QUALITY EVALUATION OF OSMO-CONVECTIVELY DRIED SAPOTA (*ACHRAS SAPOTA L.*) POWDER

SUCHITA V. GUPTA, BHAGYASHREE N. PATIL, PRADIP A. BORKAR, AMRAPALI A. AKHARE

Abstract: The osmotic dehydration was carried out with 40, 50 and 60 ^{o}Brix sugar syrup at 40, 50 and 60 ^{o}C syrup temperature and constant syrup to sample ratio (5:1). The osmotically dehydrated Sapota sample was dried at 60^{o}C drying air temperature and 1 m/s air velocity. With these input parameters the osmo-convectively dried Sapota product having 10.53 % (db) moisture content. The peak value in the fresh sapota were 28.00 mg/100 g dm and 72.00 mg/100 g for Ca and P. The Ca contents in the osmo-convectively dried sample were 19.00 and 9.00 mg/100 g dm in convective drying whereas P contents are 61.25 in osmo convective drying and 48.5 mg/100 g dm in convective drying of sapota . The osmo-convectively dried product was found superior with respect to taste and overall acceptability as compared to convectively dried product (without osmo). The osmo-convectively dried product was appreciated by the panelist because of its sweet taste, but convectively dried product (without osmo) showed little bit sweetness.

Key words: Osmotic dehydration, Diffusivity, Sapota, Mass transfer

Introduction: Sapota fruit has high fiber content and hence the powder can be a fiber supplement for children as well as adults. It also contains carotene, which is known as an antioxidant and it can also be consumed for its laxative property. Its powder can be considered as a complete food rich in vitamins, carbohydrates, fibers and proteins. The sapota powder could be utilized for making Indian sweets like burfi, chocolates and pulp which is used into sharbat, halwa and salad.

It has become very important to evolve a better method of preservation for increasing the shelf life and maintaining the quality of sapota and this can be achieved by some type of processing e.g. heating, dehydration (Chang et al., 2006). The main advantage of drying products is to allow longer periods of storage, minimize packaging requirements and reduce shipping weights. Controlled drying also leads to an overall improvement in the quality and economical value of the final products. The challenge of sapota drying is retention of nutrients to maximum while reducing the moisture content of product to a level where microbiological growth cannot occur. Osmotic dehydration is a widely accepted pre-treatment method of partial removal of water, by submersing fruits in sugar/salt solution. Osmotic dehydration, due to its energy and quality related advantages, is gaining popularity as a complementary processing step in the chain of integrated food processing. It protects the color, flavor and texture of food from heat and it is used as a pretreatment to improve the nutritional, sensorial and functional properties of food (Fernades et al 2006). The study of osmotic dehydration of sapota was carried out in order to remove the moisture prior to further convective drying. Osmotically dehydrated product, generally, may not have moisture content low enough to be considered as shelf stable. It is therefore, needed to be further air dried to obtain a shelf stable product i.e. stable with respect to prevention of microbial growth and enzymatic colour changes. Hence, the product obtained from the optimized levels of the osmotic dehydration was airdried in a conventional tray drier as described below.

The work was aimed to analyse the osmotic dehydration of sapota (*Achras sapota L.*) as a function of concentration and temperature of sugar syrup and to determine water and sugar diffusivity.

Materials and methods: The methodology involved osmotic dehydration with different syrup concentration, determination of water loss and sugar gain, and optimization of response parameters with RSM.

Sample and solution preparation: The fresh sapota fruits were procured from the Department of Horticulture, Dr. Panjabrao Deshmukh Krushi Vidyapeeth, Akola, India. They were sorted visually for uniform maturity and size; then were washed with tap water and surface dried with a filter paper. The average initial moisture content was determined by using oven method at 70 °C for 18 h (AOAC, 1984). Sugar syrups of various concentrations were prepared by dissolving required amount of sugar in distilled water. The commercial sugar, being cheap and easily available, was considered as an osmotic agent.

Osmotic dehydration: In every trial sapota samples of approximately 50 g were completely immersed in 250 g sugar syrup contained in a 500 ml glass beaker. The beakers were placed inside a constant temperature water bath. The syrup in the beaker was manually stirred at regular intervals to maintain uniform temperature. The beaker was removed from the water bath at a fixed time interval and the samples were immediately removed and placed on tissue paper to soak the surface moisture (gupta et al

2014). The samples were weighed and their moisture contents were determined.

