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DEVELOPMENT OF FUNCTIONAL SAPODILLA FLAKES WITH NEUTRACEUTICAL AND HEALTH REGULATORY COMPONENTS AND THEIR QUALITY CHARACTERISTICS DURING STORAGE

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Enrichment of fruits with bioactive components for improving the nutritional, functional and health beneficial qualities is a major goal for the food processing industries. The composition of the infusion media for osmotic dehydration of sapodilla (Manilkara zapota) was formulated by enhancing the incorporation of neutraceutical herb Ocimum bacilicum (basil leaves) and partially substituting maltodextrin for sucrose at different concentrations. Optimization of the process parameters viz., syrup concentration (40, 60 and 80° Brix) and process time (2, 4 and 6 hr) was also investigated. The flakes prepared with binary solute systems of malto dextrin and sucrose (50:50, 70: 30) and infusion of 0.5% basil herb scored high on various sensory attributes. Further, flakes were analyzed for their chemical, microbial and antioxidant properties at different periods of storage. Among all the treatments, mixed solute systems with incorporation of herb remained chemically and biologically safe during storage and there was better retention of nutrients and antioxidants in the product.

Keywords: Osmotic dehydration, Sapodilla, Binary solute system, Basil leaf

INTRODUCTION

Changing life styles and values have affected eating habits considerably and there is a strong demand for usage of convenience foods. Modern food industries adopt many different types of food processing and preservation techniques to obtain stable and safe foods. Hurdle technology advocates the use of different techniques in combination (Leistner, 1996). Selection and magnitude of hurdle plays an important role in achieving microbial stability without impeding the vital nutrients and sensory properties of multi target preserved products (Jayaraman and Gupta, 1995). At present, there is an increasing interest in exploiting fruits and vegetables to obtain potentially bioactive products (Rozek *et al.*, 2010). Sapodilla (*Manilkara zapota*) belongs to the family *sapodillaceae* and assigned for various properties in the traditional system of Indian medicine. Sapodilla remains as most unexplored fruit, although research has been reported on various aspects of its postharvest treatment.

Osmotic treatment, also known as dewatering-impregnation soaking, involves immersing a solid food in a hypertonic aqueous solution leading to the loss of water and a solute transfer from the solution into the food. Osmotic dehydration has been reported as a feasible treatment for incorporating physiologically active compounds into plant tissues without destroying the initial food matrix (Alzamora *et al.*, 2005). Osmotic dehydration, include significant changes in the dehydrated material such as volume reduction, membrane alteration or lysis, membrane separation from the cell wall or cell wall deformation

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(Alzamora *et al.,* 2000). All these structural changes greatly affect the sample mechanical and textural properties which define consumer acceptability of the product (Castello *et al.,* 2009). Current technologies employ sucrose for osmotic dehydration of fruit. However, in terms of health consumption of such fruit products is not ideal because of the high glycemic index of sucrose and increased chances of developing type II diabetes.

Infusion of fruits with neutraceutical and health regulatory components enhance the functionality of the product. A study on osmotic dehydration of coconut slices with the impregnation of mint extract has been conducted by Sivasakthi and Narayanaswamy (2012) and reported to have favorable results in increasing the storage and shelf life of the product with in desirable stand and limits. A similar study on infusion of fruits with neutraceutical components to enhance the functionality of the pineapple product has been reported (Jissy *et al.,* 2012). Most of the work on sapodilla is related to the nutritive value of the fresh fruit and its preserved products viz., jams, jellies, etc., but little information is available regarding the dehydration of fruits and storage quality of dried sapodilla. Hence, the study was undertaken with a work objective of optimizing the selected process parameters, developing sapodilla flakes using different formulations of infusion media and evaluating the quality characteristics during storage.

MATERIALS AND METHODS

Sapodillas (*Manilkara zapota*) were obtained from local market. To ensure homogeneity of sample, they were selected according to their quality attributes such as uniform degree of maturation, size and free from defects. The fruits were washed with clean water, manually peeled and cut in slices of 2.5 mm thickness for osmotic dehydration.

