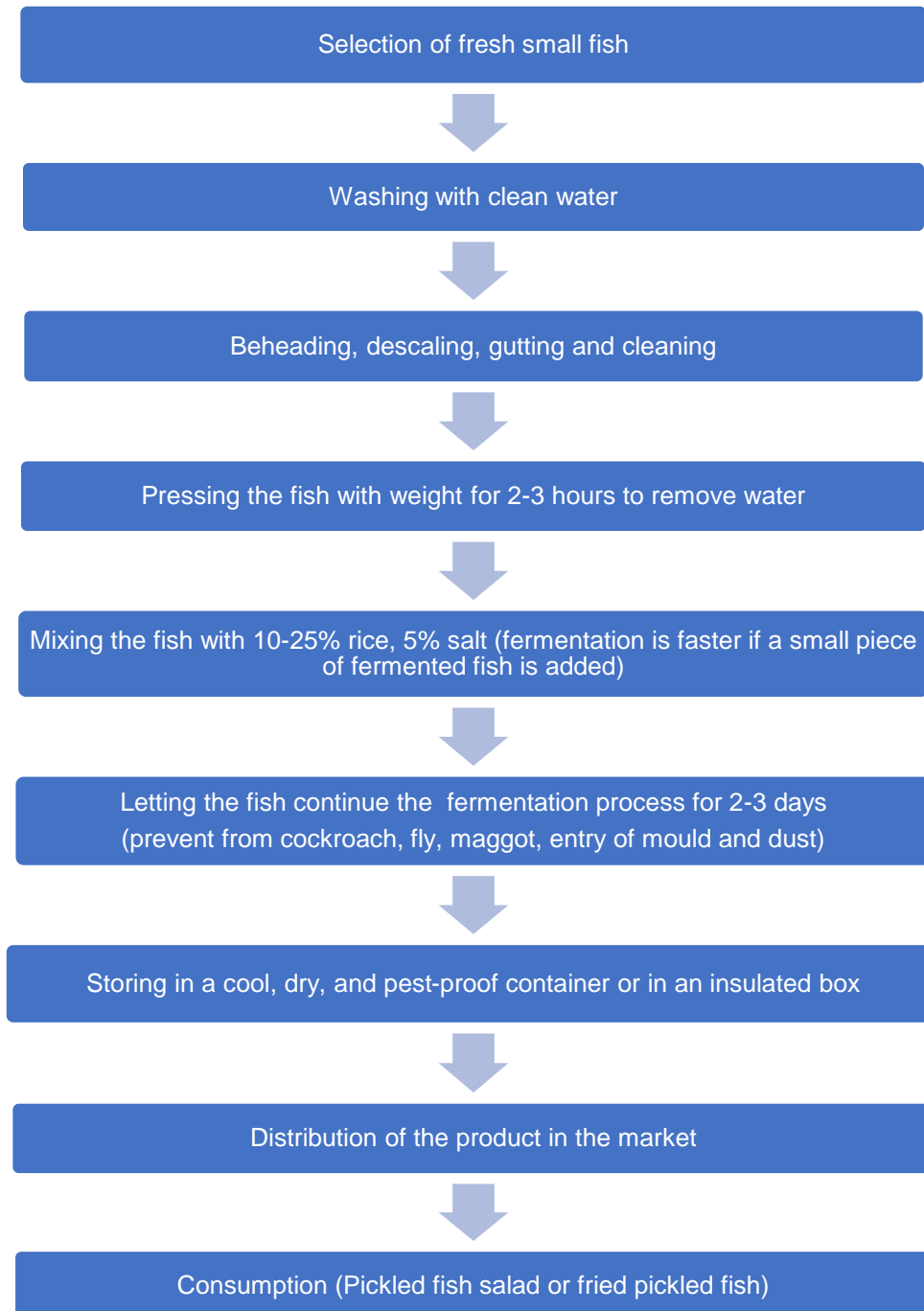


Figure 18: Flow diagram for production of pickled fish (Small whole fish)



### Raw materials used

- Silver barb and Mola carplet

### Remark

- Total product yield ratio for fermented fish is 50%.



Figure 19: Pickled fish and shrimp in Myanmar (Source: Google images)

