Osmotic dehydration of fruits and vegetables: A novel concept of value addition for Nutritional Security

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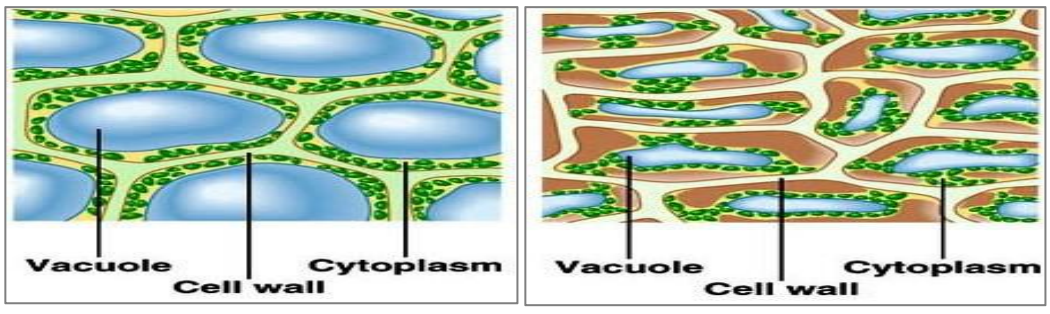
***Abstract* - Osmosis is spontaneous movement of a solvent from a lower-concentration to a higher-concentration of solution, through a semi-permeable membrane that allows the solvent to pass but not what is dissolved in, separating the two solutions. Osmosis is an essential process by means of which nutrients are delivered to the cell. This process is stopped when the osmotic pressure inside the tissue reaches the osmotic pressure of the surrounding syrup. Osmotic dehydration is a process, partial removal of water from food items such as fruits and vegetables. It is a useful technique for the production of safe, stable, nutritious, tasty, economical and concentrated food obtained by placing the fruit slices in an aqueous solution with high osmotic pressure. It involves dehydration of fruit or vegetables slices in two stages, removal of water using as an osmotic agent and subsequent dehydration in a dryer where moisture content is further reduced to make the product shelf stable. The osmo-dehydrated product can be prepared by keeping slice thickness 10 mm and blanching for 25 min and using osmotic solution having 50-60o B TSS strength at 45-50o C for higher retention of nutrients with better sensory quality and also increase the solid gain and moisture loss from product during osmotic dehydration.**

***keywords* - Osmosis, Osmo-Dehydration, Sensory Quality, Solid Gain and water loss**

I. INTRODUCTION

Fruits and vegetables are important sources of essential minerals, vitamins, dietary fibers, carbohydrates and proteins. India is the second largest producer of fruits and vegetables in the world. Osmotic dehydration is an efficient method for preservation of fruits and vegetables in recent years. The interest in inducing osmotic process in conventional dehydration has two objectives: i. Quality improvement and ii. Energy savings.

Osmosis is a essential process in biological system, as biological membranes are semi permeable. It is a process where the common salt is used as a preservative that penetrates into the tissue, hence slows the microbial activities and inactivate the enzymes. Brined vegetables preserve a fair amount of their nutritive value. This is a two steps of preserving fruits and vegetables:- Dipping of the fruits in concentrated sugar syrup or brine solution (**osmosis).** Final drying by use of dryers **(Dehydration).** There are different drying methods like, sun drying, cabinet drying, osmotic dehydration, foam mat drying, spray drying and freeze drying etc.



