

# SMOKING OF FISH



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- Smoking is the process of flavoring, cooking, or preserving food by exposing it to the smoke from burning or smoldering plant materials, most often wood.
- Meats & fish are the most common smoked foods.
- The combination of heat to dry
- the food without cooking it
- and addition of the aromatic
- hydrocarbons from the smoke
- preserves the food.



❑ Preservative value of smoke produced from burning wood which contain large no. of compounds, some of which kill bacteria. Eg. Phenol

❑ Drying by the fire which produces smoke & generates heat.

❑ Method is simple & comparatively inexpensive.

❑ Cooking of fish occurs when smoking at high temp.

❑ Destroy enzymes & kill bacteria.

- Smoked fish has typical pleasant flavor & characteristic golden brown color.



- Smoke curing of fish used to preserve fish during lean season to extend shelf life.
- Now, it's a delicacy, ready to eat product.
- Main countries producing
- These are Russia, U.K.,
- Germany, Netherland etc.
- In India, smoking & smoked fish are popular in North-eastern states.



## • THEORY OF SMOKING

- The fuel used for smoking is wood., saw dust or coconut husk depending on the flavor required.
- Smoke imparts a specific aroma & taste to the product with golden brown color.
- Also an effective carrier of heat & moisture.
- Another method is using frictional smoke generator.
- End of a wood piece is pressed against rapidly revolving drum or disc.
- Due to friction temp of wood rise up to  $350^{\circ}\text{C}$  & smoke is produced.

- Commonly used wood for smoking in western countries are alder, beech, oak, poplar etc.
- Wood contains both combustible & non-combustible component.
- Combustible parts made up of organic substances like cellulose, lignin, pentosan, phenols, tannic acid, resins, terpenes & other proteins which gives flavor.
- Smoke produce typical aerosol that contains gases, hydrocarbons.
- Organic substances produced by distillation of wood are  $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{H}_2$  & hydrocarbons.
- Non-combustible substances – moisture & ash.

- Incomplete combustion – smoke contains organic substances, that react with fish giving a smoky flavor
- Good quality smoke obtained from saw dust.
- Main constituent of fuel is carbon.
- Heat generated by one carbon to  $\text{CO}_2$  is 8100 Kcal
- $100\text{--}150^\circ\text{C}$  temp – destructive distillation of wood & release of gas & vapours.
- $200^\circ\text{C}$  – charring of wood,
- Volatiles mainly  $\text{CO}$  &  $\text{CO}_2$
- $250^\circ\text{C}$  – Hydrogen & hydrocarbon increases
- $300^\circ\text{C}$  – wood catches fire.

## • COMPOSITION OF SMOKE :

- ✓ Smoke – a typical aerosol
  - ✓ Pyrolysis of wood
  - ✓ Solid particles – smoke proper
  - ✓ Liquid particles – mist
  - ✓ Dispersed in a gaseous
  - ✓ medium
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- ✓ All smoke particles surrounded by a gas film which prevent them from sticking.
  - ✓ During smoke curing largest conc. of smoke is at top of kiln.
  - ✓ Deposition of tarry substances is more on fish top.





- **Chemical composition of smoke is complex**
- **Gases** → CO<sub>2</sub>, CO, H<sub>2</sub>, hydrocarbon
- **Aqueous distillates** :
  - **(a) Acids & their derivatives** →
    - (i) formic acid                      (ii) acetic acid
    - (iii) propionic acid              (iv) butyric acid
    - (v) valeic acid
  - **(b) Alcohols** → methyl, ethyl, propyl
  - **(c) Aldehydes** → formaldehyde, acetaldehyde, furfuraldehyde, propionaldehyde, butryaldehyde
  - **(d) Ketones** → acetone, methyl ethyl ketone
  - **(e) Hydrocarbon** → xylene, benzene, toluene

- Nitrogen oxide, sulfur dioxide, methyl chloride, naphthalene etc.
- (f) Phenols, guaiacol, catechol, syringol etc.
- (g) Polycyclic aromatic hydrocarbons : fluorene, phenanthrene, anthracene, pyrene etc.
- (h) Pyridine
- (i) Tar distillate :
- It contains tar oils.
- Furane, valeic aldehyde phenols & their derivatives, tar contains – guaiacol, vinyl guaiacol, cresol, catechol, phenol etc.

