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Recent developments in ultrasonication assisted osmotic dehydration of food materials: A review

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ABSTRACT

Drying is a widely used method for preserving foods and agricultural products. Newer drying methods are being conceived because it is a long-lasting process. Typically agricultural products have less shelf life because ofa large amount of water. Therefore, methods have been developed to decrease the total amount of water present in edible tissues.Osmo-dehydration is one such method that reduces moisture and is an efficient and less time-consuming method. Osmotic pressure is the driving force for the diffusion of solutesduring this technique. To increase the osmo-dehydration process's efficiencyand the quality of the final product, ultrasound has been used in combination with Osmo-dehydration. The current review presents a state-of-the-art overview of the current developments in ultrasonic-assisted osmotic dehydration (UOD) of food materials.

1. Introduction

Various drying techniques are carried out to ensure the stability of perishable food products. The thermal drying process is widely employed to increase microbiological stability.It reduces the product's weight and volume and results in a decreasing handling and processing costs.The dehydration process has been applied from early periods, and nowadays, it is used in all the industry branches. As conventional drying has many drawbacks, such as being time-consuming, energy deficient, and poor product quality, it requires further developments and is considered a well-known technology (Musielak et al., 2016).

Osmo-dehydration is a pre-management technique. During osmotic dehydration, a fruit or vegetable material is kept in a highly concentrated solution to reduce the moisture content, and moisture diffusion occurs from food material (Tortoe, 2010; Shi & Xue, 2009). Simultaneously, in the osmotic dehydration method, solutes are absorbed by the fruit material, and water is ejected from the interior of the sampleand dischargedin a highly concentrated solution. Moreover, the solid transfer from the food materials into the hypertonic solution occurs via the highly porous cell membrane (Ahmed et al., 2016). The process has many benefits, including improved product quality, less energy requirement, no chemical treatment, and product stability during storage. As osmotic dehydration occurs at mild temperature (30- 50 ^{0}C), this gives an advantage of minimal damage to the final product. Moreover, it prevents the loss of volatile substances from the product and oxidative browning (Ahmed et al., 2016).

Sound waves having frequencies between 20 kHz-1 MHz,usually known as ultrasounds, which are not audible to humans,are generally used in food processing because of their physical and chemical effects. For the significant improvement in the counter-current diffusion of solutes and water molecules, the ultrasonic technique with greater power strength has become very popular nowadays in thermal processing (Kek et al., 2013). Ultrasounds cause their influence through longitudinal waves,also known as the "sponge effect" due to this,water is maintained inner side of the food tissue, and the microscopic voids are formed, thus, efficiently removing the moisture (Allahdad et al., 2018). Ultrasound technique is essential,significantly affecting the evaluation of different methods in the industrial unit. With the application of ultrasound, complete food dehydration methods nowadays may be finished in a short time, producing excellent reliability and decreasing industrial costs. Thus, due to many phenomena associated with the ultra-sonication process, ultrasound possesses several industrial-scale applications,as presented in Table 1(Chemat & Khan, 2011). The application of ultrasound in the osmotic dehydration process improves