A. Normal cell structure **B. Cell structure after osmosis**

Fig :1 Osmosis process in cell tissue

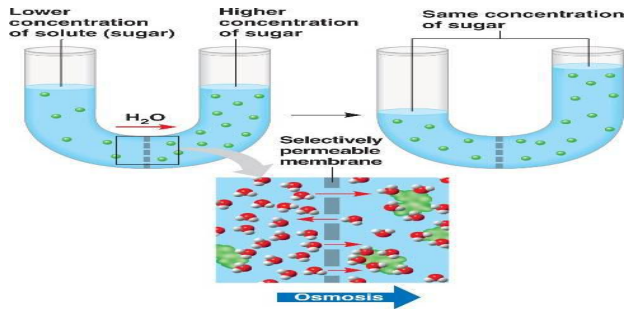
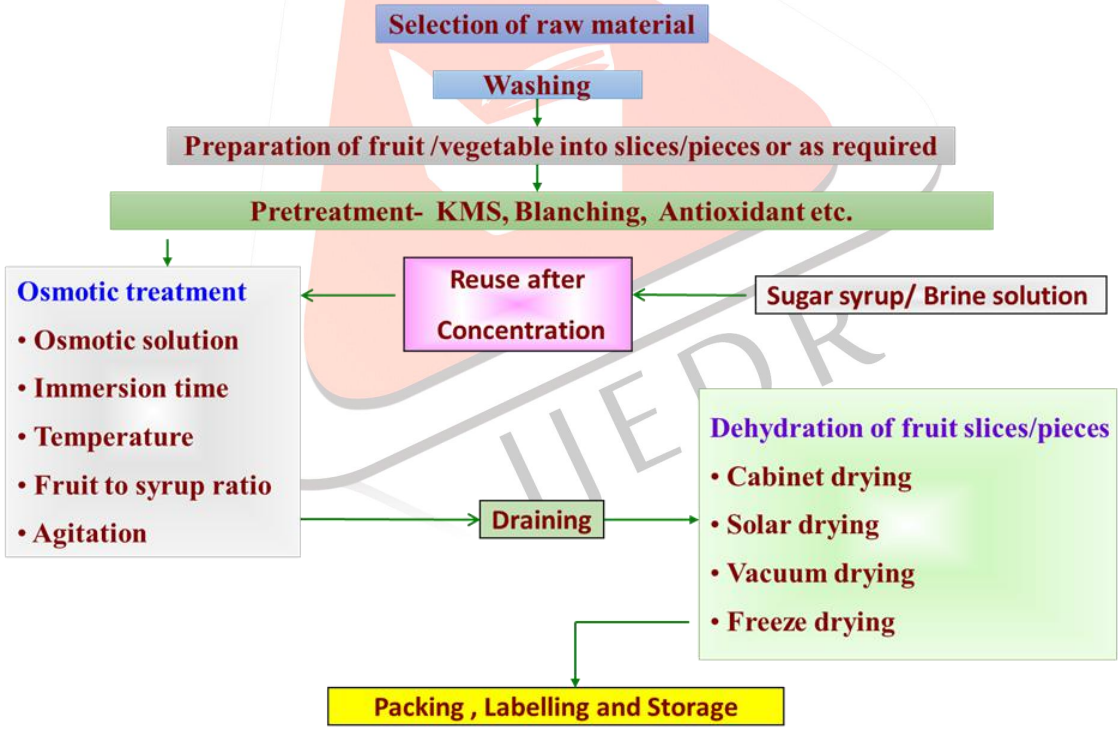


Fig: 2 Osmosis process

II. DIFFERENT OSMOTIC AGENTS AND THEIR EFFECTS ON OSMOTIC DEHYDRATION PROCESS:

1. **Calcium chloride :-** Which is raising the firmness of fruits and prevents browning.
2. **Ethanol :-** It can be used for decreasing the viscosity and freezing point of osmotic solution in cooling and freezing process.
3. **Malto-dextrin :-** Malto-dextrin is used as an osmosis solute at higher total solids concentrations.
4. **Sodium chloride :-** Nacl is most commonly used for vegetables, which is retards oxidative as well as non-enzymatic browning.
5. **Fructose :-** It is used for Increasing the dry matter content by 50 percent as compared to sucrose due to higher penetration rate.
6. **Sucrose :-** Sucrose solution is using as a best osmotic agent, which is reduce the browning by preventing the entry of oxygen.