Osmotic Treatment

An acqueous sucrose and maltodextrin solutions were used as dehydrating agents. Osmotic solutions were prepared by blending different combination of solutes. To enrich the medium, basil leaves (*Ocimum bacilicum*) at 0.5% concentration were introduced into the media. The prepared fruit slices (2.5 mm) were immersed in the mentioned infusion media at 30 °C temperature. The weight ratio of solution to fruit was 1:2, to avoid the dilution of the medium. The beaker was covered with a sheet of aluminium film to prevent evaporation of syrup. The system was maintained at the selected temperature by immersion in a constant temperature water bath. The flakes were prepared using 100% sucrose solution (control), 100% maltodextrin solution, 50:50 and 30:70 proportions of sucrose and maltodextrin respectively with and without the infusion of 0.5% of basil leaves and were coded as A_1, A_2, B_1, B_2, C_1, C_2, D_1 and D_2.

Optimization of Process Parameters

Preliminary infusion process was conducted at 30 °C in 40° Brix, 60° Brix and 80° Brix solutions at different osmosis periods (2 h, 4 h and 6 h). The solutions were stirred at an interval of 15 minutes to stimulate an ongoing osmotic process. Samples were withdrawn from the osmotic solution after the determined time, drained and dried with filter papers to remove adhering solution from the surface of the slices. The weight of the samples (i.e., slices) and volume of the osmotic solution were measured prior to immersion and after the specified time.

Preliminary quantitative analysis was carried out to determine the moisture content of the samples. After the analysis, 4 hrs soaking time with 60° Brix concentration were found best to obtain the fruit with desirable characteristics and further used for the development of sapodilla flakes. Sapodilla flakes were prepared by convective air drying of the osmotically dehydrated sapodilla slices. The sapodilla flakes prepared from the selected treatments were stored in LDPE pouches and qualitative, microbial and sensory analysis were conducted periodically at different storage periods.

Mass Transfer Mechanism

The overall mass transport data namely, mass reduction, water loss, sugar gain and soluble solid concentration were used to indicate the overall exchange of solute and water between sapodilla slices and infusion media. Weight Loss (WL), Solid Gain (SG) and Mass Reduction (MR) of the samples were done by using the method given by Panagiotou *et al.* (1998). The amount of water loss, solid gain and mass reduction after infusion and oven drying of sapodilla was calculated as follows:

$$Water\ loss(\%) = \frac{(M_0 - m_0) - (M - m)}{M_0} \times 100$$

$$Mass\ reduction(\%) = \frac{M_0 - mass\ at\ time(T)}{M_0} \times 100$$

$$Solid\ gain(\%) = \frac{(m - m_0)}{M_0} \times 100$$

where, M_0 is the initial weight of fruit before infusion (g), M is the weight of fruit after infusion (g) and m_0, m are the dry matter content of untreated fruits (g) and infused fruits.

Quality Analysis

Moisture content of the sample was determined by the method given by Jissy *et al.* (2012). Dehydration and rehydration ratio of the samples were determined using the method given by Ranganna (2002). TSS was determined by using the method given by Jissy *et al.* (2012) using digital refractometer (Atago, Model PAL-1 Japan make) having range of 0-53°Brix. The increase in absorbance of sample extract at 440 nm was taken as a measure of non enzymatic browning (Berwal *et al.*, 2004). The titrable acidity of samples were analyzed by the method developed by Ranganna, (2002). Reducing sugars and total sugars were estimated by Lane and Eynon method (Rajarathnam and Ramtake, 2011).

For antioxidant assays, samples (1 g) were crushed using a mortar and pestle and transferred into a 25 ml volumetric flask and made up the volume to 25 ml with methanol. The mixture was shaken manually and was kept overnight and filtered under suction. The filtrate was transferred to a 50 ml volumetric flask and made up the volume up to the mark. Vitamin C content was estimated by the method given by Ranganna (2002). Total phenol content was determined by Folin-Ciocalteu's method given by Singleton and Rossi (1965). The yeast and mold count of the fruit was determined by pour plate method using Potato Dextrose Agar (PDA) as a media as described by Aneja (2001) and expressed as log cfu/g of sample.

Statistical Analysis

The data were reported as average of triplicate observations. To investigate the significant differences amongst the average values of treatment and duration, ANOVA and Duncan's Multiple Range Test (DMRT) were applied using SPSS VERSION 18.0 package.

