



# Principles and Preparation of fish paste products

1. Minced meat technology
2. Surimi production
  - selection of raw materials
  - Manufacturing of surimi
  - Role of cryoprotectants
  - Grading of surimi

# Surimi and its processing

## Definition:

Surimi is a Japanese word means ground fish paste

- Mechanically deboned fish meat minced, water washed, refined, mixed with cryoprotectants for prolonged shelf life during frozen storage.
- surimi is a uniquely functional food ingredient made of fish proteins and used in surimi seafood products.
- consists of fish proteins that are refined through heading, gutting and mincing the fish, then washing, removing water, and freezing the

- remaining protein.
- Good quality surimi is odorless and has a creamy white appearance. Surimi has excellent gelling properties so that it can be formed into various shapes.
- Different from minced fish
- Minced fish is raw material for surimi.
- Minced meat is washed with water to remove water soluble components, blood, pigments and odour bearing compounds results in surimi.

- Because of its high gel strength, surimi is used as intermediate in processing in several value added products
- They have texture, flavour and appearance such as shrimp, lobster tail, scallop meat and crab leg.
- First surimi production in 1960 & technology developed by Japanese.
- Fish muscle – dark & white
- Active swimmers – dark muscle more than sluggish fish.
- Dark muscle – higher haeme & lipid content
- Affects color & flavor of surimi

- White color & bland flavor preferred for surimi.
- White flesh & low fat fish desirable.
- **Raw surimi is a wet concentrate of myofibrillar protein & possess enhanced gel strength, elasticity, water holding, fat binding & other functional properties.**
- Recovery, conc., protection of myofibrillar protein is important in surimi processing.

# 1. Selection of raw material:

- Economic when made from low value , abundant species with year round availability.



- Allaska Pollock (*Theragra chalcogramma*) is best suited for surimi production.
- followed by Pacific whiting in manufacture of surimi.
- *Nemipterus japonicus* is best tropical species for production of surimi.



Other fishes such as :

croakers

Lizard fish

barracuda

Striped mullet

leather jacket

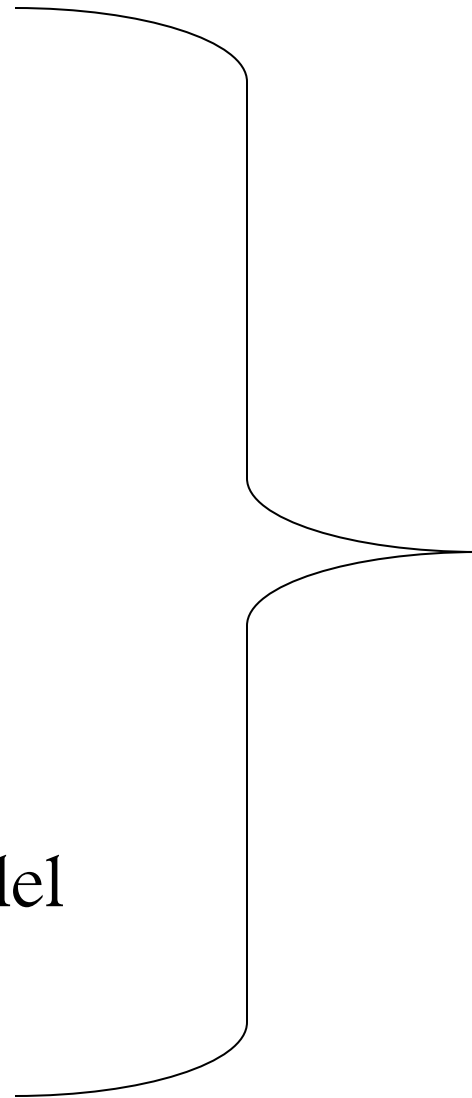
Cod

Hake

Whiting horse mackerlel

Barracuda

Ribbon fish



Used for  
surimi  
production

## The important criteria in selection of fish for surimi

- Low cost
- White fleshed & non oily.
- Round year availability
- Good gelling ability
- As fresh as possible (less blood & gut content)
- Fresh fish – lower degree of autolysis.
- Small pelagic fishes like sardine and mackerel are abundantly available in tropical waters
- Surimi processed out of it is of inferior quality due to high fat content





- High myoglobin content
- Presence of dark muscle.
- Rotary freeze method, pressure washing & density gradient used to remove dark meat.

