INDIAN JOURNAL OF
ARID HORTICULTURE
2018, Vol. 13 (1-2):42-49

Study on changes of nutritional quality of different *karonda* (*Carissa carandas*) processed products during storage

Lalit Kumar[1], R. N. Singh[2] and Gajanand Jat[3]
Amar Singh P.G. College, Lakhawati, Bulandsahar (UP)
Choudhary Charan Singh University, Meerut (UP))
[1]Fertilizer Association of India, New Delhi
[2]Ex- Reader, Amar Singh P.G. College, Lakhawati, Bulandsahar (UP)
[3]Assistant Professor (Soil Science), Rajasthan College of Agriculture, Udaipur (Rajasthan)
(Received: 13.02.2017; Accepted: 23.04.2018)

Abstract

Karonda is an important crop indigenous to India which is used in alternative medicine, health foods and herbal products. It has good potential in processed forms but little information is available on changes of nutritional quality of different karonda processed products during storage. Therefore, the present investigation was carried out to study the changes of nutritional quality of different karonda processed products during storage. Four products were made from karonda viz., jelly, jam, candy and squash, stored for 120 days and analyzed biochemically. The four months storage study revealed that across all the products the total soluble solids, acidity, reducing sugar, total sugar and browning was found to increased significantly from the initial mean values of 67.5 ^{o}Brix, 0.35%, 25.9%, 61.7% and 0.38 O.D. of fresh products to the final value of 74.2 ^{o}Brix, 2.11%, 31.8%, 63.3% and 0.44 O.D. at the end of storage, respectively. While, the non reducing sugar, ascorbic acid, moisture content and anthocyanin content of various karonda products were decreased significantly from the initial mean values of 33.6%, 3.53 mg/100g, 4.86%, and 2.39 mg/100g of fresh products to the final value of 29.4%, 1.76 mg/100g, 1.83%, and 0.99 mg/100g at the end of storage, respectively. Across all the products, an increasing trend in bacterial and fungal count was recorded up to 120 days of storage as compared to fresh products. Minimum bacterial (1.84 x 10^5 cfu/g) and fungal count (2.09 x 10^4 cfu/g) was obtained in fresh products and it was increased to 7.37 x 10^5 cfu/g bacteria and 9.78 x 10^4 cfu/g fungi in 120 days of storage.

Key words: Karonda, nutritional quality, processed products, storage

Introduction

Karonda (*Carissa carandas* L.) is an underutilized indigenous fruit crop of India, thrives well throughout tropics and sub-tropics of the world and arid and semi-arid areas of the country. It can also flourish well on problematic soils, particularly on highly saline and alkaline soils. Fruit is slightly sour and astringent in taste, therefore, it is not popular as dessert fruit but it is rich source of essential vitamins and minerals required for adequate human health. It is rich source of iron and vitamin C and therefore, very useful for curing anemia and has antiascorbutic properties. The ripe fruit have antioxidant properties and reported to be useful in bilious (Watt, 1972), cough, diabetes, leprosy, anemia and intestinal worming (Vasu, 1986).

Besides its nutritional and medicinal importance, the karonda fruit has good potential of processing and has potential for export as fresh fruits and processed products such as preserve jam, candy, juices, pickles etc (Chandra and Jindal, 2001). Karonda becomes ready for harvesting from mid November to first week of January. Since, it is a perishable commodity, it needs quick disposal. The post harvest losses in karonda vary from 30-40 %. Huge harvest of the produce during peak harvesting season creates glut and the growers are compelled to sale their produce at low prices which reduces the markets value of the fruit. Hence, value addition through processing would be the only effective tool for economic utilization of karonda. Besides, being acidic in nature karonda is not consumed as fresh and not popular as table fruit. Since, karonda is a seasonal fruit, its preservation in different products is necessary to avoid its spoilage and to make its availability round the year (Parvathi and Anby, 1997). Both unripe and ripe fruits are processed into a number of value added products.

The storage of fresh karonda fruits for longer time is not quite feasible. Therefore, storage in the form of processed products is more feasible. Also, longer shelf life of value added products of karonda (candy, squash, jelly and jam) is important from consumers and marketing point of view.Little attempts have been made to study the shelf life of processed products of karonda fruit. Keeping these points in view, the present investigation was undertaken to study the storage stability, non-enzymatic browning, anthocyanin content and microbial growth in processed products of karonda.