RESULTS AND DISCUSSION

Mass Transfer Mechanism in Sapodilla

Changes in Water Loss (%WL) and Solid Gain (%SG)

Mass transfer in osmotic dehydration is a combination of simultaneous water loss and solute uptake. Sucrose, maltodextrin and combination of the both in different proportions, with and without the addition of basil leaves as a means of dewatering showed a significant effect on water loss and solid gain (Table 1). Over all infusion process for all the treatments resulted in removal of half the moisture content of fresh sapodillas (60-70%). Maximum reduction in water content (%WL) was observed in sucrose medium (A_1 and A_2). It was observed that the water loss was lowest in maltodextrin infused samples (B_1). A significant influence of solutes were observed in solid gain (SG%) of sapodilla slices. Maximum solid gain was observed in sucrose infused samples (A_1 and A_2) and minimum in combined infusion medium of sucrose and maltodextrin (C_2 followed by D_2).

The results indicated that the solute uptake was a function of water content in the fruit, and also the type of solutes and its concentration. Studies reported that temperature has a significant influence on the rate of osmosis. However, in the present study this factor had not been taken into consideration and the infusion process was carried out at constant 30 °C temperature. From the study, it can be noted that the reduction in the moisture content of the infused fruits may be attributed to large osmotic driving force difference between the cell sap of the fruit and the surrounding hypertonic infusion medium. Similar observation was noted for osmotic dehydration of watermelon fruit (Falade *et al.*, 2007).

Table 1: Effect of Osmotic Dehydration on % Mass Transfer Mechanisms of Sapodilla Slices

Treatment	WL (%)	MR (%)	SG (%)
A_1	43.4	40.6	2.8
A_2	37	34.7	2.3
B_1	26.3	29.5	-3.2
B_2	28.1	32.1	-4
C_1	31.2	30	2
C_2	34.9	39.8	-4.9
D_1	28.9	29.2	-0.3
D_2	32	33.6	-1.6

Note: Values are mean±S.D, n = 3.

Dehydration Ratio

Dehydration ratio studies on the developed sapodilla flakes with different treatments revealed a significant difference among the treatments which could be due to the use of different solutes in different proportions and added additive in the infusion media (Table 2).

Table 2: Influence of Different Osmotic Dehydration Treatments on Dehydration and Rehydration Ratio of Developed Sapodilla Flakes

Treatment	Dehydration Tatio	Rehydration Ratio
A_1	1.54	3.61
A_2	1.71	3.15
B_1	2.16	3.33
B_2	2.14	3.32
C_1	1.89	3.02
C_2	1.95	3.86
D_1	2	3.29
D_2	1.94	3.13

Note: Values are mean±S.D, n = 3.

Dehydration ratio was less with 100% sucrose treated samples, i.e., A_1 (1.54) followed by A_2 (1.71). Superior drying ratios were obtained in the B_1, B_2 and D_1 samples. The better result of these samples could be due to the faster removal of water. Osmo-air dried maltodextrin treated samples responded well to the drying due to the open porous structure of tissues, which is useful to remove water from the inner tissues to the outer wall. Similar results have been reported for mango, guava and aonala slices by Suresh Kumar and Sagar (2010).

Rehydration Ratio

Higher rehydration ratio was recorded by C_2 samples (3.86). However, upon storage a reduction in rehydration ratios was evident (Table 2). Higher rehydration displayed might be due to the faster drying process that cause less cellular and structural changes in the final product. Poor rehydration ratios may be due to poor texture of the products, poor R^H maintenance and fluctuations in air flow (Suresh Kumar and Sagar, 2010). The difference in rehydration of the present study can be correlated to the increase in moisture content upon storage.

Effect of Osmotic Dehydration and Drying on Quality Characteristics of Sapodilla Flakes

Moisture

The moisture content increased linearly with storage period. The initial moisture content of the flakes ranged between 0.1 to 8.5%. There was a significant difference ($P<0.05$) in moisture content of different treated flakes. The treatment with osmotic solution of maltodextin and sucrose in the proportion of 50:50 with basil leaves addition (C_2) exhibited higher mositure content (8.5%) and the treatment with the osmotic solution of maltodextrin and sucrose in the proportion of 70:30 without basil leaves addition (D_1) exhibited least moisture content (0.01%). This difference in the initial moisture content of the samples could be due to the difference in the proportion of ingredients of the infusion media that provided a greater barrier for moisture transfer from the sample.

