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Physico-chemical properties of osmotically dehydrated karonda (*Carissa carandas* L.)

■ **L. SUHASINI, K. VANAJALATHA[1], A.S. PADMAVATHAMMA[2] AND P. VEKATESHWAR RAO[3]**

Members of the Research Forum

Associated Authors:
[1]Department of Horticulture, Dr. Y.S.R. Horticultural University, Venkatramanna gudem, WEST GODAVARI (A.P.) INDIA
Email : dsa@drysrhu.edu.in

[2]Department of Horticulture, Dr. Y.S.R. Horticultural University, Rajendranagar, HYDERABAD (TELANGANA) INDIA
Email : ranjani-21@gmail.com

[3]Department of Crop Physiology, College of Agriculture, Prof. Jayshankar Telangana State Agricultural University, Rajendranagar, HYDERABAD (TELANGANA) INDIA
Email : pvraophy@gmal.com

Author for correspondence :
L. SUHASINI
Department of Horticulture, College of Horticulture, Dr. Y.S.R. Horticultural University, Rajendranagar, HYDERABAD (TELANGANA) INDIA
Email : chinni18113@gmail.com

ABSTRACT : The present investigation was carried out during 2013–2014 at College of Horticulture, Rajendranagar, Hyderabad. The osmotic dehydration of karonda was studied with two concentrations of NaCl *viz.*, 2 per cent and 5 per cent, NaCl with three different durations of dipping times *viz.*, 1, 2 and 3 hours. After osmosis of the karonda slices in the NaCl (salt) solutions, these were laid on the hot air oven for dehydration. After osmotic dehydration, the products were packed in high density polyethylene bags and stored in ambient temperature for a period of 4 months. The physico-chemical properties like moisture content, ascorbic acid, Fe content, acidity of the product were evaluated during the storage period. During storage, slight decrease in ascorbic acid, iron content, acidity and increase in moisture content of osmo-dried product of karonda was noticed. All the products were acceptable at all the storage periods. However, osmotic pre-treatment with 5 per cent NaCl for 3 hours was found highly acceptable.

KEY WORDS : Ascorbic acid, Karonda, Osmotically dehydrated, Physico-chemical properties, Salt

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Karonda (*Carissa carandas* L.) belongs to family Apocynaceae which consists of 300 genera and 1000 species. It is a large shrub with simple thorn and commonly cultivated throughout Pakistan for hedges and is called Kakronda (Morton *et al.*, 1987). Karonda is found in throughout India mainly in the semi-arid regions. Karonda tree is widely cultivated in the home gardens, farmer's fields and orchards as hedge plant. Karonda is commonly used as a condiment or additive to Indian pickles and spices (Maheshwari *et al.*, 2013). Usually the fruit is pickled before it gets ripened. Ripe Karonda fruit contains high amount of pectin, therefore, it is also used in making jelly, jam, squash, syrup, tarts and chutney which are of great demand in international market (Wani *et al.*, 2013).

Fruits are important sources of vitamin and minerals. They are got rotten before the final consumption due to lack of preservation and storage facilities. Osmotic dehydration is an operation used for the partial removal of water from plant tissues by immersion in an osmotic solution. This is a 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, 2012). Osmotic dehydration is a method of preservation in which the food is dipped in concentrated salt or sugar solutions. Partially dehydrated fruits and vegetables prepared in this way can be added to foods such as desserts, yogurt, ice-cream, confectionery, and bakery products (Torreggiani and Bertolo, 2001). To know the physico-chemical changes and sensory evaluation of osmotically dehydrated product and the changes in composition of osmotically dehydrated product of karonda during storage, a study was undertaken.

RESEARCH METHODS

The experiment was conducted at the Processing Laboratory Department of Fruit Science at Dr. Y.S.R. Horticultural University, College of Horticulture Rajendranagar, Hyderabad during the year 2013-2014. The one kg whole karonda fruits were osmotically dehydrated in NaCl of different concentrations *viz*., 2 per cent and 5 per cent prepared at room temperature (25°C). Then, 0.1 per cent each of potassium metabisulphite and sodium benzoate and 0.3 per cent citric acid as a preservatives were added to salt solution after dissolving in little drinking water. The weight ratio of osmotic medium to fruit sample was 3:1 to avoid significant dilution of the medium and subsequent decrease of the driving force during the process. Samples were removed from the solution at 1, 2 and 3 hours of immersion, drained and the karonda slices were washed with fresh water.