Materials and Methods

The present investigation was conducted at the Post-harvest Technology Laboratory, Department of Horticulture and Food Processing, Uttar Pradesh, Saharanpur, India, during June to November, *2007 and 2008*. Healthy and matured karonda fruits of two genotypes viz., 'White with Pink blush' and 'Green with Purple blush' were used in experiments. The data of the experiment was statistically analyzed using randomized block design with three replications. In case of two treatments, sample means were compared using the't' test (Chandel, 1991). One kilogram mature fruits each of 'Pink with White blush' and 'Green with Purple blush' genotypes were taken for assessing the biochemical analysis. For biochemical analysis, fruit pulp from both genotypes was taken for estimating various parameters like total soluble solids (TSS) (oBrix), acidity (%), ascorbic acid (mg/100 g), moisture content (%), reducing sugar (%), non-reducing sugar (%), total sugar (%) and anthocyanin (mg/100 g). TSS was determined by hand refractometer. The acidity was measured by using standard solutions of pH 4.0 and 7.0 as reference to calibrate. The ascorbic acid content of karonda pulp was estimated by visual titration method (Freed, 1966) and the moisture content was determined according to AOAC (1970) method. Reducing sugar, non-reducing sugar and total sugars were estimated by volumetric method (Gauri Shankar, 1999). Total *anthocyanins* were determined by the procedure of Fuleki and Francis, 1968.

Four products were made from karonda *viz.*, candy, squash, jelly and jam. Different processed products were prepared by standardized recipes. Glass bottles were used as packaging material for storage of jelly, jam, candy and squash for different periods. Karonda products were stored for 120 days at ambient temperature and the biochemical and microbial analysis was done at each month interval. Both bacterial as well as fungal counts were done at each storage periods. Serial dilutions of the processed products were made using sterilized buffer medium. Products (Jelly, Jam, Candy and Squash) were diluted to four dilutions 10^1, 10^2, 10^3 and 10^4 for bacterial and three dilutions 10^1, 10^2 and 10^3 for fungi. A sample of 1.0 ml from each dilution was transferred into sterilized Petri-plates containing 20 ml solidified media and spread uniformly over the entire surface with the help of sterilized bent glass rod. The petri plates were allowed to dry at least for 15 minutes prior to inversion of Petri plates in B. O. D. for incubation at 30^0C for 24 hours. After 24 hours of incubation, the population of bacteria and fungus were counted and it was expressed as colony forming unit (cfu) per g of sample as per following formula-

Organism c.f.u/g of sample = No. Of colonies (Avg. of 3 replicates)/ Amount paired x dilution

Result and Discussion

Biochemical analysis of karonda fruits

Studies on biochemical characters of karonda genotypes showed a significant range of variability in TSS, moisture, reducing sugar, total sugar and anthocyanin content (Table 1). Green with Purple blush genotype was recorded higher TSS (7.27 ^{0}Brix), acidity (3.67%), ascorbic acid (14.23 mg/100 g), reducing sugar (4.86%), non-reducing sugar (1.81%), total sugar (6.49%) and anthocyanin content (6.85 mg/100 g) than Pink with White Blush genotype which contains 6.26 ^{0}Brix TSS, 3.32% acidity, 12.26 mg/100g ascorbic acid, 4.02% reducing sugar, 1.51% non-reducing sugar, 5.36% total sugars and 2.47 mg/100 g anthocyanin. Pink with White Blush genotype was recorded highest moisture (77.52 %) than Green with Purple genotype containing 70.52 % moisture. The differences in chemical characters of fruits in present investigation may be due to the differences in locations, fruit maturity and genotypes (Singh *et al.*, 2006).

