www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(1): 1396-1401

www.thepharmajournal.com
Received: 08-12-2022
Accepted: 12-01-2023

Shivani Verma
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha, Jammu and Kashmir, India

Anju Bhat
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha, Jammu and Kashmir, India

Neeraj Gupta
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha, Jammu and Kashmir, India

Akshay Kumar
Division of Agroforestry, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha, Jammu and Kashmir, India

Corresponding Author:
Shivani Verma
Division of Food Science and Technology, Sher-e-Kashmir University of Agricultural Sciences and Technology, Jammu, Chatha, Jammu and Kashmir, India

Physio-chemical characteristics of osmotically dehydrated karonda (*Carissa carandas* L.) with different pre-treatments during storage

Shivani Verma, Anju Bhat, Neeraj Gupta and Akshay Kumar

Abstract
The osmotically dehydration of karonda was studied while subjected to 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 and then packed in low density polyethylene pouches for storage at an ambient temperature at regular period of 3 months. The physio- chemical properties like moisture content, iron content, titratable acidity, ascorbic acid, anthocyanin, total phenols, reducing sugar and total sugar of the product were estimated. During storage slight decrease in titratable acidity, ascorbic acid, anthocyanin, total phenols, iron and increase in moisture, reducing sugar, total sugar of osmo-dried product was observed. The osmo-dried karonda prepared from the treatment T4 (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 color, texture, taste and overall acceptability. No microbial spoilage was detected up to 90 days of storage.

Keywords: Karonda, astringent, sugar, jaggery, osmotic dehydration, ambient storage

Introduction
Karonda (*Carissa carandas* L.) is a semi-wild berry fruit belongs to family Pinaceae grows well in higher temperatures and 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 fiber. This fruit generally contains 83.67% moisture, 2-3% protein, 1.77% fat and iron (39 mg). Fruit is usually harvested when it was fully ripe, and it also emit a milky white latex which is further wiped in order to proceed with its processing. Karonda fruit can be stored for 3-4 days under room temperature as well as in refrigeration. For the dehydration of fruit like karonda, the osmotic solutions with concentration ranging from 50-70° Brix have been used. 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) [11]. Sugars and salt are the most common preservatives of Indian kitchen therefore , sugar solution as an osmotic agent proves out to be the best as it reduces browning by preventing oxygen entrance, provides stability to pigments and helps to retain volatile compounds during drying of osmotically treated materials (Pattanapa *et al*.,2010) [14]. In addition to preservation, drying is also used to reduce the cost or difficulty of packaging, handling, storage and transportation, by converting the raw food into a dry product (Raj *et al.*, 2006,) [17].

Material and Methods
Physiologically ripe karonda fruits at 100% maturity were purchased from the Rainfed Research Sub- Station for Sub-Tropical Fruits Raya, Jammu. 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 700 Brix respectively. Soon after then the karonda slices were dipped in sugar and jaggery solutions (24 hours) for osmotic dehydration. 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 55-600
C. After that product is packed in low density polyethylene pouches for storage at an ambient temperature at regular period of 90 days.

Selection of ripe karonda fruits
⇩
Washing of fruits
⇩
Slicing the fruits and removing seeds
⇩
Preparation of sugar and jaggery syrup (50, 60 and 700 Brix)
⇩
Addition of 600 ppm 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 °C)
⇩
Packaging the osmo-dried karonda in 400 guage LDPE pouches
⇩
Storing the product at an ambient temperature

Fig 1: Flow chart for osmo-dehydrated karonda

Treatments

T1: Control
T2: Dipping in 50°Brix sugar syrup.
T3: Dipping in 60°Brix sugar syrup.
T4: Dipping in 70°Brix sugar syrup.
T5: Dipping in 50°Brix jaggery syrup.
T6: Dipping in 60°Brix jaggery syrup.
T7: Dipping in 70°Brix jaggery syrup.