Selection of hard ripe fruits
↓
Washing
↓
Slice the fruit into two equal parts
↓
Remove seeds
↓
Salt solution preparation
↓
Osmotic treatment
↓
Draining
↓
Hot-air oven drying
↓
Packaging
↓
Storage

Fig. A: Flow chart for osmotic dehdyration of karonda

Treatments :

T_1D_1 : Dipping in 2 per cent NaCl for 1 hour
T_2D_2 : Dipping in 2 per cent NaCl for 2 hours
T_3D_3 : Dipping in 2 per cent NaCl for 3 hours
T_4D_4 : Dipping in 5 per cent NaCl for 1 hour
T_5D_5 : Dipping in 5 per cent NaCl for 2 hours
T_6D_6 : Dipping in 5 per cent NaCl for 3 hours
T_7D_7 : Control (Dip in 0.1% KMS + 0.1% SB for 10 min).

From T_1 to T_6 all treatments contained 0.1 per cent KMS + 0.1 per cent SB+ 0.3 per cent citric acid but control contained only 0.1 per cent KMS + 0.1 per cent SB.

The following parameters were recorded during storage period :

Moisture content (%) :

$$\text{Moisture content (\%)} = \frac{\text{Moisture loss}}{\text{Sample weight}} \times 100$$

Ascorbic acid: (mg 100g^{-1}) :

Ascorbic acid content of fresh and dehydrated karonda fruit slices was estimated as suggested by Ranganna (1991). Ten grams of sample was taken and 0.4 per cent oxalic acid was added to it. It was thoroughly grinded, filtered and volume was made upto 100 ml. Titration of 10 ml of this aliquot against standardized 0.025 per cent. 2, 6-Dichlorophenol-indophenol dye was done to get light pink colour as an end point. The ascorbic acid content was calculated and expressed as mg per 100 g of fruit.

$$\begin{array}{c}\text{mg of ascorbic acid / 100g}\\ \text{or ml of sample for estimation}\end{array} = \frac{\text{Titre value} \times \text{Dye factor} \times \text{Volume made up} \times 100}{\text{Aliquot of extract taken} \times \text{Wt or volume of sample taken for estimation}}$$

Iron content (mg 100g^{-1}) :

The dehydrated samples were decontamined by washing thoroughly with ordinary water, 0.2 per cent detergent (Teepol laboratory grade), 0.1 N HCl, distilled water and finally by using deionised water. These samples were dried in oven at 60°C till the constant weights were obtained. For the determination of iron, the dried samples were digested with a diacid mixture consisting of HNO_3: $HClO_4$ (9:5). The digest was made upto 50 ml volume and iron was determined in atomic absorption spectrophotometer with hallow cathode lamps at appropriate wavelengths (AOAC, 1965).

Titratable acidity :

Titratable acidity was analyzed by titrating a known aliquot of sample against standard 0.1 N NaOH using phenolpthalein as indicator and was expressed as per cent citric acid.

$$\text{Total acid (\%)} = \frac{\text{Titre value} \times \text{N of alkali} \times \text{vol. made up} \times \text{equlent. wt. of acid} \times 100}{\text{Volume of sample taken for estimn.} \times \text{Wt. or vol. of sample taken} \times 1000}$$

Rehydration ratio :

In the present study, 5 g of dehydrated sample was added to 100 ml of water and boiled for 3 minutes. Then it was filtered and the sample was weighed.

The rehydration ratio was arrived by dividing the weight of the rehydrated sample by the dried weight.

$$\text{Rehydration ratio} = \frac{\text{Weight of rehydrated sample (WR)}}{\text{Weight of dried sample (WD)}}$$

The data from study were subjected to analysis in a Completely Randomized Design (CRD) with factorial concept.

Statistical analysis :

The obtained data was analyzed by statistical significant at P<0.05 level, S.E. and C.D. at 5 per cent level by the procedure given by (Panse and Sukhatme, 1994).

