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Studies on preparation of carambola (*Averrhoa carambola* L.) nectar

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ABSTRACT : The nectar from carambola (*Averrhoa carambola* L.) fruits with 20, 25, 30 per cent juice and 15 and 20°B T.S.S. was prepared and stored for storage period of 3 months. During storage, the nectar was analyzed for physico-chemical parameters such as colour (L*, a* and b*), viscosity, total soluble solids, acidity, reducing sugars, total sugars and ascorbic acid and organoleptic quality. The data were analyzed statistically using factorial-completely randomized design. An increasing trend in a* and b* values for colour, total soluble solids, acidity, reducing and total sugars, and decreasing trend in L* value for colour, viscosity, ascorbic acid content of carambola nectar was noticed with the advancement of storage period. Nectar prepared with the recipe of 20 per cent juice, 20 per cent T.S.S. and 0.3 per cent acidity was found to be best recipe with respect to organoleptic qualities like colour, flavour, taste and overall acceptability and it was found acceptable up to three months of storage.

KEY WORDS : Carambola, Nectar, Storage, Organoleptic quality

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Carambola (*Averrhoa carambola* L.) belongs to the family Oxalidaceae. It is an important fruit of warm tropical and subtropical areas of the world. It is believed to be native to Malaysia or Indonesia. In India, carambola is grown in the western coastal areas and the Nilgiri hills which is more popularly known as star fruit and also coromendal gooseberry, kamaranga, or five fingers. The fruit of carambola is a rich source of reducing sugars, ascorbic acid, oxalic acids and minerals such as k, Ca, Mg and P. The star sections of the fruits are used in salads and on cakes. They are also used for preparing juice, preserves, jam, jelly and pickles. The juice of carambola fruit has good medicinal property against jaundice disease (Singh *et al*., 2006).

High juice content, attractive colour and strong fruity aroma indicate good potentiality for processing of carambola fruits. No work has been reported on the beverages of carambola fruit up till now. Keeping this in view, the current research was undertaken to find out the ideal recipe for preparation of carambola nectar and also to assess the qualitative changes and storage stability of the product.

RESEARCH METHODS

The ripe carambola fruits of uniform size and good quality were procured from Regional Fruit Research Station, Wakawali, Tal. - Dapoli, Dist- Ratnagiri, Maharashtra. After washing, the fruits were cut into small pieces and the juice was obtained with the help of pulper and strained through muslin cloth to remove the coarse and fibre particles. Carambola nectar was prepared with 20, 25 and 30 per cent juice concentrations with final T.S.S. of 15 and 20°B and 0.3 per cent acidity in all treatments. The chemical preservative, potassium metabisulphite was added @ 140 mg/kg of finished product. The prepared nectar was filled into 200 ml pre-sterilized glass bottles, sealed air tight with crown corking machine and pasteurized in boiling water for 30 minutes (Fig. A). The nectar, thus prepared was stored for three months at room temperature and analyzed at monthly interval for the physico-chemical and sensory quality parameters. The colour of carambola nectar was measured using colour reader (make Konica Minolta, Japan) and expressed as *L**, *a** and *b** values. The viscosity of carambola nectar was measured using Brookfield viscometer (DV – 2+) at a speed of 140 rpm, with probe no. 61 and expressed as cP. Total soluble solids content was measured using Atago hand refractrometer. Titratable acidity, reducing sugars, total sugars and ascorbic acid were estimated by methods suggested by Ranganna (1997). It was also evaluated for sensory

attributes like colour, flavour, taste and overall acceptability by panel of 5 judges on 9 point hedonic scale (Amerine *et al*., 1975) during storage. The data were statically analyzed by using Factorial Completely Randomized Design (FCRD) as described by Panse and Sukhatme (1985).

