Vegetables supplemented with phenolics from unused chokeberries by ultrasound-assisted osmotic treatment

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Recently, industrial interest has focused on developing foods supplemented with active components that provide greater physiological benefits. Osmotic treatment is widely used to modify the composition of solid foods by partially removing water and adding solutes (Rastogi et al., 2002). Even though osmotic treatment has been extensively used to produce intermediate moisture products, it has only been used to a limited extent to produce functional foods from vegetables. In particular, it has been used to impregnate plant foods with probiotics and minerals. Recently, osmotic treatment was described as being a suitable method for infusing solid foodstuffs with grape phenolics (Rózek et al., 2007).

However, the rate of mass transfer during osmotic dehydration is generally low. A number of pretreatments such as high pressure, pulsed electrical field, partial vacuum, and centrifugal force are reported to enhance the rate. The ultrasound in combination with osmotic dehydration results in higher rate of water loss and solute gain due to increased cell wall permeability owing to the formation of microscopic channels, which facilitated the transport of water and solute (Nowacka et al., 2014).

Aronia melanocarpa berries (black chokeberries) are one of the richest plant sources of phenolic compounds. Different beneficial effects on health have been reported for black chokeberries and their extracts, such as prevention and treatment of cardiovascular diseases and colon cancer, antidiabetes, and antimutagenic effects. This may principally be due to the antioxidant activity exhibited by phenolic species in these berries and their extracts (Galvan D'Alessandro *et al*, 2014). Applications for food preservation are also possible, since natural polyphenols enable to limit lipids degradation.

Although *A. melanocarpa* berries have a good value of edible use, it could be unfavorable for direct consumption because of its heavy astringent taste. The overproduction and non-marketable products lead to unusued fruits that are becoming "waste". Research for valorization of agricultural waste and by-products has increased during the last decade; however, it has been focused mainly on the waste of the major horticultural products, such as citrus fruits, grapes, raspberries, pomegranates, and apples, while numerous other vegetables, fruits and berry species, including chokeberry, remain underexplored. Therefore, considerable effort has been devoted to the extraction of phenolic compounds from *A. melanocarpa* in order to use the extracts as dietary supplements or as food colorants.

The development of new and improved processed products from potato appears to represent an excellent means of increasing the utilization of this high yielding and nutritious species. Osmotically dehydrated potato can be used as a quick-cooking product or as an ingredient in salads and soup mixes. In this work, osmotic dehydration was assessed as an operation for supplementing potato with pomegranate peel phenolics to increase its antioxidant properties. The aims of the present work are (i) to study the rate of phenolics infusion into potato cubes during osmotic dehydration, (ii) to determine the diffusion coefficients of water, solute as well as phenolics during the treatments, and (iii) to evaluate the possible enhancement of mass transfer during osmotic dehydration due to application of ultrasound treatment.

Experiments with ultrasound application were carried out without stirring the solution using a probe system. Potato cube samples were placed in a basket consisted of shelves and immersed in the osmotic solution in a beaker where the ultrasonic probe horn was immersed. To investigate how the nature of osmoactive solutes affects mass transfer of pomegranate peel phenolics, sodium chloride and maltodextrin (12 DE) were used as osmoactive solutes. The cubes were treated with different osmotic solution concentrations under different temperatures for different times (30, 60, 120, 180, 240, and 300 min). Mass transfer of total phenolics were characterized by the diffusional approach and Peleg's model.

Ultrasound treatment resulted in higher moisture and solid mass transfer due to the breaking of cell structure as revealed by microstructure examination. The present study concluded that osmotic dehydration is a feasible technology for impregnation of functional ingredients into foods.

References

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