



Evaluation of cashew varieties for RTS beverage and jam

A. Sobhana^{*,**}

Cashew Research Station, KAU, Madakkathara, Thrissur 680656, Kerala

ABSTRACT

Cashew apple, weighing 8-10 times that of nut is usually wasted even though it is highly nutritious, with a few exceptions in places like Goa. The present study conducted at Cashew Research Station, Madakkathara, during 2016-17, aimed at screening varieties suitable for the preparation of cashew apple RTS drink and jam. Thirteen cashew varieties were selected for the study of which twelve varieties released from Kerala Agricultural University namely Madakkathara 2, Damodhar, Amrutha, Poornima, Priyanka, Sulabha, Kanaka, Panama, K-22-1, Dharasree, Dhana and Raghav, and one variety Vridhachalam-3 from Tamil Nadu Agricultural University), and products were prepared. The qualitative analysis of fresh cashew apple, products and sensory evaluation of the two products using 9-point Hedonic scale were carried out. The results revealed that the variety Vridhachalam-3 contained the highest TSS (14.2 °B); Amrutha, the lowest amount of tannin (0.23%); Panama, the lowest titrable acidity (0.25%); Sulabha, the highest vitamin C (295.70mg/100g) and K-22-1, the maximum juice yield (95.75%). When products were subjected to qualitative analysis, it was found that for RTS drink, variety Dhana gave the maximum TSS (23.2 °B); K-22-1, Amrutha, Dharasree and Madakkathara-2, the minimum acidity (0.26%) and K-22-1, the highest vitamin C (61.72 mg/100g). In case of jam the variety Dharasree had the highest TSS (80 °B), Amrutha, Raghav and Poornima had the minimum titrable acidity (0.26%) and Panama had the highest vitamin C (18.60mg/100g).

The sensory evaluation of products revealed Poornima and Vridhachalam-3 as the best varieties for the preparation of cashew apple RTS drink and jam, respectively. The shelf life studies indicated that the RTS beverage of all the cashew varieties could be stored up to two weeks under the refrigerated condition and jam for five months under room temperature.

Key words: *Anacardium occidentale*, pseudo fruit, sensory scoring.

INTRODUCTION

Cashew (*Anacardium occidentale* L.) is an important commercial foreign exchange earning crop of our country. Cashew nut is considered as the only economical part of the crop. However, cashew apple, the pseudo fruit attached to the nut, can be regarded as an equally valuable produce from the crop if it is economically exploited. Cashew apples are rich in sugars, minerals, vitamins especially vitamin C. It is found that cashew apple juice contain the highest amount of vitamin C (203.5 mg/100 ml), almost four times the amount of vitamin C in the popular citrus fruits (Akinwale, 2). In spite of having high nutritional value, neither fresh cashew apples nor juice are consumed or exploited for value addition. The main reason for this is the presence of astringency in the fruit which makes it less palatable. Astringency of cashew apple is due to polyphenols, tannins (0.35%), and unknown oily substances (3%) present in the waxy layer of the skin. The binding of tannins to salivary glycoproteins develops astringent taste (Talasila *et al.*, 14). In order to increase the acceptability of fruits, it is necessary

to remove the tannin. The process of removal of tannin and other polyphenols from cashew apple is known as clarification, which can be done with different materials like sago, gelatin, PVP, starch etc. A study conducted by Jayalekshmy and John (8) proposed that sago is the efficient and economic natural product for clarification of cashew apple juice compared to other clarifiers. The study conducted by Mini and Mathew (12) standardized the quantity of sago required for the clarification of cashew apple juice as 5 g/litre of juice. Talasila *et al.* (14) found different amount of organics, polyphenols and tannin in different varieties of cashew. All these factors influence the sensory and nutritional qualities of the products prepared out of it. The shelf life is another important factor which determines the quality of cashew apple product to a great extent, since it is an easily perishable fruit owing to quick fermentation. Cashew Research Station has standardized the technology for the preparation of many value added product and commercialized eight products from cashew apple (Mathew *et al.*, 11). Even though the preparation of RTS beverage and jam were standardized, difference was noticed in varieties with respect to quality and acceptability. The present

*Corresponding author's E mail: sobhana.a@kau.in

**Fruit Crops Research Station, KAU, Vellanikkara

study was conducted to find out the best variety for the preparation of cashew apple RTS beverage and jam.