### Precaution:

Washing with sodium bi carbonate removes most of the fat.

Always post rigor fish is preferred to extract minced meat from fish.

### 2. Dressing the fish :

Heading

Gutting



## Filleting

### 3. Meat-bone separation & mincing:

- Deboning: separation of bones/fins/scales/skin.
- Dia of the perforation ranges from 4–7 mm.
- Mincing using meat mincer

### 4. Washing:

**Leaching/ bleaching:** Cyclic washing of minced meat with chilled water 2–4<sup>0</sup> C (non salt)

### Objectives of water washing is to remove

- Water soluble sarcoplasmic proteins
- Protease enzymes

- Blood & pigment
- Lipids
- Haeme pigments responsible for lipid oxidation
- Increase gel strength (concentrate actin & myosin)
- Reduce microbial load.
  
- Hard water contains ions of calcium and magnesium which cause textural degradation and ion of manganese will affect colour during storage.
- Fresh water has pH in a range 6.5 to neutrality, water used also should have pH near to that, to facilitate retention of its original water holding capacity.

- Salt may added at the level of 0.1–0.2% in last washing which aids in dewatering.
- Ionic strength /concentration of inorganic salts of leaching water affects swelling tendency of minced meat.
- Greater the ionic strength of water easier is to remove water from meat and vice versa.

### 1. Batch process:

Fish to water ratio is 1:4 to 1:5.

on board washing if done then 1:2 to 1:3 ratio can be used.

- In case of lean fishes 1 to 2 washings and for fatty fishes 4-5 washings are used.
- During washing, slurry must be agitated to aid easy removal of water and WSP.
- Each washing cycle should be of 4-5min. Agitation is done for 3 min.
- Slurry is allowed to settle and water decanted.

## 2. Continuous Process:

Water is sprayed over the minced fish and the meat is kept in contact with water for 30-40 min.

- Moisture content may increase to 85% after washing and permitted level is 79% for surimi.
- **5. Dewatering:**
- After washing the water content of meat has to be reduced to about 80%.
- Dewatering can be done by using screw press / centrifugation

#### **6. Refining/ straining:**

The process of removal of any connective tissue, bones, skin, scales and dark muscle from washed mince

- Can be performed before/after dewatering
- Mince should have 80–90% of moisture.

## 7. Addition of cryoprotectants:

The dewatered mince is mixed with sucrose(4%), sorbitol(4%) and poly phosphate(0.2–0.3%) which prevent protein denaturation during frozen storage.

For blending equipments used is silent cutter.

