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EFFECT OF STORAGE ON CHEMICAL CHARACTERISTICS OF OSMOTICALLY DEHYDRATED KARONDA (*CARISSA CARANDAS* L.)

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ABSTRACT

The present investigation was conducted to determine the effect of water activity, microbial, organoleptic characteristics and economics of osmotically dehydrated karonda during 90 days of storage. For developing such product, karonda slices were dipped into various osmotic solutions like sugar and jaggery having different concentrations (50, 60 & 70° Brix) and the dipping time duration was set for 24 hours. After that the syrups were drained out, karonda slices were spread in cabinet dryer for dehydration. After osmotic dehydration, karonda slices were packed in low density polyethylene pouches and stored at an ambient temperature for a period of 3 months. With the advancement of storage period an increasing trend was observed in water activity hunter colour a* however a decreasing trend was observed in hunter colour L* and b*. Although no microbial growth was detected but treatment T_4 (70°Brix sugar syrup) adjudged as the superior on the basis of sensory attributes by scoring 7.90, 7.92, 7.95, 7.92 values for colour, texture, taste and overall acceptability during the entire storage period of the product.

***Keywords* :** Karonda, microbial count, jaggery, osmotic dehydration , sensory evaluation.

Introduction

Karonda (*Carissa carandas* L.) is indigenous to India. It belongs to family apocynaceae. It is evergreen, thorny and bushy plant generally used as live fence. It is a hardy multipurpose horticultural bush flourishes well without much care in arid and semi-arid conditions. In India, Karonda is commercially cultivated in Madhya Pradesh, Rajasthan and Uttar Pradesh (Vishal Nath ,1999). It is mostly found in the kandi belt of Jammu region. Karonda fruit is a rich source of iron, contains fair amount of vitamin C and also possess important minerals, carbohydrates and fibre. They got rotten before the final consumption due to lack of preservation and storage facilities. This fruit generally contains 83.67% moisture, 2-3% protein, 1.77% fat and iron (39 mg). Fruit is usually harvested when fully ripen and bears a distinct property of being astringent. Due to this property, karonda cannot be used as table fruit. Therefore, processing makes easier for its consumption and value addition. In the present study, osmotic treatment was done on the basis of minimum dehydration for food. This is useful technique to extend the shelf life and decrease the energy cost. It also helps to improve the sensorial, nutritional and organoleptic properties of foods (Khan *et al*., 2012). For the dehydration of fruit like karonda, the osmotic solutions with concentration ranging from 50-70° Brix have been used. Osmotic treatment with many advantages over conventional methods, much of them include its mechanical simplicity and processed flexibility because without any change, water can be removed. This process was done at room temperature to avoid the degradation of color, texture and nutritional values of the food. In this process, loss s volatile compounds and oxidative changes was lowered (Marani *et al.,* 2007). The osmotic process has received considerable attention as pre-drying treatment so as to reduce the energy consumption and improve food quality (Mondhe *et al.,* 2012). Hence developing such technology will reduce post -harvest losses and found to be more acceptable.

Material and Methods

The experiment was carried out in the division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu during the year 2020-2021. Fully matured (1kg) karonda fruits were washed thoroughly with clean water and sliced. After removing seeds, karonda slices are blanched properly. On the other hand, sugar and jaggery syrups were prepared having different concentrations *viz.* 50, 60 and 70^0 Brix respectively. Soon after then the karonda slices were dipped in following concentrations of osmotic solutions i.e. sugar and jaggery for 24 hours. After the completion of dipping time the sugar and jaggery syrups were drained and the karonda slices were spread on trays. The karonda slices were dried for 2-3 days in a cabinet dryer at $55\text{-}60^0$ C.

