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Nutritional composition, sensory attributes and shelf life of value added products of Karonda (Carissa SPP)

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Abstract
Karonda is a nutritionally rich underutilized fruit and can be utilized by making products and served to everyone may be poor or rich. The study was conducted to examine the physico-chemical properties of *karonda* and sensory characteristics and acceptability of its processed products. The ripe fruits of two varieties of *karonda* namely pink (pinkish white) and green (reddish purple) were analysed for their nutritional composition and values were found to be in the range of, the moisture 87.32 - 89.06%, crude protein 0.64 - 1.52%, crude fat 3.66 - 4.31%, crude fiber 1.37 - 1.53%, ash 0.57 - 0.61% and carbohydrate 4.28 - 5.69% respectively. Three products namely *chutney*, *murabba* and jam were also prepared from the same two varieties and their sensory characteristics were analyzed up to six months. Among all the products *murabba* prepared from pink variety found to be the best, but all the products of both varieties showed good overall acceptability in fresh. The study recommended that all the three *karonda* products can be stored easily up to four months without much decline in the sensory characteristics.

Keywords: Karonda, value added products, sensory characteristics

Introduction
Karonda (*Carissa* spp.) belongs to the family Apocynaceae and is characterized by pairs of strong thorns, short stem and dichotomous branches with evergreen medium sized shrub (Wiart 2006) [11]. Usually *karonda* fruit is called as *karmada*, *karvanda*, *karunda*, *kavali* but in English it is called as Bengal currant. *Karonda* plant is found in wide range of soil and temperature conditions like tropical and subtropical to semi-arid regions and thrives well in saline and sodic soil because it is drought-tolerant, hardy plant. In India, *karonda* wild plants are seen in the Bihar, West Bengal, Shiwalik Hills, the Western Ghats of Karnataka and the Nilgiri hills. The details of area and production of *karonda* in India are not available, as the shrubs grow wild and no systematic cultivation is undertaken (Morton 1987) [5].

In India, *karonda* wild plants are cultivated as hedge plant in the orchards, home gardens and farmer's fields as a good bio-fence. *Karonda* fruit has been reported a rich source of phenolic contents, terpenoids, flavonoids, vitamins, acids, minerals, peptides and sugars. The fruit are also a rich source of iron and vitamin-C, and thus have antiscorbutic properties and are useful in prevention of anaemia. Despite, its multiple usefulness, it remained an underexploited fruit, probably, due to its small berry size and sour taste. Yet keeping in view the rising awareness among the people for health foods, alternative form of utilization may be devised to encourage its increased consumption. The *karonda* wild fruit are available in plenty in their natural habitats; hence, there is enormous scope for this fruit by creating awareness among the locals and popularization of processed products from these fruit.

Methodology
The ripe *karonda* fruit of two species of *karonda* namely pink (pinkish white) and green (reddish purple) were harvested between the months of August-October, 2018. The fruit was brought in the food analysis laboratory of department of Food and Nutrition, Punjab Agricultural University, Ludhiana, where it was immediately washed with water, dried and used for biochemical analysis in fresh form as well as for product development. Three products namely *chutney*, *murabba* and jam made from two *karonda* species were standardized. No artificial color, flavor and preservative were added to the products.

The proximate composition of the products was determined using the AOAC (2000) [1]. procedures. The pectin content of the fruits was determined by the methods of Sadasivam and Manickam (1996) [8]. Total soluble solids (TSS) was recorded using the hand refractometer and the titrable acidity was determined by the methods given by Ranganna (1986) [7].The method of Dubois *et al* (1956) [3]. was used for total sugars and the method of Somogyi (1952) [9]. was used to analyze reducing sugars. The standardized products were evaluated for their sensory properties by a panel of ten semi- trained members at 0, 2, 4 and 6 months of storage period. The panelists scored different products made from *karonda* pink and green varieties based on their appearance, texture, taste, flavour and overall acceptability by using nine-point Hedonic Rating Scale where 9 indicated “like extremely” and 1 indicated “dislike extremely”.