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

The moisture content was determined by using electronic moisture analyzer at 1050C by spreading a weighed sample (2g) in an aluminum sample holder and evaporated moisture losses were automatically expressed as percent moisture content. The values for iron content and titratable acidity was estimated according to Association of Official Analytical Chemists AOAC, 1965 [2] and AOAC, (1975) [1] respectively. Ascorbic acid, reducing sugars and total sugars were estimated by the method of Ranganna (1997) [18]. Anthocyanin was determined by the method of Harborne 1973 [5], and total phenols was determined by the procedure of Icier (2012) [6].

Results and Discussion

Moisture Content

The highest moisture content of 18.48 percent was recorded in treatment T7 (70 0 Brix jaggery syrup) and lowest 14.31percent in treatment T1 (Control) in Table 1. During storage period of three months the mean values of moisture content of osmo-dried karonda showed an increase trend from initial value of 16.47 to17.28 percent. The increase in moisture content during storage might be due to absorption of moisture from the atmosphere and relative humidity. Similar results were obtained by Suhasini *et al*., (2015) [22] in osmo-dried karonda and Rahman *et al*., (2012) [16] in osmo-dried jack-fruit slices.

Table 1: Effect of treatments and storage period on moisture content (percent) of osmo-dried karonda

Treatments	Storage period (months)				
	0	1	2	3	Mean (Treatments)
T1: Control	14.31	14.48	14.63	14.87	14.46
T2: Dipping in 50°Brix sugar syrup	16.00	16.30	16.65	16.80	16.43
T3: Dipping in 60°Brix sugar syrup	16.30	16.85	17.05	17.25	17.01
T4: Dipping in 70°Brix sugar syrup	16.90	18.07	18.51	18.75	18.39
T5: Dipping in 50°Brix jaggery syrup	16.16	16.35	16.70	16.85	16.51
T6: Dipping in 60°Brix jaggery syrup	17.15	17.30	17.49	17.55	17.37
T7: Dipping in 70°Brix jaggery syrup	18.48	18.55	18.76	18.90	18.67
Mean (Storage)	16.47	16.84	17.11	17.28	

Effect	CD (p=0.05)
Treatment (T)	0.06
Storage (S)	0.08
T × S	0.16

Titratable acidity

The highest titratable acidity of 5.15 percent was recorded in treatment T1 (Control) and the lowest of 3.48 percent in treatment T4 (70 0 Brix sugar syrup) in Table 2. On assessing the mean values titratable acidity decreased significantly, at 5percent level of significance from 3.80 to 3.51percent after three months of storage period. The decrease in acidity might be due to the variation of acid content in osmotically dehydrated karonda slices which in turn results from varying solid uptake and drying ratio of the product. Similar findings have been also reported by Suhasini (2014) [23] in osmo-dehydration of karonda and Singh *et al*., (2017) [19] in bale preserve and candy.

Table 2: Effect of treatments and storage period on titratable acidity (%) of osmo-dried karonda

Treatments	Storage period (months)				
	0	1	2	3	Mean (Treatments)
T1: Control	5.15	5.09	4.85	4.65	4.93
T2: Dipping in 50°Brix Sugar Syrup	3.58	3.51	3.47	3.10	3.41
T3: Dipping in 60°Brix Sugar Syrup	3.53	3.46	3.39	3.32	3.42
T4: Dipping in 70°Brix Sugar Syrup	3.48	3.43	3.37	3.30	3.39
T5: Dipping in 50°Brix Jaggery Syrup	3.67	3.60	3.52	3.46	3.56
T6: Dipping in 60°Brix Jaggery Syrup	3.64	3.56	3.49	3.41	3.52
T7: Dipping in 70°Brix Jaggery Syrup	3.60	3.52	3.45	3.36	3.48
Mean (Storage)	3.80	3.73	3.64	3.51	