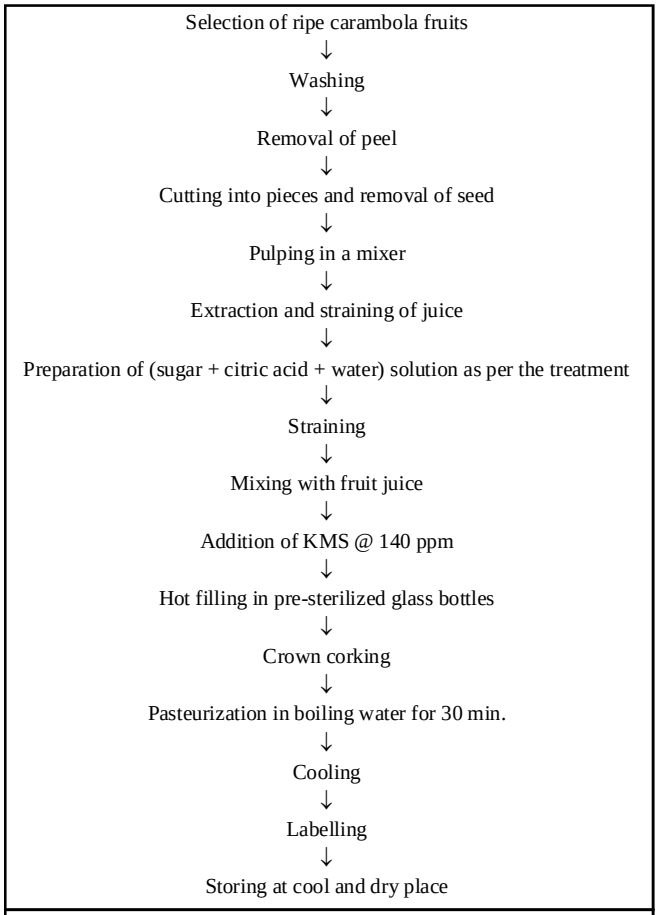

Fig. A : Flow chart for preparation of carambola nectar

RESEARCH FINDINGS AND DISCUSSION

The changes in chemical composition *viz.*, TSS, acidity, reducing sugars, total sugars and ascorbic acid content of carambola nectar during storage are presented in Table 3a and 3b.

The changes in physical composition of carambola nectar during storage are presented in Table 1 and 2. A significant increase in the a* and b* value for colour with decrease in L* value for colour. It is evident from the data that carambola nectar was more reddish in colour at the end of the storage period of 3 months. The results were supported by Doodnath and Badriel (2000). However, during storage carambola nectar becomes less viscous with significant decrease in viscosity at the end of storage period. The observations are in accordance with findings reported by Khurdiya (1993).

Studies on the qualitative changes during storage of carambola nectar revealed that total soluble solid content of the nectar showed an increasing trend during storage period of 90 days. This might be due to increase in soluble solids content and total soluble sugars caused by the hydrolysis of polysaccharides like starch, cellulose and pectin substances into simpler substances (Lad *et al*., 2013). Total soluble solids of aonla nectar (Jain *et al*., 2007) have been also reported to increase during storage. It is evident from the data that the titratable acidity of carambola nectar varied significantly with different recipe treatments as well as storage period. The acidity of carambola nectar witnessed an increasing trend during storage period of 90 days. Increase in the acid content may be due to desertification of pectin molecules (Singh *et al*., 2005). Similar results were reported by Kalra and Tandon

