IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Osmotic Dehydration And Hot Air Drying Of Orange Peel

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ABSTRACT

Osmotic dehydration is one of the best and suitable method to increase the shelf life of fruits and vegetables. This process is preferred over others due to their vitamin and minerals, color, flavor and taste retention property. In the present investigation, effect of process parameters on osmotic dehydration on osmo-convective dried orange peel candy was carried out. The results of this study consist of osmotic dehydration of orange peel followed by its convective drying. The process parameters considered for the study were sugar concentration (50-70°Brix), immersion time (30-90 min) at constant sugar syrup to orange peel slices ratio (5:1), sugar syrup temperature (70°C) and drying temperature (60°C) in cabinet dryer and evaluated their effects on mass transfer properties and sensory properties. The standardized process parameters obtained were: 70 °Brix of sugar concentration and 60 min of immersion time for maximum water loss and sugar gain with higher sensory score compared to other samples.

Keywords: Orange peel, Osmotic dehydration, Water loss, Solid gain

India is one of the largest fruit producing country in the world. Citrus is an important fruit crop of India grown on large scale. Orange (*Citrus reticulata Blanco*) is most common among citrus fruits grown in India. It is commonly known as Narangi or Santra. Oranges can be utilized as healthy snack with low calories. Shredded whole frozen orange is used to sprinkle on top of salad, ice cream, soup, noodles, rice and fish dishes. Oranges are cherished around the globe due to their nutritional value, physicochemical properties, natural antioxidants, and sensory attributes. The natural polyphenols in oranges and its peel comprise some bioactive compounds like hesperidins, vitamin C, carotenoid, naringin, ferulic acid.

Orange is seasonal, and has a limited shelf life at ambient conditions. It creates heavy glut during production season and becomes scanty during off season. Limited shelf life coupled with inadequate processing facilities resulted in heavy revenue loss in the country. Orange peels are beneficial in management and treatment of several disease conditions. Orange peel contains pectin, a natural fiber which prevents problem like constipation and maintain the blood sugar level. Pectin also helps in promoting the growth of good bacteria in the intestine which results in better digestion. Therefore, it become need of the day to process the oranges in RTE dehydrated slices with peel. Osmo-convective dried orange peel slices with healthy osmotic agents could be very appreciated by consumers.

Osmotic dehydration is a process in which partial water is removed by immersion of water containing cellular solid in a concentrated aqueous solution of high osmotic media for a specific time and temperature. The osmotic dehydration is one of the preservative methods which offer many advantages, such as energy intensive, reduced weight of produce, require low capital investment and also offer a way to save highly perishable products and enhance the quality and availability of the produce.

Therefore, in light of above points, the present investigation is planned to study the effect of osmotic process parameters (sugar concentration and immersion time) on quality responses (water loss and solid gain) and also to Standardize these parameters for production of osmo-convectively dried orange peel candy.

MATERIAL AND METHODS:

Material

Fresh oranges (*Citrus reticulata Blanco*) are purchased locally, which thoroughly washed with water. Sugar, the osmotic agent, was purchased from a local supermarket.

Sample preparation and Experimental procedure

The selected oranges were washed with water and unwanted material like dust, dirt, and surface adhering were removed. The orange peel was cut using a sharp stainless steel knife into slices of approximate 5 mm ± 1mm thickness. The initial moisture content of raw and treated orange slices was determined by using oven method (AOAC, 2012). Before osmotic dehydration blanching was carried out for 12 min. Osmotic dehydration was done in sugar solution with different concentrations such as 50, 60 and 70 °Brix.

The concentration of the solution was measured by using Abbe refractometer at room temperature. The sample to solution ratio was constant 1:5 (w/w). The orange slices were weighed and submerged in the sugar solution at 70 °C. The samples were removed from the solution at different time intervals (30, 60 and 90 min.). The orange slices were drained after removing from sugar solution and the excess solution at the surface of orange slices adhered with tissue paper for subsequent weight measurement.

Mass Transport Parameters for Osmotic Dehydration

The mass transfer parameters i.e water loss and sugar gain reflecting as one of the quality attributes of orange slices were calculated by following equation given by Kedarnath *et al*., (2014).

Water loss (WL)

$$WL = \frac{W_i . X_i - W_\theta . X_\theta}{\mathrm{W_i}}$$

Mass reduction (MR)

$$MR = \frac{W_i - W_\theta}{W_i}$$

Solid gain (SG)

$$SG = \frac{W_\theta(1 - X_\theta) - W_i(1 - X_i)}{W_i}$$

Where,

WL= Water loss (g per 100 g mass of orange slices), SG = solid gain (g per 100 g mass of orange slices),

MR= Mass reduction (g per 100 g mass of orange slices), W_Θ = mass of orange slices after time Ө, g,

W_i = initial mass of orange slices, g, X_Θ = water content as a fraction of mass of orange slices at time Ө.

X_i = water content as a fraction of initial mass of orange slices, fraction.

Result and Discussion

Effect of process variable on water loss

The values of variation in water loss of orange slices were studied by syrup concentration and immersion time in experimental studies and it is presented in Table 2. A wide variation in water loss was observed for different experimental combination i.e. 17.25 to 39.95%. It was observed that the immersion time and concentration of syrup contributed maximum for water loss. It was observed that the water loss increased rapidly in the early stages of osmosis, further the rate of water loss gradually slowed down with time.