MATERIALS AND METHODS

The present study was conducted at Cashew Research Station, Madakkathara, Kerala Agricultural University, Thrissur during 2016-1. Thirteen cashew varieties were selected for the study. Out of these, twelve varieties released from Kerala Agricultural University- Madakathara 2, Damodar, Amrutha, Poornima, Priyanka, Sulabha, Kanaka, Panama, K-22-1, Dharasree, Dhana and Raghav, and one variety Vrindhachalam-3 from Tamil Nadu Agricultural University (Plate 1). Quantitative parameters like fruit length, fruit weight, fruit girth and juice yield were measured and qualitative analysis was carried out for TSS, vitamin C, tannin and titratable acidity. The colour of fruit was also noted. TSS of fruits was recorded directly using digital hand refractometer and expressed in degree brix. The estimation of acidity was done using standard procedure described by AOAC (3). Ascorbic acid (Vitamin C) content was estimated by titration with 2, 6-dichlorophenol indophenol dye (Sadasivam and Manickam, 13) and the value of vitamin C was expressed in mg per 100g fruit. The tannin content was estimated through standard procedure described by AOAC (3) using spectrophotometer.

Fresh cashew apples free from damages and blemishes were collected from the field. After cleaning, juice was extracted from fruits using hydraulic press. Clarification of the juice was done by adding sago @ 5g/litre of juice (Mini and Mathew, 12). The clear juice obtained after clarification was used for RTS drink preparation. For preparing pulp, the collected cashew apples were cleaned and detanned by dipping in the common salt solution at 5% level for three consecutive days, changing the salt solution daily. After three days, the detanned fruits were taken out and washed. These were steamed with pressure cooker for 15 minutes without putting the whistle, and then made in to a pulp, which was used for the preparation of jam (Mini and Mathew, 12).

The standard procedure for the preparation of RTS beverage and jam was adopted as given by Mini and Mathew, 12). In this process, Clarified juice (150 g) Sugar (20 g), water (730 g) and citric acid (5 g) was used as ingredient. Required quantity of sugar and citric acid was added in water and boiled, after switching off the flame, added cashew apple juice; transferred in to bottles, when cooled. For jam preparation, Cashew apple pulp (1 kg), sugar (1 kg) and citric acid (5 g) was taken. Sugar and pulp were mixed thoroughly and there after citric acid was added to it and cooked with continuous stirring. When it reached the stage of jam, which was assessed

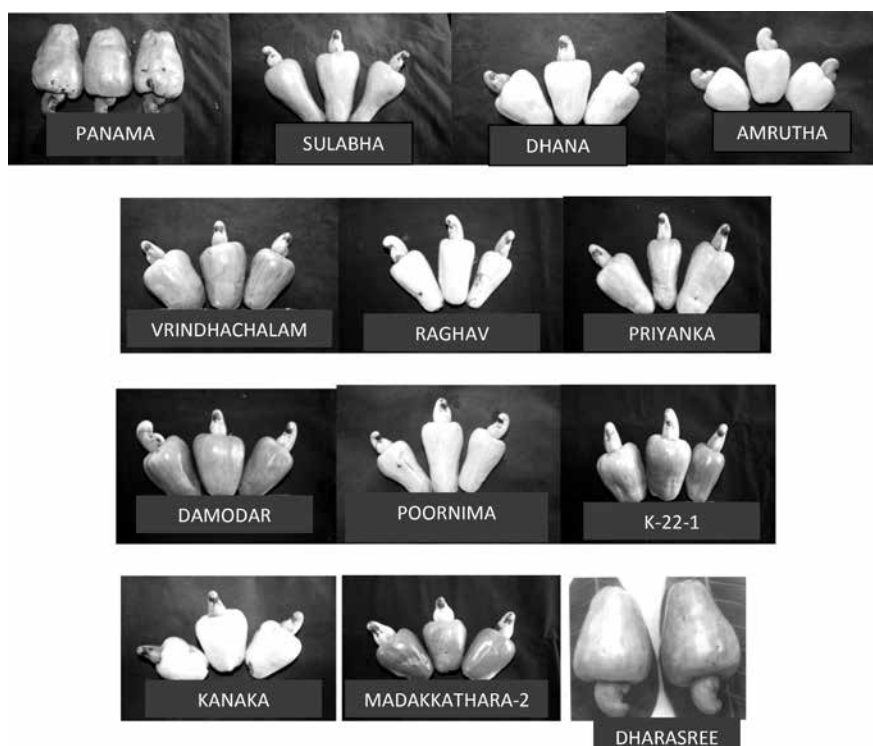


Plate 1. Cashew varieties used in the study.