All the developed products were stored in sterilized air tight glass containers and stored in refrigerator at 4-6 ˚C for six months. The products were tested for their sensory characteristics, comparing the difference in appearance, texture, taste, aroma and overall acceptability during storage using 9-point hedonic scale.

All the experiments were carried out in three replicates. Mean and standard deviation for the different parameters were computed. Analysis of Variance (ANOVA) was

employed following CRD (Completely Randomized Design) and Statistical Analysis Tool Pack and SPSS 16 (statistical package for the social sciences). Least significant difference at 5% was calculated using SAS (Statistical Analysis System, version 9.3 for windows) software for the comparison among the parameters.

Results and Discussion

Physico-chemical characteristics of *karonda* varieties

The results in the table 1 revealed that there was a significant difference ($p \leq 0.05$) observed in the pectin content of the fruit. Higher pectin content was found in pink variety fruit (3.38%) than green variety fruit (3.09%). The total soluble solids (TSS) was more in green variety, the values were 7.37 and 6.47 per cent in green and pink fruit. There was a significant difference ($p \leq 0.05$) found in acidity, between pink and green variety fruit and green variety had higher percentage of acidity (1.49 %) than pink varity (1.37 %). The green variety recorded higher percentage of total sugars (1.68%) and reducing sugars (1.57 %) but there was no significant difference ($p \leq 0.05$) observed between pink and green varieties. Mishra (2009) [4]. noticed the chemical composition of *karonda* fruit i.e. total soluble solids, acidity, reducing sugar, non-reducing sugar, total sugar varied from 3.00 - 4.50, 0.654 - 5.99, 0.93 - 2.4 per cent, respectively. Similar results were reported by Dalal *et al* (2010) [2]. The Total Soluble Sugars and total sugars of mature to ripe fruit varied between 6.76 - 7.8 per cent and 3.96 - 5.28 per cent.

Proximate composition of *karonda* varieties

The pink *karonda* had a moisture content of 89.06 per cent which was significantly higher than the green variety i.e., 87.32 per cent. But there was no significant difference ($p \leq 0.05$) in the ash content representing the total minerals was observed among the fruit. The highest protein content was observed in green *karonda* which was significantly higher than pink *karonda*. The crude fat content was not significantly differed between green (3.97%) and pink (3.76%) *karonda* varieties. On the other hand, pink *karonda* recorded the higher crude fiber percentage (1.49%) compared to green *karonda* (1.40%). The carbohydrate percentage was calculated by difference, in that significantly higher percentage was found in green *karonda* when compared to pink fruit. Mishra (2009) [4]. reported the protein content and total minerals ranged from 0.57 - 1.33 and 1.65 - 3.80 % in *karonda* fruit.

Patra and Basak (2017) [6]. reported that in *Carissa carandas*, highest level of moisture (90.59%) was found in fruit collected from Khorda region and maximum amount of total carbohydrate (13.75%) were found in Malkangiri region.

Proximate composition of *karonda* products prepared from *karonda* varieties

The moisture content among the pink variety of *karonda* products differed significantly. The moisture content in the products ranged from 21.72 to 34.57 per cent. In the crude fat content, the *murabba* recorded the highest value i.e. (0.51%) followed by jam (0.11%) and *chutney* (0.09%), respectively. Significant difference ($p \leq 0.05$) was observed in the crude protein content and ranged from 0.71 to 0.83 per cent. In total ash content *chutney* had significantly highest level of ash i.e. (2.94%) followed by jam (0.50%) and *murabba* (0.44%). The crude fiber content was significantly higher in *chutney* (0.58%) followed by jam (0.53%) and lowest in *murabba* (0.49%) correspondingly. There was a significant difference ($p \leq 0.05$) in carbohydrate content of the products and ranged from 63.22 to73.85 per cent.

Among the products of green variety of *karonda*, *murabba* had the highest content of moisture (39.68%) followed by jam (28.77%) and *chutney* (27.12%), respectively. In the crude fat content, the *murabba* recorded the highest value i.e. (0.68%) followed by jam (0.12%) and *chutney* (0.11%). The protein content ranged from 0.68 to 0.78 per cent respectively. In total ash content, *chutney* had the highest level of ash i.e. (2.88%) followed by *murabba* (0.36%) and jam (0.36%) respectively. The crude fiber content was significantly higher in *murabba* (0.93%) followed by *chutney* (0.62%) and lowest was in jam (0.42%) correspondingly. The carbohydrate content ranged from 57.66 to 69.65 per cent and significant difference ($p \leq 0.05$) was found in among products.