Table 1 : Changes in physical composition of carambola nectar during storage

Treatments	L* value for colour					a* value for colour					b* value for colour				
	Storage period (days)					Storage period (days)					Storage period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
T_1	34.97	34.35	34.07	33.87	34.32	1.00	2.26	3.43	3.46	2.53	4.66	5.46	7.81	8.16	6.52
T_2	35.67	33.62	33.44	32.47	33.80	1.12	2.76	4.08	4.43	3.10	4.37	7.26	8.93	9.27	7.46
T_3	35.70	34.05	33.35	32.99	34.02	0.93	2.37	3.76	3.76	2.71	5.54	6.60	9.41	9.61	7.79
T_4	35.96	34.84	34.59	34.44	34.96	1.01	1.98	2.91	3.48	2.35	3.46	4.70	6.40	7.42	5.50
T_5	35.34	34.45	34.20	33.62	34.40	0.87	2.28	3.5	3.83	2.62	5.72	6.66	8.11	8.70	7.30
T_6	35.40	33.77	33.45	33.09	33.93	0.95	2.35	0.76	4.11	2.79	5.87	7.65	9.28	9.51	8.08
Mean	35.51	34.18	33.85	33.42		0.98	2.33	3.57	3.85		4.94	6.39	8.33	8.78	
	S.E. ±	C.D. (P=0.05)				S.E. ±	C.D. (P=0.05)				S.E. ±	C.D. (P=0.05)			
Treatment	0.098	0.277				0.053	0.149				0.189	0.535			
Storage	0.080	0.226				0.043	0.121				0.155	0.437			
T x S	0.196	0.554				0.105	0.297				0.379	NS			

T_1 : 20% Juice + 15°B + 0.3% acidity T_2 : 25% Juice + 15°B + 0.3% acidity T_3 : 30% Juice + 15°B + 0.3% acidity
T_4 : 20% Juice + 20°B + 0.3% acidity T_5 : 25% Juice + 20°B + 0.3% acidity T_6 : 30% Juice + 20°B + 0.3% acidity

(1984) in guava nectar and Singh *et al*. (2005) in pomegranate nectar. The reducing sugar content of the recipes as influenced by different levels of juice and total soluble solids and their interactions resulted in increase in reducing sugar content significantly. The reason for rise in reducing sugars might be ascribed to the conversion of non reducing sugars to reducing sugars due to process of hydrolysis. The increase in reducing sugars was also reported by Baramanray *et al*. (1995) in guava nectar. There was a significant increase in total sugar content in stored carambola nectar. A similar observation was noticed by Kumar *et al.* (2009) in ber nectar and Ravindra *et al.* (2012) in blended nectar of shatavari, aloe and mango ginger. It could be observed from the data that ascorbic acid content was significantly influenced by nectar recipe and storage period.