The osmotically dehydrated sapota samples were loaded on the drying trays and inserted into the dryer. The drying data were recorded at 10 minute interval until the completion of experiment.

Sensory evaluation: The dehydrated sapota sample should have a typical taste, flavour, colour and texture. To test these organoleptic characteristics, sensory evaluation was carried out with the help of a taste panel consisting of 10 panelists. The sensory evaluation was done on the basis of numerical sensory card based on BIS: 6273 (Part II, 1971) as given in Table 1.

Table 1: Score cards for sensory evaluation

Quality grade description	Score
Excellent	8-10
Good	6-7
Fair	4-5
Poor	2.0-3
Very poor	0-1

The sensory evaluation was carried out for taste and over all acceptability. Samples of dehydrated sapota were served for the evaluation of above parameters to ten panelists. The score sheet was provided with the product and the panelists were requested to mark the product score according to their liking. Based on the individual marking the average score was computed.

For determination of mineral the dry ashing was carried out and the volume was made to 100 ml. This solution was used for determination of minerals. All the determinations were done in triplicate. Standard procedures were used for determination of minerals as given by Ranganna (2000).

Calcium: Twenty ml aliquot of ash solution obtained by dry ashing was added to a 250 ml beaker. Ten ml of saturated ammonium oxalate solution and 2 drops methyl red indicator was added to it. The solution was made slightly alkaline and slightly acidic (pH 5) by the addition of dilute ammonia and a few drops of acetic acid. Then the content of flask was heated to the boiling point and allowed to stand overnight. The content of flask was filtered through Whatman (No. 42) filter paper. The precipitate was washed through hot dilute H_2SO_4 followed by hot water into the beaker. Then the content of the beaker was titrated with 0.01 N $KMnO_4$ till faint pink colour was obtained. The precipitate was added finally to solution and the titration was completed till permanent pink colour was obtained. The burette reading (titre) was recorded and used for calcium determination. Calcium was determined by using following formula:

Calcium (mg / 100 g dm) = (Litre x 0.2x total volumetaken for ash x 100 x 100)/(volume taken for estimation x weight for) ..... (1)

Phosphorus: Five ml of molybdate reagent was added to 5 ml of ash solution, obtained by dry ashing, into a 50 ml volumetric flask. Two ml of aminonaphthol sulphonic acid was added to it, mixed and the volume was made up to 50 ml. Similarly a blank was prepared using water in place of the sample. The content was allowed to stand for 10 minutes and the colour was measured at 650 nm, setting the blank at 100 % transmittance.

To prepare standard curve, 0, 0.1, 0.2, 0.3, 0.4 and 0.5 ml of standard potassium dihydrogen phosphate which correspond to 0, 10, 20, 30, 40 and 50 ppm P was pipetted and the procedure followed for magnesium was followed. The standard curve was prepared by plotting concentration against absorbance and phosphorus content was determined with the help of this curve.

Results and discussion: Quality Evaluation:

Sensory evaluation: Convectively dried product (Drying air temperature 60 ^oC, Velocity-1m/s) and osmo-convectively dried product (Optimized conditions) were served for the evaluation to a ten panelists at a time. The score sheet (Appendix G) was provided with product and panelists were requested to mark the product according to their liking. The sensory evaluation was carried out for colour, taste and overall acceptability. The homogeneity of correlation coefficient was calculated to compare between convectively dried and osmo-convectively dried product for various organoleptic characteristics.

The difference between convectively dried and osmo-convectively dried product was significant for taste and overall acceptability at 5 per cent level of significance (Table 3) whereas colour was non-significant. Hence the osmo-convectively dried product was found superior with respect to taste and overall acceptability as compared to convectively dried product (without osmo). The osmo-convectively dried product was appreciated by the panelist because of its sweet taste, but convectively dried product (without osmo) showed little bit sweetness. It is in agreement with an earlier study (Raoult-Wack et al., 1991; Allaeddini and Emam-Djomeh, 2004) where osmotic pre-treatment was able to improve quality of dried product.

