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Effect of different genotypes and solutions on sensory evaluation of osmotically dehydrated Karonda (*Carissa carandas* L.)

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Abstract:
An experiment was conducted to study the effect of different genotypes and solutions on sensory evaluation like texture, taste, colour, aroma and overall acceptability of osmotically dehydrated karonda genotypes viz. Pink and Green, during 90 days of storage. The osmotically dehydrated karonda was studied while subjected to various osmotic solutions like sugar and jaggery having different concentrations viz. 50 ºBrix, 60 ºBrix and 70 ºBrix. The results revealed that, there was a gradual decrease in sensory score of osmotically dehydrated karonda during 90 days of storage. The treatment combination G_2S_3 (Green genotype + 70 °Brix sugar solution) scored highest with respect to texture, taste, colour, aroma and overall acceptability. The present investigation revealed that among the different genotypes and osmotic solutions tested, G_2 (green genotype) in combination with S_3 (70 ºBrix sugar solution) was the most effective for preparing osmotically dehydrated karonda. This is due to more consumer acceptability to the treatment combination G_2S_3 (Green genotype + 70 °Brix sugar solution) during 90 days of storage. These findings suggest that osmotically dehydrated karonda can be preserved effectively for up to 90 days without major deterioration in quality, making it a promising ingredient for developing value-added products with extended shelf life and nutritional benefits.

Keyword: Karonda, Osmotic dehydration, Genotype, Sugar, Jaggery

Introduction

Karonda (*Carissa carandas* L.) belongs to the family Apocynaceae with a chromosome number 2n=22 which is a native plant of Indo-Malaysia is best known for its fruits, which contain about 75 per cent juicy edible pulp. Because of its high moisture content and fragile flesh, karonda has a very limited shelf life one week at 13 °C and 95% relative humidity (Mitra *et al.,* 2010). Fruits are valuable sources of essential vitamins and minerals. However, due to inadequate preservation and storage facilities, they often spoil before being consumed. Osmotic dehydration is a process that partially removes water from fruit tissues by soaking them in an osmotic solution. This technique is beneficial for extending shelf life, reducing energy costs and enhancing the sensory, nutritional and organoleptic qualities of food (Khan, 2012). For the dehydration of fruit like karonda, the osmotic solutions with concentration ranging from 50-70 ºBrix have been used. The ideal osmotic agents are sugar and jaggery solution since they stabilize pigments, helps to retain volatile components during the drying process of osmotically treated materials and decreases browning by blocking oxygen entry (Pattanapa *et al.,* 2010).

Material and Methods

The present experiment entitled "Studies on osmotic dehydration of karonda genotypes viz. Pink and Green" was carried out at Post Graduate Laboratory, Department of Horticulture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani (MS) in order to study the physico-chemical characters of osmotically dehydrated karonda. An experiment was laid out on Factorial Completely Randomized Design (FCRD) with two replications. The experiment was conducted during the year 2024-25.

Treatment details:

Factor A: Genotypes (G)

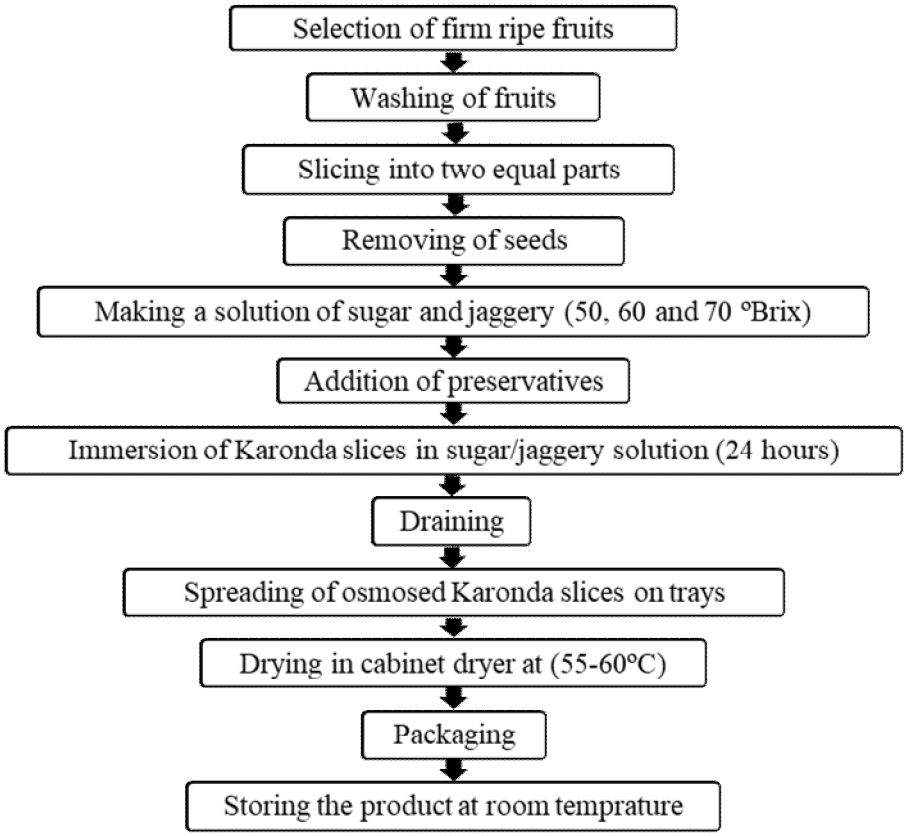
1. Pink genotype (G_1)
2. Green genotype (G_2)

