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RESEARCH ARTICLE

Influence of Osmotic Dehydration in Processing of *Tamarindus indica* Jam

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Abstract

Tamarind (*Tamarindus indica* L.) has long been used as a spice, food component and traditional medicine. It has high content of total phenols, proanthocyanidin and tannins *Tamarindus indica* has a high commercial value affordable functional foods. Howeever it has short shelf-life during post-harvest handling owing to high moisture content. It's necessary to preserve this valuable fruit for long-term use. Objective of this research focused on the effectiveness of various processing parameters such as pretreatment with KMS solution, sugar concentration, immersion time, and agitation speed during the osmotic dehydration of *Tamarindus indica* into jam. Our results showed that the optimal dehydration process should be pre-treated with 0.25% KMS solution, sugar 60°Brix, immersion in 75 min, agitation 500 rpm. From this approach, the added value of *Tamarindus indica* fruits would be enhanced. Osmotic dehydration showed minimum heat degradation to nutritional components owing to low temperature moisture removal. It contributed some advantages such as limiting the thermal damage to the aroma, color, preventing the browning of enzymes and decreasing the energy consumption.

Keywords: *Tamarindus indica, Osmotic dehydration, Pretreatment, Immersion, Agitation, Sugar.*

Introduction

Osmotic dehydration is an approach used for the partial removal of moisture from plant tissues by immersion in a hypertonic solution such as sugar or salt to reduce the water activity before full drying step [1].The removal of moisture during osmotic process is mainly by diffusion and capillary flow.

It presents some benefits such as reducing the damage of heat to the flavor, color, inhibiting the browning of enzymes and decreases the energy costs [2].Osmotic dehydration is affected by various parameters such as osmotic agent, solute concentration, temperature, time, size, and shape and tissue compactness, agitation and solution/sample ratio. The osmotic dehydration should be conducted before the drying process to improve the mass transfer rate while maintaining the product quality and wholesomeness [3].

Tamarind (*Tamarindus indica* L.) is a tree planted mainly for its fruits.

The ripened fruits were used in many food applications [4].The tamarind fruit pulp is an excellent source of sugars and vitamin B, minerals and phenolic compounds as antioxidants [5, 6]. The fruit contained glucose, fructose and arabinose as inverted sugars. The tamarind pulp is used as a digestive, carminative, laxative, expectorant and blood tonic; the seeds are used as an anthelmintic, antidiarrheal and emetic [7].

There was not many studies mentioned to osmotic dehydration of *Tamarindus indica* fruit. The influence of temperature and solution concentration on the osmotic dehydration of tamarind pulp (*Tamarindus indica* L.) was determined [8].Therefore, objective of this our study focused on the

effectiveness of processing variables such as pretreatment with KMS solution, sugar concentration, immersion time, and agitation speed during the osmotic dehydration of *Tamarindus indica*

Materials and Method

Material

Tamarind *(Tamarindus indica)* fruits were collected from Can Tho city, Vietnam. After collecting, they must be kept in cool and dry cotton box, conveyed to laboratory for experiments. Outer skin of *Tamarindus indica* fruits were removed by knife. They were subjected to the osmotic dehydration under different conditions. This research was conducted from 2018 to 2019 in the scientific laboratory of Soc Trang Nanotech Ltd.

Researching Procedure

Effect of Ascorbic Acid Concentration in Pretreatment of Tamarindus Indica Jam

Raw *Tamarindus indica* pulp was dipped in KMS solution (0.1, 0.15, 0.2, 0.25, 0.3%) for 45 minutes prior to drying to prevent enzymatic browning of fruit. Sensory evalution would be carried out to demonstrate the optimal KMS solution in pretreatment.

Effect of Sugar Concentration to the Quality of Tamarindus Indica Jam

Different sugar concentrations (50, 55, 60, 65, 70^{o}Brix) were examined. Sensory evalution and water loss (%) would be carried out to demonstrate the optimal sugar concentration during the osmotic dehydration.

Effect of Immersion Time to the Quality of Tamarindus Indica Jam

The immersion was prepared in different durations (30, 45, 60, 75, 90 min). Sensory evalution and water loss (%) would be carried out to demonstrate the optimal immersion time during the osmotic dehydration.

Effect of Agitation Speed during Osmotic Treatment to the Quality of Tamarindus Indica Jam

The osmotic treatment examined different agitation speeds (0, 250, 500, 750, 1000 rpm). Sensory evaluation and water loss (%) would be carried out to demonstrate the optimal agitation speed during the osmotic dehydration.

Physico-chemical, Sensory and Statistical Analysis

Water loss (%) was estimated by comparing the weight before and after treatment. Sensory score was evaluated by a group of panelist using 9 point-Hedonic scale. The experiments were run in triplicate with three different lots of samples. Statistical analysis was performed by the Stat graphics Centurion XVI.

Result & Discussion

Effect of Ascorbic Acid Concentration in Pretreatment of *Tamarindus indica*

Pretreatments leaded to increase the osmotic process in fruits and vegetables [9].In our research, raw *Tamarindus indica* pulp was dipped in KMS solution (0.1, 0.15, 0.2, 0.25, 0.3%) for 45 minutes prior to drying to prevent enzymatic browning of fruit. Our result showed that the tamarind pulp should be pretreated with 0.25% KMS for 45 minutes before the osmotic dehydration.