Effect	CD (p=0.05)
Treatment (T)	0.08
Storage (S)	0.06
T × S	0.16

Ascorbic acid

The highest ascorbic acid content of 11.71 mg/100g was recorded in T2 (50 0 Brix sugar syrup) the lowest 5.05 mg/100g in T1 (Control) in Table 3. The mean values of ascorbic acid during the storage period decreased from 10.08 to 3.92 mg/100g. The ascorbic acid showed a decreasing trend in all the treatments over a storage period of three months. It is well explained that ascorbic acid is most sensitive to heat, so oxidized quickly in the presence of oxygen hence it might have been destroyed during processing and subsequently during storage as reported by Nayak *et al*., (2012) [13] in anole candy and Kuchi *et al*., (2014) [8] in guava jelly bar.

Table 3: Effect of treatments and storage period on ascorbic acid (mg 100g-1) of osmo-dried karonda

Treatments	Storage period (months)				
	0	1	2	3	Mean (Treatments)
T1: Control	5.05	4.81	3.15	1.71	3.68
T2: Dipping in 50°Brix Sugar Syrup	11.71	7.65	6.35	5.89	7.90
T3: Dipping in 60°Brix Sugar Syrup	11.35	7.93	5.65	4.42	7.33
T4: Dipping in 70°Brix Sugar Syrup	11.20	7.85	5.45	4.00	7.12
T5: Dipping in 50°Brix Jaggery Syrup	10.66	5.48	4.45	4.01	6.14
T6: Dipping in 60°Brix Jaggery Syrup	10.42	5.28	4.10	3.82	5.90
T7: Dipping in 70°Brix Jaggery Syrup	10.18	4.95	3.81	3.64	5.64
Mean (Storage)	10.08	6.27	4.70	3.92	

Effect	CD (p=0.05)
Treatment (T)	0.12
Storage (S)	0.16
T × S	0.32

Reducing sugars

The maximum and minimum reducing sugar content of 48.40 percent was recorded in T4 (70 0 Brix sugar syrup) and lowest value of 11.80 percent in treatment T1 (Control) in Table 4. On the basis of overall mean values, it was observed that reducing sugar content increased from 32.99 to35.68 during storage. This increase in reducing sugars during storage might be due to hydrolysis of polysaccharides and inversion of non-reducing sugars to reducing sugars. The results are in accordance with Priya and Khatkar (2013) [15] in anole preserve. Babariya *et al*., (2014) [3] also reported similar results during standardization of a recipe for the preparation of candy from unripe papaya.

Table 4: Effect of treatments and storage period on reducing sugars (%) of osmo-dried karonda.

Treatments	Storage period (months)				
	0	1	2	3	Mean (Treatments)
T1: Control	10.18	10.75	11.32	11.80	11.01
T2: Dipping in 50°Brix Sugar Syrup	28.25	29.11	30.18	31.25	29.69
T3: Dipping in 60°Brix Sugar Syrup	36.15	38.82	39.18	40.05	38.55
T4: Dipping in 70°Brix Sugar Syrup	48.40	48.35	49.12	50.20	49.01
T5: Dipping in 50°Brix Jaggery Syrup	26.25	27.12	28.36	29.15	27.72
T6: Dipping in 60°Brix Jaggery Syrup	34.40	35.23	36.45	37.05	35.78
T7: Dipping in 70°Brix Jaggery Syrup	47.32	48.08	49.12	50.32	48.71
Mean (Storage)	32.99	33.92	34.81	35.68	

Effect	CD (p=0.05)
Treatment (T)	0.18
Storage(S)	0.24
T×S	0.49

Total sugars

The highest amount of total sugar content of 53.18 percent was recorded in treatment T4 (70 0 Brix sugar syrup) and the lowest of 11.10 percent was observed inT1 (Control) in Table 5. The storage means values of the total sugar content of osmo-dried karonda increased significantly from 38.84 to 41.54 percent. The possible reason for gradual increase in total sugar during storage period could be explained by the fact that the polysaccharides might have converted into monosaccharides. The present findings are also in conformity with the reported works of Gupta (2007) who observed significant increase in total sugar in apricot and osmo-dehydrated beer during storage and Uppuluti *et al*., (2017) [24] in pineapple fruit slices.