As it was observed from the Table 3, there was only a slight increase in the moisture content during 15th, 30th and 45th day of storage. The increase in the moisture content of the developed product might be due to the hygroscopic nature of the prepared product. D_1 treatment gained maximum moisture and A_2 and B_1 treatment gained least percent moisture increase upon storage. The less moisture uptake could be due to the LDPE packing material used which could have had good moisture barrier properties. There was a significant interaction effect between treatment and storage. Mir *et al.* (2009) observed that the increase in moisture content of dehydrated products during storage is attributed to environmental changes which bring changes in the relative humidity outside the packaging system.

The increase in R^H outside will allow the outside water vapour to move inside the package hence, causing the gain of moisture. However, the lower increase in the moisture content in osmo-air dried samples during storage could be probably attributed to the modifications caused in cellular integrity and pore size as reported by Rastogi *et al.* (2006). These results are also in agreement with the findings of Levi *et al.* (1985) who concluded an increase in moisture content of some tropical fruits during storage. Similarly Sra *et al.* (2011) reported an increase in moisture content of dried carrot slices upon storage.

Non Enzymatic Browning

Non-Enzymatic Browning (NEB) indicates the quality of the stored product. Miao and Roos (2005) observed that NEB rate in moisture food system was accelerated by crystallization of component sugars. This fact agrees with the present study.

Table 4 shows the increase in NEB upon 15th day of storage indicating that the product became darker. However, the colour of the sample exhibited significant variation

Table 3: Effect of Osmo-Air Dehydration Treatments on Moisture Content (%) of Developed Sapodilla Flakes Upon Storage

Treatment	Storage Duration			
	0 Day	15^{th} Day	30^{th} Day	45^{th} Day
A_1	1.0 ± 0.124^b	2.16 ± 0.080^e	2.52 ± 0.077^d	3.0 ± 0.294^d
A_2	4.5 ± 0.008^d	2.15 ± 0.028^d	3.28 ± 0.024^f	5.5 ± 0.024^f
B_1	0.5 ± 0.024^a	0.55 ± 0.016^a	0.89 ± 0.016^a	1.0 ± 0.028^a
B_2	5.5 ± 0.087^e	1.93 ± 0.204^e	2.25 ± 0.151^e	2.5 ± 0.040^e
C_1	3.5 ± 0.061^c	6.14 ± 0.024^g	8.77 ± 0.054^h	10.0 ± 0.135^h
C_2	8.5 ± 0.062^f	2.26 ± 0.120^d	2.98 ± 0.192^e	3.5 ± 0.070^e
D_1	0.1 ± 0.032^a	1.59 ± 0.020^b	3.55 ± 0.028^e	6.0 ± 0.274^g
D_2	1.0 ± 0.115^b	2.80 ± 0.037^f	1.96 ± 0.139^b	2.0 ± 0.055^b

Note: Values are mean±S.D, n = 3. Means within treatments in a column not having common superscripts are significantly different ($p<0.05$).

Table 4: Effect of Osmo-Air Dehydration Treatments on Non-Enzymatic Browning of Developed Sapodilla Flakes Upon Storage

Treatment	Storage Duration			
	0 Day	15^{th} Day	30^{th} Day	45^{th} Day
A_1	0.13 ± 0.0216^a	0.31 ± 0.0169^{bc}	0.26 ± 0.0262^{ab}	0.04 ± 0.0124^a
A_2	0.10 ± 0.0309^a	0.21 ± 0.0309^a	0.16 ± 0.0262^a	0.01 ± 0.0124^a
B_1	0.76 ± 0.0216^b	1.00 ± 0.2160^f	0.30 ± 0.0816^c	0.28 ± 0.0169^d
B_2	0.11 ± 0.0124^a	1.22 ± 0.0124^g	0.33 ± 0.0126^b	0.12 ± 0.0169^c
C_1	0.22 ± 0.0081^c	0.30 ± 0.0262^b	0.22 ± 0.0169^a	0.43 ± 0.0216^e
C_2	0.10 ± 0.0081^c	0.30 ± 0.0124^c	0.19 ± 0.0402^a	0.18 ± 0.0216^e
D_1	0.38 ± 0.0124^d	0.65 ± 0.0216^e	0.19 ± 0.0124^a	0.09 ± 0.0309^b
D_2	0.13 ± 0.0216^{ab}	0.55 ± 0.0402^d	0.18 ± 0.0355^a	0.01 ± 0.0049^a

Note: Values are mean±S.D, n = 3. Means within treatments in a column not having common superscripts are significantly different ($p<0.05$).

among the different treatments from initial to final storage periods. The degree of browning was observed more in sapodilla flakes developed from maltodextrin (1.2) solution when compared to only sucrose sample (0.23). Among the different treatments, A_2, B_2, C_2 and D_2 samples were found to be significantly higher in non enzymatic browning indicating the effect of the added additives on NEB of the sapodilla flakes.