Selection of ripe karonda fruits

⇩

Washing of fruits

⇩

Cutting the fruits and removing seeds

⇩

Preparation of sugar and jaggery syrup (50,60 and 70^0Brix)

Addition of 600ppm sodium benzoate and 1% citric acid

⇩

Immersion of karonda slices in sugar / jaggery syrup (24 hours)

⇩

Draining out the syrup through muslin cloth

⇩

Spreading of karonda slices in trays

⇩

Drying of osmosed karonda slices in cabinet dryer for 2-3 days at ($55-60^0$C)

⇩

Packaging the osmo-dried karonda in 400 guage LDPE bags

⇩

Storing the product at an ambient temperature

Fig. 1 : Flow chart for osmo-dehydrated karonda

Treatments :

T_1: Control
T_2 : Dipping in 50°Brix sugar syrup
T_3 : Dipping in 60°Brix sugar syrup
T_4 : Dipping in 70°Brix sugar syrup
T_5 : Dipping in 50°Brix jaggery syrup
T_6 : Dipping in 60°Brix jaggery syrup
T_7 : Dipping in 70°Brix jaggery syrup

From treatment 1 to 7 all treatments contain 0.1% sodium benzoate as preservative.

The following parameters were recorded during storage period:

Water activity

Water activity (a_w) was measured AOAC (2012), using a water activity meter series 3TE (Decagon Devices, Inc., Washington, DC, USA) at room temperature (25^{o}C). The device was equipped with a container that was half-filled with ground sample and placed into the device. The water activity was obtained within 3-5 min after loading the sample.

Microbial Content

Spread plate technique using dilution method as described by Pelczar and Chan (1997), was followed 1g of sample was aseptically transferred into test tubes containing sterile saline water and mixed vigorously. After mixing, 1 ml of the mixture was again transferred to a test tube containing 9 ml sterile water for further dilution. The process was continued until 3rd dilution 10-3. The petri-plates containing potato dextrose agar PDA was inoculated with 0.1 ml of the diluted sample 10-3, by spread plate technique and were incubated at 37 ^{0}C for 24 hours by keeping the petri-plated upside down. The plates were computed and colonies counted after 24 and 36 hours and multiplied by dilution factor.

$$\text{Microbial load} = N \times 1/V \times D$$

N = no. of colonies counted; V= volume of inoculums and D = dilution factor.

Sensory evaluation of the product

The osmo-dried karonda samples were evaluated on the basis of colour, texture, taste and overall acceptability by semi-trained panel of 9-10 judges using 9-point hedonic scale assigning scores like 9-like extremely to 1- dislike extremely. A score of 5.5 and above was considered acceptable. (Amerine, 1965).

Economics of the product

The cost of production of product was determined by taking into consideration the cost of raw materials, chemicals, packaging materials etc. used in the preparation of the product.

Results and Discussion

Physico-chemical characteristics of fresh karonda

The physico-chemical composition of fresh karonda as shown in Table 1, revealed that the moisture content, total soluble solids (TSS), acidity, ascorbic acid, reducing sugar, total sugar, anthocyanin, total phenol, iron was found to be 90.08%, 5.80^{0}Brix, 3.32%, 6.05mg/100g, 1.88%, 2.25%, 55.20 mg, 100g, 410 mg/100g GAE and 10.34%, respectively.

Table 1: Physico-chemical characteristics of fresh karonda

Attributes	Quantity
Moisture Content (%)	90.08
TSS (^{0}B)	5.80
Acidity (%)	3.32
Ascorbic Acid (mg/100g)	6.05
Reducing Sugar (%)	1.88
Total Sugar (%)	2.25
Non-Reducing sugar (%)	0.34
Anthocyanin Content (mg/100g)	55.20
Total phenols (%)	410
Iron (%)	10.34
pH	2.90