## 10.6. Production of pickled fish meat

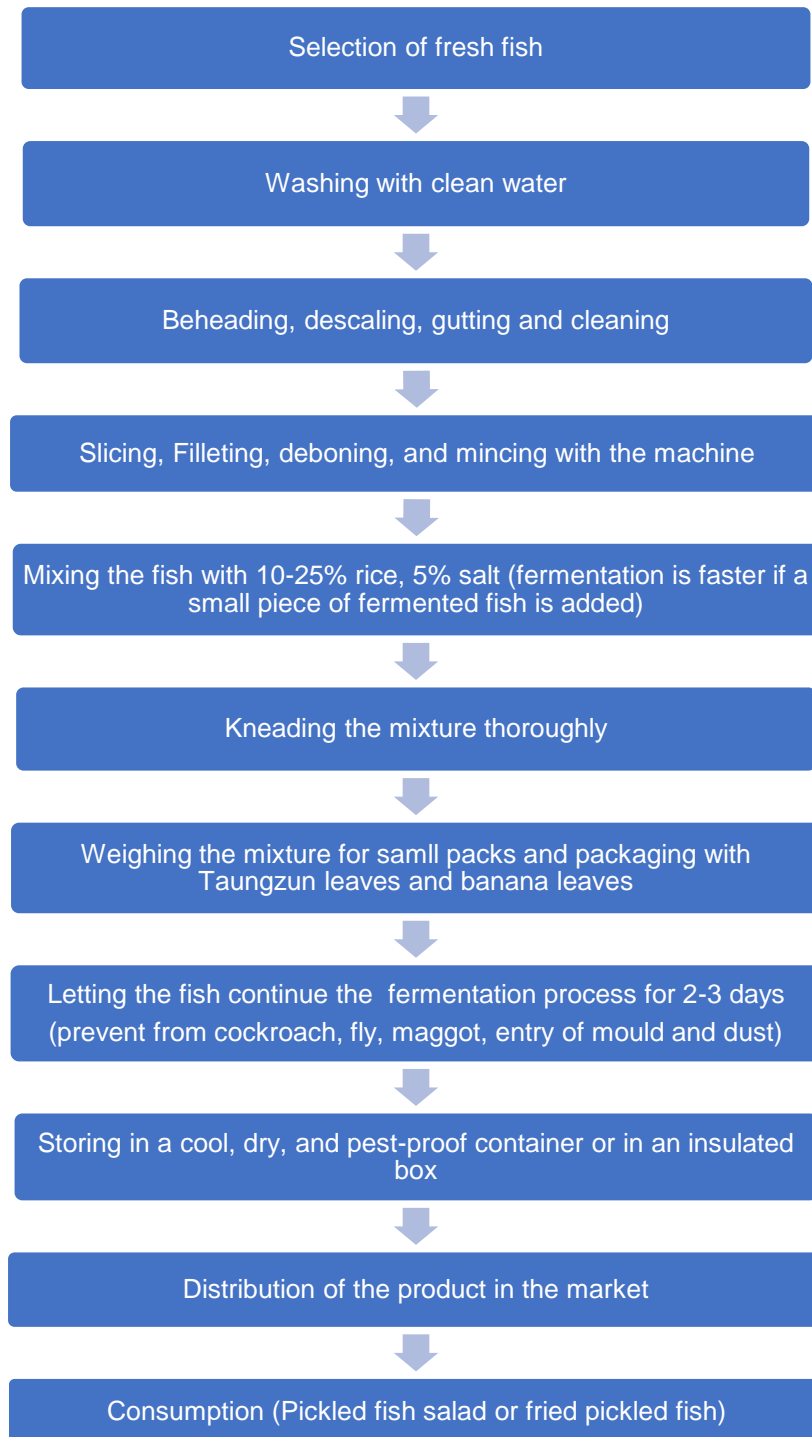


Figure 20: Flow diagram pickled fish meat production

### Raw materials used

- Rohu, Carp, Fresh water herring, Snakehead, Silver barb,

### Remark

- Total product yield ratio for fermented fish is 50%.
- The product has the shelf-life of 5-7days in normal room temperature, but it has a shelf-life of one month in refrigerated temperature – 5-7 °C.

### Weighing and unit conversion

Balance and scales	Units
Kat Tar weighing scale	Viss and Pound
Top loading balance	Kilogram (kg) and Gram (g)
Digital balance	Viss, Kilogram, Gram, and Pound
Pound weighing scale	Ounce and Pound
Weight Conversion	
1 kg	1 litre = 1000 gm/ml/cc/cm <sup>3</sup> 2.204 lb 0.612 viss 61.2 tickles
1 g	1ml 1 cc 1 cm <sup>3</sup>
1 gallon	4.54 L 4.54 kg
1 MT (Water)	1000 kg 220.26 gallon
1 viss	100 tickles 3.6 pound 1.624kg 1624 g

1 pound	27.5 tickles 454 g
1 Metric Ton	1000 kg 613 viss 2204 pound
1 Long Ton	2240 pound
<b>Length Conversion</b>	
1 centimeter	10 millimeters
1 meter	100 centimeters 39.36 inches
1 inch	2.54 centimeters
1 acre	209 feet x 209 feet
1 heatare	2.6 acres
1 kg ice	80 kcal



Figure 21: Different types of weighing fish in Myanmar (Sources: Google images)

## Chapter (11)

### Development of traditional fishery products

#### Objective

- To improve the workplace and working condition of the traditional fishery product manufacturing such as fish paste, dried fish, fish sauce, and pickled fish.

#### Personal hygiene of workers

- Workers must be in good health and free from communicable diseases.
- Uniform must be clean. No contamination from uniform must not be transmitted to food.
- Workers must wear clean head cover, apron, gloves, gum boots or shoes designated for use in workplace only.
- Women workers must not wear jewelry, nail polish, traditional skin care (Thanatkha) and lipstick inside the processing place.
- Workers must not have long fingernails. Longer fingernails must be trimmed short.
- Workers' hand must be washed thoroughly before entering the workplace. (e.g., using soap, water, and chlorine)
- Workers' must enter the workplace only after proper hand washing every time after using toilet.
- Injuries and wounds should be covered with waterproof bandage or plaster.

#### Environmental hygiene

- Processing place or worksite should be free from smoke, dust, flood, standing water and of air pollution.
- Worksite must be protected from cyclone, heavy rain or sandstorm.
- Worksite must be protected from other means of contamination such as waste bin.

#### Processing

- Good quality fish and shrimp must be used.
- Potable water must be available for use.
- Hand washing must be done frequently and as required during processing.
- Increase in fish and shrimp temperature during handling and delay in operation time must be controlled.
- Fish and shrimp raw materials must be protected against cross contamination from waste.

- Crushed ice should be used if available.
- Pests (domestic animals such as dog, cat, pig and insects such as rat, fly, cockroach) must be protected entering the worksite.
- Clean cloth must be worn.
- Good manufacturing practices must be implemented.
- Facilitates and utensils used must be adequate and easy to clean.
- Rusty knives and utensils must not be used.
- Fish and shrimp must not be put directly on ground.

### **Packaging materials and techniques**

- Prevent packaging materials from leakage and cracking.
- Protect packaging materials from exposure to mold, bacteria, flies, and other pests.
- Store the packaging material properly to avoid contamination such as dust and dirt.
- The packaging materials must have the capacity to maintain the original odor, flavor, and texture of the products.
- The packaging materials must have the ability to maintain the product's shelf life.
- Labels and required information must be provided on the packaging materials. (e.g., product name, manufacturing date, expiry date, nutritional composition, net weight etc.)

### **Ingredients used in processing fishery products**

- The quality of salt used in processing must be food grade, and other ingredients used must be suitable for intended products.
- Salt must be free from contaminants such as dust, sand, mud, and dirt.
- Moisture content, magnesium, calcium, and sulphate contents must be low.
- Salt must have a good clarity, and small size.
- Salt must be free from microbiological hazards.
- Chemical additives must not be used.
- Only the allowed chemical (i.e., preservatives and dyes) must be used in compliance with the regulations and should be in line with the specified dosage.

### **Marketing the products**

- The products must be produced to meet the market requirements.
- The products must be acceptable by the market and consumers.
- The products and market must have good and harmonious linkages.



- Fish and shrimp products must be produced with advance techniques and price should be adjusted in timely manner.