RESEARCH FINDINGS AND DISCUSSION

Physico-chemical properties of osmo-dried karonda during storage period :

Moisture content (%) :

The moisture content of osmotically dehydrated karonda was increased significantly during storage period. It was observed that samples obtained using higher concentration of NaCl and longer duration of osmosis has lowered moisture content. The gain in moisture by samples during storage may be due to absorption of moisture from the atmosphere (Abdelhaq

Table 1 : Physico-chemical parameters of fresh karonda fruit

Sr. No.	Physical parameters	Results
1.	Avg. weight of fruit (g)	5.18 g
2.	Diameter (mm)	20mm
3.	Average seed number/ fruit	6
4.	Average seed weight/ kg fruit	96.38 g
5.	Average fruit slices weight/kg fruit	867.48 g
Chemical parameters		
1.	Moisture content (%)	90.08%
2.	TSS (°Brix)	5.80^0
3.	Ascorbic acid (mg/100g^{-1})	6.05mg 100g^{-1}
4.	Iron content (mg/100g^{-1})	10.34mg 100g^{-1}
5.	Acidity (%)	3.32%
6.	Total sugars (%)	2.25%
7.	Reducing sugars (%)	1.88%
8.	Non-reducing sugars (%)	0.34%
9.	pH	2.90

Table 2 : Effect of different osmotic treatments on moisture content (%) in osmotically dehydrated slices of karonda at different stages of storage

NaCl concentration (T)	Initial month of storage				2 months of storage				4 months of storage			
	Duration of dipping (D)				Duration of dipping (D)				Duration of dipping (D)			
	1 hour	2 hours	3 hours	Mean	1 hour	2 hours	3 hours	Mean	1 hour	2 hours	3 hours	Mean
2%NaCl	11.39	11.08	10.88	11.12	12.87	12.24	11.80	12.30	13.79	13.30	12.83	13.31
5%NaCl	10.67	10.55	10.28	10.50	11.54	11.25	10.97	11.25	12.54	12.20	11.93	12.22
Mean	11.03	10.82	10.58		12.21	11.74	11.38		13.17	12.75	12.38	
Control		14.87				15.34				16.27		
		S.E. ±	C.D. (P=0.05)			S.E. ±	C.D. (P=0.05)			S.E. ±	C.D. (P=0.05)	
Concentration (T)		0.01	0.05			0.02	0.06			0.02	0.06	
Duration (D)		0.02	0.07			0.02	0.07			0.02	0.08	
T×D		0.03	0.10			0.03	0.10			0.03	0.11	

and Labuza, 1987). The increase might be due to the higher relative humidity, that was obsorbed by the fruit slices during storage period and the increase in moisture content of the osmotic dehydrated jackfruit the change in acidity is very small reported by Rahman *et al*. (2012). The data presented in Table 2.

Ascorbic acid content (mg 100g^{-1}) :

In comparison to initial content, it was generally found that ascorbic acid content in osmotically dehydrated karonda slices decreased during storage. There was a significant variation among the treatments. Increased the solution concentration and dipping time decreased the ascorbic acid content. The maximum retention of ascorbic acid content was recorded in 2 per cent NaCl concentration and it was maximum at 1 hour of dipping time. In general ascorbic acid is a water soluble vitamin. Ascorbic acid is most sensitive to heat, hence, oxidized quickly in the presence of oxygen during processing and subsequently during storage. This could be explained by a combination of two factors: leaching with water diffusion due to the high degree of vitamin-C solubility in water and chemical degradation (enhanced by during temperature) reported by Devic *et al*. (2010) in apple. Chemical degradation during subsequent drying of potato slices in a sucrose/ salt solution reported by (Islam and Flink, 1982). When temperature is high, chemical degradation as well as diffusion seemed to be the most significant phenomena reported by (Vial *et al*., 1991). A similar result was found by Jayaraman *et al*. (1990); Azoubel and Murr (2004), in the cauliflower and cherry tomato, respectively, with and without osmotic dehydration. The data presented in Table 3.

Iron content (mg 100g^{-1}) :

The iron content was gradually decreased during storage period. In general processing and storage effects the nutritive value. Soil and agro-climatic conditions, influence the iron content. Cell wall membrane permeability and leakage also influence the decreased iron content. The iron content losses during osmotic dehydration might be attributed to the leaching from the product to the osmotic solution during the osmotic process and chemical degradation during subsequent drying of

Table 3 : Effect of different osmotic treatments on ascorbic acid (mg 100g^{-1}) in osmotically dehydrated slices of karonda at different stages of storage