Table 1: Mean sensory score data for individual characters

Character	Mean		Sd		SEd	T
	Convectively dried	Osmo-convectively dried	Convectively dried	Osmo-convectively dried		
Colour	5.5	8.3	0.850	0.483	0.259	2.262**
Flavour	3.4	8.0	0.516	0.667	0.106	2.262**
Taste	3.6	8.4	0.516	0.699	0.12	2.262**
Overall acceptability	4.2	8.3	0.478	0.353	0.088	2.262**

** Significant at 5% level

Table 2: Homogeneity of Correlation coefficient

spear rank	Correln	1+R	1-R	{1+R}/{1-R}	LOG C	Z	3*z	N-3
1,R	0.9571	1.9571	0.0429	45.620	1.659	0.830	2.489	3
2,R	0.8714	1.8714	0.1286	14.552	1.163	0.581	1.744	3
3,R	0.9958	1.9958	0.0042	475.190	2.677	1.338	4.015	3
4,R	0.9571	1.9571	0.0429	45.620	1.659	0.830	2.489	3
5,R	0.8571	1.8571	0.1429	12.996	1.114	0.557	1.671	3
6,R	0.9429	1.9429	0.0571	34.026	1.532	0.766	2.298	3
7,R	0.9429	1.9429	0.0571	34.026	1.532	0.766	2.298	3
8,R	0.8143	1.8143	0.1857	9.770	0.990	0.495	1.485	3
9,R	0.8714	1.8714	0.1286	14.552	1.163	0.581	1.744	3
10,R	0.8715	1.8715	0.1285	14.564	1.163	0.582	1.745	3
						SUM	21.977	30

Chi Square = 0.7326

The non significance of Chi square indicates judges and researchers are in agreement with each other as regards the characters such as colour, flavour, taste and overall acceptability under this study.

Minerals: The osmo-convectively dried product were evaluated for their mineral content and reported in Fig. 5.32. Ca and P were found the predominant mineral elements in the fresh and osmo-convectively dried sapota sample (Fig. 5.32). The peak value in the fresh sapota were 28.00 mg/100 g dm and 72.00 mg/100 g for Ca and P. The Ca contents in the osmo-convectively dried sample were 19.00 and 9.00 mg/100 g dm in convective drying whereas P contents are 61.25 in osmo convective drying and 48.5 mg/100 g dm in convective drying of sapota. Similar results were reported for aloe vera by Garcia- Hernandez et al., (2010) and Miranda et al., (2009). However all the osmo-convectively dried sapota sample showed considerable decrease in mineral content with respect to the fresh samples may be due to leaching of inorganic compounds into osmotic solution during osmosis (Sablani, 2006). Nevertheless, the mineral content may vary widely among vegetables, depending on several factors such as ripeness, variety, soil type, the use of fertilizers, intensity and exposure time to sunlight, temperature, rain and cultivation area (Garcia – Hernandez *et al.*, 2010). Among the minerals studied, the level of Ca was high (1569.33 ± 44.11 mg/100 g dm) followed by Na (1258.67 ± 38.07 mg/100 g dm) in osmo-convectively dried samples. Ca is important for human given its role in bone and tooth development (Ozcan and Haciseferogullari, 2007). Furthermore, Ca may be used for the prevention and treatment of hypertension, since it stabilizes vascular membranes, blocks its own entry into cells and reduces vasoconstriction. The P content in osmo-convectively dried sample was found to be 51.33 ± 6.11 mg/100 g dm. Phosphorus is the second most abundant mineral in the human body. Together with Ca, P constitutes part of the inorganic structure of bones. Phosphorus also contributes to the maintenance of acid base equilibrium in the blood (Martinez and Garcia, 2001).

Conclusions:

1. The osmodehydrated sapota sample convectively dried with optimized input parameters could retain 19 mg/100 g dm Ca, and 61 mg/100g dm P.

2. The difference between convectively dried and osmo-convectively dried product was significant for taste and overall acceptability at 5 per cent level of significance (Table 2) whereas colour was non-significant. Hence the osmo-convectively dried product was found superior with respect to taste and overall acceptability as compared to convectively dried product (without osmo).
3. Osmo-convectively dried Sapota product at optimized input parameters was highly appreciated by the consumers than convectively dried product (without osmo).

Acknowledgement: The authors are highly thankful to Dr. Panjabrao Deshmukh Agricultural University, Akola, India, for providing facilities for conducting the research work.