### **Raw materials and freshness**

- Both freshwater and saltwater fishery products must be fresh.
- Quality is better when beheading and gutting are done on the boat.
- Raw materials remain fresh if ice and ice boxes are used.
- When there is no ice available, do not put fish and shrimp under direct sunlight for longer period.
- Formalin must not be used to preserve fish and shrimp. Chemical and additives must be used in accordance with the guidelines set by Department of Fisheries.
- Temperature and time must be wisely managed.
- Shrimp must be sorted and separated from mud, decay leaves and branches.
- Product should be produced as quickly as possible soon after raw materials is ready.

### **Advance production techniques and quality control of final products**

- Physical characteristic, weight, colors, quality inspection (Physical test).
- Moisture content, bone, blood, saltiness, nitrate and nitrite, alum flavor, pesticide analysis (Chemical or Biochemical test)
- Molds, larvae, parasites, bacterial analysis (Microbiology or bacteriological test).
- Inspection on natural flavor of fishery products, odor, color and texture (Sensory test).



Figure 22: Fishery product processing with modern technology (Sources: Google images)

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## Chapter (12)

### Post-harvest losses of fishery products (FAO, 2011)

#### Introduction

The chapter of post-harvest losses is the topic that is introduced before training on processing, food safety and quality control of fishery products.

This topic is very relevant to the fish farmers, the beneficiaries, of the project because many fish farmers have very limited awareness on the fact that the post-harvest losses can have direct and indirect impacts on their livelihoods and nutritional security. This training manual offers opportunities for fish farmers to improve the information on the importance of post-harvest handling and value addition of their external products. The following topics were subtracted from various information sources and this guidance will be revised after the training depending on the feedback of trainees and supporters.

#### Objective

- To identify the post-harvest losses and their impacts.
- To identify root causes of post-harvest losses in every step of fishery product value chains.
- To identify the ways to minimize the losses in fishery product value chains.

#### Target participants

Small-scale fish farmers, traders, processors, workers in fish industry.

#### Training aid materials

Flip charts, cards, pens, photos showing various method of fishery product value chain in Myanmar.

#### Post-harvest losses (Source – Fish Site, 2011 & FAO 2016)

Post-harvest losses mean fishery products which must be disposed or sold with reduced price due to changes in market or downgraded quality. It means that people involve in fishery industry (workers, processors, traders and supply chain actors) lose the income they deserve. On the other hand, it also means the supply of low-quality fishery products to consumer. It also affects the food safety. (Fish site, 2011)

According to FAO in 2016, the global post-harvest loss of fishery products is least 35%. There is no official data that is specifically reported for Myanmar.

Post-harvest losses happen because of biological and microbial deterioration of fish after death. Live fish naturally have mechanism to prevent deterioration however, the mechanism stops when fish die. Then, the enzymatic oxidation and biological deterioration that can damage the quality of fish start to come out. (Fish site, 2011)

### **Factors influencing the rate of deterioration in fish (Fish Site, 2011)**

Deterioration of processed fish is unavoidable as it occurs gradually even though ice is used, and fish is chilled during the interval from the time of fish death and the time of consumption.

### **Post-harvest losses**

#### **Deterioration caused by temperature abuse**

At 20°C and above, fish deterioration commonly happens whilst maintaining the fish at the temperature less than or equal to 5°C can help reduce the losses by slowing down the rate of bacterial multiplication and deterioration.

#### **Fish handling methods**

Improper fish handling methods such as use of unhygienic boat, inappropriate facilities (utensils), containers and baskets, poor hygiene condition, cleaning fish with contaminated water, filthy fish storage area, rough handling of fishes, stepping on the fish etc. can accelerate the fish deterioration.

### **Factors effecting post-harvest losses and deterioration**

- Disposing the small fish (that are not valuable or not intended to catch) at sea.
- Improper processing and packaging techniques that can cause injuries to fish.
- Fish eaten by other animals and pest infestation.
- Incorrect packaging and storage practices which can deteriorate the final products.
- Unstable price and income because of market turning points and market fluctuation

In Myanmar, the hygiene condition of the fishery product processing is weak for using wooden or plastic boxes throughout the long supply chain from fish farm to consumers by road transport. Wooden boxes can damage the quality of products and are difficult to clean and recycle due to their rough surfaces and overloading. (FAO, MOAL, LIFT, 2016)

### **Types of fishery products losses (FAO, 2011)**

Physical loss can occur in production of smoked fish especially when the products are eaten by animals and are disposed when the fish are over-burnt. Amount of money loss can be calculated by multiplying the fish weight and market price of the fish. Quality loss means the difference

between highest price of fishery products and the price of low quality fishery products. This happens due to poor handling, lack of ice usage and inadequate processing, inappropriate packaging and incorrect storage. For e.g., quality of the final fishery product decreases when it is produced from the fish without using ice.

### **Loss by market pressure**

It happens when the supply and demand are imbalance. Knowledge on market potential is of critical in avoiding the loss. The loss can happen when there is no substitute market at the time of peak production periods.

### **Reasons for losses of fishery products during harvesting (Fish Site, 2011)**

The losses due to physical (external) factors, quality and market pressure happen along the value chain from each stage of production until consuming. Consequently, income loss and food safety risk may arise.

The three main causes of post-harvest losses in fishery products value chain are expressed briefly in Table (1).

Step	Reason	Types of losses
Fishing	Fishing by means of harmful methods such as fishing by using dynamite, poisons etc. can cause damage to fish and decrease the quality.	Physical quality
	Falling out of fishing net or throwing fish that is unwanted or unintended for catching	Physical quality
	Damage of fish inside the net due to leaving net for a long time (before lifting the net).	Physical quality
Prolonged storage of fish on boat	Delay transporting time to shore, Leave the fish caught under high temperature at sea.	Physical quality
	No cleaning and cold storage facilities on boat	Quality
	Stepping with foot on fish	Quality
Off-loading	Contamination due to poor cleaning	Quality
	Fish jumping out of tray and buckets to the shore	Physical quality
	Putting the fish at higher temperature under direct sunlight during price negotiation	Quality

	Stolen during off-loading at the jetty	Physical quality
Selling fish at the market	No use of adequate ice, no use of insulated boxes	Physical quality
	Limited facilities during harvesting. e.g., ice, processing facilities	Physical quality
	Higher supply in the market due to inadequate market information	Market Physical Quality
	Delay from buyers	Quality
Processing and packaging	Processing low quality and damaged fish	Physical quality
	Processing fish under unhygienic condition and pest infestation	Physical quality
	Drying fish on the ground, rock or bush	Physical quality
	Oxidative rancidity in oily fishes due to oxidation	Quality
Storage	Molding in fish	Quality
	Pest infestation during fish storage	Physical quality
	Discoloration due to chemical reaction	Quality
	Inadequate storage facilities	Physical quality
Distribution	Delay in selling, inadequate cold storage, warehouse, facilities and lack of sufficient ice	Physical quality
	Arriving to the market on unsuitable time	Market
	Weak buying power of buyers and consumers	Market



Figure 23: Fish catching by net (Source: [www.thefishsite.com](http://www.thefishsite.com))

## Chapter (13)

### Factors reducing post-harvest losses in fish farming (FAO 2011)

#### Objectives

- To increase income for rural fish farmers and fish industry workers by reducing losses in harvesting, transportation, processing, and marketing the fishery products.