Water activity

The data shown in Table -2 illustrated that there was an increase in water activity during storage. Initially, the highest water activity of 0.55 was recorded in treatment T_7 (70 ^{0}Brix jaggery syrup) followed by the treatment T_6 (60 ^{0}Brix jaggery syrup) and treatment T_5 (50 ^{0}Brix jaggery syrup) having values as 0.39 and 0.29 while the lowest 0.15 in treatment T_1 (Control). After the three months of storage the highest water activity of 0.65 was recorded in treatment T_7 (70 ^{0}Brix jaggery syrup) and the lowest of 0.27 in treatment T_1 (Control). During storage period of three months the mean values of water activity of osmo-dried karonda showed an increase trend from initial value of 0.29 to 0.40. The interaction effect between the treatment and storage were found not significant at 5 per cent level of significance. Water activity measures availability of water responsible for microbial and other deteriorative reactions. The effect of treatment and storage on the water activity of osmo-dried karonda showed a gradual increase in the water activity as observed with the increase in storage period. Maximum water activity was found in treatment T_7 (70^{0}Brix jaggery syrup) and minimum was observed in T_1 (Control). The increase in water activity during storage might be due to the reduction in moisture and increase in solute concentration in osmotic solution Biswal and Le Maguer (1988) Similar findings were also reported by Kumar *et al.* (2017).

Microbial studies

All the samples were found to be free from microbial count during 90 days of storage. The total plate count was not affected by the treatments and storage. At the beginning, all the treatments were found to be free from microbial growth and remains same after 90 days of storage. Therefore, during storage no increase or decrease in microbial count was seen. Hence storage did not affect the total plate count of the dried product. No microbial growth was detected throughout the 90 days of storage period. This might be due to the presence of natural preservative like sugar and jaggery. Hasanuzzaman *et al.* (2014) did not observe any microbial growth in the tomato candy.

Sensory evaluation of the osmo-dried karonda

Colour

The data in table 3 revealed that the colour score of osmo dried karonda decreased during the entire storage period. Initially the maximum score of 8.23 was observed in treatment T_4 (70 ^{0}Brix sugar syrup) followed by T_3 (7.96) and T_2 (7.36) while minimum 7.11 in Control. After three months of storage period, the highest score of 7.52 was recorded in treatment T_4 (70^{o}Brix sugar syrup) and 6.31 in Control. The highest overall mean colour score of 7.90 was observed in T_4 (70 ^{0}Brix sugar syrup) and the lowest in Control having score of 6.72. On assessing the colour score of the osmo dried karonda, the mean colour score during storage period of three months decreased significantly from 7.60 to 6.87. On comparing the treatment and storage means interactions with each other all were found to be differing significantly at 5 per cent level of significance. The highest mean score for colour was observed in treatment T4 (70 ^{0}Brix sugar syrup) which was significantly higher from rest of the treatments while lowest was found in T_1 (control). This decrease in appeal for colour was probably due to browning reactions occurring in the product. Similar results have been reported by Durrani *et al.* (2011) in honey based carrot candy and Hiremath and Rokhade (2012) in sapota candy.

Texture

In beginning, the highest score of 7.92 was recorded in treatment T_4 (70 ^{0}Brix sugar syrup) which was followed by T_3 (60 ^{0}Brix sugar syrup) and T_2 (60 ^{0}Brix sugar syrup) and minimum 6.77 in Control. It is evident from the table that the texture score of osmo-dried karonda decreased significantly during entire storage period. After three months of storage period, the highest of 7.56 was recorded in treatment T_4 (70 ^{0}Brix sugar syrup) and 6.45 in T_1 (Control). During the storage period of three months, the mean texture score of osmo-dried karonda decreased significantly from 7.55 to 6.94 at 5 per cent level of significance. The interaction between the treatment and storage was found to be significant at 5 per cent level of significance. Highest mean score for texture was observed in treatment T4 (70 ^{0}Brix sugar syrup) while lowest was found in T_1 (control) during three months of storage. Moreover, the osmo-dried karonda prepared from T4 (70 ^{0}Brix sugar syrup) showed the highest treatment mean score for texture during three months of storage which was significantly higher from rest of treatments. This might bedue to the higher concentration of sugar solution. Chauhan *et al* (2014) also noticed a decreasing trend in scores for texture in papaya candy during storage.