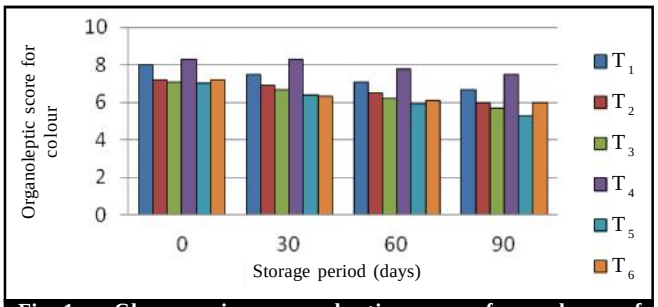

Fig. 1 : Changes in organoleptic score for colour of carambola nectar

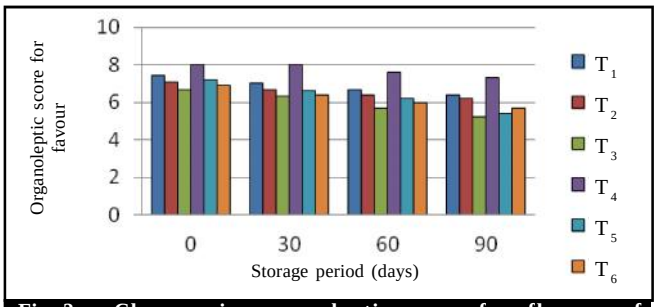

Fig. 2 : Changes in organoleptic score for flavour of carambola nectar

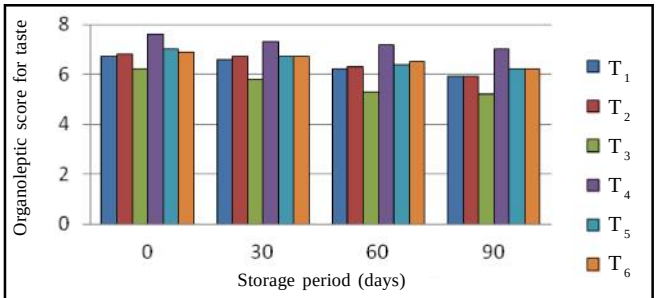

Fig. 3 : Changes in organoleptic score for taste of carambola nectar

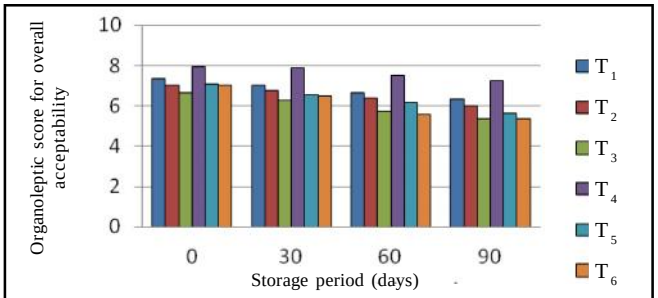

Fig. 4 : Changes in organoleptic score for overall acceptability of carambola nectar

T_1 : 20% Juice + 15°B + 0.3% acidity
T_2 : 25% Juice + 15°B + 0.3% acidity
T_3 : 30% Juice + 15°B + 0.3% acidity
T_4 : 20% Juice + 20°B + 0.3% acidity
T_5 : 25% Juice + 20°B + 0.3% acidity
T_6 : 30% Juice + 20°B + 0.3% acidity

Table 2 : Changes in physical composition of carambola nectar during storage

Treatments	Viscosity (cP)				
	Storage period (days)				
	0	30	60	90	Mean
T_1	7.46	6.72	3.47	3.16	5.20
T_2	7.46	6.37	3.81	3.21	5.21
T_3	9.96	6.64	3.90	3.50	6.00
T_4	9.96	5.59	3.90	3.50	5.99
T_5	9.96	6.91	3.98	3.48	6.08
T_6	8.71	6.19	3.61	3.20	
Mean	7.46	3.93	2.61	2.31	4.08
	S.E. ±	C.D. (P=0.05)			
Treatment	0.077	0.216			
Storage	0.063	0.177			
T x S	0.153	0.433			

T_1 : 20% Juice + 15°B + 0.3% acidity
T_2 : 25% Juice + 15°B + 0.3% acidity
T_3 : 30% Juice + 15°B + 0.3% acidity
T_4 : 20% Juice + 20°B + 0.3% acidity
T_5 : 25% Juice + 20°B + 0.3% acidity
T_6 : 30% Juice + 20°B + 0.3% acidity

The continuous decreasing trend was observed in carambola nectar during storage due to thermal oxidation during processing. The other possible factor responsible for loss of ascorbic acid was its oxidation into dehydro-ascorbic acid or furfural or hydroxy methyl furfural at room temperature and due to its sensitive nature (Kumar *et al*., 2009). Similar results of reduction in ascorbic acid content were observed by Kalra and Tandon (1984) in blended nectar of guava and mango and Kumar *et al*. (2009) in ber nectar.

Organoleptic quality determines the storage stability of the product. Nectar prepared with 20 per cent juice, 20 per cent TSS and 0.3 per cent acidity *i.e.* treatment T_4 recorded highest score of 7.98, 7.72, 7.27 and 7.66 for colour, flavour, taste and overall acceptability,respectively (Fig. 1, 2, 3 and 4) which was significantly superior to all other recipes. Overall acceptability of carambola nectar was influenced by the interaction effect of juice and total soluble solids. In present finding, there was decrease in organoleptic score of carambola nectar during ambient storage. Similar observations were also recorded by Singh *et al*. (2005) in pomegranate nectar and Jain *et al*. (2007) in aonla nectar.