Table 5: Effect of treatments and storage period on total sugars (%) of osmo-dried karonda

Treatments	Storage period (months)				
	0	1	2	3	Mean (Treatments)
T1: Control	11.10	11.45	12.00	12.32	11.71
T2: Dipping in 50° Brix Sugar Syrup	36.90	37.15	38.65	39.35	38.01
T3: Dipping in 60° Brix Sugar Syrup	43.25	44.35	45.60	46.25	44.86
T4: Dipping in 70° Brix Sugar Syrup	53.18	54.40	55.60	56.20	54.84
T5: Dipping in 50° Brix Jaggery Syrup	34.92	35.65	36.32	37.65	36.13
T6: Dipping in 60° Brix Jaggery Syrup	41.49	42.15	43.05	44.32	42.75
T7: Dipping in 70° Brix Jaggery Syrup	51.05	52.10	53.15	54.75	52.76
Mean (Storage)	38.84	39.60	40.62	41.54	

Effect	CD (p=0.05)
Treatment (T)	0.26
Storage (S)	0.35
T × S	0.70

Anthocyanin content

The highest anthocyanin content of 80.53mg/100g in osmo-dried karonda was recorded in T4 (70 0 Brix sugar syrup) while minimum value of 72.00 mg/100 g recorded in treatment T1 (Control) in Table 6. The mean values of anthocyanin content decreased from 71.54 to 70.77 mg/100 g during three months of storage The decrease in anthocyanin content might be due to the increase in browning due to lower activation energy of anthocyanin. These results are in accordance with Kumar (2013) [9] in osmo-dried karonda and similar observations of decrease in anthocyanin content was also supported by Singh (2014) [20] in value added products of karonda.

Table 6: Effect of treatments and storage period on anthocyanin (mg 100g-1) of osmo-dried karonda

Treatments	Storage period (months)				
	0	1	2	3	Mean (Treatments)
T1: Control	72.00	72.45	71.93	71.78	72.04
T2: Dipping in 50° Brix Sugar Syrup	64.16	64.00	63.90	63.82	63.97
T3: Dipping in 60° Brix Sugar Syrup	72.45	72.05	71.89	71.68	72.01
T4: Dipping in 70° Brix Sugar Syrup	80.53	80.10	79.90	79.88	80.10
T5: Dipping in 50° Brix Jaggery Syrup	62.16	61.93	61.79	61.55	61.85
T6: Dipping in 60° Brix Jaggery Syrup	70.20	69.79	69.45	68.01	69.36
T7: Dipping in 70° Brix Jaggery Syrup	79.32	79.00	78.89	78.82	78.98
Mean (Storage)	71.54	71.33	71.10	70.77	

Effect	CD (p=0.05)
Treatment (T)	0.18
Storage (S)	0.24
T×S	0.49

Total Phenols

The maximum total phenol content value of 349.12 mg/100g was recorded in treatment T7 (70 0 Brix jaggery syrup) whereas lowest value of 319.20 mg/100 g was recorded in treatment T2 (50 0 Brix sugar syrup) in Table 7.The decrease in total phenols during storage might be due to oxidation, degradation and the polymerization of phenolic compounds with proteins (Valera Santos et al., 2012) or might be due to their condensation in brown pigments. Similar findings were observed by Mondal *et al*., (2017) [10] in anole candy and was also supported by Munaza (2018) [12] while working on value added products from quince.

