

## LECTURE 2

### 2.0 WATER IN FOODS

- Water as basic constituent of ALL foods.

### 2.1 FORMS OF WATER IN FOOD

- Free water/moisture
- Hydrates of water
- Imbibes water
- Adsorbed water

### 2.2 PROPERTIES OF WATER

- Structure and Bonds in water H<sub>2</sub>O, covalent and H-bonds.
- Some physical properties of water and ice.
  - \* Density
  - \* Vapour pressure
  - \* Refractive index
  - \* Viscosity
  - \* Specific heat
  - \* Heat of vapourization
  - \* Thermal conductivity
  - \* Dielectric constant
  - \* Coefficient of thermal expansion
  - \* Melting point
  - \* Boiling point.

### 2.3 WATER ACTIVITY

- The concept of water activity relates the moisture (water) in a food to the RH of the air surrounding the food and is defined as ratio of the partial pressure of water in a food to the vapour pressure of water at the same temperature.

$$a_w = p/p_o \text{ where } P = \text{vapour pressure of water in food}$$

$$P_o = \text{vapour pressure of pure water at the same temperature}$$

$$a_w = \text{Water Activity.}$$

OR  $a_w$  can be defined as the ratio of the vapour pressure of water in a food to the saturated vapour pressure of water at the same temperature.

i.e.  $P/P_o$  where  $P$  (pa) = Vapour pressure of water in food

$P_o$  = Vapour pressure of pure water at the same temperature.

$a_w$  = water activity

- for pure water  $a_w = 1.0$
- High m.c. amount of moisture > that of solids,  $a_w \leq 1.0$
- Adsorption process  
Dry product subjected to increasing moisture levels in the surrounding/Environment.
- Desorption process  
Moist product gradually equilibrating with lower moisture levels of the surrounding/environment.
- Hysteresis loop
  - Difference between adsorption and desorption isotherms.
  - It occurs because adsorption and desorption isotherms are more identical.

## 2.4 **WATER ACTIVITY AND FOOD SPOILAGE**

- Moisture content and  $a_w$  are important factors which affect ratio of spoilage of food in terms of chemical, biochemical and microbiological reaction.
- for M.c 5-15% - moist, dried foods (powdered) - Great storage stability
- M.C. 20-40% - Intermediate moisture foods - less stable than dried foods.

### 2.4.1 **Biochemical/Chemical Reactions Attached By $a_w$**

- Most Enzymes are inactivated when  $a_w < 0.85$  e.g. Amylases, peroxidases etc
- Lipases are still active at  $a_w$  0.3 or less.
- Maillard reactions occur at  $a_w$  0.6 – 0.7.

### 2.4.2 **Microbiological reactions**

- Bacterial growth – Impossible at  $a_w < 0.90$
- Molds and yeasts – Inhibited between  $a_w$  0.88 – 0.80
- Osmophilic yeasts can grow at  $a_w$  of 0.65