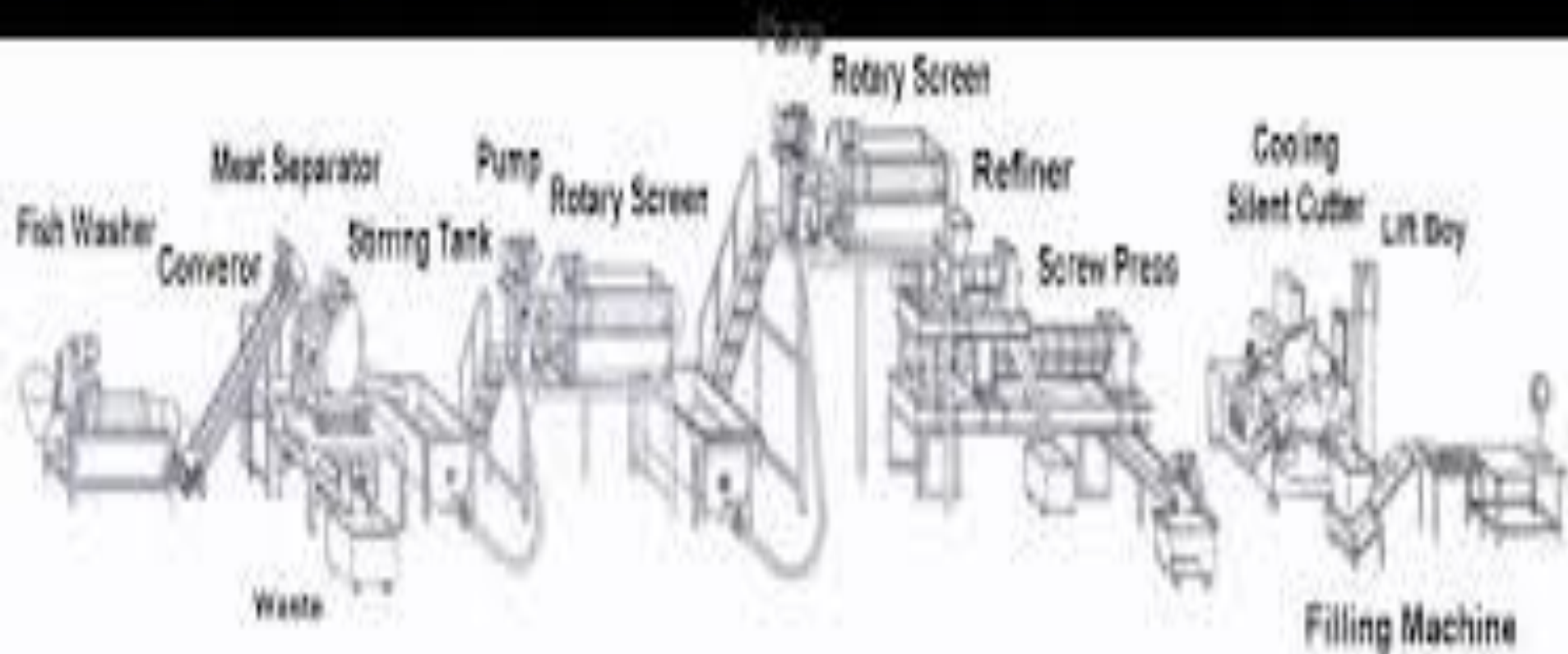
## 8. Filling, packaging & Freezing:

Blocks of surimi (10 kg) packed in polythene bags.

Frozen at  $-40^{\circ}\text{C}$  in a contact plate freezer and stored at  $-20^{\circ}\text{C}$ .



Fish Washing	Fish Meat Extracting	1st Bleaching	Draining & Bleaching	2nd Bleaching	Draining & Bleaching	Straining	Dehydrating	Mixing & Adding	Packing
Fish Washer	Meat Separator	Stirring Tank	Rotary Screen	Stirring Tank	Rotary Screen	Refiner	Screw Press	Cooling Silent Cutter	Salts Filling & Forming Machine





- **Role of cryoprotectant:**

1. **Sugar (4%) :**

- Prevents denaturation
- Increase the surface tension of water and increases amount of bound water
- Prevent drip loss
- Stabilize the proteins.

2. **Poly phosphate (0.2 -0.3%)**

- Prevents drip loss
- Improve water holding capacity

### 3. Sodium chloride (2-12%)

- Solubilize surimi or myofibrillar proteins
- Permits the elastic and firm gel after cooking
- <2% , may not sufficient to solubilize
- >12%, cause dehydration
- Nacl at lower concentration enhances water uptake and swelling of surimi.

### 4. Starch:

- Enhances the textural property by increasing gelatinization
- Maintains stability.