Storage stability of processed products of karonda

Total Soluble Solids (TSS)

The data (Table 2) indicate that TSS of candy, squash, jelly and jam increased slightly during storage. The TSS content in the original fruit was found to be 6-7 ^{0}Brix and the moisture content in fresh fruit was 70-80%. However, the average TSS content of the processed products (candy, squash, jelly and jam) during storage was found to be increased from 67.4 ^{0}Brix of fresh to 74.2 ^{0}Brix at 120 days of storage. Maximum mean TSS content of all the four products (74.2 ^{0}Brix) was recorded at 120 days of storage period and it was

Table 1. Biochemical character of karonda genotypes (mean of 2 years)

Genotypes	TSS (^{o}Brix)	Acidity (%)	Ascorbic acid (mg/100 g)	Moisture Content (%)	Reducing Sugar (%)	Non-Reducing sugar (%)	Total Sugar (%)	Anthocyanin (mg/100 g)
Green with Purple Blush	7.27	3.67	14.23	70.52	4.86	1.82	6.49	6.85
Pink with White Blush	6.26	3.32	12.26	77.52	4.02	1.51	5.36	2.47
Mean	6.77	3.5	13.25	74.02	4.44	1.67	5.93	4.66
Observed value of t	14.82	1.74	4.01	14.82	4.91	2.53	4.13	9.13
Table value of t at 5%	4.03	4.03	4.03	4.03	4.03	4.03	4.03	4.03
Result	S	NS	NS	S	S	NS	S	S

10.0% higher over initial (0 days) mean TSS content of the products (67.4 ^{0}Brix). Hydrolysis of polysaccharides of processed products of fruits during storage may be possible reason for increase in TSS. Dhawan and Gupta (1996) also reported a significant increase in TSS in storage, which might be due to the conversion of some of the insoluble fraction into soluble fraction.

Acidity

The results indicate that titrable acidity of various karonda products increased significantly during storage (Table 3). On comparing the acidity of different products with the fresh fruit, it was found that there was general loss in acidity due to processing. On the basis of mean values, at the end of storage period the maximum acidity was recorded in jelly (3.74%) and the minimum in squash (1.34%) which was 1000 and 415.3%, respectively higher over their initial acidity. Maximum mean acidity of all the four products (2.11) was recorded at 120 days of storage period and it was 502.8% higher over initial mean acidity of the products (0.35%). Degradation of pectin substances have been reported for increased acidity in fruit products (Conn and Stumf, 1976). The significant interaction between different karonda products and storage periods was recorded with respect to acidity.

Ascorbic Acid

The results (Table 4) indicate that ascorbic acid content of various karonda products decreased significantly during storage. In general the processing of the fruits through various recipes employed for preparation of karonda products (candy, squash, jelly and jam) resulted in remarkable loss of ascorbic acid content from a value of 12 to 14 mg/100 g of fresh fruit to an average value of 3.53 mg/100 g of fresh products. The final products obtained after 120 days of storage were found to contain ascorbic acid ranging from 3.31 to 0.22 mg/100 g. Similarly, the average ascorbic acid content diminished from 3.53 to 1.76 mg/100 g amongst various products. The maximum initial ascorbic acid content was recorded in candy (4.32 mg/100 g) followed by jam (4.25 mg/100 g), squash (2.89 mg/100 g) and jelly (2.68 mg/100 g). On the basis of mean values, at the end of storage period the maximum ascorbic acid was recorded in candy (3.31 mg/100 g) and the minimum in jelly (0.88 mg/100 g) which was 30.5 and 204.5%, respectively reduced over their initial ascorbic acid content. Minimum mean ascorbic acid content of all the four products (1.76 mg/100 g) was recorded at 120 days of storage period and it was 100.6% lower over initial mean ascorbic acid of the products (3.53 mg/100 g).The significant interaction between different karonda products and storage periods was recorded with respect to ascorbic acid content. Reduction in ascorbic acid content could be due to oxidation by trapped oxygen in container which resulted in formation of dehydro- ascorbic acid. Present findings are similar to those of Maciel *et al.* (1999) in acerola jelly and Singh and Singh (1994) in litchi squash.