Factor B: Solutions (S)

1. 50 ºBrix sugar solution (S_1)
2. 60 ºBrix sugar solution (S_2)
3. 70 ºBrix sugar solution (S_3)
4. 50 ºBrix jaggery solution (S_4)
5. 60 ºBrix jaggery solution (S_5)
6. 70 ºBrix jaggery solution(S_6)
7. Control (S_7)

Treatment	Combinations	Details
T_1	G_1S_1	Pink genotype + 50 ºBrix sugar solution
T_2	G_1S_2	Pink genotype + 60 ºBrix sugar solution
T_3	G_1S_3	Pink genotype + 70 ºBrix sugar solution
T_4	G_1S_4	Pink genotype + 50 ºBrix jaggery solution
T_5	G_1S_5	Pink genotype + 60 ºBrix jaggery solution
T_6	G_1S_6	Pink genotype + 70 ºBrix jaggery solution
T_7	G_1S_7	Pink genotype + Control
T_8	G_2S_1	Green genotype + 50 ºBrix sugar solution
T_9	G_2S_2	Green genotype + 60 ºBrix sugar solution
T_{10}	G_2S_3	Green genotype + 70 ºBrix sugar solution
T_{11}	G_2S_4	Green genotype + 50 ºBrix jaggery solution
T_{12}	G_2S_5	Green genotype + 60 ºBrix jaggery solution
T_{13}	G_2S_6	Green genotype + 70 ºBrix jaggery solution
T_{14}	G_2S_7	Green genotype + Control

Procedure of osmotic dehydration of karonda



Results and Discussion

Table 1: Physical characters of karonda fruits

Sr. No.	Parameter	Genotype	
		Pink	Green
1	Weight (g)	5.26	5.61
2	Length (cm)	2.28	2.55
3	Diameter (cm)	1.74	1.96
4	Volume (cm^3)	5.00	5.46
5	Shape	Oval	Oval
6	Colour	Pinkish white	Greenish purple
7	No. of seeds per fruit	5	6

*Each value is an average of five determinations.

Table 2: Chemical characters of karonda fruits

Sr. No.	Parameter	Genotype	
		Pink	Green
1	TSS (°Brix)	7.2	7.6
2	Moisture content (%)	90.13	88.74
3	Acidity (%)	4.03	3.21
4	Ascorbic acid (mg/100g)	11.75	12.35
5	Total sugar (%)	5.62	6.17
6	Reducing sugar (%)	4.25	4.45
7	Non-reducing sugar (%)	1.37	1.72
8	Anthocyanin (mg/100g)	54.81	51.25

9	Iron content (mg/100g)	7.76	8.28

*Each value is an average of five determinations.

Physical characters of karonda fruits

The physical characters of karonda fruits were represented in Table 1. The green genotype exhibited a slightly higher fruit weight (5.61 g) compared to the pink (5.26 g). The length of fruit observed higher in green genotype (2.55 cm) as compared to pink (2.28 cm). Similarly, the diameter of fruit was higher in green genotype (1.96 cm) compared to pink (1.74 cm). The fruit volume followed a similar trend, with the green fruits having a slightly higher volume (5.46 cm^3) compared to the pink fruits (5.00 cm^3). Both genotypes had an oval shape. There was a notable difference in coloration. The pink genotype fruits were showed as pinkish white, whereas the green genotype showed a greenish purple hue. The green genotype had a slightly higher number of seeds per fruit (6) as compared to the pink genotype (5).

The above observations confirm that green genotype fruit had larger size compare to pink genotype fruit. Similar results regarding physical characters of karonda fruit was reported by Singh and Bajpai (2009) [11], Bons and Paul (2020) [1] and Hegde *et al.* (2020) [2].

