International Journal of Modern Agriculture,Volume 10, No.1, 2021
ISSN: 2305-7246

A Review on Osmotic Dehydration Technique and its scope in startup industries.

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Abstract

Fruits and vegetables are the most important part of our daily life. The largest producer of fruits and vegetables in the world is India. Processing of foods by drying is one of the ancient technologies with many benefits. But, it also has many issues such as loss of quality of the product and more time consumption. To overcome these issues osmotic dehydration process can be adopted before drying the food product. Osmotic dehydration is dipping the cellulosic food material inside a solution containing solids. The pressure difference is the driving force for dehydration in this process. This osmotic dehydration technique reduces production cost, production time and also improves the quality of the product. In this context osmotic dehydration, osmotic agent, applications and factors influencing osmotic dehydration has been discussed briefly.

KeyWords: Diffusion, Drying, Mass Transfer, Osmotic dehydration, Tapioca tuber.

I. INTRODUCTION

The ancient convective drying technique increases shelf life, decreases shipping weight, enables easy packaging, handling and transportation of food products [1]. But, convective drying has many issues such as long duration, loss of color, flavor, texture, nutrition and sensory value [2]. The high temperature in this process leads to this loss of quality. Though low temperature yields good quality, it further increases production time and cost [3]. Thus various pre-treatment techniques before drying such as osmotic dehydration can be undergone to overcome the issues in convective drying. The osmotic pressure existing in nature can be used for dehydrating the food material before drying it [4].

Osmotic dehydration is dipping the cellulosic food material inside a solution containing solids. Here, the solution (hypertonic medium) has more osmotic pressure whereas inside the food material (hypotonic medium) the pressure is low. This potential difference drives the dehydration process. So that no external energy is involved in this process. The cellular structure of food material serves as the semi-permeable membrane. This process can be

done with room temperature itself. However, by applying a rise in temperature the efficiency of the process can still be increased. In osmotic dehydration the loss of volatile compounds and oxidative changes are minimal [5].

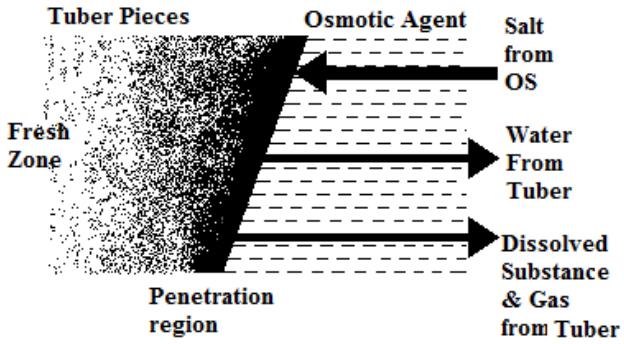

Fig. 1. Schematic demonstration of the osmotic dehydration process

Osmotic dehydration is used to improve the nutritional, sensorial and functional properties of food without changing its integrity [6, 7]. It reduces water activity. It is effective around ambient temperature leading to 20-30% energy consumption. So, the damage to texture, color and flavor is minimal. It also increases solute to acid ratio, improves the texture and stability of pigments during dehydration and storage. There is no need for a phase change in this process. The osmotic solution leftover can also be reused again or can be used in beverage industries. No sophisticated equipment is involved in this process [8].

II. APPLICATION

Large scale production of dehydrated food products like fruits, vegetables, candies is the main industrial application. Osmotic dehydration has good scope for start-up industries even in rural areas. Food additives can also be added using this mechanism [9, 10].

III. FACTORS INFLUENCING OSMOTIC DEHYDRATION

The parameters influencing osmotic dehydration are temperature (optimum is 20-50ºC), immersion time, osmotic agent's concentration, agitation, pretreatment (biological, mechanical and chemical), solution-sample ratio, physical, chemical, structural (cell porosity, packaging, membrane permeability), geometrical properties and nature of food. Application of ultrasound, centrifugal force, gamma-irradiation, microwave, pulsed vacuum, pulsed electric field, external high pressure also influences the mass transfer [11].

IV. OSMOTIC DEHYDRATION

The hypertonic medium or the dipping solution is known as an osmotic agent. More than one osmotic agent can be used in mixed form for osmotic dehydration. Osmotic agents must be inert, soluble, effective, easily available, cheap, edible, non-toxic and have good sensory value. Salt, sugar, corn syrup, honey, ethanol, starch, maple syrup, jaggery, sucrose, glucose, glucose syrup, fructose, fructo-oligosaccharides, glycerol, sorbitol and maltodextrin are some of the osmotic agents [12]. Honey containing fructose, glucose, maltose, sucrose and other carbohydrates has high osmotic pressure and permits rapid water diffusion than sugar solution [13]. Using ethanol as the osmotic agent increases shelf life, lowers water activity of the product and viscosity of the solution. Out of

all sugar and salt are the best agents. By preventing oxygen entrance the sugar solution reduces browning, retains volatile compounds and provides stability to pigments [14]. Sugar is more effective than the combination of different osmotic agents. But, sugar solution has more viscosity and it requires more energy for agitation. On the other hand, the density difference between the solution and the sample makes the sample to float. In the case of salt solution, this issue will not be there [15].

V. REUSING OSMOTIC DEHYDRATION

From an economic point of view, the osmotic solution/agent can be reused after re-concentration (addition of fresh agent/evaporation) [16]. While reusing, the properties such as color, flavor, pH, water activity and viscosity of the solution will be changed. Moreover, increase in organic content can also provide a substrate for microbial growth. But, the used solution can be further used in food processing, pharmaceutical and brewery industries as a natural additive [17].

VI. CONCLUSION

In literature many studies exist in osmotic dehydration. But the behavior is not unique due to the change in composition from one food product to another [18]. Osmotic dehydration saves about 70% of energy and doesn't damage the texture, color, flavor and taste of the dried samples [4]. Osmotic dehydration has good scope for start-up industries even in rural areas; hence no sophisticated technology is involved in this process. Large scale production of dehydrated natural vegetables / fruits are feasible and also economical. Dried ready to cook vegetable chips is an innovative product with good commercial value. When salt is used as the osmotic agent, it extends the shelf life of the product and also enhances the sensory value. Future works in osmotic dehydration such as process optimization, kinetic modeling, shelf life study and sensory evaluation have good scope as the data available in the literature is scarce.

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