Moisture content

The results (Table 5) indicate that moisture content of various karonda products decreased significantly during storage. In general, the processing of the fruits through various recipes employed for preparation of karonda products (candy, squash, jelly and jam) resulted in remarkable loss of moisture content from 70-80% of fresh fruit to an average value of 4.86% of fresh products. The maximum initial moisture content was recorded in squash (9.67%) followed by jam (4.33%), jelly (3.25%) and candy (2.41%). On the basis of mean values, at the end of storage period the maximum moisture was recorded in squash (4.22%) and the minimum in jam (0.82%) which was 129.1 and 428.0%, respectively reduced over their initial moisture content. Minimum mean moisture content of all the four products (1.83%) was recorded at 120 days of storage period and it was 165.5% lower over initial mean moisture content of the products (4.86%). After 120 days of storage period the moisture content in candy, squash, jelly and jam was reduced by 104.2, 129.1, 198.1 and 428.0%, respectively over their initial (0 days storage) moisture content. The interaction between products and storage periods was non-significant in terms of moisture content. This decrease in moisture content of the products prepared by various methods was mainly due to evaporation of moisture. Similar findings were also reported by Dhawan and Gupta (1996) in guava jelly and Maciel *et al.* (1999) in acerala jelly.

Table 2. Changes in TSS (^{o}Brix) during storage of karonda products (mean of 2 years)

Products (A)	Storage period (B)					Mean
	0 Day	30 Days	60 Days	90 Days	120 Days	
Candy	76.9	81.9	83.9	86.9	90.9	84.1
Squash	50.0	51.1	51.5	52.0	53.0	51.5
Jelly	69.0	69.7	70.4	71.0	73.0	70.6
Jam	73.9	75.9	77.2	78.9	79.9	77.1
Mean	67.5	69.6	70.8	72.2	74.2	
	A	B	A x B			
S.Ed.	1.12	1.15	2.33			
CD at 5%	2.3	2.3	NS			

Table 3. Changes in acidity (%) during storage of karonda products (mean of 2 years)

Products (A)	Storage period (B)					
	0 Day	30 Days	60 Days	90 Days	120 Days	Mean
Candy	0.56	0.63	0.65	1.54	1.65	1.01
Squash	0.24	0.51	1.25	1.26	1.34	0.92
Jelly	0.34	2.15	3.42	3.61	3.74	2.65
Jam	0.26	0.62	1.62	1.64	1.70	1.17
Mean	0.35	0.98	1.74	2.01	2.11	
	A	B	A x B			
S.Ed.	0.092	0.091	0.191			
CD at 5%	0.19	0.18	0.38			

Table 4. Changes in ascorbic acid (mg/100 g) during storage of karonda products (mean of 2 years)

Products (A)	Storage period (B)					
	0 Day	30 Days	60 Days	90 Days	120 Days	Mean
Candy	4.32	4.20	3.71	3.63	3.31	3.83
Squash	2.89	2.54	1.45	1.13	0.22	1.65
Jelly	2.68	2.16	1.89	1.10	0.88	1.74
Jam	4.25	3.70	3.21	3.17	2.61	3.39
Mean	3.53	3.15	2.57	2.26	1.76	
	A	B	A x B			
S.Ed.	0.063	0.081	0.146			
CD at 5%	0.13	0.16	0.29			

Table 5. Changes in moisture content (%) during storage of karonda products (mean of 2 years)

Products (A)	Storage period (B)					
	0 Day	30 Days	60 Days	90 Days	120 Days	Mean
Candy	2.41	1.85	1.58	1.35	1.18	1.67
Squash	9.67	5.93	5.02	4.82	4.22	5.93
Jelly	3.25	2.78	2.11	1.45	1.09	2.16
Jam	4.33	2.47	1.81	0.98	0.82	2.08
Mean	4.86	3.26	2.63	2.15	1.83	
	A	B	A x B			
S.Ed.	0.523	0.542	1.120			
CD at 5%	1.05	1.09	NS			

Reducing sugar

The results (Table 6) indicate that reducing sugar content of various karonda products increased significantly during storage. In general the processing of the karonda resulted in increase of reducing sugar content from 3-4% of fresh fruit to an average value of 25.9% of fresh products. Data further reveals a gradual increase in reducing sugar content in all the products stored for 0, 30, 60, 90, and 120 days. Mean values of different products at different storage periods were found varied from initially 25.9% to 31.8% at after 120 days. Similarly, mean values of different products (candy, squash, jelly and jam) varied from 9.26% in squash to 40.5% in jam. The maximum reducing sugar content at initial and 120 days of storage period was recorded in jam followed by jelly, candy and squash. After 120 days of storage period the reducing sugar content in candy, squash, jelly and jam was found increased by 18.7, 74.0, 19.7 and 17.9%, respectively over their initial (0 days storage) reducing sugar content. The increase in reducing sugars of products could be due to inversion of non-reducing sugars into reducing sugars. Similar trend of sugars content was also recorded in date palm jelly (Ali *et al.*, 1990) and pomegranate juice (Waskar and Deshmukh, 1995).