#### Factors reducing the post-harvest losses in fish farming (FAO, 2011)

##### Tips for reducing post-harvest losses

- Use ice or fish storage ice box.
- When no ice is used, fish are susceptible to quick deterioration and thus, selling price is low.
- When fish are properly handled, good selling price can be guaranteed within a short time. Additionally, fish can be sold to different markets where better price is offered.

##### Losses during trading

- When fish are placed on dirty ground under the direct sunlight, quality deteriorates quickly and consequently selling price is reduced.
- Lengthy price negotiation during trading could also result in decreasing fish quality and thus selling price is reduced.

##### Losses during transportation

- Transporting fresh fish with bicycle leads to prompt quality deterioration due to long transportation time and high temperature.
- Using cart or open truck also damage the quality of fish due to direct exposure with higher temperature.
- Fish should not be transported in open canoe or small boat. Higher temperature could lead the fish to deteriorate quickly.
- The quality of fish can be maintained by using insulated ice boxes safely during transport.
- Using insulated box for fresh fish and insulated partition box for processed fish can reduce quality losses.

##### Transportation with insulated partition box

- Transporting processed fish in overloaded truck for long period of time can lead to damage or break the products into pieces and eventually result in losses.



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### **Losses during processing**

- Remove the inner viscera of fish where spoilage bacteria can be accumulated.
- Split and dry the fish for rapid drying.
- Clean the fish with potable water before processing.
- Drying fish on sand can contaminate the fish and require longer time for proper drying. It also increases the losses when the products are soaked wet by rain.
- Financial losses can be resulted when there is animal invade and consume the products, and pest infestation during drying.
- Drying over the rack is better than drying over the sand or on the ground. Birds can be controlled or prevented by many techniques.

### **Losses during packaging and storage**

- Overloading the products in packs during transport to reduce logistics fees can lead to damage the physical appearance of the products and selling price is lower due to laws of the external features.
- Processed fishery products should be stored in well-structured and ventilated area (or) in a proper warehouse. Otherwise, physical features and quality can be damaged due to higher humidity, animals' invasion, or possibility of stealing the products, and damaged by rain.
- Some traders re-process or manipulate the stored fishery products to reduce the losses. This can result in prosecution when the manipulation is harmful to consumers.

### **Market force losses**

- Formerly produced fishery products can be faced with the pressure to lower the price when there are newly produced fishery products entering into the market.
- Poor calculation on product costing and inadequate price setting of the product can also lead to losses.

## Dried fish manufacturing process in Myanmar

(Source – Food and Agriculture Organization, Ministry of Agriculture and Irrigation, Livelihood, and Food Security Trust Fund (LIFT), 2016)

For the dried fish manufacturing, it is important to keep the moisture content at less than 15%. Although the amount of spoilage bacteria and enzymatic decomposition can be decreased after sun drying by reducing the moisture content of fresh fish/shrimp to 25%, the growth of mold can only be prevented by reducing the moisture content to less than 15%.

- Fishery products should not be in direct contact with the ground or floor while drying.
- Pests such as rodents, mosquitos, flies, birds, and insects must be prevented and controlled from contamination.
- Waterproof plastic cover sheet must be in place to prevent the products from rain.
- Drying rate of fishery products can be faster only when there is a good ventilation in the surrounding area.
- Shelves or racks used for drying fishery products must be constructed with slopes that can be used as a drainage for liquid oozed out from the products.
- Nylon net or tatami mat could be used in sun dryer construction either on the floor or as a cover.



Figure 24: Drying fish in Myanmar (Source: [www.twenty20.com](http://www.twenty20.com))

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## Chapter (14)

### Background of value-added fishery products in Myanmar

Myanmar is a country with the abundance resources of freshwater, saltwater (marine) and brackish water fish. Among them, freshwater fish species are very important as they are plentiful fish resources found in the country. Majority of value-added fishery products are produced by using the freshwater fish. Processing steps and ingredients for making fish cracker and fish murukku from cheap and abundant freshwater rohu will be presented in this training chapter.

#### 14.1. Production of fish cracker, quality control, and cost calculation

Processing steps and ingredients for one of the value-added products, fish cracker, is made from cheap and abundant freshwater fish called rohu will be represented here.

In Malaysia, fish cracker is known as “Keropok”. In Myanmar, fish cracker is called “Nga-Mont”. Fish cracker can be made from marine fish (saltwater fish) and freshwater fish. Taste of fish cracker differ from region to region depending on the types of fish and ratio of ingredients included as per availability of fish within the region.

Types of marine fish which can be used for fish cracker are Mackerel, Goldfish, Swordfish, Nga Hmway Htoe, and freshwater fish are rohu and freshwater herring. Fish crackers are sold in various brand names in the market. The product presented here is made from freshwater rohu fillet, as it is one of the tasty and special value-added products. Fish cracker is one of the favorite traditional snacks of all ages throughout the country. It can also be consumed together with rice. Shelf-life or expiry date of prepacked ready to eat fried fish cracker is also sold in many different places (such as school, market, minimarket, supermarket, shopping center and hotel) are about 2 weeks. The shelf-life or expiry date of dried, ready to fry fish cracker is about 1 year. It is straightforward storage and transport not only for small and medium enterprises but also for consumers as it has long shelf-life.

The training on processing method for fish cracker, fish murukku, other value-added products, traditional fishery products and frozen fish and shrimp are delivered at the Fishery Products Processing Technique Section of Fishery Institute under the umbrella of Department of Fisheries.