Chemical characters of karonda fruits

The chemical characters of karonda fruits were represented in Table 2. The chemical characters of Karonda fruits were observed from both pink and green genotypes. The Total Soluble Solids (TSS) were found to be slightly higher in the green genotype (7.6ºBrix) compared to the pink (7.2ºBrix). The moisture content was higher in the pink (90.13%) as compared to green (88.74%). The acidity was observed to be higher in the pink genotype (4.03%) compared to the green (3.21%). The ascorbic acid content was slightly greater in the green genotype (12.35 mg/100g) compared to pink (11.75 mg/100g). In terms of sugar content, the green fruits recorded higher reducing, non-reducing and total sugar as compared to pink. Anthocyanin content found slightly more in pink genotype (54.81 mg/100g) compared to Green (51.25 mg/100g). Lastly, the iron content was also found to be higher in the green genotype (8.28 mg/100g) as compared to pink genotype (7.76 mg/100g).

Overall, the green genotype exhibited slightly superior chemical characters in comparison to the pink genotype. Similar trends regarding chemical characters of karonda fruit was reported by Hiregoudra *et al.* (2012) [3], Suhasini (2015) [12] and Hegde *et al.* (2020) [2].

Sensory evaluation: Osmotically dehydrated karonda were evaluated for their sensory qualities. Sensory scores were obtained for texture, taste, colour, aroma as well as overall acceptability. Scores ranged from 9 - Like extremely, 8 - Like very much, 7 - Like moderately, 6 - Like slightly, 5 - Neither like nor dislike, 4 - Dislike slightly, 3 - Dislike moderately, 2 - Dislike very much and 1 - Dislike extremely. It was observed that as the storage period increases the sensory attributes like, texture, taste, colour and aroma and overall acceptability of osmotically dehydrated karonda decreased considerably.

Texture

The texture of osmotically dehydrated karonda was significantly influenced by different genotypes and solutions were presented in Table 3. The texture was best in G_2S_3 (Green genotype + 70 ºBrix sugar solution) scored 8.96, 8.82, 8.52 and 8.24 at 0, 30, 60 and 90 days of storage period, respectively. Whereas, the lowest texture score was observed in G_1S_7 (Pink genotype + Control) recording, 5.51, 5.29, 5.11 and 4.85 at 0, 30, 60 and 90 days, respectively. The result found that during 3 months of storage the texture score of G_2S_3 (Green genotype + 70ºBrix) was found superior over all the treatments. The texture of the osmotically dehydrated karonda exhibited a decreasing trend across all treatments during the 90 days of storage period. The osmotically dehydrated karonda prepared using sugar solution received the highest texture score compared to the one prepared with jaggery solution. Similar

results were reported by Verma et al. (2023B) [13] in osmo-dried karonda.

Taste

Taste of osmotically dehydrated karonda was significantly affected by different genotypes and solutions were presented in Table 4. The taste was best in G_2S_3 (Green genotype + 70 ºBrix sugar solution) scored 8.96, 8.84, 8.70 and 8.41 at 0, 30, 60 and 90 days of storage period, respectively. Whereas, the lowest taste score was observed in G_1S_7 (Pink genotype + Control) recording, 5.45, 5.29, 5.08 and 4.90 at 0, 30, 60 and 90 days, respectively. Taste score of G_2S_3 (Green genotype + 70 ºBrix sugar solution) was found superior over remaining treatments during 90 days of storage. Taste score of the osmotically dehydrated karonda exhibited a decreasing trend across all treatments during the 90 days of storage period. The osmotically dehydrated karonda prepared from sugar syrup scored highest taste as compared to jaggery based osmotically dehydrated karonda. Similar findings were reported by Madan and Dhawan (2005) [6] in carrot candies and Verma et al. (2023B) [13] in their study on osmo-dried karonda.

Colour

Colour of osmotically dehydrated karonda was significantly affected by different genotypes and solutions were presented in Table 5. The colour score was maximum in G_2S_3 (Green + 70 ºBrix sugar solution) recording, 8.95, 8.79, 8.68 and 8.50 at 0, 30, 60 and 90 days of storage period, respectively. Whereas, the lowest colour score was observed in G_1S_7 (Pink + Control) recording, 5.30, 5.15, 4.95 and 4.76 at the same storage intervals. The colour score of osmotically dehydrated karonda decreased throughout the entire storage period. This reduction in colour may be attributed to browning reaction occurring within the product. Initially, the high organoleptic score for colour could be due to the glossy appearance imparted by the surface coating of sugar or jaggery. The osmotically dehydrated karonda prepared by using sugar solution received the highest colour score compared to the one prepared with jaggery solution. However, during storage, the decline in colour score may also be influenced by the adsorption of atmospheric moisture, which affects the visual quality of the product reported by Nazaneen et al. (2015) [9] in osmotically dehydrated pineapple cubes.