Taste

Treatment and storage period had significant effect on the sensory score of taste of osmo-dried karonda. Initially the maximum score of 8.19 was scored by treatment T_4 (70 ^{0}Brix sugar syrup) and minimum 7.20 in Control. The taste score of the osmo-dried karonda decreased significantly during entire period. After three months of storage, the maximum score 7.70 was observed by T_4 (70^o Brix sugar syrup) and minimum 6.41 in Control. On assessing the taste score of osmo-dried karonda, the mean score during storage period of three months decreased significantly from 7.80 to 7.16. On comparing the treatment and storage means interactions with each other all were found to be differing significantly at 5 per cent level of significance. Taste score of different treatments decreased during three months of storage. Highest was observed in treatment T_4 (70 ^{0}Brix sugar syrup) while lowest was found in T_1 (control) during three months of storage. Similar results were reported by Nayak *et al.* (2012) in aonla candy and Jothi *et al.* (2014) in pineapple preserve and candy.

Overall acceptability

The overall acceptability score of osmo-dried karonda significantly decreased over a period of three months. During storage of three months, the mean storage for overall acceptability score decreased significantly from 7.65 to 6.99. The treatment T_4 (70 ^{0}Brix sugar syrup) registered the highest score of 8.19 and was closely followed by T_3 (60 ^{0}Brix sugar syrup) and lowest score of 7.11 was assigned to Control, in treatment mean values. However, same pattern was followed during three months' storage. The interaction between the treatment and storage was found to be significant. Overall acceptability score of osmo-dried karonda decreased during three months of storage. Highest was observed in treatment T4 (70 ^{0}Brix sugar syrup) while lowest was found in T_1 (control) during three months of storage. The decrease in overall acceptability score in product may be due to increase in non-enzymatic browning to some extent, change in chemical composition of the product and loss of colour, texture and flavour during storage period of three months. Similar findings have been reported by Patil *et al.* (2014) in karonda candy and Kumar *et al.* (2017) in guava candy.

Cost of production

The cost of production of osmo-dried karonda was based upon the fixed and variable cost of all the ingredients used and some other factors viz. processing charges, packaging materials etc. The cost was calculated on the basis of current market price of ingredients used. The cost of production of osmo dried karonda comes to 54.39/60g (Table 16). Since the cost of production has been calculated on the laboratory scale basis, however, there may be some variation in cost if manufactured on large scale. Cost was calculated by taking into consideration the prevailing market prices for various ingredients like karonda, packaging material and other charges such as tax etc. The cost of production of best treatment T_4 (70 ^{0}Brix sugar syrup) comes out to be Rs. 54.39 per 60 g of pouch.

Conclusion

Based on the results it is concluded that osmo-dried karonda can be utilized properly to add nutrition in developed value added product. It would increase aesthetic and therapeutic value of the product. Such products can be kept for longer duration (at least 3 months) without adversely affecting their physio-chemical and sensory characteristics. But on the basis of sensory evaluation the osmo-dried karonda prepared from T_4 (70 ^{0}Brix sugar syrup) proved superior in terms of colour, texture, taste and overall acceptability. The cost of production of osmo-dried karonda is economically feasible. The storability study revealed that osmo-dried karonda prepared with T_4 (70^0Brix sugar syrup) have good shelf life and can be kept for more than 90 days. Hence developing such technology will reduce post harvest losses and found to be more acceptable.

Table 2: Effect of treatments and storage period on water activity (a_w) and microbial count (cfu/g×10^{-4}) osmo-dried karonda

Treatments	Water activity (a_w)					Microbial count (cfu/g×10^{-4})				
	Storage period (months)					Storage period (months)				
	0	1	2	3	Mean (Treatments)	0	1	2	3	Mean (Treatments)
T_1: Control	0.15	0.19	0.22	0.27	0.20	ND	ND	ND	ND	ND
T_2:Dipping in 50°Brix Sugar Syrup	0.17	0.21	0.26	0.30	0.23	ND	ND	ND	ND	ND
T_3: Dipping in 60°Brix Sugar Syrup	0.24	0.27	0.34	0.37	0.29	ND	ND	ND	ND	ND
T_4: Dipping in 70°Brix Sugar Syrup	0.25	0.29	0.32	0.36	0.31	ND	ND	ND	ND	ND
T_5: Dipping in 50°Brix Jaggery Syrup	0.29	0.33	0.37	0.41	0.35	ND	ND	ND	ND	ND
T_6: Dipping in 60°Brix Jaggery Syrup	0.39	0.43	0.46	0.48	0.44	ND	ND	ND	ND	ND
T_7: Dipping in 70°Brix Jaggery Syrup	0.55	0.58	0.61	0.65	0.59	ND	ND	ND	ND	ND
Mean (Storage)	0.29	0.32	0.36	0.40		ND	ND	ND	ND	