**Reference: Utilization of freshwater fish for value-added products project, SEAFDEC/MFRD, Singapore (2011-2013) May Kyi (Fisheries Institute)**

## Production of fish cracker from freshwater fish - Rohu

Product name – Fish cracker

Common fish name – Rohu

Name of fish species - *Labeorohita*



Figure 25: Fish crackers made in Myanmar (Source: Google images)

### Product formulation for fish cracker

No.	Ingredients	Weight (g)	%
1	Minced Rohu meat	320	42.67
2	Starch (tapioca starch)	320	42.67
3	Drinking water (cold)	40	5.33
4	Dry anchovy powder Small amount of pepper	40	5.33
5	Table salt	15	2.00
6	Sugar	10	1.33
7	Monosodium glutamate	5	0.67
	Total	750	100

Remark: Final product percentage of dried fish cracker - 48 %

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## Processing steps for dried fish cracker

### 1. (A) Preparation of fish meat

- Store the whole fresh rohu temporarily in refrigerated temperature (3-5) °C or keep the fish with ice. (Avoid direct contact with ice because the texture of the fish meat can be softened).
- Make fillet from the fish or mince the fish meat with knife.
- Weigh the meat for desire amount and re-store at refrigerated temperature (3-5) °C.

### 1. (B) Preparation of ingredients

- Weigh the ingredients in required amount – starch (or) tapioca powder, dried anchovy powder, table salt, sugar, monosodium glutamate, potable cold water.

### 2. Mixing

- Mix the minced fish meat with ingredients in mixer.
- Add the cold potable water as needed.
- Mix the ingredients thoroughly during mixing.

### 3. Filling

- Fill the meat dough of desired size into plastic bag and tie both ends of plastic bag with plastic or aluminum band.
- Meat dough can be made into desired size.
- Optimum size is 5-6 cm.

### 4. Steaming

- Steam the meat dough at temperature 90-95 °C about 1.5 hrs.

### 5. Cooling and leaving over night

- Cool down the meat dough in cold water for 30 min and let it dry for a night.

### 6. Slicing

- Slice the dried meat with circular shape in 2 mm thickness.

### 7. Drying

- Dry the sliced meat in dryer at 50°C for approximately 1.5 hrs. Then, dry it continuously for 3 hrs at 70°C (or) sun drying for 2 days.
- Moisture content of dried meat should not exceed 10%. If it is over 10% moisture content, dried fish cracker cannot expand enough when frying.

## 8. Packing and storage

- Pack the product in good quality and moisture resistant plastic bag as per desired weight and size.
- Airtight Styrofoam boxes, paper boxes, can or glass bottle can also be use for packaging.

## 9. Marketing

- Both ready to eat fish cracker and ready to fry fish cracker in packages are sold in various places such as school, market, minimarket, supermarket, shopping center and hotels.

