

# SALTING OF FISH



**Hauzoukim**

- **Salting**

- a traditional method of preservation of fish
- in most countries.
- Salt is the preservative
- Used to enhance
- shelf life.



- Practiced in combination
- with drying & smoking
- Reduce microbial activity or inactive bacteria.
- Salt penetrates in tissue by process of osmosis and fluid comes out of fish.

- **Advantages of salting/salt curing :**

- Does not require elaborate equipments.
- Capital outlay is small.
- Method is simple & comparatively inexpensive.
- Salting applied to any type of fish.
- Finished products don't require special storage facilities.
- Reasonably good shelf life.
- Nutritionally products are comparable to other fish products.

- **Salting & related water activity :**
- When fish mixed with salt, some water removed from flesh.
- Salt enters, water moves out by osmosis.
- Loss of water from fish flesh reduces  $a_w$ .
- Process continues until equilibrium reaches between conc of salt in fish flesh & surrounding brine.
- $a_w$  of saturated brine is 0.75.
- Fish flesh equilibrium with brine will have  $a_w$  similar to this.

- **Sources of salt, composition & properties :**
- Pure common salt : sodium chloride (NaCl)
- All commercial salt contains impurities & depend upon source & production method.
- Common salts used :
- **i) Solar salt :** sea water / salt lake water evaporated by action of sun & wind.
- contaminated with sand & may harbour bacteria.
- **ii) Rock salt :** mined from natural deposits, contains varying % of salt (80–99%). Ground to diff degree of fineness.

- **iii) Brine salt** : underground salt deposit brought to surface in solution & evaporated.
- **Chemical composition:**
  - commercial salt – NaCl (80–99%)
  - Ca & Mg chlorides, sodium sulphate & carbonate, traces of copper & iron.
  - Ca & Mg increase rate of spoilage.
  - Fish salted in pure NaCl – soft texture & yellow color
  - Ca & Mg in 1 % conc. imparts white color & bitter taste.
  - Salt used should have at least 95% NaCl.

- Should be as dry as possible.
- **Microbial quality :**
- Solar salt : large no of halophiles.
- Halophiles cause red/pink discoloration on wet/partially dried salted fish.
- **Physical properties :**
- Size of salt influence salting time.
- Fine grain dissolve more rapidly – rapid removal of water from fish surface.
- Prevent penetration of salt inside fish flesh (salt burn).

- Large & coarse salt crystals : less contact area & affects dissolution.
- **How salt cure fish :**
- Initially fish surface sticky.
- Alters colloidal property of proteins & change nature of hydration.
- At low conc. i.e. initial stage, Salting in, protein swelling.
- At later stages, sufficient conc. of salt absorbed inside, protein passed swelling stage.
- start to shrink, loose water from flesh.
- become hard in texture.



- Sod. chloride strong electrolyte, so release bound Water of protein & affect its state.
- Sod. chloride exerts high osmotic pressure, causing reduced moisture & plasmolysis of bacterial cell.
- Alters state of protein, block protein nuclei, affecting enzymes.
- Protein becomes impervious to action of enzymes.
- Enzymes destroyed/inactivated.
- Salt penetrates through dialysis mechanism until equilibrium reaches.
- Salt affect physical state of fish.

- **Salt preservative**
- Effective preservative against MO & enzymes.
- Retards microbial property & chemical spoilage in fish.
- 6–10% salt – prevents of most spoilage bacteria & autolytic degradation.
- 20% or above conc– decomposition very slow.
- Halophiles require high salt conc. So may survive.

- **Factors influence salting time :**
- **Size & thickness :** more thicker fish slower salt penetration.
- **Fat content :** high fat – low salt uptake.
- **Freshness :** fresher fish – slower salt penetration
- **Temperature :** higher temp – rapid salt uptake. 1% increase in temp salting rate increases to 2,5 – 3.6%
- Salt tends to absorb moisture from atmosphere & reach above 75% which may stop drying further.