NaCl concentration (T)	Initial month of storage				2 months of storage				4 months of storage			
	Duration of dipping (D)				Duration of dipping (D)				Duration of dipping (D)			
	1 hour	2 hours	3 hours	Mean	1 hour	2 hours	3 hours	Mean	1 hour	2 hours	3 hours	Mean
2%NaCl	5.52	5.07	4.75	5.12	5.08	4.81	4.64	4.84	5.03	4.64	4.43	4.70
5%NaCl	4.43	4.25	3.94	4.21	4.28	4.05	3.51	3.95	4.09	3.85	3.25	3.73
Mean	4.97	4.66	4.34		4.68	4.43	4.07		4.56	4.25	3.84	
Control	5.91				5.72				5.23			
	S.E. ±		C.D. (P=0.05)		S.E. ±		C.D. (P=0.05)		S.E. ±		C.D. (P=0.05)	
Concentration (T)	0.01		0.04		0.01		0.03		0.01		0.02	
Duration (D)	0.01		0.05		0.01		0.04		0.01		0.03	
T × D	0.02		0.07		0.02		0.06		0.01		0.04	

Table 4 : Effect of different osmotic treatments on iron content (mg 100g^{-1}) in osmotically dehydrated slices of karonda at different stage of storage

NaCl concentration (T)	Initial month of storage				2 months of storage				4 months of storage			
	Duration of dipping (D)				Duration of dipping (D)				Duration of dipping (D)			
	1 hour	2 hours	3 hours	Mean	1 hour	2 hours	3 hours	Mean	1 hour	2 hours	3 hours	Mean
2%NaCl	14.30	7.39	7.69	9.79	7.03	4.01	4.17	5.07	6.29	2.70	2.89	3.96
5%NaCl	8.57	8.68	5.79	7.68	5.59	6.00	2.92	4.83	3.65	3.42	0.46	2.51
Mean	11.43	8.03	6.74		6.31	5.00	3.54		4.97	3.06	1.68	
Control	6.96				3.91				0.85			
	S.E. ±		C.D. (P=0.05)		S.E. ±		C.D. (P=0.05)		S.E. ±		C.D. (P=0.05)	
Concentration (T)	0.02		0.07		0.01		0.04		0.01		0.03	
Duration (D)	0.02		0.08		0.01		0.04		0.01		0.03	
T × D	0.04		0.12		0.02		0.06		0.01		0.05	

potato slices in a sucrose/ salt solution reported by (Islam and Flink, 1982). The data presented in Table 4.

Acidity (%) :

The interaction between NaCl concentration and duration of dipping was found to be significantly vary. The lowest acidity was recorded in 5 per cent NaCl concentration. At 1 hour of dipping time it was recorded maximum. The NaCl solution contained the additional 0.3 per cent acidity, increased acidity in final product but acidity slightly decreased during storage. The main reason of variation in the acid content in osmotically karonda slices was the varying solid uptake and drying ratio of the products. As the salt solution contained the additional 0.3 per cent acidity, this added acidity played significant role in the increased acid content of the final product. These results are also conformity with the findings of Thippana (2005) in case of osmotic dehydration of banana. The results are in conformity with the findings on papaya (Ahmed and Choudhary, 1995); apricot (Babic *et al*., 2006 and Sharma *et al*., 2004) and Anitha and Tiwari (2007) in Alahabad Safeda

Table 5 : Effect of different osmotic treatments on acidity (%) in osmotically dehydrated slices of karonda at different stages of storage

NaCl concentration (T)	Initial month of storage				2 months of storage				4 months of storage			
	Duration of dipping (D)				Duration of dipping (D)				Duration of dipping (D)			
	1 hour	2 hours	3 hours	Mean	1 hour	2 hours	3 hours	Mean	1 hour	2 hours	3 hours	Mean
2%NaCl	4.87	4.44	4.34	4.55	4.78	4.36	4.28	4.48	4.71	4.32	4.24	4.43
5%NaCl	4.03	3.88	3.48	3.80	3.93	3.81	3.39	3.71	3.91	3.73	3.35	3.66
Mean	4.45	4.16	3.91		4.35	4.08	3.83		4.31	4.02	3.79	
Control	4.91				4.81				4.74			
	S.E. ±		C.D. (P=0.05)		S.E. ±		C.D. (P=0.05)		S.E. ±		C.D. (P=0.05)	
Concentration (T)	0.01		0.04		0.01		0.03		0.01		0.03	
Duration (D)	0.01		0.05		0.01		0.04		0.01		0.03	
T × D	0.02		0.07		0.01		0.05		0.01		0.05	