by sheet test, transferred in to sterilized glass bottles. The products RTS drink and jam, prepared out of thirteen varieties were subjected to sensory evaluation using 9-point Hedonic scale (Lawless *et al.*, 9), with the help of twenty judges. RTS drink and jam were subjected to qualitative analysis; TSS, titratable acidity and vitamin C, using the standard procedure as described earlier.

The data were subjected to statistical analysis using DMRT software. Kendall's W test was used to assess the mean rank values of the sensory parameters (Legendre, 10).

RESULTS AND DISCUSSION

The data on quantitative and qualitative analyses of different varieties of cashew are presented in Table 1. From the present study it is understood that there is difference among cashew varieties with respect to size, TSS, titratable acidity and juice content of cashew apple. Length and weight of cashew apple was observed to be maximum in the variety Panama (10.00cm and 195.06 g respectively). The highest TSS (14.2 °B) was observed in Vridhachalam-3 and the lowest in Kanaka (10.01 °B). Dharasree had the maximum tannin content of 0.79% and Amrutha had the minimum (0.23%). Sulabha had the maximum vitamin C (295.70mg/100g) and Madakkathara 2 had the minimum (166.60mg/100g). Titratable acidity was minimum in the variety Panama (0.25%) while it was maximum in Dhana and Raghav (0.44%). K-22-1 gave the maximum juice yield (95.75%) followed by Dhana (83.78%). Madakkathara-2 had

the least juice recovery (49.01%). Among the thirteen varieties tested, Panama had the largest cashew apple with minimum titratable acidity due to which it can be recommended for table purpose or fresh consumption. Since K-22-1 yielded maximum juice, it can be recommended for beverage preparations and Madakkathara 2, with minimum juice recovery can be recommended for the pulp based products like jam, fruit bar halva etc. Vitamin-C content was highest for Sulabha (295.70 mg/100g) followed by Poornima (221.70 mg/100g) and Dhana (220.10 mg/100g). Madakkathara 2 had the lowest Vitamin C content (166.60 mg/100g).

The data on qualitative analysis of RTS drink are presented in Table 2. The RTS drink prepared from the variety Dhana gave the maximum TSS (23.2 °B), followed by Panama, Sulabha and Vridhachalam 3 (22 °B). Among the different varieties, the titratable acidity ranged from 0.26% to 0.51 %. RTS drink of K-22-1, Amrutha, Dharasree and Madakkathara-2 had the minimum acidity of 0.26% and that of Poornima and Mdakkathara 2 had the maximum acidity of 0.51%. The ascorbic acid content (Vitamin C) of different varieties ranged from 9.87-61.72mg/100g. The highest vitamin C content was observed in the variety K-22-1 (61.72 mg/100g) and the lowest in Madakkathara 2.

The data on quality analysis of jam are presented in Table 3. Jam prepared from the variety Dharasree had the highest value for TSS (80 °B), followed by Kanaka (76 °B). Regarding titratable acidity, Damodhar gave the maximum value of 0.96% and Amrutha,

Table 1. Quantitative and qualitative analysis of cashew apple varieties.