- **Maturing/ripening process :**
- More significant in flavor development in brine pickled fatty fish.
- Enzyme responsible may derive from digestive system, fish muscle & bacteria growing on fish & brine.
- Products of lipolysis & proteolysis are dominant
- Products from carbohydrate fermentation & Maillard browning reaction also contribute in flavor of ripened fish.



- **Salting process :**

- Preliminary to other processes like smoking, drying, canning etc.

- **Preparation of fish for salting :**

- Varies based on size of fish.
- Whole surface of fish brought in contact with salt for a successful salting.
- Washing fish to remove unwanted particles
- Dressing – gills, entrails removed. Fish split open along vertebral column.
- Bleeding

- Throating
- Big fish – deep scores are made at several point, filleted.
- Small fish – salted whole.
- Process of salting involves –
- Washing & dressing of fish,
- Mixing with salt,
- Packaging.



# Methods of salting

- **1. Dry salting :**
- Dressed fish mixed with salt crystals in a container.
- Salt rubbed into the gill cavity & scores are made in flesh.
- Salt spread at the bottom of container.
- Salt & fish in alternate layers.
- Natural brine formed not drained out & fish may float on it.
- Weight is kept over the fish to keep it immersed.
- Fish in brine for 2-3 days & dried.





Sardine -- layering  
with salt



- **2. Kench salting :**
- Similar to dry salting.
- Granular salt is rubbed off on the surface of split fish.
- Fish stacked with sprinkling of salt between each layer of fish.
- Self brine formed is drained away.



**Salted mackerel**

- **3. Brine salting :**
- Fish kept immersed in brine of desired conc. (20–25%).
- Brine becomes diluted by the water released from fish, so strong cure is not possible.
- Brine replaced with a strong one after initial brine becomes diluted.
- **Disadvantage** – fish floats on brine due to difference in sp. gravity (SG of fish – 1.2 & brine– 1.05)
- Floating prevented by keeping weight on top.



**Brine salted Sardine**

648

- **4. Mixed salting (pickled curing):**
- Large/fatty fish – slow salting rate.
- Take long time for natural brine to form & cover fish
- May cause spoilage of fish in top layer before salt penetrates in it.
- In MS fish packed in air tight container with salt sprinkled between each layer.
- Then topped with saturated brine.
- A cover placed on top to hold fish under the surface of the brine.

- **Advantage** -- fish completely surrounded by brine.
- Quickens salting process.
- Dry or kench salting generally not recommended for use in tropical region.
- As fish is not covered with pickle/brine. So, fish may be spoiled or susceptible to insect attack.
- Exposure of fish to air & presence of salt encourage fat oxidation giving rise to discoloration & rancid flavor.
- Saturated salt solution – 36 Kg of salt to every 100 kg of water at 25° C.

- **Types of salted fish :**

- i) **Light salted fish** : 20–30% of salt on dry wt basis.
- ii) **medium salted fish** : 30–40% salt on DWB.
- iii) **Heavily salted fish** : 40–45% salt on DWB.

- **Types of salting :**

- Based on condition of salting :
- i) **Warm salting** : fish temp around 15–20° C. followed in most tropical countries.
- ii) **Chilled salting** : fish salted after cooling to a temp of 0–5° C.
- iii) **Cold salting** : done by freezing fish in ice & salt mixture to a temp of –2 to –4° C.



- **Salting based on containers used :**
- **i) Vat salting :** wooden vats or cement tanks are used.
- **ii) Barrel salting :** fish mixed with salt & kept in barrel.
- **iii) Pile salting :** no containers used. Fish & salt are piled in alternate layers on floor.

# Spoilage in Salted fish

- Common spoilage observed in salted fish are :
- **1. Microbial spoilage :**
- **i) Pink or Red discoloration :**
- Bacterial spoilage.
- Common in salted fish in warm weather condition.
- Surface of fish covered by red slime, giving an unpleasant odour.
- Colonies of bacteria appears red on surface of fish.
- Causative agent is halophilic rod & cocci originates mainly from solar salt.