Effect	CD ($_{p=0.05}$)	Effect	CD ($_{p=0.05}$)
Treatment (T)	0.06	ND = Not Detected	
Storage (S)	0.08		
T × S	NS		

Table 3: Effect of treatments and storage period on colour and texture (hedonic scale) of osmo-dried karonda

Treatments	Colour					Texture				
	Storage period (months)					Storage period (months)				
	0	1	2	3	Mean (Treatments)	0	1	2	3	Mean (Treatments)
T_1: Control	7.11	6.82	6.64	6.31	6.72	7.03	6.87	6.73	6.45	6.77
T_2:Dipping in 50°Brix Sugar Syrup	7.36	7.15	6.92	6.62	7.01	7.36	7.16	7.05	6.71	7.07
T_3: Dipping in 60°Brix Sugar Syrup	7.96	7.70	7.51	7.28	7.61	7.47	7.34	7.17	6.85	7.20
T_4: Dipping in 70°Brix Sugar Syrup	8.23	8.04	7.81	7.52	7.90	8.17	8.09	7.87	7.56	7.92
T_5: Dipping in 50°Brix Jaggery Syrup	7.51	7.27	7.09	6.80	7.16	7.89	7.77	7.59	7.29	7.63
T_6: Dipping in 60°Brix Jaggery Syrup	7.23	6.94	6.78	6.47	6.85	7.19	7.01	6.89	6.59	6.92
T_7: Dipping in 70°Brix Jaggery Syrup	7.83	7.57	7.39	7.14	7.48	7.75	7.61	7.46	7.14	7.49
Mean (Storage)	7.60	7.35	7.16	6.87		7.55	7.40	7.25	6.94	

Effect		CD ($_{p=0.05}$)Effect	CD ($_{p=0.05}$)
Treatment (T)	0.01	Treatment (T)	0.08
Storage (S)		0.01 Storage (S)	0.06
T×S		0.03T×S	0.16

Table 4: Effect of treatments and storage period on taste (hedonic scale) and overall acceptability of osmo-dried karonda

Treatments	Taste					Overall Acceptability				
	Storage period (months)					Storage period (months)				
	0	1	2	3	Mean (Treatments)	0	1	2	3	Mean (Treatments)
T_1: Control	7.20	6.93	6.65	6.41	6.79	7.11	6.87	6.67	6.39	6.76
T_2:Dipping in 50°Brix Sugar Syrup	7.59	7.31	7.05	6.85	7.20	7.43	7.20	7.00	6.72	7.09
T_3: Dipping in 60°Brix Sugar Syrup	7.72	7.48	7.22	7.09	7.37	7.71	7.50	7.3	6.07	7.39
T_4: Dipping in 70°Brix Sugar Syrup	8.19	8.08	7.84	7.70	7.95	8.19	8.07	7.84	7.59	7.92
T_5: Dipping in 50°Brix Jaggery Syrup	7.97	7.79	7.53	7.36	7.66	7.79	7.61	7.40	7.15	7.48
T_6: Dipping in 60°Brix Jaggery Syrup	8.10	7.91	7.66	7.50	7.79	7.50	7.28	7.11	6.85	7.18
T_7: Dipping in 70°Brix Jaggery Syrup	7.85	7.63	7.38	7.24	7.52	7.81	7.60	7.41	7.17	7.49
Mean (Storage)	7.80	8.59	7.33	7.16		7.65	7.45	7.24	6.99	

Effect		CD ($_{p=0.05}$)Effect	CD ($_{p=0.05}$)
Treatment (T)	0.02	Treatment (T)	0.01
Storage (S)		0.01Storage (S)	0.02
T×S		0.04T×S	0.04