Table 7: Effect of treatments and storage period on total phenols (mg 100g-1 GAE) of osmo-dried karonda

Treatments	Storage period (months)				
	0	1	2	3	Mean (Treatments)
T1: Control	327.20	321.10	316.30	310.10	318.67
T2: Dipping in 50°Brix Sugar Syrup	319.20	314.10	311.05	307.25	312.90
T3: Dipping in 60°Brix Sugar Syrup	332.15	329.30	324.20	319.30	326.23
T4: Dipping in 70°Brix Sugar Syrup	341.10	336.02	331.50	328.10	334.18
T5: Dipping in 50°Brix Jaggery Syrup	324.20	321.08	317.10	312.10	318.62
T6: Dipping in 60°Brix Jaggery Syrup	338.12	334.05	328.15	323.05	330.84

T7: Dipping in 70°Brix Jaggery Syrup	349.12	341.20	335.30	330.12	338.93
Mean (Storage)	333.01	328.12	323.37	318.57	

Effect	CD (p=0.05)
Treatment (T)	0.16
Storage (S)	0.21
T × S	0.43

Iron content

The highest iron content of 35.58 percent was recorded in treatment T2 (50 0 Brix sugar syrup) and lowest 20.16 percent in treatment T1 (Control) in Table 8. During storage period of three months the mean values of moisture content of osmo-dried karonda showed an increase trend from initial value of 28.97 to 28.36 percent. The decrease in iron content during storage might be due to leaching from the product to the osmotic solution during osmotic process and chemical degradation during subsequent drying of potato slices in a sucrose / salt solution (Islam and Flink, 1982) [7]. Similar findings were also reported in osmotic dehydrated karonda by Suhasini *et al*, (2015) [22].

Table 8: Effect of treatments and storage period on iron content (mg 100g-1) of osmo-dried karonda

Treatments	Storage period (months)				
	0	1	2	3	Mean (Treatments)
T1: Control	20.16	19.90	19.65	19.15	19.71
T2: Dipping in 50°Brix Sugar Syrup	35.38	35.13	34.93	34.80	35.06
T3: Dipping in 60°Brix Sugar Syrup	28.05	27.91	27.75	27.40	27.77
T4: Dipping in 70°Brix Sugar Syrup	25.65	25.40	25.12	24.85	25.24
T5: Dipping in 50°Brix Jaggery Syrup	33.15	33.00	32.90	32.78	32.95
T6: Dipping in 60°Brix Jaggery Syrup	32.30	32.00	31.89	31.76	31.98
T7: Dipping in 70°Brix Jaggery Syrup	28.16	28.01	27.92	27.80	27.97
Mean (Storage)	28.97	28.76	28.59	28.36	

Effect	(p=0.05)
Treatment (T)	0.2
Storage (S)	0.3
T × S	NS

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 T4 (70 0 Brix sugar syrup) proved superior in terms of color, texture, taste and overall acceptability. The storability study revealed that osmo-dried karonda prepared with T4 (70 0 Brix 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.

Reference

1. AOAC. Official Methods of Analysis. Association of Official Analytical Chambers. 12th Edition, Washington, D.C., c1975.
2. AOAC. Official Methods of Analysis, Association of Official Agriculture Chemists, AOAC, Washington, DC., c1965.
3. Babariya VJ, Makwana AN, Hadwani M, Panjair N. Standardization of a recipe for the preparation of candy (tuti fruiti) from unripe papaya. The Asian Journal of Horticulture. 2014;9(1):94-99.
4. Gupta N. Studies on processing and preservation of ber, P h. D. thesis, Sher-e-Kashmir University of Agricultural, Sciences and Technology-Jammu, India. c2007.
5. Harborne JB. Phytochemical Methods. Chapman Hall, Toppan Co. Ltd., New York, USA, c1973.
6. Icier NC. Extraction of pomegranate peels phenolics with water and microencapsulation of the extracts. M. Sc. Thesis, Erciyes University, Turkey. c2012.
7. Islam MN, Flink LN. Dehydration of potato II – osmotic concentration and its effect on air drying behavior. Journal of Food Technology**.** 1982;17(3):387-403.
8. Kuchi VS, Gupta R, Gupta R, Tamang S. Standardization of recipe for preparation of guava jelly bar. Journal of Crop and Weed. 2014;10(2):77-81.
9. Kumar N. Optimization of method for the preparation of osmo-dried plum (*Prunus salicina* L.). M.Sc. Thesis submitted to College of Horticulture Dr Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Solan - 173 230 (H P), India, c2013.
10. Mondal SC, Kamal Md M, Mumin MIA Md, Hosain M, Ali Md R. Effect of sucrose on the physicochemical properties, organoleptic qualities and shelf-life stability of aonla (*Emblica officinalis*) candy. Journal of Environmental Science, Toxicology and Food Technology. 2017;11(12):2319-2402.
11. Mondhe DS, Gupta SK Hand T, Alam MS. Drying kinetics of osmotically treated papaya (*Carica papaya* L.). Green farming Vol. 2012;4(1):103-105.
12. Munaza B. Optimization of drying conditions for development of value-added products from quince (*Cydonia oblonga* Miller). Thesis submitted to Sher-e-Kashmir University of Agricultural Science and Technology, Jammu, c2018.
13. Nayak P, Tandon DK, Bhatt DK. Study on changes of nutritional and organoleptic quality of flavored candy prepared from anole (*Embolic officinalis* G.) during storage. International Journal of Nutrition and Metabolism. 2012;4(7):100-106.
14. Pattanapa K, Therdthai N, Chantrapornchai W, Zhou W. Effect of sucrose and glycerol mixtures in the osmotic