- *Halobacterium salinaria*, *H. cutirubum*, *Sarcina morrhuae*, *S. littoralis*, *Micrococcus resens* etc.
- Aerobic orgs & active in contact with air.
- Thermophiles. Do not grow below 10° C.
- Spoilage manifest as pink sheen on surface of fish.
- Can be rubbed off at initial stage
- In severe cases may cause softening of fish by protein denaturation giving ammoniacal off odour.
- **Prevention :**
- airtight packaging.
- Storing below 10° C.

- Use of Food grade salt.
- Treatment with formaldehyde or sulphur dioxide vapours.
- Dipping in solution of sodium metabisulphite.
- **ii) Dun spoilage :**
- Caused by halophilic moulds.
- Grow profusely at RH 75% or more.
- Optimum growth temp is 30–35° C.
- Occurs in heavily salted fish.
- Black, grey or brown spots on fleshy side of fish.  
Appearance of sprinkled ground black pepper on fish.

- *Sporendonema epizoum*, *Wallemia* sp.
- Optimum growth at 10–15 % salt conc., 75% RH & 25° C.
- Fish becomes soft & paves way for other spoilage.
- Solar salt main source.
- **Prevention :**
- Initially easily scraped or brushed away
- In severe infection 0.1% sorbic acid gives protection
- Use of Good quality salt
- Low temp & humidity to be maintained.
- Well ventilated & dry storage condition.

- **iii) Saponification :**

- Damage by aerobic m.o at very low temp.
- Malodorous slime on surface of light salted fish eg. Boxed herring in contact with air.
- Prevention is by keeping fish in brine containing vinegar for some time.

- **iv) Putrefactive spoilage :**

- If salting is very slow.
- Longer time for salt to reach at centre.
- Putrefactive process in those region.
- Flesh near backbone gets tanned or reddened.

- Develop offensive putrid smell.
- Pre-salting operation like gutting, splitting etc. can accelerate salt penetration & prevent tanning.
- **Non-Microbial spoilage :**
- **i) Insect infestation :**
- Occurs at early stage of drying.
- Diptera commonly called blowfly causes infestation.
- Cheese flies (*Drosophila casei*) also associated.
- Adult flies lay egg on fish, hatches out in a day or two & larvae (maggots) spread rapidly infesting whole fish.

- Larvae metamorphose into red pupae from which flies emerge.
- **Prevention :**
- Infested fish can be washed roughly in brine & stored in uncontaminated container.
- If fish is put into brine, maggot floats on top, can be collected & destroyed.
- Maintenance of handling & processing premises clean & fly proof.
- Ensuring that fish is well covered during salting.
- Processing premises should be cool.



- Dipping dried fish in insecticidal solution of pyrethins, piperonyl butoxide could control beetle infestation.
- Some plant & plant extract act as insect repellent eg. Neem, citrus peel, oils, peppers.
- **ii) Rust :**
- Oily fishes sardine, mackerel prone to rusting.
- Rusted iron like color, rancid flavor & unpleasant taste.
- Brought about by oxidation of fat by atm  $O_2$ .
- Cu & Fe in salt accelerate the process

- Initially rust on the surface of fish, later penetrates into flesh.
- **Prevention :**
- When in surface can be easily washed away with dil solution of sod bicarbonate.
- Keeping fish away from contact with air
- Cover fish with brine during salting.
- Pack & dry fish properly.
- **iii) White spot :**
- Presence of Ca & Mg salts cause whitening of flesh of salted fish.



- white spots on surface occurs from crystals of disodium hydrogen phosphate by enzymatic breakdown of nucleotides.
- **iv) Fragmentation :**
- Cured & dried fish become brittle & break during storage & transportation.
- Denaturation of protein, hollowing fish by insect attack & use of spoiled fish for salting cause this.
- Use of fresh fish, avoiding physical damage & proper packing can prevent this.