Variety	Length (cm)	Weight (g)	Girth (cm)	Colour	TSS (°B)	Vitamin C (mg/100g)	Tannin (%)	Titratable acidity (%)	Juice yield (%)
Poornima	8.33	87.66	16.00	Yellow	10.66	221.70	0.50	0.32	75.00
Damodhar	6.66	99.00	16.10	Red	13.90	202.60	0.33	0.32	68.75
Raghav	9.00	113.33	16.66	Yellow	12.50	200.60	0.50	0.44	70.00
Dharasree	8.20	80.50	16.50	Orange red	11.60	196.20	0.79	0.40	67.00
Dhana	7.50	96.33	17.83	Yellow	11.02	220.10	0.42	0.44	83.78
K-22-1	8.16	136.33	19.16	Red	12.40	202.00	0.31	0.38	95.75
Priyanka	8.83	135.66	22.50	Yellowish red	10.50	181.10	0.36	0.32	78.00
Kanaka	6.00	86.00	17.00	Yellow	10.01	208.10	0.56	0.38	82.50
Sulabha	8.50	63.66	13.50	Light orange	11.90	295.70	0.30	0.38	57.50
Panama	10.00	195.06	21.00	Yellowish red	12.10	181.34	0.45	0.25	50.00
Amrutha	5.50	69.00	16.50	Yellow	12.43	215.25	0.23	0.38	73.33
Vridhachalam 3	6.16	80.33	16.16	Red	14.20	215.00	0.43	0.32	75.21
Madakkathara 2	6.16	65.23	15.00	Red	10.60	166.60	0.44	0.32	49.01
CD @ 5%	1.26	4.24	1.09		1.73	2.95	NS	0.04	3.83

Table 2. Qualitative analysis of cashew apple RTS beverage of different varieties.

Varieties	TSS (°B)	Titrateable acidity (%)	Vitamin C (mg/100g)
K-22-1	18.0	0.26	61.72
Amrutha	20.0	0.26	12.34
Dhana	23.2	0.38	44.44
Panama	22.0	0.38	19.75
Poornima	20.4	0.51	32.43
Sulabha	22.0	0.38	24.69
Dharasree	20.4	0.26	24.69
Kanaka	19.2	0.26	12.34
Madakkathara-2	18.4	0.51	9.87
Raghav	20.0	0.32	33.60
Vridhachalam-3	22.0	0.38	24.31
Damodhar	20.2	0.30	24.60
Priyanka	19.6	0.36	28.30
CD (5%)	2.46	NS	1.69

Table 3. Qualitative analysis of cashew apple jam of different varieties.

Varieties	TSS (°B)	Titrateable acidity (%)	Vitamin C (mg/100g)
K-22-1	72.00	0.51	13.95
Amrutha	75.00	0.26	11.62
Dhana	71.00	0.45	9.30
Panama	66.00	0.32	18.60
Poornima	70.00	0.26	9.30
Sulabha	75.00	0.41	11.62
Dharasree	80.00	0.51	9.30
Kanaka	76.00	0.64	12.09
Madakkathara-2	71.00	0.32	6.97
Raghav	63.00	0.26	6.97
Vridhachalam-3	64.00	0.38	9.30
Damodhar	74.00	0.96	9.30
Priyanka	69.00	0.32	11.62
CD (5%)	3.13	0.05	0.89

Raghav and Poornima gave the minimum value of 0.26%. Vitamin C content was observed to be the highest in Panama (18.60mg/100g) followed by K-22-1 (13.95mg/100g). However, while comparing the vitamin C content in RTS drink and jam, it is clear that RTS drink contained more vitamin C than jam. This can be attributed to the loss of vitamin C in jam due to long period of heating as compared to RTS drink.

Varietal differences in titrateable acidity and total soluble sugars were also observed in various value added products of other fruits as well. According to Jain and Nema (7), the highest TSS was observed in the guava leather prepared from Allahabad Safeda and Apple colour. The leather acidity was also

found to be affected by cultivars significantly. The maximum mean acidity was observed in leather from Allahabad Safeda and lowest in Red Fleshed. The Langra variety of mango exhibited higher acidity, lower pH and total soluble solids (TSS) among all the tested varieties (Akhtar *et al.*, 1). Tyagi *et al.* (15) found that the papaya cultivar Red lady was the best among other cultivars in terms of TSS (13%) and total sugars (7.9%).