Changes in sensory characteristics of *karonda* products during storage

The changes in sensory characteristics during six months of storage in glass bottles under refrigerated conditions (4 to 6˚C) of the *karonda* products namely *chutney*, *murabba* and jam are shown in Tables 4 to 6. In figure 1 to 3 the comparison of overall acceptability of the products prepared from two *karonda* have been shown.

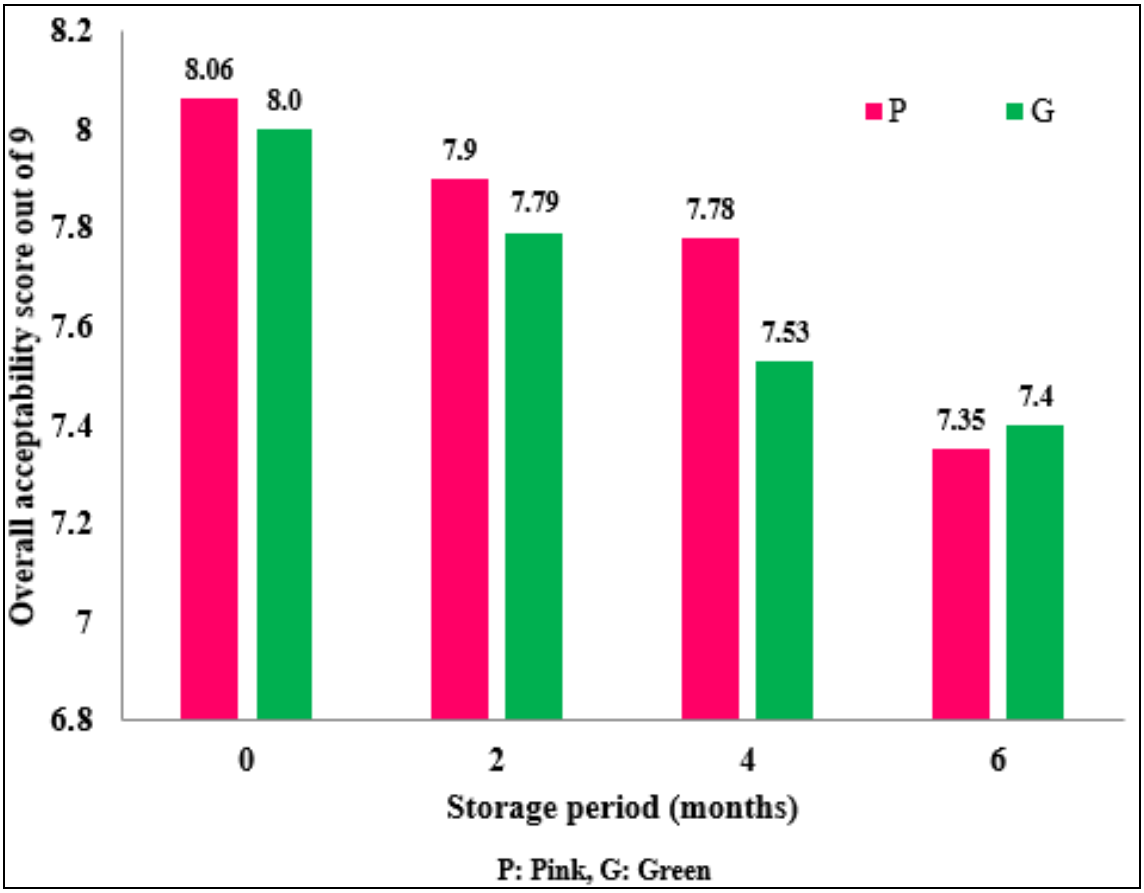

Fig 1: Overall acceptability of Chutney prepared from *karonda* varieties during storage