Studies have reported that the browning is caused mainly by the conversion of endogenous phenols into quinones which then polymerizes to brown pigments (Ding *et al.*, 2002). NEB of basil leaf added samples increased indicating the formation of brown products resulting from oxidation of phenols. Further, it was noted that there was a slight reduction in NEB of the flakes stored from 15th to 45th day.

Total Soluble Solids

Figure 1 represents the results of the total soluble solids in developed sapodilla flakes. The soluble solid levels after infusion process were higher than the fresh untreated sapodillas (12°Brix). Osmo-air dried samples upon storage showed a significant decrease in TSS of all the samples. The TSS was found to decrease more in C_2 samples followed by B_2 and D_2 samples in comparison with the other samples.

Titrable Acidity

The percentage acidity of the samples ranged between 0.02 and 0.54%. There was a significant interaction effect between the treatments and storage period. Initial acidity value was highest in B_2 treatment (0.54) and lowest in D_2 (0.02) among the treatments. The acidity values were invariably found to increase in all the treatments as the storage period progressed. Gradual increase in the acidity of the products upon 45th day of storage ranged between 0.12% (D_2) to 1.10% (B_2) which might be due to the degradation of sugars into acids. Similar trends have also been observed in dehydrated mango pulp and dates (Pragati *et al*., 2003).

An increase in the acidity was reported by Paul *et al.* (2014) for osmotically pretreated and vaccum dried pine apple cubes. This supports the findings of the current study for the increase in acidity value. The increase in acidity might have been due to formation of acids due to inter convesion of sugars and other chemical reactions which were accelerated at high temperature.

Total Sugars

The data revealed that the total sugar contents were affected by all the treatments. It was found that the total sugar contents of C_1 and C_2 flakes were significantly higher (30.0 and 10.4 g/100 g) than other treatments due to increased absorption of sugars during osmosis. Comparison of mean values of sugars from 15th to 30th day indicated a significant increase in all the treatments (Figure 2). The increased sugar in the present study might be because of increased inversion of non reducing sugars which ought to occur on prolonged storage under normal temperature. However, decrease in total sugars was observed in all the treatments on 45th day of storage. A similar trend has been observed for osmo-air dried aonla fruits. The decrease in the total sugars might be due to the non specific hydrolysis of macromolecule, interconversion of sugars and aggregation of monomers during storage (Pragati *et al*., 2003).

Effect of Osmotic Dehydration and Drying on Antioxidant Content of Sapodilla Flakes

Ascorbic Acid

Ascorbic acid is recognized as an important antioxidant compound of natural origin (Almeida *et al*., 2011). In this study, ascorbic acid content (expressed as mg of ascorbic acid per 100 g dry weight) varied from 0.04 to 0.05 mg/100 g on 0-day. Mean comparison of values indicated that there was no significant difference among the treatments. On further storage, a reduction in vitamin C was observed from 15th day to 45th day of storage. The reduction was more pronounced in B_2 treatment (0.021 mg/100 g) followed by C_1 treatment (0.02 mg/100 g) (Figure 3).

The reduction in ascorbic acid content might be due to oxidation during storage at ambient temperature. A similar trend has been reported for the reduction in ascorbic acid content of osmo-air dried aonla fruits from 178.54 mg/100 g to 142.26 mg/100 g after 90 days of storage.

Progressive loss of ascorbic acid with storage duration might be due to increase in water activity (a_w). The rate of oxidation of ascorbic acid in low moisture food system was found to increase progressively with water activity and was thought to be associated with increased availability of water to act as a solvent for reactants and catalysts (Dennison and Kirk., 1978). Mir *et al.* (2009) reported the fall in ascorbic acid levels during storage because of increase in moisture content as well as atmospheric temperature and oxygen.