Table 6 : Effect of different osmotic treatments on rehydration ratio in osmotically dehydrated slices of karonda

NaCl concentration (T)	Duration of dipping (D)			
	1 hour	2 hours	3 hours	Mean
2% NaCl	1:2.34	1:2.21	1:2.19	1:2.25
5% NaCl	1:2.12	1:1.94	1:1.73	1:1.93
Mean	1:2.23	1:2.07	1:1.96	
Control	1:3.43			
	S.E.±		C.D. (P=0.05)	
Concentration (T)	0.01		0.01	
Duration (D)	0.01		0.02	
T × D	0.01		0.03	

Table 7 : Effect of different osmotic treatments on over all acceptebility of osmotically dehydrated slices of karonda at different stages of storage

NaCl concentration (T)	Initial month of storage				2 months of storage				4 months of storage			
	Duration of dipping (D)				Duration of dipping (D)				Duration of dipping (D)			
	1 hour	2 hours	3 hours	Mean	1 hour	2 hours	3 hours	Mean	1 hour	2 hours	3 hours	Mean
2%NaCl	63.63	65.90	70.28	66.60	60.10	62.83	66.95	63.30	52.80	56.83	60.90	56.80
5%NaCl	73.68	77.80	82.05	77.84	71.03	75.10	79.43	75.18	64.75	69.20	73.10	69.00
Mean	68.66	71.85	76.17		65.57	68.97	73.19		58.78	63.02	67.00	
Control	44.80				41.20				34.43			
	S.E. ±		C.D. (P=0.05)		S.E. ±		C.D. (P=0.05)		S.E. ±		C.D. (P=0.05)	
Concentration (T)	0.04		0.14		0.02		0.07		0.03		0.10	
Duration (D)	0.05		0.17		0.03		0.09		0.04		0.12	
T × D	0.08		0.24		0.04		0.13		0.05		0.18	

and Red fleshed variety of guava. The data presented in Table 5.

Rehydration ratio :

The maximum rehydration ratio was observed in 2 per cent NaCl concentration and among the duration of dipping times 1 hour of dipping time was recorded maximum rehydration ratio. Low rehydration ratio of osmotically dehydrated carrot cubes may be explained on the basis that, the osmotically pretreated sample contain 8-12 per cent solute which got infused during osmotic dehydration and leached into water during rehydration process without contributing to the rehydrating process reported by Singh *et al.* (2007). High –pressure pretreated samples could not adsorb more water in comparison with control because of cell permeabilization caused by the treatment. At the same time, solute loss during rehydration also reduced, possibly due to structural changes induced by high pressure treatment reported by Rastogi *et al.* (2000) in pineapple. The data presented in Table 6.

Over all acceptability :

Statistically significant variations due to different NaCl concentrations and dipping times were observed with respect to score for overall acceptability. Effect of different osmotic treatments indicates that karonda slices made using 5 per cent NaCl for 3 hours rated significantly superior (73.10) and followed by 5 per cent NaCl for 2 hours (69.20). The minimum score was observed in control (34.43). The samples treated with tri sodium citrate (salts) retained the original colour with more suitable flavour and texture when compared to non-treated samples reported by Kaymak-Ertekin and Cakaloz (1996). The molecular weight of NaCl is small, the smaller molecular weight of solutes were penetrated into food more rapidly than higher molecular weight. The smaller molecular weight was desirable for the process of infusion then end product quality was excellent reported by Saurel *et al.* (1994) and Kuntz (1995) (Table 7).

Conclusion :

The product prepared with 5 per cent NaCl for 3 hours was significantly superior over the rest of the treatments, while lowest total score was noticed in control samples.

REFERENCES

Abdelhaq, E.H. and Labuza, T.P. (1987). Air drying characteristics of apricot. *J. Food Sci.*, **52**(2):342-345.

Ahmed, J. and Choudhary, D.R. (1995). Osmotic dehydration of papaya. *Indian Food Packer*, **49**(4):5-11.

Anitha, P and Tiwari, R.B. (2007). Studies on osmotic dehydration of guava (*Psidium guajava* L.). *J. Agric. Search*, **1**(1):49-53.

AOAC (1965). *Official methods of analysis*,Association of Official Agricultural Chemist, AOAC, WASHINGTON, D.C.