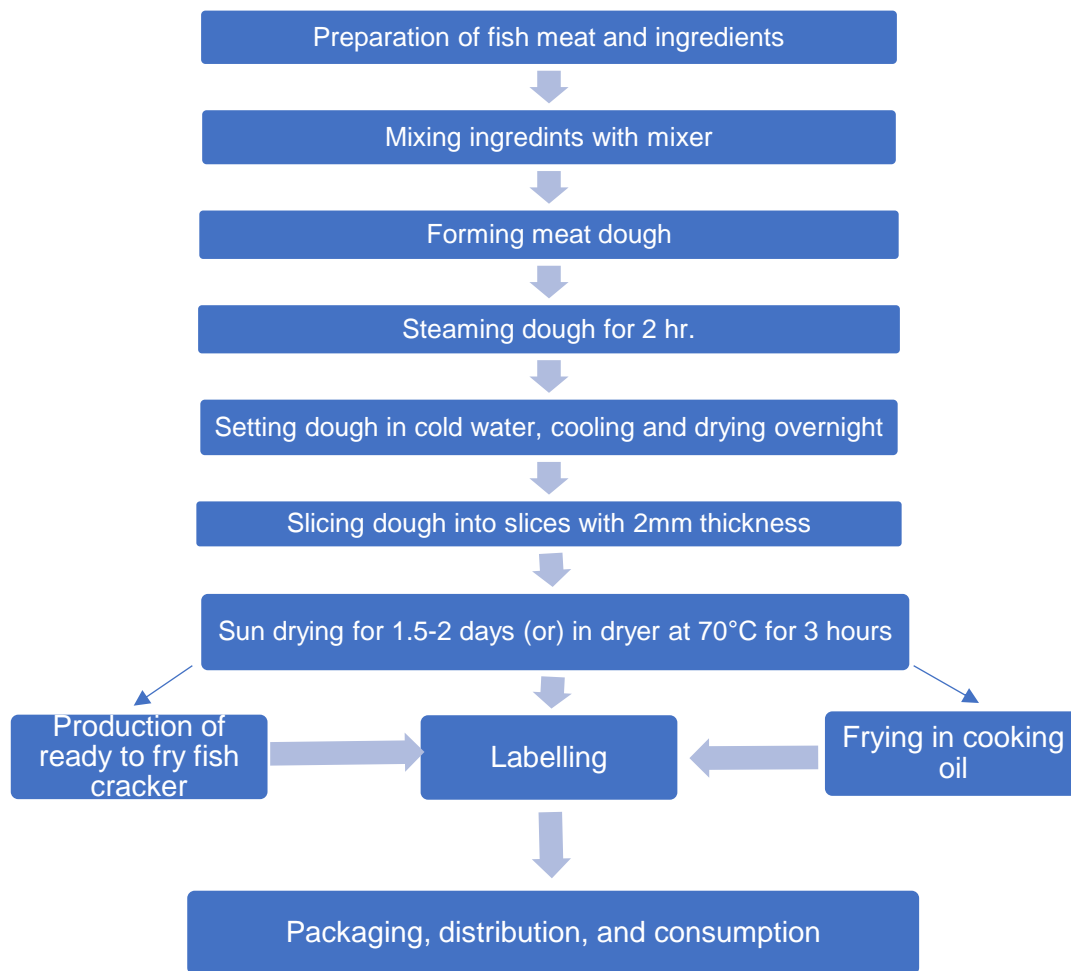


Figure 26 Flow diagram of fish cracker production



## ငါးမုန့်ခြောက် ပြုပြင်ထုပ်လုပ်ပုံ အဆင့်ဆင့်



ငါးမြစ်ခြင်း



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ငါးမြစ်ခြင်းအသား



၅။ အအေးခံခြင်းနှင့်တစ်ညတာလေသလပ်ခံခြင်း



၁။ ပေါင်းစပ် ပစ္စည်းများ ပြင်ဆင်ခြင်း



၆။ အဝိုင်းပြားလေးများ လှီးဖြတ်ခြင်း



၂။ ငါးအသားနှင့် ရောနှောကြိတ်ခြင်း



၇။ အခြောက်ခံခြင်း



၃။ အသားတောင့် ပြုလုပ်ခြင်း



၈။ ငါးမုန့်ခြောက်ကြော်ခြင်း

Figure 27: Pictorials for fish cracker production

### Estimated production cost for fish cracker

No.	Ingredients	Weight (g)	Cost (MMK*)
1	Minced Rohu meat	320	2400
2	Starch (tapioca starch)	320	500
3	Drinking water (cold)	40	25
4	Dry anchovy powder Small amount of pepper	40	400
5	Table salt	15	5
6	Sugar	10	10
7	Monosodium glutamate	5	10
8	PE plastic bag		300
	Total	750	3650

\*MMK= Myanmar Kyat

<b>Remark:</b>	<b>dried fish cracker</b>
Raw materials weight	750 g
Product – dried fish cracker weight	360 g
Final product percentage	48%

### Nutritional composition of fish cracker

No.	Product name	Moisture content (%)	Protein (%)	Fat (%)	Fiber (%)	Mineral (%)	Carbohydrate (%)	Calories/100g
1	fried fish cracker	4.35	16.23	23.06	0.00	2.30	53.98	487

## 14.2. Production of fish muruku, quality control, and cost calculation

Product name – Fish Murukku

Common fish name – Rohu

Name of fish species - *Labeorohita*

### Fish Murukku

- Fish murukku is a value-added product made from freshwater fish called Rohu. It is a ready to eat snack.
- Fish murukku is one of a favorite snack of many people in India and Southeast Asia and South Asia. It is a crispy snack with strong odor of spices.
- It is one of the unique and exotic snacks for people in Myanmar.
- It can be transported and stored at normal room temperature.
- The production percentage of the final product is 59%.



Figure 28: Fish Maruku produced in Myanmar

## Product formulation for fish cracker

No.	Ingredients	Weight (g)
1	Minced Rohu meat	320
2	Rick powder	300
3	Starch	173
4	Drinking water (cold)	400
5	Margarin	115
6	Sesame seed	32
7	Cumin seed	32
8	Table salt	10
9	Onion and garlic powder	10
	Total	1609
10	Oil	400

Remark: final product percentage of fish murukku - 59 %

## Processing steps for fish murukku

### 1 (A) Preparation of fish meat

- Store the whole fresh rohu temporarily at refrigerated temperature (3-5) °C.
- Make fillet from the fish or mince the fish meat with knife.
- Weigh the meat for desired amount and re-store it at refrigerated temperature (3-5) °C.

### 1 (B) Preparation of ingredients

- Weigh the ingredients (rice powder, starch powder, sesame, cumin seed, onion and garlic powder and cold potable water) for required amount.

### 2. Mixing

- Mix the minced fish meat with ingredients in mixer.
- Add the cold potable water as needed.
- Mix the ingredients thoroughly.

### 3. Molding desired shapes

- Fill the prepped ingredients into the murukku mold and form the desired murukku shape.
- Any desired size of murukku can be made.

#### 4. Deep frying

- Fry murukku in pan at temperature 150-160 °C about 3min until golden yellow color is developed.

#### 5. Cooling

- Cool down the murukku at normal room temperature for 20-30 min.

#### 6. Packing and storage

- Pack the product in good quality and moisture resistance plastic bag with vacuum sealing. Size and weight can be adjusted as needed.
- Airtight Styrofoam boxes and glass bottle can also use for packaging.

#### 7. Marketing

- Ready to eat fish murukku can be sold in various places such as school, market, or supermarket.