Non-reducing sugar

The non-reducing sugar content of various karonda products decreased significantly during storage (Table 7). In general the processing of karonda resulted in increase of reducing sugar content from 1.3-1.6% of fresh fruit to an average value of 33.64% of fresh products. Data further reveals a gradual reduction in non-reducing sugar content in all the products stored for 0, 30, 60, 90, and 120 days. Mean values of different products at different storage periods were found varied from initial 33.64% to 29.40% at 120 days. Similarly, mean values of different products (candy, squash, jelly and jam) varied from 25.27% in jelly to 41.04% in candy. The maximum non-reducing sugar content at initial and 120 days of storage period was recorded in candy followed by squash, jam and jelly. After 120 days of storage period the non-reducing sugar content in candy, squash, jelly and jam was decreased by 4.87, 9.55, 28.6 and 23.7%, respectively over their initial (0 days storage) non-reducing sugar content. The decrease in non-reducing sugars of products could be due to inversion of non-reducing sugars into reducing sugars. Similar trend of different sugars content was also recorded in date palm jelly (Ali *et al.*, 1990) and pomegranate juice (Waskar and Deshmukh, 1995).

Total sugar

Total sugar content of various karonda products increased significantly during storage (Table 8). In general the processing of karonda resulted in increase of total sugar content from 5-6% of fresh fruit to an average value of 61.7% of fresh products. Mean values of different products at different storage periods were found varied from initial 61.70% to 63.27% at 120 days. Similarly, mean values of different products (candy, squash, jelly and jam) varied from 44.57% in squash to 70.14% in candy. The maximum total sugar content at initial was recorded in jam followed by candy, jelly and squash while at 120 days of storage period the maximum total sugar content was recorded in candy, jam, jelly and squash which were increased by 3.94, 4.57, 0.85 and 1.48%, respectively over their initial (0 days storage) total sugar content.

Anthocyanin content

The anthocyanin content of various karonda products decreased significantly during storage (Table 9). The processing of the fruits in to processed products resulted in remarkable loss of anthocyanin content from 2 to 7 mg/100 g of fresh fruit to an average of 2.34 mg/100 g of fresh products. The maximum initial anthocyanin content was recorded in candy (4.82 mg/100 g) followed by jam (2.91 mg/100 g), jelly (1.16 mg/100 g) and squash (0.67mg/100 g). While at the end of storage period (120 days), the maximum anthocyanin was recorded in candy (2.39 mg/100 g) followed by jam (1.06 mg/100 g), squash (0.35 mg/100 g) and jelly (0.15 mg/100 g) which were decreased by 101.6, 91.4, 673.3 and 174.5%, respectively over their initial anthocyanin content (0 days storage). Minimum mean anthocyanin content of all the four products (0.99 mg/100 g) was recorded at 120 days of storage period and it was 141.4% lower over initial mean anthocyanin of the products (2.39 mg/100 g). Statistical analysis revealed that the interaction of products and storage periods were significant with respect to anthocyanin content. It was both the degradation of anthocyanin and formation of hydroxymethyl-furfural was responsible for loss of anthocyanin in sour cheery and blackberry juices during storage (Louvric, 1965).