- (j) **Trace elements** : Na, Mg, Al, Si, Cl, S, K, Ca, Cr, Mn, Fe, Cu, Zn etc.
- Hard woods made up of mainly three materials : cellulose, hemicellulose, lignin.
- Cellulose & hemicellulose are basic structural component of wood cells – aggregate sugar molecules.
- when burnt, they effectively caramelize, produce carbonyls, which provide most of the color components & sweet, flowery, and fruity aromas.
- Lignin, a highly complex arrangement of interlocked phenolic molecules.

- Produces a number of distinctive aromatic elements when burnt.
- Produce smoky, spicy, and pungent compounds such as guaiacol, phenol, and syringol, and sweeter scents such as the vanilla-scented vanillin and clove-like isoeugenol.
- Guaiacol is the phenolic compound most responsible for the "smokey" taste, while syringol is the primary contributor to smokey aroma.
- Wood also contains small quantities of proteins, which contribute to roasted flavors.

- Some softwoods, especially pines and firs, hold resin, which produces a harsh-tasting soot when burned; these woods are not often used for smoking
- Actual component responsible for odour may be terpene & related compound, paraffin compound & aromatic compound.
- Role of each compounds is preservation & flavoring of smoked fish.

## • **Role of smoke in preservation :**

- Preservation action of smoke is mainly due to salting, drying & natural chemicals produced during thermal breakdown of wood.
- Salting prior to smoking reduces  $a_w$  and inhibits growth of many spoilage micro orgs & pathogens.
- Smoking causes partial surface drying of fish, present a physical barrier to the passage of m.o. & retard proliferation of aerobic orgs.
- Hot smoking destroy enzymes & bacteria.
- A number of wood smoke compounds act as preservatives.

- Phenolics like guaiacol & its homologues are effective antioxidants protect against autooxidation of lipid.
- other organic acids, which give wood smoke a low pH—about 2.5.
- **Bactericidal property of smoke :**
- Presence of chemicals such as formaldehyde, phenols, organic acids & other organic compounds that make up the tarry substances.
- Smoke kills pure culture of m.o. & microflora.

- Eg. Streptococcus in 3 hrs., and Bacillus subtilis & B. mesentericus can survive 7 hrs. of exposure.
- Smoke below 40° C has a weak antibacterial effect .
- Hot smoking cause effective reduction of m.o.
- **Phenols in smoked fish :**
- Formation of colour in smoked fish is due to deposition & oxidation of phenols.
- Wood smoke known to have pronounced antioxidant effect on fish -- attributed to guaiacol, phenols & three cresols, catechol, 4 methyl catechol & to a lesser extent 1,3 dimethyl pyrogallol.



- **Preparation of fish for smoking :**

- **i) Splitting, gutting etc.**

- Pelagics – best for smoking with high fat content
- Fish to be smoked generally kept chilled.
- Small fish → whole, large → split, gutted or
- Made into fillet.
- Fish may be split with backbone
- retained in one fillet.
- Method employed depend
- on end product desired.



- **ii) Salting :**

- Either by mixing with solid salt or by immersing in brine.
- Salting is so adjusted that fish takes 2-3% salt , optimum requirement of smoked fish.
- Dry salted fish takes more salt, so
- soaked in water before smoking.

- **iii) Hanging :**

- After salting flesh becomes moist,
- proteins dissolve in brine & yield a sticky solution.
- On hanging , the sticky solution dry on surface, make the skin glossy.



- split & salted fish should be in stretched position for proper smoking in all parts of fish.
- Fish can hung/ spread
- on wire mesh trays.
- Large split fish suspended by
- tail & kept open by sticks or
- skewers threaded through flesh.