Aroma

Different genotypes and solutions had a significant effect on aroma of osmotically dehydrated karonda at all the storage intervals which is presented in Table 6. The aroma was best in G_2S_3 (Green genotype + 70 ºBrix sugar solution) scored, 8.98, 8.81, 8.60 and 8.38 at 0, 30, 60 and 90 days of storage period, respectively. Whereas, the lowest aroma score was observed in G_1S_7 (Pink genotype + Control) recording, 5.33, 5.29, 5.08 and 4.90 at 0, 30, 60 and 90 days, respectively. The osmotically dehydrated karonda prepared using sugar solution received the highest aroma score compared to the one prepared with jaggery solution. The reduction in aroma score of osmotically dehydrated karonda during storage may be primarily attributed to the oxidation of ascorbic acid. During storage, especially under suboptimal packaging or humid conditions, ascorbic acid can be oxidized to dehydroascorbic acid and further degraded into diketogulonic acid and other volatile compounds. These degradation products not only lead to a reduction in the nutritive value of the product but also contribute to off-flavours, thereby diminishing the perceived aroma quality. Similar results reported by Mamatha (2016) [7] in osmotically dehydrated banana slices and Khekare (2020) [5] in karonda candy.

Overall acceptability

Different genotypes and solutions had a significant effect on ascorbic overall acceptability of osmotically dehydrated karonda at all the storage intervals which is presented in Table 7. Based on mean score for overall acceptability, the maximum overall acceptability was observed in G_1S_3 (Green genotype + 70 ºBrix sugar solution) recording, 8.96, 8.81, 8.62 and 8.38 at 0, 30, 60 and 90 days of storage period, respectively. However, it was minimum in G_1S_7 (Pink genotype + Control) recording, 5.40, 5.25, 5.05

and 4.85 at 0, 30, 60 and 90 days, respectively. From the present study, it is evident that an optimal dried product will result with low final moisture content and reasonably sweet product which is acceptable to consumers in terms of colour, aroma, taste and texture. More sugar intake in highly concentrated solution increased the sweetness and consumer acceptability of the osmo-air dried fruit products. The samples having high contents of sugars had higher overall acceptability. The overall acceptability found decreasing during storage. The results obtained in the present study are in line with Madan and Dhawan (2005) [6] in carrot candies, Khekare (2020) [5] in karonda candy & Verma et al. (2023B) [13] in osmo-dried karonda.

Table 3: Effect of different genotypes and solutions on texture of osmotically dehydrated karonda

Treatment	Texture			
	Storage period (Days)			
	0	**30**	**60**	**90**
G_1S_1	7.89	7.63	7.44	7.18
G_1S_2	8.50	8.22	7.99	7.80
G_1S_3	8.73	8.50	8.31	8.09
G_1S_4	6.90	6.71	6.48	6.30
G_1S_5	7.81	7.51	7.29	7.09
G_1S_6	8.14	7.90	7.68	7.43
G_1S_7	5.51	5.29	5.11	4.85
G_2S_1	8.60	8.30	8.08	7.82
G_2S_2	8.78	8.61	8.33	7.96
G_2S_3	8.96	8.82	8.52	8.24
G_2S_4	7.87	7.66	7.48	7.37
G_2S_5	8.59	8.35	8.19	8.00
G_2S_6	8.92	8.72	8.44	8.13
G_2S_7	5.70	5.40	5.20	5.06
SE (m)±	**0.05**	**0.02**	**0.05**	**0.05**
CD at 5%	**0.14**	**0.07**	**0.15**	**0.14**

Table 4: Effect of different genotypes and solutions on taste of osmotically dehydrated karonda

Treatment	Taste			
	Storage period (Days)			
	0	**30**	**60**	**90**
G_1S_1	7.84	7.67	7.51	7.30
G_1S_2	8.41	8.26	8.07	7.86
G_1S_3	8.63	8.38	8.20	7.96
G_1S_4	6.87	6.67	6.42	6.24
G_1S_5	7.73	7.42	7.18	6.99
G_1S_6	8.06	7.93	7.70	7.50
G_1S_7	5.45	5.29	5.08	4.90
G_2S_1	8.75	8.51	8.28	8.10
G_2S_2	8.85	8.71	8.48	8.34
G_2S_3	8.96	8.84	8.70	8.41
G_2S_4	7.85	7.65	7.50	7.30
G_2S_5	8.81	8.67	8.40	8.32