The data on sensory evaluation of RTS beverage and jam of the thirteen different varieties are presented in Tables 4 & 5 respectively and Fig. 1. Varietal difference could be noticed in the acceptance of the value added products, RTS beverage and jam. In the sensory evaluation of RTS beverage, the

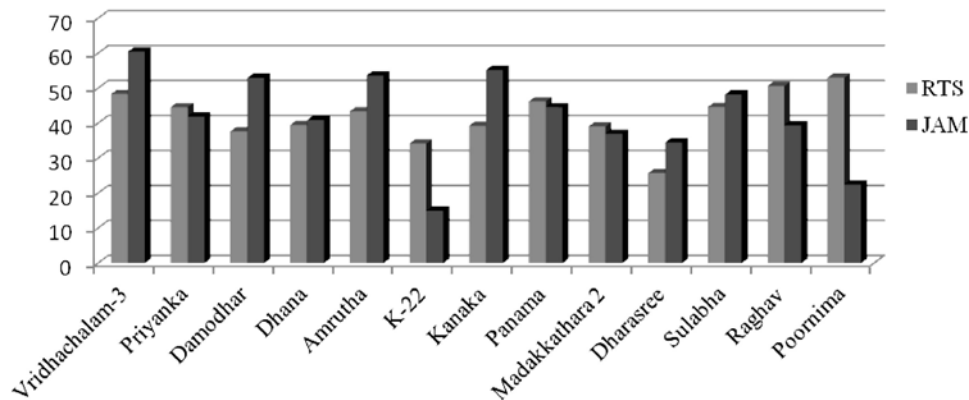


Fig. 1. Rank total RTS beverage and jam of cashew different varieties.

Table 4. Organoleptic scoring of cashew apple RTS drink of different varieties.

Varieties	Appearance		Colour		Flavor		Taste		Texture		Overall acceptability		Rank total
	Mean score	Rank value	Mean score	Rank value	Mean score	Rank value	Mean score	Rank value	Mean score	Rank value	Mean score	Rank value	
Vridhachalam-3	6.75	8.18	6.49	7.55	6.35	9.05	6.50	8.30	6.29	7.68	6.35	7.55	48.31
Priyanka	6.10	7.00	6.15	7.08	6.05	7.35	5.85	6.68	6.55	8.98	6.30	7.48	44.57
Damodhar	5.45	5.80	5.30	5.62	5.15	5.65	6.00	7.25	5.30	6.12	5.90	7.22	37.66
Dhana	5.60	6.22	6.10	6.78	5.25	6.18	5.70	7.05	5.85	6.98	5.75	6.25	39.46
Amrutha	5.95	6.90	6.45	7.42	5.60	6.70	6.39	7.75	6.25	7.62	5.79	6.98	43.37
K-22	5.55	6.15	6.00	6.95	4.95	5.98	4.65	4.80	5.20	5.35	4.95	4.95	34.18
Kanaka	5.48	5.85	6.55	7.90	4.95	5.95	5.49	6.22	5.60	6.62	5.75	6.70	39.24
Panama	6.65	8.12	6.25	7.20	6.15	8.02	6.15	7.30	6.30	7.80	6.45	7.92	46.22
Madakkathara-2	6.35	7.80	5.60	5.78	5.60	6.92	5.40	5.95	5.28	5.48	5.90	7.12	39.05
Dharasree	5.00	5.08	4.90	4.72	4.05	4.30	3.80	4.00	4.70	4.45	4.00	3.15	25.70
Sulabha	6.25	7.52	6.47	7.48	5.85	7.40	6.25	7.68	5.80	6.62	6.45	7.92	44.62
Raghav	6.65	8.12	6.85	8.45	6.25	8.60	6.60	8.55	6.50	8.58	6.60	8.35	50.65
Poornima	6.85	8.40	6.75	8.08	6.29	8.90	6.75	9.48	6.51	8.72	7.00	9.40	52.98
Kendall's Wa	0.09		0.08		0.14		0.16		0.14		0.18		

Table 5. Organoleptic scoring of cashew apple jam of different varieties.