References:

1. AOAC (1984) Official Methods of Analysis. 14 th Ed. Edited by Sidney Williums.Published by the Association of Official Analysis Chemists,Inc. Arlinton, Virginia, 22209, USA
2. *Aarti Chavda, V.C.Soni, Bhupat Radadia, Shabanam Saiyad,* Tree Species Selection for Roosting By House Sparrow (*Passer Domisticus)* in Rajkot, Gujarat; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Issue 2 (2015): Pg 314-318
3. Chang LX, Wang C, Feng Y, and Liu Z (2006) Effects of heat treatments on the stabilities of polysaccharides substances and barbaloin in gel juice from Aloe vera Miller. Journal of Food Engineering, 75:245-251.
4. Falade, K. O., Igbeka, J. C. and Ayanwui, F. A. (2007) Kinetics of mass transfer and colour changes during osmotic dehydration of watermelon. Journal of Food Engineering 80: 979-985.
5. Arvind N. Singh, Saumya Rajan, D. Raghavendra ,S. Rajendra Prasad, Repellent Activity of Ethanolic Extract of Argemone; Life Sciences International Research Journal , ISSN 2347-8691, Volume 1 Issue 1 (2014): Pg 395-397
6. Eshun, K. and He, Q. (2004) Sapota: A valuable ingredient for the food, Pharmaceutical and cosmetic industries - A review. Critical Reviews in Food Science and Nutrition, 44(2):91-96.
7. Fernandes F.A.N., Rodrigues S, Gaspareto O.C.P., and Oliveira E.I. (2006) Optimization of osmotic dehydration of bananas followed by air-drying. Journal of Food Engineering., 77(1):188-193.
8. Gupta, S.V., Patil B.N., Wankhade, V.R, Nimkar, P.M. & Borkar P.A., (2014) Modeling and optimization of osmotic dehydration of sapota by response surface methodology., J. of Food, Agriculture & Environment, Vol. 12(2), 135-140.
9. Gracia-Segovia, P., Mognetti, C., Andres-Bello, A. and Martinez-Monzo, J.(2010) Journal of Food Engineering 97: 154-160
10. S. Vinodh, M. Kannan ,M. Jawaharlal, Effect of Post Harvesttreatments of Sucrose, 8 – HQ; Life Sciences International Research Journal , ISSN 2347-8691, Volume 1 Issue 1 (2014): Pg 389-394
11. Jain, S.K. (2007) Studies on osmotic and air drying of papaya. Unpublished Ph.D. Thesis. Submitted to Maharana Pratap University of Agriculture and Technology, Udaipur
12. Martinez J, and Garcia P (2001) Nutricion Humana, Editorial U.P.V., Valaencia, Spain.
13. Miranda M, Maureira H, Rodriguez K, and Vega, A. (2009) Influence of temperature on the drying kinetics, physicochemical properties and antioxidant capacity of aloe vera (Aloe Barbadensis Miller) gel. Journal of Food Engineering., 91:297-304.
14. Ozcan MM, and Haciseferogullari H (2007) The strawberry (Arbutus unedo L.) Fruits Chemical composition, physical properties and mineral contents, Journal of Food Engineering., 78:1022-1028.
15. *N.Venumadhav, N.Thirumala Chary, N.Gangadar, L.Srinivas, M.Arjun,* Effect of Part Replacement of Chemical Fertilizers With Organic and Bio-Organic Agents in Ground Nut, (Arachishypogea) inkarimnagar District, North Telangana State, India; Life Sciences International Research Journal , ISSN 2347-8691, Volume 2 Issue 2 (2015): Pg 337-342
16. Ranganna, S. (2000) Handbook of Analysis and Quality Control for Fruits and Vegetable Products Tata McGraw Hill Publishing Co. Ltd., New Delhi.
17. SeoshinY., Lee K. S., Lee, J. S. and Lee. C. H. (1995) Preparation of yoghurt added with sapota and its quality characteristics. Journal of Korean Science Food Nutrients 24: 254-60.

***

Suchita V. Gupta/ Head/Department of Farm Structures/ Bhagyashree N. Patil/ Assistant Professor
Pradip A. Borkar/ Head/Department of Agricultural Process Engineering/
Amrapali A. Akhare/Assistant Professor/Biotechnology Centre/Dr. Panjabrao Deshmukh Krishi Vidyapeeth
Akola/Maharashtra/India/ 444104/