Polyphenols

In the present study, the content of polyphenols from the developed sapodilla flakes is expressed as mg gallic acid equivalents (GAE/100 gm of dry weight). The total polyphenol content of the treatments is given in Table 5.

On the initial day, the polyphenol contents of different treatments varied from 16.8 to 29 mg/100 g. In case of basil leaves added treatments a higher total phenols were observed. The highest was recorded in D_2 treatment followed by A_2, C_2 and D_1 treatments.

An increase in polyphenols upon storage (15th day) was observed in A_1, B_1, B_2 and D_2 samples. Carvilho *et al.* (2012) observed that the processing of sapodilla pulp jelly resulted in increase in total phenolic compounds from 21 mg GAE/100 g to 102 mg GAE/100 g. A similar significant trend was found in the present study with the above treatments upon 45 days of storage.

Figure 1: Effect of Osmo-Air Dehydration Treatments and Storage on TSS (°Brix) of Sapodilla Flakes

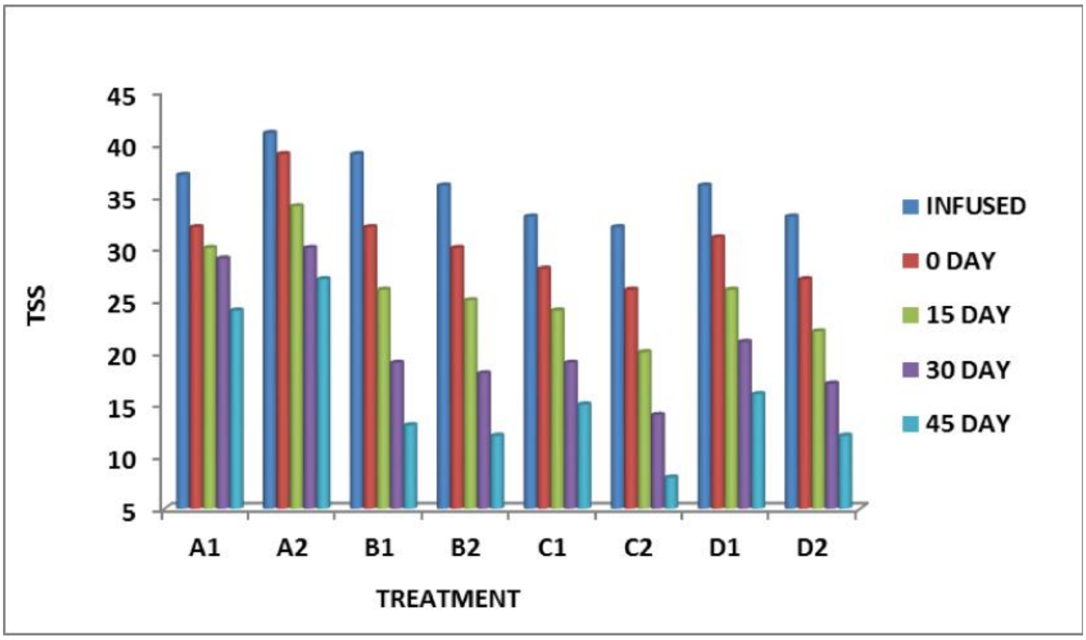
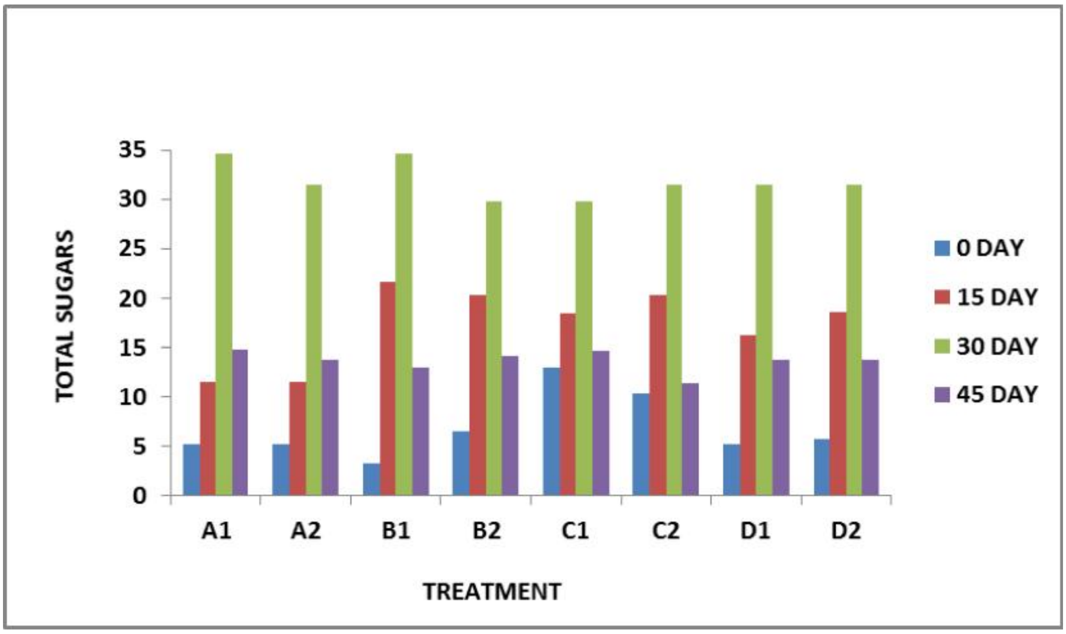