Nonenzymatic browning in products

An increasing trend in browning was recorded up to 120 days of storage as compared to fresh products (Table 10). The browning of various products (candy, squash, jelly and jam) in different storage periods were significant and the interaction between products and storage periods were also found significant. Minimum mean browning of 0.38 O.D. was observed in freshly prepared products and browning was increased to 0.44 O.D. in 120 days of storage period. At 120 days of storage period the highest browning was observed in candy (0.78 O.D.) followed by jam (0.64 O.D.), jelly (0.21 O.D.) and squash (0.12 O.D.). Similar results were reported during storage by Singh and Singh (1994) in squash of litchi and Ashraf (1987) in jamun jelly. The browning in product develops due to decline in ascorbic acid content of the product (Stadman, 1948). Production of 5-hydroxymethyl; 2-furfuraldehyde in fruit juices from sugar, particularly ketones by heating during processing and caused browning with the reaction of amino compounds and sugars (Diemair and Jury, 1965).

Microbial analysis

Bacterial count

In various products of karonda during different storage periods significant variation in bacterial count was observed (Table 11). An increasing trend in bacterial count was recorded up to 120 days of storage as compared to fresh products. Minimum bacterial count of 1.84×10^5 cfu/g was obtained in fresh products and it was increased to 7.37×10^5 cfu/g in 120 days of storage. The highest bacterial count was obtained in jelly (6.24×10^5 cfu/g) followed by jam (5.61×10^5 cfu/g of sample), squash (3.04×10^5 cfu/g of sample) and candy (1.90×10^5 cfu/g of sample). Interaction between products (candy, squash, jelly and jam) and storage periods (0, 30, 60, 90 and 120 days) was also found significant. The study shows that the sugar used as a protecting agent caused microbial growth in various karonda products. Microbial growth was increased due to improper sanitation practices. Similar

Table 6. Changes in reducing sugar (%) during storage of karonda products (mean of 2 years)

Products (A)	Storage period (B)					
	0 Day	30 Days	60 Days	90 Days	120 Days	Mean
Candy	25.0	25.9	26.7	27.8	29.6	27.0
Squash	6.8	8.2	8.7	10.8	11.8	9.3
Jelly	34.5	36.3	36.7	38.6	41.3	37.5
Jam	37.6	38.5	40.0	42.1	44.4	40.5
Mean	25.9	27.2	28.0	29.8	31.8	
	A	B	A x B			
S.Ed.	0.44	0.48	1.04			
CD at 5%	0.9	1.0	NS			

Table 7. Changes in non-reducing sugar (%) during storage of karonda products (mean of 2 years)

Products (A)	Storage period (B)					
	0 Day	30 Days	60 Days	90 Days	120 Days	Mean
Candy	42.0	41.7	41.1	40.4	40.0	41.0
Squash	34.6	33.5	33.3	33.0	31.6	33.2
Jelly	28.1	26.9	24.9	24.6	21.8	25.3
Jam	29.9	28.6	27.5	25.8	24.1	27.2
Mean	33.6	32.7	31.6	31.0	29.4	
	A	B	A x B			
S.Ed.	0.55	0.57	1.19			
CD at 5%	1.1	1.14	NS			

Table 8. Changes in total sugar (%) during storage of karonda products (mean of 2 years)

Products (A)	Storage period (B)					
	0 Day	30 Days	60 Days	90 Days	120 Days	Mean
Candy	69.0	69.7	69.9	70.3	71.7	70.1
Squash	43.5	43.8	44.1	45.9	45.5	44.6
Jelly	64.7	63.7	65.4	65.4	65.3	64.9
Jam	69.6	69.2	69.6	70.0	70.6	69.8
Mean	61.7	61.6	62.2	62.9	63.3	
	A	B	A x B			
S.Ed.	0.74	0.82	1.64			
CD at 5%	1.5	1.7	NS			

Table 9. Changes in anthocyanin (mg/100 g) during storage of karonda products (mean of 2 years)

Products (A)	Storage period (B)					
	0 Day	30 Days	60 Days	90 Days	120 Days	Mean
Candy	4.82	4.41	4.23	3.39	2.39	3.85
Squash	0.67	0.56	0.46	0.44	0.35	0.5
Jelly	1.16	0.54	0.36	0.26	0.15	0.49
Jam	2.91	2.7	2.45	2.28	1.06	2.28
Mean	2.39	2.05	1.88	1.59	0.99	
	A	B	A x B			
S.Ed.	0.175	0.132	0.343			
CD at 5%	0.35	0.27	0.69			

Table 10. Non-enzymatic browning (O.D.) in karonda products during storage (mean of 2 years)