G_2S_6	8.91	8.80	8.65	8.38
G_2S_7	5.82	5.66	5.35	5.17
SE (m)±	**0.04**	**0.04**	**0.05**	**0.05**
CD at 5%	**0.12**	**0.13**	**0.14**	**0.14**

Table 5: Effect of different genotypes and solutions on colour of osmotically dehydrated karonda

Treatment	**Colour**			
	Storage period (Days)			
	0	**30**	**60**	**90**
G_1S_1	7.89	7.72	7.40	7.22
G_1S_2	8.23	8.06	7.90	7.71
G_1S_3	8.56	8.40	8.21	8.06
G_1S_4	6.93	6.69	6.39	6.15
G_1S_5	7.33	7.11	6.91	6.72
G_1S_6	7.80	7.55	7.33	7.15
G_1S_7	5.30	5.15	4.95	4.76
G_2S_1	8.82	8.62	8.30	8.14
G_2S_2	8.87	8.67	8.48	8.33
G_2S_3	8.95	8.79	8.68	8.50
G_2S_4	7.87	7.67	7.49	7.31
G_2S_5	8.61	8.41	8.19	7.99
G_2S_6	8.89	8.70	8.50	8.36
G_2S_7	5.82	5.69	5.47	5.31
SE (m)±	**0.04**	**0.04**	**0.04**	**0.04**
CD at 5%	**0.11**	**0.13**	**0.14**	**0.12**

Table 6: Effect of different genotypes and solutions on aroma of osmotically dehydrated karonda

Treatment	**Aroma**			
	Storage period (Days)			
	0	**30**	**60**	**90**
G_1S_1	7.90	7.68	7.51	7.29
G_1S_2	8.53	8.25	8.08	7.86
G_1S_3	8.75	8.38	8.20	7.96
G_1S_4	6.91	6.67	6.42	6.23
G_1S_5	7.71	7.40	7.18	6.99
G_1S_6	8.60	7.93	7.70	7.50
G_1S_7	5.33	5.29	5.08	4.90
G_2S_1	8.69	8.51	8.27	8.12
G_2S_2	8.80	8.62	8.40	8.16
G_2S_3	8.98	8.81	8.60	8.38
G_2S_4	7.84	7.65	7.50	7.30
G_2S_5	8.61	8.47	8.24	8.09
G_2S_6	8.86	8.80	8.55	8.28
G_2S_7	5.82	5.66	5.35	5.17
SE (m)±	**0.04**	**0.05**	**0.05**	**0.04**
CD at 5%	**0.13**	**0.14**	**0.15**	**0.13**

Table 7: Effect of different genotypes and solutions on overall acceptability of osmotically dehydrated karonda

Treatment	Overall acceptability			
	Storage period (Days)			
	0	**30**	**60**	**90**
G_1S_1	7.88	7.67	7.46	7.24
G_1S_2	8.41	8.20	8.01	7.80
G_1S_3	8.67	8.41	8.23	8.01
G_1S_4	6.90	6.68	6.42	6.23
G_1S_5	7.64	7.36	7.14	6.94
G_1S_6	8.15	7.83	7.60	7.39
G_1S_7	5.40	5.25	5.05	4.85
G_2S_1	8.71	8.48	8.23	8.04
G_2S_2	8.82	8.65	8.42	8.19
G_2S_3	8.96	8.81	8.62	8.38
G_2S_4	7.85	7.66	7.49	7.32
G_2S_5	8.65	8.47	8.25	8.10
G_2S_6	8.89	8.75	8.53	8.29
G_2S_7	5.79	5.60	5.34	5.17
SE (m)±	**0.03**	**0.02**	**0.02**	**0.04**
CD at 5%	**0.09**	**0.07**	**0.06**	**0.13**

Conclusion:

The study revealed that the sensory quality of osmotically dehydrated karonda specifically texture, taste, colour, aroma and overall acceptability was gradually declined over the 90-day storage period. However, among all treatment combinations, G_2S_3 (Green genotype + 70 °Brix sugar solution) consistently achieved the highest sensory scores at all storage intervals, indicating superior product quality and better consumer acceptability. This was followed by treatment combination G_2S_6 (Green genotype + 70 °Brix sugar solution). In contrast, G_1S_7 (Pink genotype + control) recorded the lowest sensory ratings, reflecting poor product quality. These findings provide a clear recommendation for processors and farmers: adopting the green genotype and 70 °Brix sugar solution treatment (G_2S_3) can yield high-quality osmo-dried karonda while maximizing profitability. This approach promotes value addition and income enhancement in karonda processing.

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