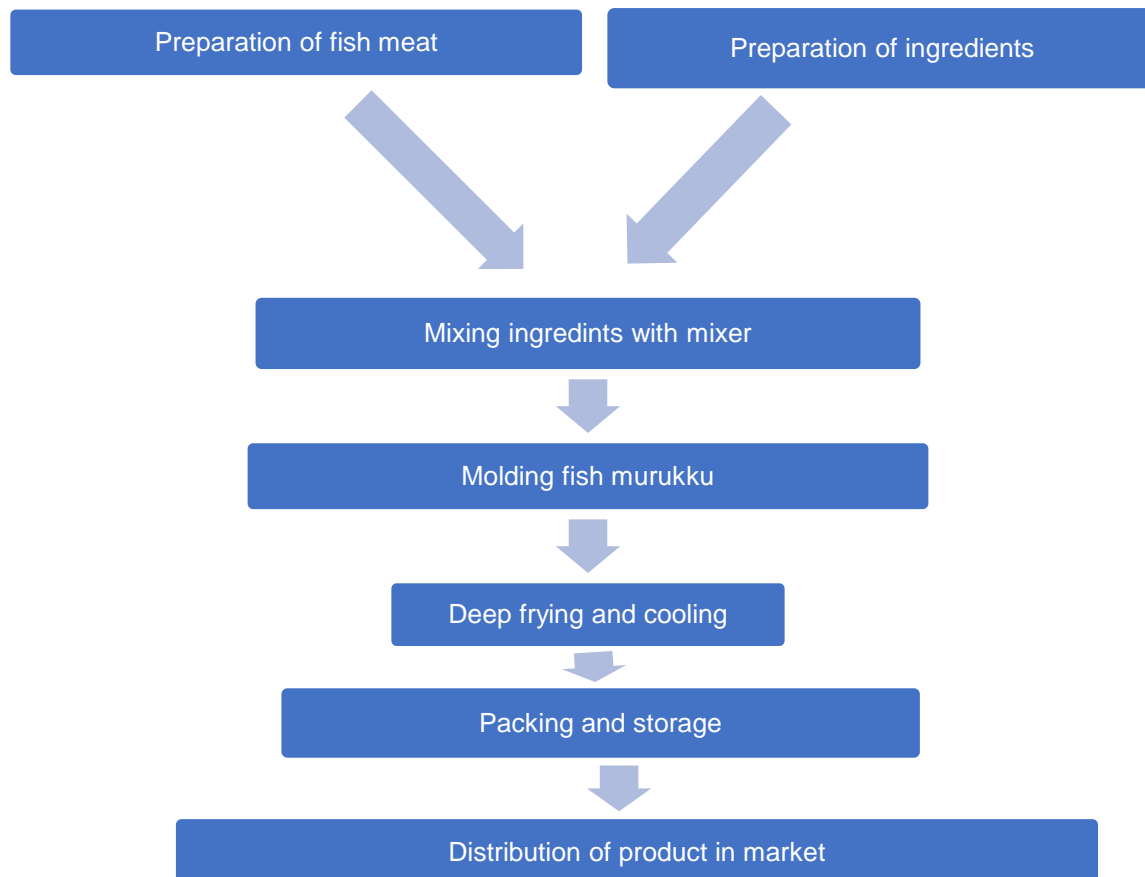


Figure 29: Flow diagram for production of fish maruku



## ငါးစာလေးခွေပြုပြင်ထုတ်လုပ်ပုံအဆင့်ဆင့်



ငါးမြစ်ချင်း



၄။ ငါးစာလေးခွေများပုံသွင်းခြင်း



၁။ ငါးမြစ်ချင်းအသား



၅။ ပုံသွင်းပြီးငါးစာလေးခွေများ



၂။ ပေါင်းစပ်ပစ္စည်းများ ပြင်ဆင်ခြင်း



၆။ ငါးစာလေးခွေများဆီတွင်ကြော်ခြင်း  
(150-160° C တွင် ၃ မိနစ်)



၃။ ငါးအသားနှင့်ရောနှောကြိတ်ခြင်း



၇။ အခန်းအပူချိန်တွင်အအေးခံခြင်း



၉။ အသင့်စားငါးစာလေးခွေများ



၈။ လေစုပ်စက်ဖြင့်ထုပ်ပိုးခြင်း

Figure 30: Production of fish maruku in Myanmar



No.	Ingredients	Weight (g)	Cost in MMK*
1	Minced Rohu meat	320	2400
2	Rick powder	300	400
3	Starch	173	300
4	Drinking water (cold)	400	100
5	Margarin	115	1000
6	Sesame seed	32	100
7	Cumin seed	32	50
8	Table salt	10	50
9	Onion and garlic powder	10	100
	Total	1609	4500
10	Oil	400	

**MMK\*= Myanmar Kyat**

Table 2: Production cost in MMK for fish maruku production in Myanmar

<b>Remark:</b>	<b>Dried fish murukku</b>
Raw materials weight	1609 g
Product – fish murukku weight	950 g

#### Nutritional composition of fish murukku/fish cookie

No.	Product name	Moisture content (%)	Protein (%)	Fat (%)	Fiber (%)	Mineral (%)	Carbohydrate (%)	Calories/100g
1	Fish murukku/fish cookie	8.35	14.05	15.03	0.00	2.06	60.51	435

## Chapter (15)

### Good Manufacturing Practices (GMP)



Figure 31: 7 Principles of GMP

#### Sanitation Standard Operation Procedures, SSOP (An eight steps approach)

##### 1. Safety of water and ice

Water and ice used in fish processing must be potable. Regular check on chemical and biological examination is a must.

##### 2. Food contact surfaces

Food contact materials used in fish processing must be clean and sanitized.

##### 3. Cross contamination

Products must be prevented from cross contamination.

##### 4. Hygiene at workplace

Canteen, hand washing basin, footbath, and toilet must be clean.

##### 5. Chemical and food additives

Products must not be adulterated with harmful additives and cleaning chemicals.

##### 6. Labelling

Chemicals and additives must be labelled properly and stored separately.

### **7. Worker health and hygiene**

Workers must have a regular hygiene and medical check.

### **8. Pest control**

Pest control program must be in place for processing facilities to keep the workplace out of reach of domestic pets such as cats and dogs, pests such as rats, mosquitos, flies, or cockroaches.

**Motto of Hazard Analysis and Critical Control point (HACCP) System**  
**“Do what you document, document what you do”.**

### **What is HACCP system?**

A system that identifies, evaluates and control hazards significant for food safety. HACCP is a useful tool to implement at fishery processing plants to set out the critical control points for the hazards identified.