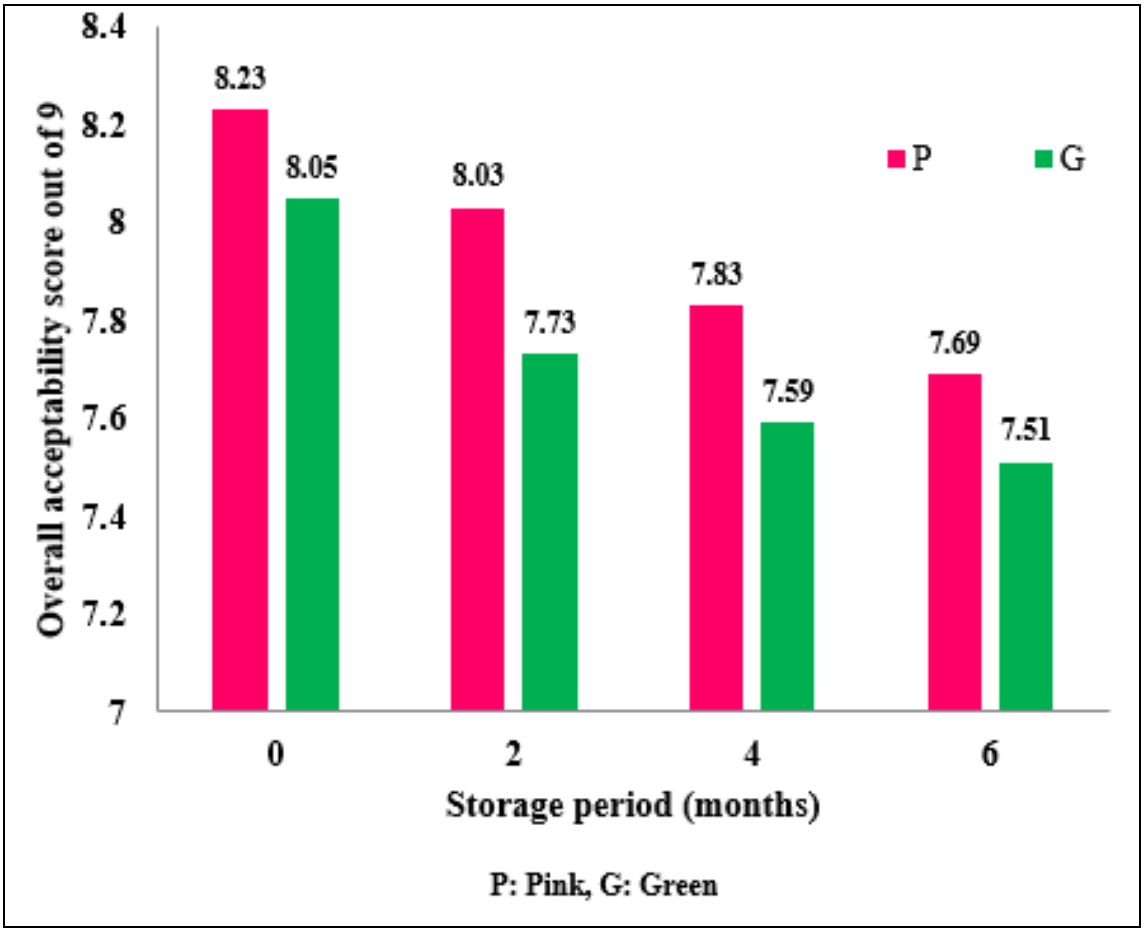

Fig. 2: Overall acceptability of murabba prepared from *karonda* varieties during storage