The water loss increased with increase in concentration of syrup as well as with immersion time over the entire osmotic dehydration process. The similar findings have been reported for osmosis of mango (Duduyemi Oladejo *et al.*, 2013).

Effect of process variable on sugar gain

The experimental values of sugar gain during osmotic dehydration of orange slices by varying the process parameters is 4.6 to 10.39%. Table 2 shows that the effect of all process variables was significant interaction level for sugar gain. Table 2 shows that sugar gain increased with increase in sugar concentration and immersion time. Increased concentration of the sugar syrup also led to increase in sugar gain (Table 2) which might be due to increase of osmotic pressure gradient and consequent loss of functionality of cell plasmatic membrane that allows solute to enter. Similar results were found for orange slices (Harati *et al*., 2011), mango (Duduyemi Oladejo *et al*., 2013).

Sensory evaluation

Sensory properties of osmo-convectively dried orange peel slices were evaluated in terms of color and appearance, flavor, texture, taste and overall acceptability. Table 3 shows the score of sensory properties of osmo-convectiely dried orange peel slices prepared by varying process parameters. From Table 3 it was observed that the color and appearance, flavor, taste and overall acceptability of osmo-convectively dried orange peel slices varied significantly at different concentration and immersion time. Osmotically dehydrated orange peel slices at 70 ^{o}B sugar concentration and 60 min immersion time dried at 60^{o}C obtained highest score than other treatments in all sensory attributes (Table 3). Similar results were found for papaya cubes (Jain *et al.*, 2011).

CONCLUSIONS

It can be concluded from the results of this investigation that sugar concentration, and immersion time having significant effect on osmotic dehydration of orange peel slices. The standardized conditions for maximum water loss and acceptable sugar gain correspond to Immersion time of 60 min. and sugar concentration of 70 ^{o}B in order to obtain maximum water loss of 37.14% and desired sugar gain of 8.94%.

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Table 1: Details of different treatments for osmotic dehydration

Parameters	**Process variables**		
Concentration of syrup, °B	50	60	70
Time of immersion, min.	30	60	90
Experiments	09		

Table 2: Observed water loss and sugar gain under varying processing parameters

Treatments	Water loss (%)	Sugar gain (%)	Mass Reduction
T1	17.25±0.03	4.6±0.04	12.83±0.05
T2	19.28±0.09	5.35±0.07	15.73±0.01
T3	23.35±0.07	6.15±0.08	18.27±0.05
T4	25.45±0.11	6.84±0.03	20.34±0.06
T5	28.5±0.08	7.15±0.06	26.45±0.07
T6	32.94±0.09	7.83±0.12	28.81±0.05

T7	35.4±0.01	8.10±0.02	30.86±0.11
T8	37.14±0.02	8.94±0.06	31.27±0.05
T9	39.95±0.05	10.39±0.05	33.06±0.07
SE	0.41	0.43	0.102
CD	1.02	1.11	0.46

C- Sugar concentration, (°B), ϴ- Immersion time, (min). Significant at 0.05, NS - Non significant

Table 3: Sensory evaluation of osmo-dehydrated orange peel

Sr No	Color and Appearance	Taste	Flavour	Texture	Overall acceptability
Control	3±0.01	4.2±0.11	4.4±0.07	4.3±0.03	4.2±0.03
T1	5±0.03	5.9±0.03	5.1±0.08	4.9±0.03	5.6±0.03
T2	6.8±0.07	5.9±0.02	5.5±0.06	5.1±0.0	5.6±0.03
T3	6.8±0.06	6.0±0.12	6±0.03	5.3±0.03	6.4±0.03
T4	7.1±0.05	6.4±0.03	6.3±0.05	6.4±0.03	6.6±0.03
T5	8.1±0.08	6.8±0.13	6.8±0.07	6.7±0.03	6.8±0.03
T6	8.2±0.03	7.2±0.20	7.5±0.13	7.0±0.03	7.2±0.03
T7	8.6±0.07	8.3±0.04	8.3±0.23	7.9±0.03	8.0±0.03
T8	8.7±0.05	8.5±0.07	8.4±0.20	8.5±0.03	8.5±0.03
T9	8.6±0.04	8.2±0.11	7.9±0.33	7.9±0.03	8.2±0.03
SE	0.5	0.2	0.3	0.3	0.3
CD	1.5	0.8	1.2	0.9	0.8

** Non significant at 5%, In each column, means with same superscripts do not vary significantly
* Significant at 5%,

Where,
T1 = Sugar concentration 50˚Bx; Immersion time 30 m; Solution temperature 70˚C
T2 = Sugar concentration 50˚Bx;Immersion time 60 m.; Solution temperature 70˚C
T3 = Sugar concentration 50˚Bx; Immersion time 90 m.; Solution temperature 70˚C
T4 = Sugar concentration 60˚Bx; Immersion time 30 m.; Solution temperature 70˚C
T5 = Sugar concentration 60˚Bx; Immersion time 60 m.; Solution temperature 70˚C
T6 = Sugar concentration 60˚Bx; Immersion time 90 m; Solution temperature 70˚C
T7 = Sugar concentration 70˚Bx; Immersion time 30 m; Solution temperature 70˚C
T8 = Sugar concentration 70˚Bx; Immersion time 60 m.; Solution temperature 70˚C
T9 = Sugar concentration 70˚Bx; Immersion time 90 m ; Solution temperature 70˚C