Table 5: Cost of production of osmo-dried karonda

Ingredients	Rate	Quantity	Amount (Rs.)
Karonda	50/kg	2kg	100
Sugar	40/kg	1kg	40
Jaggery	20/kg	1kg	20
Sodium benzoate	120/kg	0.5g	0.60
LDPE bags	1	12	12
Total ingredients			**172.60**
Overhead charges (including labour fuel and machinery depreciation	@20%		34.52
Profit	**@15%**		**31.06**
GST	**@12%**		**28.94**
Grand Total			**267.12**
Cost/ pouches/(60 g)			54.39

Conflict of Interest

The author claims no conflicts of interest to conduct this research work.

References

Amerine, M.A.; Pangborn, R.M. and Roessler, E.B. (1965). Principles of Sensory Evaluation of Food. Academic Press, New York, 602.

AOAC (2012). Official Methods of Analysis, Association of Official Analytical Chemists. 19th Edition, Washington D.C.; USA.

Chauhan, A.; Ugulino, E.M. and Dalal, M.R. (2014). Development of papaya candies. *Journal of Food Science and Technology*, 65: 154-160.

Durrani, A.M.; Srivastava, P.K. and Verma, S. (2011). Development and quality evaluation of honey based carrot candy. *Journal of Food Science and Technology*, 48(4): 502–505.

Hasanuzzaman, M.; Kamruzzaman, M.; Islam, M.M.; Khanom, S.A.A.; Rahman, M. M.; Lisa, L.A. and Paul, D.K. (2014). A study on tomato candy Prepared by dehydration technique using different sugar solutions. *Journal of Food and Nutrition Sciences,* 5: 1261-1271.

Hiremath, J.B and Rokhade, A.K. (2012). Preparation of sapota candy. *International Journal of Food, Agriculture and Veterinary Science*, 2(1): 107-112.

Jothi, C.; Tsami, E. and Favetto, G.J. (2014). Physico-chemical analysis of pineapple candy by combined methods. *Food Research International,* 25: 89-96.

Khan, R.M. (2012) Osmotic dehydration technique for fruits preservation – A review. *Pakistan Journal of Food Sciences*, 22(2): 71-85.

Kumar, M.; Bahadur, M. and Prasad, M. (2017). Effect of osmotic dehydration onquality and shelf-life of dehydraed guava slices. *The Allahabad Farmer*, 5: 35-40.

Kumar, P. and Vikram, B. (2017). Studies on different treatments on osmotic dehydrated Allahabad safeda guava slice (*Psidium guajava*). *International Journal of Pure and Applied Biosciences,* 5 (3): 144-150.

Marani, C.M.; Anelli, M.E. and Mascheroni, R.H. (2007) Osmo-frozen fruits: Masstransfer and quality evaluation. *Journal of Food Engineering*, 79: 1122-1130.

Le Maguer, M. (1988). Osmotic dehydration: review and future directions. Production Symposium on Progress in Food Preservation Processes., 1: 183-309.

Mondhe, D.S.; Gupta, S.K. Hand, T. and Alam, M.S. (2012). Drying kinetics of osmotically treated papaya (*Carica papaya* L.). *Green farming,* 4(1): 103-105.

Nayak, P.; Tandon D.K. and Bhatt, D.K. (2012). Study on changes of nutritional and organoleptic quality of flavoured candy prepared from aonla (*Emblica officinalis* G.) during storage. *International Journal of Nutrition and Metabolism*, 4(7): 100-106.

Patil, R.; Raut, V.U. and Wankhade, R.S. (2014). Studies on the sensory quality and economics of preparation of karonda candy. *International Journal of Processing and Post Harvest Technology*, 5: 169-172.

Pelczar, M.J. and Chan, E.C.S. (1997). Laboratory Exercise in Microbiology. Black Dot Inc. New York.

Vishal Nath (1999). Bagwani main karonda ugayen. *Krishi evam Gramin*., 2(11): 10.