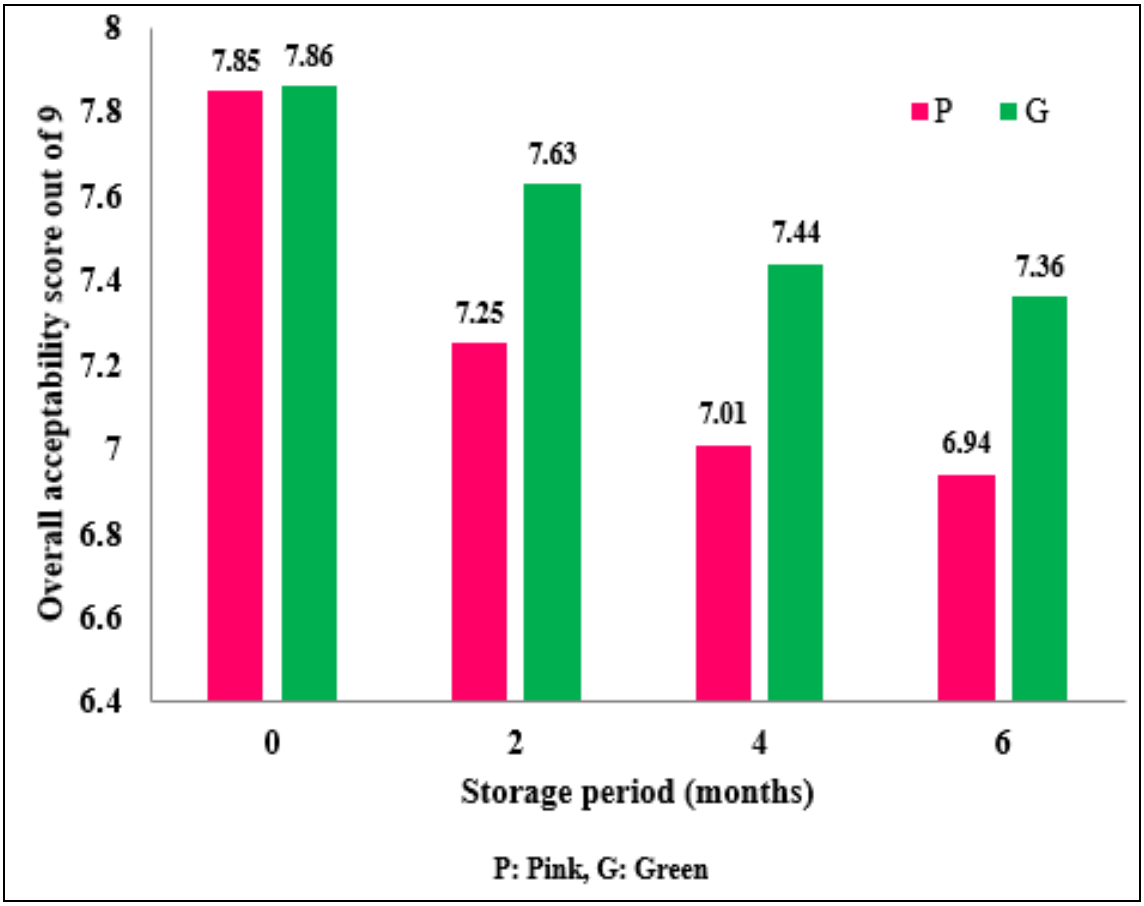

Fig 3: Overall acceptability of jam prepared from *karonda* varieties during storage

Chutney

The chutney prepared from both pink and green variety of *karonda* fruit had a good overall acceptability score in sensory characteristics till four months of storage. The appearance of pink *karonda* chutney was stable up to fourth months and then there was a noticeable change in scores was found. Where as the texture, taste and flavour decreased constantly with storage. In green variety chutney the constant decrease in sensory quality was found during storage. In the comparison, the pink chutney recorded slightly higher sensory scores than green variety, that may be due to slightly high pectin content and attractive pink colour of pink variety.

Murabba

The *murabba* prepared from both karonda varieties recorded the higher sensory scores and considered as best product among the three. The pink variety *murabba* recorded the highest sensory score after six months also its sensory scores were higher when compared to others and is best suitable for *murabba* preparation. This may be due to the attractive pink colour and high pectin content in pink variety.

In green variety *murabba* there was no significant difference ($p \leq 0.05$) in appearance, texture, taste, flavour and overall acceptability found during six months of storage. But pink variety was comparatively better suited for murabba than green variety.