Conclusion:

From the present investigation, it could be concluded that the product nectar could be successfully stored at ambient temperature condition without any deterioration for the period of three months. The nectar recipe *i.e.* 20 per cent juice, 20 per cent TSS and 0.3 per cent acidity was found to be the best recipe for carambola nectar with highest score for organoleptic qualities.

Table 3a : Changes in chemical composition of carambola nectar during storage

Treatments	TSS (°B)					Titratable acidity (%)					Reducing sugars (%)				
	Storage period (days)					Storage period (days)					Storage period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean	0	30	60	90	Mean
T_1	15.25	15.87	15.92	16.02	15.77	0.303	0.313	0.321	0.340	0.319	8.39	9.07	9.96	10.39	9.45
T_2	15.42	15.98	15.98	16.17	15.89	0.308	0.313	0.324	0.344	0.321	9.15	10.00	10.87	11.54	10.39
T_3	15.27	15.80	15.80	15.95	15.71	0.308	0.314	0.326	0.343	0.323	11.16	11.95	12.72	13.12	12.24
T_4	20.22	21.00	21.10	21.22	20.89	0.305	0.315	0.321	0.342	0.321	14.26	15.05	16.07	16.73	15.53
T_5	20.25	21.12	21.15	21.15	20.94	0.305	0.314	0.324	0.342	0.321	15.15	16.15	17.12	17.84	16.56
T_6	20.15	21.07	21.22	21.37	20.96	0.307	0.315	0.324	0.346	0.323	17.06	17.63	18.25	19.01	17.99
Mean	17.76	18.47	18.53	18.67		0.306	0.314	0.323	0.343		12.53	13.31	14.17	14.77	
	S.E. ±	C.D. (P=0.05)				S.E. ±	C.D. (P=0.05)				S.E. ±	C.D. (P=0.05)			
Treatment	0.021	0.060				0.0006	0.001				0.050	0.142			
Storage	0.017	0.049				0.0005	0.001				0.041	0.116			
T x S	0.043	0.120				0.0012	0.003				0.101	0.285			

T_1 : 20% Juice + 15°B + 0.3% acidity T_2 : 25% Juice + 15°B + 0.3% acidity T_3 : 30% Juice + 15°B + 0.3% acidity
T_4 : 20% Juice + 20°B + 0.3% acidity T_5 : 25% Juice + 20°B + 0.3% acidity T_6 : 30% Juice + 20°B + 0.3% acidity

Table 3b : Changes in chemical composition of carambola nectar during storage

Treatments	Total sugar (%)					Ascorbic acid (mg/100g)				
	Storage period (days)					Storage period (days)				
	0	30	60	90	Mean	0	30	60	90	Mean
T_1	10.73	10.91	11.00	11.34	10.99	31.64	24.37	18.74	13.19	21.99
T_2	10.91	11.72	11.87	11.97	11.62	38.25	29.06	15.17	13.89	24.10
T_3	11.72	12.10	12.90	13.54	12.57	42.18	37.18	20.53	15.97	28.97
T_4	14.88	15.23	16.50	17.13	15.94	31.79	20.5	12.49	9.03	18.45
T_5	15.69	16.32	17.98	18.19	17.05	35.54	30.62	14.28	10.42	22.72
T_6	17.91	18.03	18.78	19.20	18.48	37.49	34.69	18.74	14.58	26.38
Mean	13.64	14.05	14.84	15.23		36.16	29.41	16.66	12.85	
	S.E. ±	C.D. (P=0.05)				S.E. ±	C.D. (P=0.05)			
Treatment	0.024	0.070				0.581	1.638			
Storage	0.020	0.057				0.474	1.338			
T x S	0.049	0.139				1.162	3.277			

T_1 : 20% Juice + 15°B + 0.3% acidity T_2 : 25% Juice + 15°B + 0.3% acidity T_3 : 30% Juice + 15°B + 0.3% acidity
T_4 : 20% Juice + 20°B + 0.3% acidity T_5 : 25% Juice + 20°B + 0.3% acidity T_6 : 30% Juice + 20°B + 0.3% acidity

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