Table 1: KMS concentration (%) in pretreatment of *Tamarindus indica* pulp

KMS concentration (%)	0.10	0.15	0.20	0.25	0.30
Sensory score	4.54±0.04^{c}	5.33±0.01^{bc}	6.41±0.03^{b}	7.20±0.00^{a}	7.22±0.03^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

In another report, dipping the papaya and mango slices in 0.4 percent ascorbic acid solution or 0.4 per cent ascorbic acid + 0.1 percent KMS solution for 30 min prior to osmosis process effected to obtain a high acceptable product [10].

Effect of Sugar Concentration to the Quality of *Tamarindus indica* Jam

The osmotic agent has a greater impact on texture, which causes changes in the sensory attributes such as gumminess, even crispness and flavor of the product [11]. Concentration of solution is an important factor in the osmotic dehydration process. Increased osmotic agent concentrations result in the increment of solid gain and water loss. Water loss and soluble solid content increased linearly with the increase of sugar

concentration and temperature [12]. Syrup strength in the range of 60 to 70°Brix has been found to be optimum [13].In our research; different sugar concentrations (50, 55, 60, 65, 70°Brix) were examined. Our result revealed that sugar concentration 60°Brix was adequate for the osmotic dehydration of tamarind jam.

Table 2: Sugar concentration (°Brix) in osmotic dehydration of *Tamarindus indica* pulp

Sugar concentration (°Brix)	50	55	60	65	70
Water loss (%)	41.25±0.12^{d}	43.77±0.23^{c}	49.78±0.29^{b}	50.07±0.13^{ab}	50.26±0.16^{a}
Sensory score	7.20±0.0^{c}	7.94±0.03^{bc}	8.33±0.01^{a}	8.17±0.05^{ab}	8.02±0.00^{b}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

The influence of temperature and solution concentration on the osmotic dehydration of tamarind pulp (*Tamarindus indica* L.) was determined. The experimentally water loss and weight loss and the gain of solids during osmotic dehydration within hypertonic sucrose solutions of 30, 40 and 60°Brix, and temperatures of 29 and 50°C was studied. The results showed that the higher the solution concentration and temperature, a higher water loss (53.9%), weight (53.9%) and solid gain (0,008%) were produced [8].

Effect of Immersion Time to the Quality of *Tamarindus indica* Jam

In the constant osmotic concentration, the increase of the immersion time resulted in the increase of water loss, but the rate of increase was decreased gradually. Mass exchange took place at the maximum rate within the first two hours of the osmotic treatment [10].In our research; the immersion was prepared in different durations (30, 45, 60, 75, 90 min). Our result revealed that immersion time 75 min was adequate for the osmotic dehydration of tamarind jam.

Table 3: Immersion time (min) in osmotic dehydration of *Tamarindus indica* pulp

Immersion time (min)	30	45	60	75	90
Water loss (%)	49.78±0.29^{d}	51.74±0.23^{c}	53.19±0.25^{b}	58.34±0.12^{a}	58.42±0.18^{a}
Sensory score	8.33±0.01^{b}	8.58±0.05^{ab}	8.63±0.05^{ab}	8.78±0.03^{a}	8.80±0.00^{a}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Tiwari and Jalali [14] found that increasing osmotic duration resulted an increase in weight loss of mango and pineapple; however the rate happened decrease gradually. Gaspartero et al [15].Noticed that banana and apple immersed in 70 and 50°Brix respectively, osmotic immersion temperature of 50°C for 3 hours showed the highest water loss as well as sugar accumulation.

Effect of Agitation Speed during Osmotic Dehydration to the Quality of *Tamarindus indica* Jam

The use of highly concentrated viscous sugar solutions creates major problems such as floating of food pieces, hindering the contact between food material and the osmotic solution, causing a reduction in the mass transfer rates [16, 17].

Agitation or stirring process can be applied during osmotic dehydration; the rate of osmosis will be faster due to reduced mass transfer resistance at the surface by avoiding localized dilution process [18]. The effect of stirring intensity was investigated through water loss and solid gain.

The osmotic process experiments were repeated at fixed sugar concentration (65% w/w), fixed temperature (25 °C), for five different speeds of agitation (0, 250, 500, 1000, 1500 rpm). Mass transfer coefficients were related to the agitation intensity [19]. In our research, the osmotic treatment examined different agitation speeds (0, 250, 500, 750, 1000 rpm). Our result revealed that agitation speed 500 rpm was adequate for the osmotic dehydration of tamarind jam.

Table 4: Agitation speed (mrpm) in osmotic dehydration of *Tamarindus indica* pulp

Agitation speed (rpm)	0	250	500	750	1000
Water loss (%)	58.34±0.12^{d}	62.77±0.09^{c}	68.42±0.14^{b}	69.11±0.23^{ab}	70.24±0.15^{a}
Sensory score	8.78±0.03^{b}	8.83±0.04^{ab}	8.95±0.00^{a}	8.44±0.03^{bc}	8.12±0.01^{c}

Note: the values were expressed as the mean of three repetitions; the same characters (denoted above), the difference between them was not significant (α = 5%)

Conclusion

Osmotic dehydration has got a greate attention recently as an innovative approach for storage of fruits and vegetables. It consumes less energy than other drying methods because it can be performed at low temperature while maintaining the product quality and wholesomeness. Moisture content is partly removed by osmotic substance and further dehydration in a dryer is fully reduced to a stable level.

We have successfully examined different technical variables influencing to the osmotic dehydration process of *Tamarindus indica* pulp into jam.

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