Based on the cryoprotectant added, surimi is classified into 3 types

1. Salt free – Muen surimi
2. Salted – Kaen Surimi
3. Raw – Nama Surimi

### 1. Muen surimi:

water washed minced meat with sugar & polyphosphate

### 2. Kaen surimi

Water washed minced + salt + Sugar

### 3. Nama Surimi

- Prepared on limited scale

# Quality assessment of surimi:

## Compositional quality :

- moisture
- Protein
- Fat
- Moisture content was determined by measuring the weight loss of a representative amt of surimi after drying in an oven at 105°C for about six hours.

## Physical & sensory quality :

- pH, viscosity, brightness, color, appearance, flavor, water holding capacity

- pH was measured by adding 10g of surimi to 90ml of distilled water, blending it in a food processor and measuring the slurry with a pH meter.
- The foreign element test (Suzuki, 1981) was carried out by noting the number of foreign elements (such as scales, black or white membranes etc.) above 1mm long .
- results were scored on a 10-point scale.
- **Functional quality :**

Japanese system classifies surimi according to the

- Gel forming capacity
- Strength of ashi

- textural & rheological property
- **Measurement of gel strength :**



- **Gel strength measurement :**
- Most widely method for gel strength measurement is by a Rheometer.
- Instrument has a plunger with a sphere of 5–10 mm dia at the tip of 10 cm long rod.
- Plunger pressed on to the surface of sample until it penetrates.
- The sample gets gradually deformed & broken.
- A kymograph used to show stress strain curve from which strength of ashi is calculated.
- Gel strength is expressed in g/cm.

## Determination of whiteness:

- Expressed as Percentage
- Comparing with standard
- lovibond pure whiteness of 93%.
- Hunter lab colorimeter used to
- Measure Whiteness.
- Changes in color on surface of
- surimi is measured using CIE  $L^*$ ,  $a^*$  &  $b^*$  using spectrophotometric color difference meter (NF333, Nippon Denshoku Industries Co., Ltd., Tokyo, Japan).
- The L, a, and b values were measured using a D65 light source with a viewing field angle of 2.





- The color results are expressed as the mean value of at least 10 samples.

### **Organoleptic tests:**

- Folding test & Teeth cutting test
- Carried out by trained panelist.
- Both the methods depend on the person judging.
- **(i) Folding test :**
- Slice of prepared sample folded in half & then in quarter.

- Based on extent of cracking the product is given grade AA, A, B, C etc.
- **Teeth cutting test :**
- Springiness of sample is felt by biting slice between upper & lower incisors and then scoring based on hedonic scale from 10 to 1.
- **Torsion test for gel strength:**
- Gels cut into 3 cm length & milled into hourglass shape with min dia of 1 mm at center.
- Each gel placed in modified torsion apparatus.
- Texture of each gel measured by twisting sample at 2.5 rpm until structure failure occurs.

- **Water holding capacity:**
- Slice of surimi placed between two filter papers & pressed by a small oil-compressor under fixed pressure or centrifuged at 10000 rpm for 15 min at 15° C.
- Wt difference of sample b4 & after pressing is expressed as % reflecting amt. of water pressed out.
- **Texture Profile Analysis:**
- Surimi gels of 3 cm equilibrated at room temp for 30 min in plastic bag to avoid dehydration before texture analysis.

- Texture determined using TA-XT2i stable micro-system texturometer.
- TPA performed using cylindrical probe of 50 mm.
- Samples compressed at 50% initial height using compression speed of 2mm/sec.
- Data for Hardness, springiness, cohesiveness, chewiness, adhesiveness etc. can be obtained.

- **Microbial aspect :**
- Deboner & Mincer possible causes of contamination
- Subsequent washes may help in removal of these
- Addition of salt & additives suppress their growth
- Chilled temp & wash water may harbour some psychrophilic bacteria.
- Frozen storage of surimi & heat treatments in product manufacturing prevent this.
- Food poisoning may attribute to surimi.
- A proper combination of heat processing, packaging & use of preservatives is the key to increase shelf life