Figure 2: Effect of Osmo-Air Dehydration Treatments on Total Sugars Content (%) of Sapodilla Flakes Upon Storage



Heat treatments can modify the content of the phenolic compounds due to disruption of plant cell walls, with subsequent release of these compounds (Choi, 2006). Significantly ($p<0.05$) lower polyphenolic content was observed in 15th day for A2, C1, C2 and D1 treatments. The loss of phenolic compounds in some samples can be attributed to the fact that there is a difference in thermal stability among the foods with respective to different

Figure 3: Effect of Osmo-Air Dehydration Treatments on Vitamin C (mg/100 g) Content of Developed Sapodilla Flakes Upon Storage

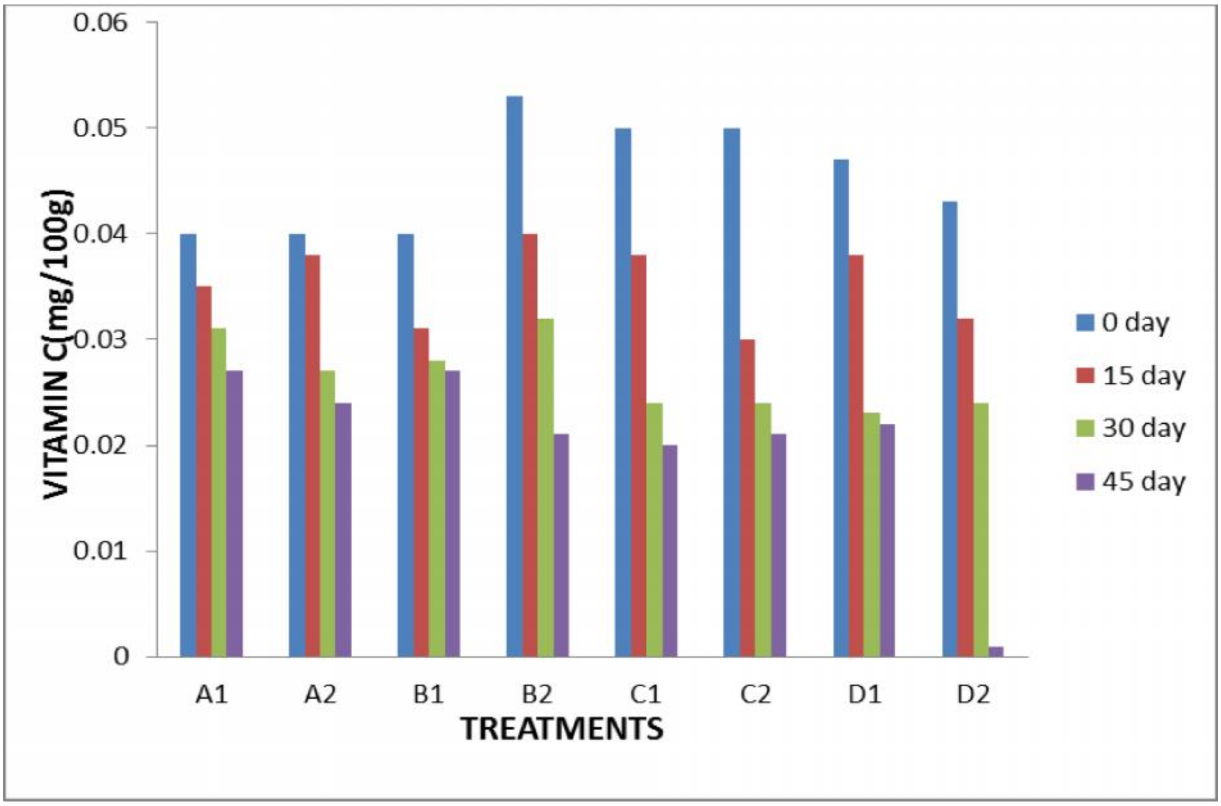


Table 5: Effect of Osmo-Air Dehydration Treatments on Polyphenols (mg/100 g) of Developed Sapodilla Flakes Upon Storage

Treatment	Storage Duration			
	0 Day	15th Day	30th Day	45th Day
A_1	18.9 ± 0.30^b	52.3 ± 0.12^h	121.3 ± 0.16^h	190.8 ± 0.44^g
A_2	22.6 ± 0.26^f	11.4 ± 0.26^a	15.2 ± 0.21^f	91.0 ± 0.16^c
B_1	19.0 ± 0.40^c	24.4 ± 0.26^e	$107.7 \pm 0.44_g$	205.0 ± 0.26^h
B_2	18.9 ± 0.35^c	24.4 ± 0.21^f	15.0 ± 0.20^e	90.5 ± 0.30^b
C_1	16.8 ± 0.35^a	16.5 ± 0.30^d	$9.3 \pm 0.16^{\backslash c}$	87.6 ± 0.26^a
C_2	21.2 ± 0.26^d	14.5 ± 0.20^c	11.5 ± 0.26^d	101.1 ± 0.21^a
D_1	21.8 ± 0.30^e	14.5 ± 0.21^b	6.75 ± 0.02^b	92.5 ± 0.30^d
D_2	29.0 ± 0.29^g	27.0 ± 0.32^g	6.16 ± 0.02^a	100.5 ± 0.26^e

Note: Values are mean±S.D, n = 3. Means within treatments in a column not having common superscripts are significantly different ($p<0.05$).

treatments. A similar reduction in phenolics have been demonstrated by Orphanides *et al.* (2013) in spearmint. Recent works also demonstrated that the temperature affects the stability of phenolic compounds in herbal infusions (Riehle *et al.*, 2013).

