

DRYING AND DEHYDRATION

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- **Drying :**

- Removal of water from food usually by heating.
- Least expensive & most widely method of food preservation.
- Removal of water reduces a_w , thus stops/slow down microbial or autolytic activity.
- Microbial growth causing spoilage & decay of food is arrested below a level of 0.6 a_w .
- Many enzymatic activity stops which promote undesirable changes in chemical composition.

- In traditional method, sun & wind used to effect evaporative drying.
- Drying characterized by two diff steps:
- **Diffusion** : migration of water from wet part of fish to a vapourization zone, where water vapourizes.
- **Evaporation** : water vapourizes to surrounding atm by circulating air.

- The outward movement of water occurs in following sequence :
 - ❑ migration within the material to the surface.
 - ❑ removal from the surface.
 - ❑ mixing with the atmosphere surrounding material.
 - ❑ removal from the vicinity of the surface.
- Inward transfer of heat in following sequence :
 - ❑ emission from the heat source.
 - ❑ transfer to the surface of the material.
 - ❑ conduction within the material.
 - ❑ provision of latent heat of evaporation.

- Thermal energy required to drain off water can be obtained by diff sources.
- Eg. Sun, controlled burning of oil, gas or wood, microwave, electromagnetic radiation or ultrasonic heating.
- Drying causes considerable shrinkage & other irreversible changes in fish & will not reconstitute to original condition.

- **Advantages of dried foods :**

- Highly concentrated foods compared to other preserved foods.
- Drying reduces microbial activity & thus spoilage of food.
- Enzymatic & many chemical processes retarded.
- No involvement of complicated machinery & equipments.
- Product stable at ambient temp.
- Distribution costs are minimum.

• **DEHYDRATION :**

- Refers to process of drying under controlled condition such as controlled operating parameters eg. Temp, relative humidity, velocity etc.
- Drying in an enclosed atm. With controlling operational parameters.
- Method aimed at preserving food by avoiding wastage at the time of plenty & making it available during off season.
- Product of desired quality & reasonable shelf life can be obtained.

- **Water content & microbial activity :**
- Fresh non fatty fish = 80% moisture.
- Reduction to 25% moisture = bacterial action stops
- 15% moisture = prevents mould growth.
- **Water content vs water activity :**
- Three layers of water,
- Water at adsorption layer – bound water
- Diffusion layer less tightly bound to adsorption layer.
- Free water – ordinary water available to support microbial growth & chemical reaction.

Most effective physical method to assess state of water in foods is measuring a_w .

- $a_w = \frac{\text{Water vapour pressure of a product at a given temp}}{\text{water vapour pressure of pure water at same temp}}$
- $a_w = P/P_0$
- Where, P = vapour pressure of product
- P_0 = vapour pressure of pure water at same temp
- a_w of pure dist. Water = 1.0
- Absolutely dry product = 0
- a_w of Salted fish is low as dissolved salt present.

- a_w of fresh fish = 0.95, as it is lowered microbial activity is inhibited.
- Reduction of a_w can be achieved by heating vapourize free water, driving force, salting, brining, pressing to remove water, adding chemicals, pickling, freezing, heating/cooking etc.
- **Measurement of a_w :**
- a_w of food stuff can be measured by enclosing food in a sealed container & holding temp to constant.
- When air in headspace reaches equilibrium with surrounding air, measure the RH of air by hygrometer.

- a_w is equated to the measured RH expressed as fraction .
- A common way of presenting a_w of a food stuff is by plotting its equilibrium moisture content against a_w for a given temp/temps.
- Curve is called “Sorptions isotherms” & sigmoid shape.

- **a_w on foods :**
- Almost all microbial activity stops below a_w 0.6
- Most fungi are inhibited below a_w 0.7
- Most yeasts below a_w 0.8 & bacteria below a_w 0.9
- Oxidation of lipid occurs at low a_w level due to action of free radicals.
- Lowering a_w decreases growth rate of micro orgs, metabolic activity of spoilage & food poisoning.

Theory of Drying

- Drying of fish – two diff phases.
- Initially, by evaporation from near surface of fish.
- Drying continues at a constant rate equal to the rate of evaporation of free water from surface.
- **Constant rate period :**
- At the beginning of drying, fish surface is moist.
- Water evaporates as free from surface.
- Rate of escape of moisture /unit time will remain constant as long as surface is wet
- Governed by condition of drying, air temp, speed over surface, its humidity.

- Heat absorbed for evaporation of water at the moist surface is balanced by heat flow from the warm air stream into wet body & both are in equilibrium.
- **Factors affecting constant rate drying are :**
- **i) Air velocity :**
- Higher air velocity, thinner surface layer greater drying rate.
- **ii) Relative humidity :**
- Limits the amt of water the air can absorb.
- Saturated air- fish can't dry at all.
- $RH < 100\%$ -- drying takes place until air saturates.

- **iii) Temperature :**

- Amt of heat transferred to product is proportional to diff in temp between air & product.
- High temp diff more heat transfer & drying rate
- Increase in air temp, fall in RH – favors evaporation.

- **iv) Surface area :**

- More surface area greater surface available for drying.
- Larger fishes are split open to increase surface area.

- **v) Product thickness :**

- More thick the product longer drying period.
- Thinner fishes dry faster as more surface area.

- **Falling rate period :**

- Water evaporates from surface of fish, water in interior transfers to surface by diffusion.
- At a stage in drying, water can no longer diffuse to surface as rapidly as it is vapourized.
- Surface is no longer wet-- “critical moisture content”.
- Rate of moisture movement continue to decrease, thus drying rate falls. It is falling rate period.

- **Factors affects falling rate period are :**
- **i) Fat content :**
- High fatty fish longer time for drying.
- **ii) Shape of fish :**
- Thicker the fish longer drying time.
- **iii) Temperature :**
- Diffusion increases with rise in temp.
- **iv) Water content :**
- Decrease in water content – diffusion rate reduces.

Fish Drying Process

- Pre-processing of fish :
- **1. Cutting/splitting :**
- Gutting & cleaning necessary b4 salting
- small & thin fishes – dried whole. Eg. Anchovies, croakers, sole etc.
- Bigger fishes – split open or cut into pieces.
- Very big fish like cat fish, shark, rays etc. split open & scores made on exposed flesh side.
- Increase surface area for greater contact for quick evaporation of moisture & reduce time of drying.



- **2. Salting :**
- Drying fish with or without salting.
- Better to immerse fish in brine than in dry salt.
- Fatty fish salted by excluding air to prevent rancidity
- Saturated brine is preferred for easy uptake of salt.