Jam

There was no significant difference found in appearance of green variety jam upto two months, whereas pink variety jam was changed significantly in appearance after fresh evaluation. The sensory evaluation revealed that, there was no significant difference found in texture, taste, flavour and overall acceptability of green variety *karonda* jam upto six months. On the other hand green variety jam was superior in comparison to pink variety jam in sensory qualities with storage. Wani *et al* (2013) [10]. reported that karonda jam can be stored for minimum three months without undergoing any deterioration, in ambient temperature storage.

Table 1: Physico-chemical characteristics of *karonda* varieties

Parameter	Pink	Green	p value	LSD
Pectin (% calcium pectate)	3.38^{b}±0.11	3.09^{a}±0.01	0.010	0.11
TSS (°Brix)	6.47^{a}±0.06	7.37^{b}±0.06	<0.001	0.08
Acidity (%)	1.37^{a}±0.03	1.49^{b}±0.05	0.038	0.06
Total sugars (%)	1.42±0.07	1.68±0.16	0.056	NS
Reducing sugars (%)	1.40±0.06	1.57±0.11	0.069	NS
Non-reducing sugars (%)	0.02±0.01	0.11±0.06	0.062	NS

Table 2: Proximate composition of *karonda* varieties (%)

Parameter	Pink	Green	p value	LSD
Moisture	89.06^{b}± 0.29	87.32^{a}±0.75	0.020	0.82
Ash	0.60±0.01	0.60± 0.03	0.866	NS
Protein	0.64^{a}± 0.09	1.07^{b}± 0.12	0.008	0.15
Crude fat	3.76± 0.145	3.97±0.107	0.106	NS
Crude fiber	1.49^{b}± 0.009	1.40^{a}±0.070	0.021	0.07
Available Carbohydrates	4.47^{a}±0.309	5.69^{b}±0.598	0.034	0.70

Values are Mean ± SD

Values in columns followed by different superscripts differ significantly ($p \leq 0.05$)

LSD: Least significant difference at 5%

Table 3: Proximate composition of *karonda* products prepared from *karonda* varieties

Product	Moisture (%)	Crude Fat (%)	Crude Protein (%)	Total Ash (%)	Crude Fiber (%)	Carbohydrates (%) (by difference)
Pink						
Chutney	21.72^{a}±0.20	0.09^{a}±0.01	0.83±0.08	2.94^{c}±0.02	0.58±0.02	73.85^{c}±0.15
Murabba	34.57^{c}±0.13	0.51^{c}±0.01	0.78±0.08	0.44^{a}±0.02	0.49±0.07	63.22^{a}±0.15
Jam	25.61^{b}±0.20	0.11^{b}±0.01	0.71±0.11	0.50^{b}±0.02	0.53±0.06	72.54^{b}±0.13
p value	<0.001	<0.001	0.334	<0.001	0.173	<0.001
LSD	0.24	0.01	NS	0.03	NS	0.19
Green						
Chutney	27.12^{a}±0.20	0.11^{a}±0.01	0.78±0.08	2.88^{b}±0.06	0.62^{b}±0.16	68.50^{b}±0.13
Murabba	39.68^{c}±0.26	0.68^{b}±0.04	0.69±0.08	0.37^{a}±0.02	0.93^{c}±0.11	57.66^{a}±0.20
Jam	28.77^{b}±0.16	0.12^{a}±0.04	0.68±0.07	0.36^{a}±0.03	0.42^{a}±0.09	69.65^{c}±0.09
p value	<0.001	<0.001	0.332	<0.001	0.006	<0.001
LSD	0.28	0.04	NS	0.05	0.18	0.2

Values are Mean ± SD.
Values in columns followed by different superscripts differ significantly (p≤0.05).
LSD: Least significant difference at 5%