Products (A)	Storage period (B)					
	0 Day	30 Days	60 Days	90 Days	120 Days	Mean
Candy	0.72	0.73	0.76	0.77	0.78	0.75
Squash	0.05	0.07	0.08	0.10	0.12	0.08
Jelly	0.14	0.16	0.20	0.20	0.21	0.18
Jam	0.60	0.62	0.63	0.63	0.64	0.62
Mean	0.38	0.40	0.42	0.43	0.44	
	A	B	A x B			
S.Ed.	0.002	0.002	0.003			
CD at 5%	0.004	0.01	0.01			

findings were reported Kanekar *et al.* (1992) in mango jam. Bacterial count was found to be higher in different karonda products as compared to fungal count.

Fungal count

In various products of karonda during different storage periods significant variation in fungal count was observed (Table 12). An increasing trend in fungal count was recorded up to 120 days of storage as compared to fresh products. Minimum fungal count of 2.09 x 10^4 cfu/g was obtained in fresh products and it was increased to 9.78 x 10^4 cfu/g in 120 days of storage. The highest fungal count was obtained in jam (7.49 x 10^4 cfu/g) followed by jelly (6.85 x 10^4 cfu/g of sample), squash (4.80 x 10^4 cfu/g of sample) and candy (2.66 x 10^4 cfu/g of sample). Data also showed that significantly highest fungal count was observed in jam stored for 120 days (7.49 x 10^4cfu/g) and the lowest in fresh candy (1.13 x 10^4 cfu/g).

The results of present investigation can be concluded that after four months storage the total soluble solids, acidity, reducing sugar, total sugar and browning was found to increased significantly from the initial mean values across all the products. While, the non reducing sugar, ascorbic acid, moisture content and anthocyanin content of various karonda products were decreased significantly from the initial mean values at the end of storage. Across all the products, an increasing trend in bacterial and fungal count was recorded up to 120 days of storage as compared to fresh products.

Table 11 . Changes in bacterial count (per ml/g of sample) during storage of karonda products (mean of 2 years)

Products (A)	Storage period (B)					
	0 Day	30 Days	60 Days	90 Days	120 Days	Mean
Candy	0.82 x 10^5	1.12 x 10^5	1.32 x 10^5	2.52 x 10^5	3.72 x 10^5	1.90 x 10^5
Squash	0.99 x 10^5	1.78 x 10^5	2.58 x 10^5	4.68 x 10^5	5.18 x 10^5	3.04 x 10^5
Jelly	3.23 x 10^5	3.53 x 10^5	5.06 x 10^5	8.03 x 10^5	11.33 x10^5	6.24 x 10^5
Jam	2.35 x 10^5	2.45 x 10^5	6.15 x 10^5	7.85 x 10^5	9.25 x 10^5	5.61 x 10^5
Mean	1.84 x 10^5	2.22 x 10^5	3.77 x 10^5	5.77 x 10^5	7.37 x 10^5	
	A	B	A x B			
S.Ed.	0.071	0.074	0.142			
CD at 5%	0.14	0.15	0.29			

Table 12 . Changes in fungal count (per ml/g of sample) during storage of karonda products (mean of 2 years)

Products (A)	Storage period (B)					
	0 Day	30 Days	60 Days	90 Days	120 Days	Mean
Candy	1.13 x 10^4	1.33 x 10^4	2.33 x 10^4	3.92 x 10^4	4.63 x 10^4	2.66 x 10^4
Squash	2.02 x 10^4	3.82 x 10^4	4.72 x 10^4	6.02 x 10^4	7.42 x 10^4	4.80 x 10^4
Jelly	1.85 x10^4	2.45 x 10^4	6.06 x 10^4	9.85 x 10^4	14.05 x 10^4	6.85 x 10^4
Jam	3.36 x 10^4	4.05 x 10^4	7.95 x 10^4	9.05 x 10^4	13.05 x 10^4	7.49 x 10^4
Mean	2.09 x 10^4	2.91 x 10^4	5.26 x 10^4	7.21 x 10^4	9.78 x 10^4	
	A	B	A x B			
S.Ed.	0.068	0.058	0.132			
CD at 5%	0.14	0.12	NS			

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