solution on characteristics of osmotically dehydrated mandarin cv. (Sai- Kamphaeng). International Journal of Food Science and Technology. 2010;45:1918-1924.

15. Priya MD, Khatkar BS. Effect of processing methods on keeping quality of aonla (*Emblica officinalis* Gaertn.) preserve. International Food Research Journal. 2013;20(2):617-622.
16. Rahman MM, Miaruddin M, Chowdhary MGF, Khan MHH, Muzahid -e- Rahman M. Preservation of Jackfruit (*Artocarpus heterophyllus*) by osmotic dehydration. Bangladesh Journal of Agricultural Research. 2012;37(1):67-75.
17. Raj D, VC Subanna, OP Ahlawat, P Gupta, AG Huddar. Effect of treatments on the quality characteristics of dehydrated onion rings during storage. Journal of food Science and Technology. 2006;43(6):571-574.
18. Ranganna S. Handbook of analysis and quality control for fruit and vegetable products second edition. Tata Mc Graw-Hill Publishing New Delhi, c1997.
19. Singh AK, Chaurasya AK, Mitra S. Quality attributes of bale preserve and candy. International Food Research Journal. 2017;24(1):298-30.
20. Singh S. Studies on storage of pulp and value added products of plum **(***Prunus salicina* L). Ph.D. Thesis submitted to Chaudhary Charan Singh Haryana Agricultural University (Haryana), c2014.
21. Suhasini L, Vanajalatha K, Padamavathama AS, Rao V. Physic-chemical properties of osmotically dehydrated karonda (*Carissa carandas* L.). Asian Journal of Horticulture. 2015;10(1):53-59.
22. Suhasini L, Vanajalatha K, Padamavathama AS, Rao V. Physic-chemical properties of osmotically dehydrated karonda (*Carissa carandas* L.). Journal of Environment and Ecology. 2015;34(1a):267-270.
23. Suhasini L. Studies on osmotic dehydration of karonda (*Carissa carandas* L.). B. Sc. Thesis, Dr. Y.S.R. Horticultural University, Andhra Pradesh, India, c2014.
24. Uppuluti A, Deb P, Reshmi PN. Study on quality analysis of osmotic dehydrated pineapple slices. The Pharma Innovation Journal. 2017;6(12):159-162.
25. Valera-Santos E, Ochoa-Martinez A, Tabilo-Munizaga G, Reyes JE, Perez Won M, Briones Labarca V. Effect of high hydrostatic pressure processng on physiochemical properties, bioactive compounds and shelf-life of pomegranate juice**.** Innovative Food Science Emerging Technology. 2012;13:13-22.