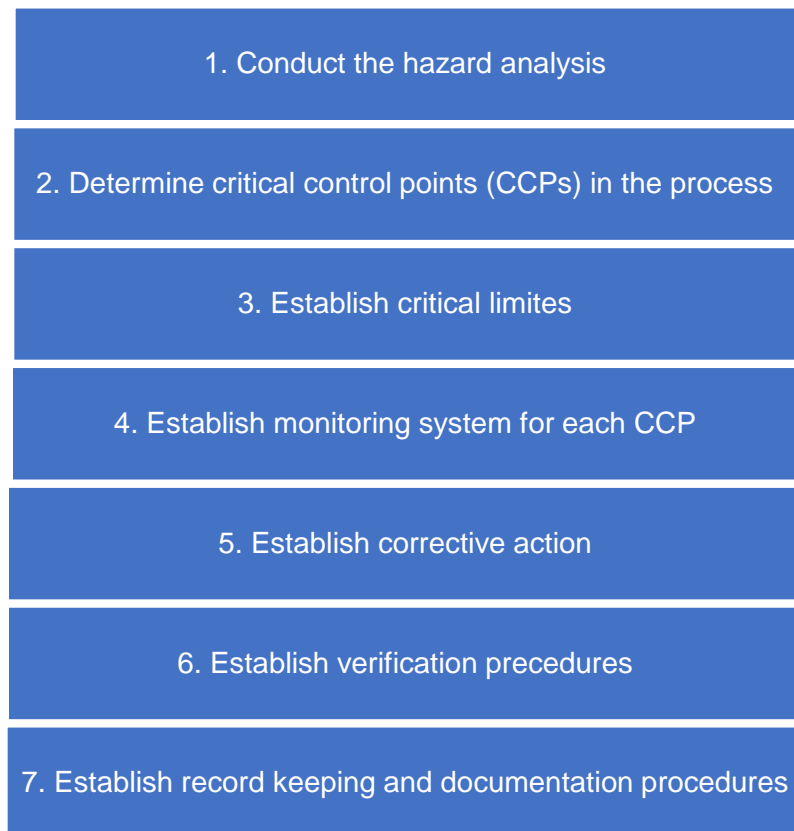


Figure 32: 7 Principles of HACCP system

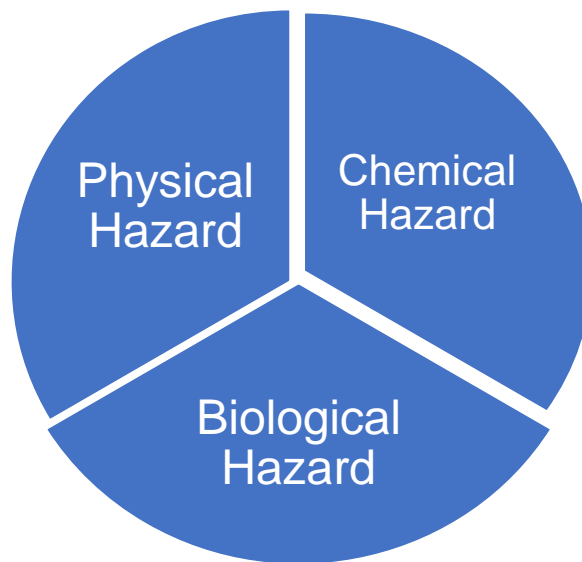


Figure 33: Types of food safety hazards

#### **Vulnerable population groups in food safety (YOPI)**

1. Y - Youth
2. O – Old
3. P – Pregnant
4. I – Immunocompromises



Figure 34: YOPI groups (Source: [www.slideserve.com](http://www.slideserve.com))

**Table 3: Different types of fish and shrimps in Myanmar for export**

Types of fish for export	Types of shrimp for export
<ol style="list-style-type: none"> <li>1. Live eel, Lobster, Grouper, Ornamental fish, Catfish</li> <li>2. Whole/ Round/ Head on/IQF (Individual Quick Frozen)</li> <li>3. Deheaded/ Beheaded/Head off/Headless</li> <li>4. Bibbed/Gilled</li> <li>5. Belly Gutted</li> <li>6. Back Gutted</li> <li>7. Gutted Gilled Scaled (GGS)</li> <li>8. Cleaned/Dressed</li> <li>9. Fillet</li> <li>10. Chunk</li> <li>11. Steak/Pieces</li> <li>12. Surimi, Value-added products (VAP)</li> <li>13. Minced</li> <li>14. Dried fish</li> <li>15. Salted fish</li> <li>16. Fish Maw/Air Bladder/Gas Bladder/ Ising Glass</li> <li>17. Fish Roe / Egg</li> <li>18. Fish Meal/ Silage</li> <li>19. Canned fish</li> <li>20. Fish Protein Concentrate (FPC)/ Fish flours</li> </ol>	<ol style="list-style-type: none"> <li>1. Live Lobster, Xannemei</li> <li>2. Head-On (HO)</li> <li>3. Head-less (HL/HLSO)</li> <li>4. Broken/Mixed meat</li> <li>5. Peeled/Shucked</li> <li>6. Peeled Undeveined (PUD)</li> <li>7. Peeled &amp; Deveined (P&amp;D)</li> <li>8. Peeled Pulled Veined (PV)</li> <li>9. Peeled Taillon (PTO)</li> <li>10. Peeled &amp; Deveined Taillon (PDTO)</li> <li>11. Butterfly</li> <li>12. Nobashi</li> </ol>

## Weighing and unit conversion

Balance and scales	Units
Kat Tar weighing scale	Viss and Pound
Top loading balance	Kilogram (kg) and Gram (g)
Digital balance	Viss, Kilogram, Gram, and Pound
Pound weighing scale	Ounce and Pound
Weight Conversion	
1 kg	1 litre = 1000 gm/ml/cc/cm <sup>3</sup> 2.204 lb 0.612 viss 61.2 tickles
1 g	1ml 1 cc 1 cm <sup>3</sup>
1 gallon	4.54 L 4.54 kg
1 MT (Water)	1000 kg 220.26 gallon
1 viss	100 tickles 3.6 pound 1.624kg 1624 g
1 pound	27.5 tickles 454 g
1 Metric Ton	1000 kg 613 viss 2204 pound
1 Long Ton	2240 pound
Length Conversion	
1 centimeter	10 millimeters



<b>1 meter</b>	<b>100 centimeters</b> <b>39.36 inches</b>
<b>1 inch</b>	<b>2.54 centimeters</b>
<b>1 acre</b>	<b>209 feet x 209 feet</b>
<b>1 hectare</b>	<b>2.6 acres</b>
<b>1 kg ice</b>	<b>80 kcal</b>
<b>Temperature</b>	
1 Celsius	5/9 (Fahrenheit-32)
Ice melts/ Freezes temperature	-18 °C 0°F
Frozen product temperature	-18 °C 0°F
Boiling point temperature	100 °C 212°F
Processing hall temperature	< + 20°C
Chilled store temperature	< + 10°C
Ante room temperature	< + 10°C
Chilled water temperature	+ 4°C to + 10°C
Cold store/ freezer store temperature	-20°C to -25°C
Freezer temperature (contact/air blast)	-35°C to -40°C
<b>Cooling capacity</b>	
1 kg ice	80 kcal
1 kcal	1000 calories
CGS 1 calorie (Centimeter-Gram-Second system of units)	1 cc water ▲ ↑ 1°C
FPS 1 Btu (Food-Pound-Second system of units and British Thermal Unit)	1 lb water ▲ ↑ 1°F

## Principles of Good Hygiene Practices (GHP)

There are 12 x hygienic operation requirement in fishery product processing as described in below table.

Sr.	Topic
1	Use of potable water and ice (Ice used in the processing factory must also be produced from potable water)
2	Cleanliness of food contact surfaces
3	Prevention of cross contamination
4	Maintenance of facilities for personal hygiene
5	Safe storage and use of toxic compound
6	Control of employee health conditions
7	Protection of food from adulteration
8	Transportation
9	Pest control
10	Waste management
11	Traceability and recall procedure
12	Training

s



Figure 35: Use of personal protective equipment  
(Source: <https://www.pmg.engineering/accessories-for-quality-maintenance/>)