Azoubel, P.M. and Murr, F.E.X. (2004). Mass transfer kinetics of osmotic dehydration of cherry tomato. *J. Food Engg.*, **61**(3):291 -295.

Babic, L., Babic, M. and Pavkov, I. (2006). Apricot drying by a new technology. *Vocarstvo.*, **40**(3):245-253.

Devic, E., Guyoi, S., Daudin, J. and Bonazzi, C. (2010). Effect of temperature and cultivar on polyphenol retention and mass transfer during osmotic dehydration of apples. *J. Agric. & Food Chem.*, **58**(1):606-614.

Islam, M.N. and Flink, L.N. (1982). Dehydration of potato II – osmotic concentration and its effect on air drying behaviour. *J. Food Tech.*, **17**(3):387-403.

Jayaraman, K.S., Das Gupta, D.K. and Babu Rao, N. (1990). Effect of pretreatment with salt and sucrose on the quality and stability of dehydrated cauliflower. *Internat. J. Food Sci. & Tech.*, **25**(1):47-60.

Kaymak-Ertekin, F. and Cakaloz, T. (1996). Osmotic dehydration of peas: Influence of osmosis on drying behaviour and product quality. *J. Food Proc.& Preser.*, **20**(2):105-109.

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

Maheshwari, R., Sharma, A. and Verma, D. (2013). Phyto-therapeutic significance of Karaunda. *Bull. Environ., Pharmacol. & Life Sci.*, **1** (12): 34- 36.

Morton, J., Julia, F. and Miami, F.L. (1987). Karanda. In: *Fruits of warm climates*. 422–424pp.

Panse, V.C. and Sukhatme, P.V. (1967). *Statistical method for Agric workers*. Second Enlarged Ed. ICAR, NEW DELHI, INDIA.

Rahman, M. M.D., Miaruddin, M.D., Ferdous Chowdhury, M.G., Hafizul Haque, M.D. and Muzahid-E-Rahman, M.D. (2012). Preservation of jack fruit (*Artocarpus heterophyllus*) by osmotic dehydration. *Bangladesh J. Agric. Res.*, **37**(10): 67-75.

Ranganna, S. (1991). *Manual of analysis of fruit and vegetable products*. 2nd Ed., Tata Mc Graw Hill Public Co. Ltd., New Delhi. 1112pp.

Rastogi, N.K., Angersbach, A., Niranjan, K. and Knorr, D. (2000). Rehydration kinetics of high-pressure preatreted and osmotically dehydrated pineapple. *J. Food Sci.*, **65** (5):838-841.

Saurel, R., Raoult-Wack, A., Rios, G. and Guilbert, S. (1994). Mass transfer phenomena during osmotic dehydration of apple. Fresh plant tissue. *Internat. J. Food Sci. & Technol.*, **29** (5) : 531-542.

Sharma, K.D., Kumar, R. and Kaushal, B.N.L. (2004). Mass transfer characteristics, yield and quality of five varieties of osmotically dehydrated Apricot. *J. Food Sci. Technol.*, **41**(3): 264-275.

Singh, B., Parmjit Panesar, S. and Nanda, Vikas (2007). Rehydration kinetics of un-osmosed and pre-osmosed carrot cubes. *World J. Dairy & Food Sci.*, **2** (1): 10-17.

Thippana, K.S. (2005). Studies on osmotic dehydration of banana (*Musa* spp.) fruits. University of Agricultural Sciences. Bangalore (KARNATAKA), INDIA.

Torreggiani, D. and Bertolo, G. (2001). *High quality fruit and vegetable products using combined processes*. Technomic Publishing Company, Inc.

Vial, C., Guilbert, S. and Cuq, J. (1991). Osmotic dehydration of kiwi fruits: Influence of process variables on the colour and ascorbic acid content. *Sciences des Aliments*, **11**: 63-84.

Wani, R.A., Prasad, V.M., Hakeem, S.A., Sheema, S., Angchuk, S. and Dixit, A. (2013). Shelf-life of Karonda jams (*Carissa carandas* L.) under ambient temperature. *African J. Agric. Res.*, **8** (21): 2447-2449.

WEBLIOGRAPHY:

Kuntz, L.A. (1995). Investigating Infusion. Food Product Design. *http://www.foodproductdesign.com*. Accessed 2010 Aug. 1l.

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