Varieties	Appearance		Colour		Flavor		Taste		Texture		Overall acceptability		Rank total
	Mean score	Rank value	Mean score	Rank value	Mean score	Rank value	Mean score	Rank value	Mean score	Rank value	Mean score	Rank value	
Raghav	4.30	5.80	5.55	8.12	4.40	6.62	3.80	5.78	4.50	7.32	3.95	5.78	39.42
K-22	2.45	2.15	2.25	1.85	2.35	2.60	2.30	2.92	2.30	2.58	2.35	2.80	14.90
Damodhar	6.45	9.58	6.85	10.05	5.75	8.32	5.15	7.95	5.30	9.12	5.55	7.95	52.97
Vridhachalam-3	6.95	10.48	6.90	10.10	6.25	9.72	6.10	9.82	5.90	9.80	6.40	10.52	60.44
Sulabha	5.95	8.62	5.36	7.90	5.15	8.00	5.20	8.42	4.85	7.65	4.75	7.58	48.17
Priyanka	4.60	6.12	4.25	4.98	5.05	7.72	4.95	7.50	4.45	6.80	5.60	8.75	41.87
Amrutha	6.20	9.38	5.75	8.15	5.79	9.18	5.85	9.80	5.00	8.48	5.55	8.65	53.64
Panama	5.05	6.50	5.26	7.85	4.80	7.35	4.25	7.02	4.90	8.18	4.85	7.68	44.58
Poornima	3.10	3.15	3.40	3.92	3.20	3.78	2.95	3.65	2.85	4.05	2.95	3.90	22.45
Kanaka	6.11	9.35	6.10	9.20	5.79	9.18	6.20	9.85	5.60	9.22	5.40	8.42	55.22
Dhana	5.60	7.92	5.25	7.05	4.80	6.80	4.55	7.08	4.25	6.20	4.15	5.82	40.87
Madakkathara-2	4.70	6.30	4.45	5.48	4.30	5.70	4.15	6.25	4.30	6.58	4.35	6.65	36.96
Dharasree	4.25	5.65	4.70	6.35	4.20	6.02	3.45	4.95	3.25	5.02	4.25	6.50	34.49
Kendall's Wa	0.45		0.42		0.32		0.35		0.32		0.31		

variety Poornima recorded the highest mean score for colour and taste. Variety Raghav had the highest score for colour, Vridhachalam 3 scored maximum for flavor and Priyanka for texture. However, overall acceptability of RTS drink was maximum for Poornima

followed by Raghav. In the case of RTS beverage, judges preferred a good sugar- acid blend in the product, which may be the reason for getting the highest overall acceptability for Poornima, since this variety had comparatively high TSS and acidity.

However, in case of jam, the variety Vridhachalam 3 scored maximum value for appearance, colour, flavor and texture and Kanaka for taste. The variety Vridhachalam 3 had highest overall acceptability (Table 5). Jam is a sweet product usually used along with bread. Hence, high sugar content is preferred by the consumers. The qualitative analysis revealed less acidity and better TSS in the variety Vridhachalam 3 which might be the reason for the good acceptability. The work done by various researchers also reported that the varieties of crops showing noticeable variation in the sensory characters of value added products prepared from the fruits. The study conducted by Cano *et al.* (5) revealed that the fruits of banana cultivar Spanish Enana were superior in their quality in terms of flavor, sweetness and taste compared to other cultivars. Jain and Nema (7) found that the organoleptic quality of the pulp from Allahabad Safeda was the best for preparing guava leather among all the five cultivars followed by Lucknow 49. The fruit nectar prepared from guava variety L 49 had the highest organoleptic score (Choudhary *et al.*, 6). In a study conducted at Department of Food and Horticultural Sciences, Pakistan, Akhtar *et al.* (1) reported that the mango variety Langra was found to be superior for colour characteristics and the variety Ratol shown to be highly acceptable for flavour, taste and overall acceptability among the other tested varieties.

Microbial analysis was carried out to find out the maximum shelf life of RTS drink and jam. The shelf life of RTS drink was found as two weeks in the refrigerated condition; whereas the RTS drink kept in the room temperature fermented on the second day itself (Plate 2). The shelf life of jam of all the cashew varieties was 5 months in the room temperature condition. Bacteria, fungi and yeast were found in the damaged samples. However, microbial count could not be taken. The shelf life studies conducted in the value added products of many fruits reported

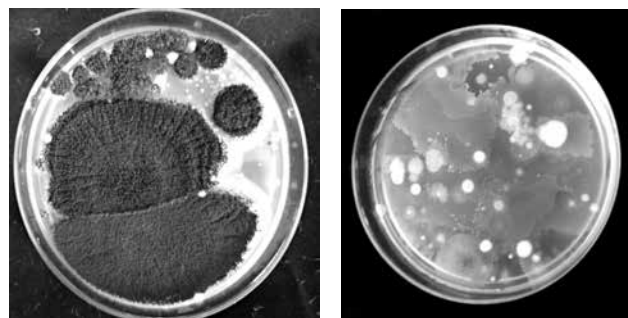


Plate 2. Microbial growth in the RTS beverage after two weeks.

similar results. According to Choudhary *et al.* (6), the chemical constituents did not change markedly until five months of storage of guava nectar as compared to fresh nectar at the time of preparation. In a study conducted by Bharadwaj and Mukherjee (4), the sand pear juice with apple, apricot and plum could be stored at room temperature for six months, without any spoilage.