Flow chart of general method of osmotic dehydration:



III. DIFFERENT PARAMETERS INFLUENCING OSMOTIC DEHYDRATION:

1. **Properties of fruits/ vegetables:** Osmotic dehydration is a process in which many co-current mechanisms, there are different levels are responsible for mass transport. Many compositional and structural forms are induced in fruits and vegetables, depends upon process variables and the tissue microstructure. Compositional and structural profiles are improved the liquid - gas exchanges in the tissue during osmotic process have a significant impact on physical, textural and chemical properties of the final product, which is influenced by the various number of cells, which are altered and unaltered during the treatment.
2. **Pre-treatments techniques:** The pre-treatment technologies include blanching, and dipping treatment, e.g. using of osmotic agents. Wet blanching is used for fruit processing due to its high nutrient retention capacity. While, in dry blanching such as using a microwave.

3. **Use of different osmotic agents:** When choosing an osmotic solution for osmotic dehydration, its specific effect is most important [1]. Mainly solutes are used an osmotic agent are sucrose, glucose, sorbitol, glycerol, glucose syrup, corn syrup and fructo-oligosaccharide. Generally, the lower molecular weight osmotic agent is convenience penetrates into the cell of fruit compared to high molecular weight osmotic agent [2]. In general, sugar and salt solutions proved to be the best choices and most common solutes which is based on aroma, easy and efficient.
4. **Concentration of osmotic solution:** During extended osmotic treatment, the increase of solute concentrations which give results in the increase in solid gain and water loss [2].
5. **Temperature during osmosis process:** The most important parameter, which affects the mass transfer in osmotic dehydration is temperature [1]. During osmotic treatment, the temperature increased then solid gain and water loss also take place [3-4]. The temperature is also maintain the viscosity of the solution and without changing the fruit quality. The higher uptake values of treatments above 20°C were due to the membrane swelling and plasticizing effect, which improved the cell membrane permeability to sugar molecules [5].
6. **Agitating process:** To intensify the mass transfer stirring process can be applied during osmotic dehydration because the used of highly concentrated viscous sugar solutions creates major problems which are floating of food pieces, inhibit the contact between food material and osmotic solution, which is reducing in the mass transfer rates [2, 6]. The agitation get decrease in the rate of solids gain for longer osmosis periods would be an indirect effect of higher water loss due to agitation. The agitation process can induce the turbulent flow, resulting in the increase of liquid diffusion during osmotic dehydration [6].
7. **Using osmotic Solution to food ratio:** An increase of osmotic solution to sample mass ratio resulted in an increment in both solid gain and water loss in osmotic dehydration. The investigators used a solution to product ratio (4:1 or 3:1) in mass transfer by changes in the concentration of the sugar solution [1].
8. **Geometry of food sample:** The geometry of sample affects the behaviour of the osmotic concentration due to the differences in surface area per unit volume and diffusion length of water and solutes [1]. The lowest water loss association with the highest A/L ratio was explained as a result of reduced water diffusion due to the high sugar gain. The higher specific surface area samples favoured sugar gain at the expenditure of lower water loss resulting in lower weight reduction. While, higher specific surface area sample shape gave higher water loss and sugar gain value compared to lower surface area samples [7].
9. **Time of the osmo-dehydration treatment:** Within the first hour of osmotic dehydration, the rate of water loss falling about 50% of the initial rate and within 3 hours, the product has lost 50% of its initial moisture, while it more than doubled its initial total solids, picking up sugar. Thus an easy way to limit solute gain and obtain large water loss [5].

Advantages:

- Keeping the flavor and color
- Raise in the solid density
- Retaining the textural quality
- Sweetening of the product
- Storage life of product is increase
- Simple equipments are required
- Less expensive
- Low energy consumption
- Enzymatic and oxidative browning is stopped
- Marketing, handling and transport become easier

Disadvantages:

- Reduces the taste of some products due to reducing acidity level.
- Sugar gain may not be desirable in certain products.

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