Table 4: Changes in sensory characteristics of *karonda* chutney during storage

Sensory Characteristics	Storage period (months)				p value	LSD at 5%
	0	2	4	6		
Pink						
Appearance	8.1^{b}±0.67	8.0^{b}±0.47	7.8^{b}±0.32	7.0^{a}±0.48	<0.001	0.502
Texture	7.9±0.32	7.7±0.57	7.6±0.57	7.3±0.60	0.072	NS
Taste	8.15±0.57	8.0±0.58	7.9±0.47	7.6±0.71	0.212	NS
Flavour	8.1±0.57	7.9±0.57	7.8±0.63	7.5±0.58	0.202	NS
Overall acceptability	8.06^{b}±0.11	7.90^{b}±0.14	7.78^{ab}±0.13	7.35^{a}±0.26	0.015	0.458
Green						
Appearance	8.0±0.67	7.9±0.57	7.6±0.84	7.4±0.67	0.220	NS
Texture	7.9±0.32	7.7±0.67	7.6±0.67	7.5±0.57	0.487	NS
Taste	8.0±0.67	7.85±0.82	7.4±0.84	7.3±0.32	0.127	NS
Flavour	8.1±0.57	7.7±0.67	7.5±0.67	7.4±0.48	0.185	NS
Overall acceptability	8.00±0.08	7.79±0.10	7.53±0.10	7.40±0.08	0.149	NS

Values are Mean ± SD
Values in columns followed by different superscripts differ significantly (p≤0.05)
LSD: Least significant difference at 5%

Table 5: Changes in sensory characteristics of *karonda* murabba during storage

Sensory Characteristics	Storage period (months)				p value	LSD at 5%
	0	2	4	6		
Pink						
Appearance	8.2±0.63	8.0±0.67	7.80±0.47	7.65±0.32	0.202	NS
Texture	8.2±0.63	8.0±0.47	7.9±0.32	7.80±0.48	0.291	NS
Taste	8.3^{b}±0.48	8.1^{ab}±0.32	7.8^{a}±0.42	7.65^{a}±0.47	0.014	0.403
Flavour	8.2±0.42	8.0±0.47	7.8±0.42	7.65±0.47	0.074	NS
Overall acceptability	8.23^{b}±0.05	8.03^{ab}±0.05	7.83^{ab}±0.05	7.69^{a}±0.07	0.036	0.423
Green						
Appearance	8.0±0.67	7.8±0.84	7.6±0.70	7.55±0.47	0.462	NS
Texture	8.0±0.47	7.70±0.67	7.65±0.88	7.55±0.47	0.461	NS
Taste	8.2±0.42	7.65±0.88	7.5±0.85	7.45±0.32	0.118	NS
Flavour	8.0±0.47	7.75±0.84	7.6±0.70	7.50±0.70	0.340	NS
Overall acceptability	8.05±0.10	7.73±0.06	7.59±0.06	7.51±0.05	0.302	NS

Values are Mean ± SD
Values in columns followed by different superscripts differ significantly (p≤0.05)
LSD: Least significant difference at 5%

Table 6: Changes in sensory characteristics of *karonda* jam during storage

Sensory Characteristics	Storage period (months)				p value	LSD at 5%
	0	2	4	6		
Pink						
Appearance	7.95±1.01	7.40±1.07	7.05±1.54	6.95±0.63	0.248	NS
Texture	7.7±0.79	7.2±1.03	6.9±1.45	6.85±0.79	0.299	NS
Taste	8.0±0.76	7.2±0.92	7.1±1.37	7.05±0.76	0.178	NS
Flavour	7.75±0.63	7.20±1.03	7.0±1.49	6.90±0.70	0.313	NS
Overall acceptability	7.85±0.15	7.25±0.10	7.01±0.09	6.94±0.09	0.229	NS
Green						

Appearance	7.90±0.99	7.8±1.03	7.4±1.17	7.30±0.97	0.523	NS
Texture	7.75±0.79	7.6±0.97	7.55±0.97	7.45±0.85	0.904	NS
Taste	8.0±0.82	7.5±0.85	7.4±0.97	7.35±0.84	0.374	NS
Flavour	7.8±0.63	7.6±0.84	7.4±0.84	7.35±0.63	0.571	NS
Overall acceptability	7.86±0.11	7.63±0.13	7.44±0.07	7.36±0.06	0.579	NS

Values are Mean ± SD
Values in columns followed by different superscripts differ significantly ($p \leq 0.05$)
LSD: Least significant difference at 5%

Conclusion

Hence, the storage study revealed that *karonda* which is a highly perishable and seasonal fruit can be stored up to six months with reasonable sensory attributes, therefore can serve the masses economically with nutritious food in the form of a range of preserved *karonda* products.

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