Asami *et al.* (2003) observed phenolic contents in infused and air dried grapes, apples and bananas. Temperature during air drying at 55 °C caused the degradation of phenolic compounds and regarded that temperatures higher than 50-60 °C are unfavourable for phenolics due to the possibility of inducing oxidative condensation or decomposition of thermo labile compounds such as catachine.

Yeast and mold count Dried and partially dried food products are considered safe with respect to microbial hazards. There is a critical water activity (a_w) below which no micro organisms can grow. Yeast and molds are more tolerant to a reduced water activity (a_w) of 0.80. Usually no growth occurs below water activity of about 0.62 (Suresh Kumar and Sagar, 2010). It was observed that the total plate count was below the detectable limits in all the treated samples from the initial day to the 45th day of storage. This might be due to the different treatments given to the samples. Hence, the quality of the developed sapodilla flakes maintained good quality and shelf life.

CONCLUSION

The use of combination of treatments in foods to make them safe and stable has been an accepted strategy of food preservation for centuries. It can be concluded from the study that the type of solute, time and concentration were the most pronounced factors affecting solid gain, water loss and moisture content of sapodilla slices during osmotic dehydration. The results obtained in the present investigation indicated that the use of mixed solutes such as sucrose and maltodextrin with the enrichment of neutraceuticals such as *Ocimum bacilicum* leaves were more acceptable. The results conclusively demonstrate that the nutritional and functional quality of the fruits can be enhanced through the present developed technology. It is also evident from the study that the sapodilla flakes prepared by using different treatments remained chemically and microbiologically safe during storage. There was better retention of nutrients and antioxidant content in the products.

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