It can be concluded that the Poornima and Vridhachalam 3 were found as the best cashew varieties for preparing cashew apple RTS beverage and jam respectively. The shelf life of RTS beverage of all the cashew varieties was two weeks in the refrigerated condition and that of jam was five months in room temperature.

ACKNOWLEDGEMENT

The authors are grateful to the All India Co-ordinated Research Project on Cashew for providing the financial support for conducting the experiment.

REFERENCES

1. Akhtar, S., Mahmood, M., Naz, S., Nasir, M. and Saultan, M.T. 2009. Sensory evaluation of mangoes (*Mangifera indica* L.) Grown in different regions of Pakistan. *Pakistan J. Bot.* **41**: 2821-29.
2. Akinwale, T.O. 2000. Cashew apple juice: its use in fortifying the nutritional quality of some tropical fruits. *European Food Res. Tech.* **211**: 205-07.
3. AOAC (Association of Analytical Chemists) 1998. Official methods of analysis. 15th edition, Washington DC, USA.
4. Bharadwaj, R.L. and Mukherjee, S. 2012. Studies on physio-chemical, sensory and microbiological qualities of Kinnow juice blends under refrigerated storage. *J. Hort. Sci.* **7**: 166-73.
5. Cano, M.P., Begonade, M.P., Cruz Matallana, A.M., Camara, M., Regler, G.M., Guiller moo, M. and Tabera, M.J. 1997. Differences among Spanish and Latin-American banana cultivars: morphological, chemical and sensory characteristics. *Food Chem.* **59**: 411-19.
6. Choudhary, M.L., Dikshit, S.N., Shukla, N., Saxena, R.R., and Dikshit, S.N. 2008. Evaluation of guava (*Psidium guajava* L.) varieties and standardization of recipe for nectar preparation. *J. Hort. Sci.* **3**: 161-63.

7. Jain, P. K. and Nema, P. K. 2007. Processing of pulp of various cultivars of guava (*Psidium guajava* L.) for leather production. *Agric. Engineering Int. CIGR J.* **4**: 234-39.
8. Jayalekshmy, V.G., and John, P.S. 2004. 'Sago' - a natural product for cashew apple juice clarification. *J. Tropical Agric.* **42**: 67-68.
9. Lawless, T., Harry T., and Hildegarde, H. 2010. *Sensory Evaluation of Food: Principles and Practices*. Springer Science Business Media, 957 p.
10. Legendre, P. (2005). Species associations: The Kendall coefficient of concordance revisited. *J. Agric., Biol. Environ. Stat.* **10**: 226-45.
11. Mathew, J., Mini, C. and Sobhana, A. 2009. *Multiple uses of cashew apple and the contributions of cashew research station, Madakkathara*. In: Cashew-Research and development in humid tropics with emphasis on cashew apple processing, Mathew, J., Mini, C. and Abraham, M. (Eds.). Kerala Agricultural University, Thrissur, pp. 143-149.
12. Mini, C. and Mthew, J. 2008. *Recipes for Cashew Apple Products*. Kerala Agricultural University, Vellanikkara, Thrissur, 14 p.
13. Sadasivam, S and Manickam, A. 1991. *Biochemical Methods for Agricultural Sciences*. Wiley Eastern Limited, Madras, 246 p.
14. Talasila, U., Vechalapu, R.R., and Shaik, K.B. 2012. Clarification, preservation, and shelf life evaluation of cashew apple juice. *Food Sci. Biotech.* **21**: 125-28.
15. Tyagi, M., Singh, H., Jawandha, S.K. 2015. Performance of papaya cultivars grown under protected conditions. *Indian J. Hort.* **72**: 334-37.

Received : October, 2018; Revised : February, 2019;
Accepted : February, 2019