Research Article

doi: 10.25081/jpc.2021.v49.i1.7060
Journal of Plantation Crops, 2020, 49(1): 42-55

Standardisation of RTS beverage from reconstituted cashew apple-based blended juice powder along with *Sugandi*

K. Umamaheswara Rao*, B. Prasanna Kumar, D.V. Swami, B. Salomi Sunnetha, K. Uma Krishna and D.D. Smith

AICRP on Cashew, Cashew Research Station, Dr. Y.S.R. Horticultural University, Bapatla-522 101, Andhra Pradesh, India

(Manuscript Received: 12-10-2020, Revised: 21-12-2020, Accepted: 15-01-2021)

Abstract

Cashew has commercial value for its nut and peduncle (false fruit), known as cashew apple. Requirements of consumers considering convenience, food safety, health benefits and sensory quality have increased demand for fruit juices. Instant juice powders can meet consumer requirements being cheap to transport and with prolonged shelf life. Then the blended juice was mixed with maltodextrin @15 per cent, *i.e.,* 15 g for 100 mL of blended juice by proper homogenisation. The roots of the sugandi (Swallow root - *Decalepsis hamiltonii*) were collected, cleaned thoroughly and the central white portion of the roots was discarded. Among the blended juice treatment combinations, the highest pH of 3.45 was recorded in B_3 (75% cashew apple juice + 25% pineapple juice powder at 150°C inlet temperature with a flow rate of 10 mL min^{-1}). The ready-to-serve (RTS) beverage, along with sugandi stored under refrigerated condition, were free from microbial proliferation till the end of the storage period (60^{th} day of storage), indicating its fitness for consumption with maximum flavour, taste and overall acceptability.

Keywords: Beverage, blended juice powder, cashew apple RTS, sugandi

Introduction

Cashew (*Anacardium occidentale* L.), belonging to the family Anacardiaceae, one of the important dry land plantation crops cultivated in India, ranks third in its export value among internationaly traded kernels. It is native to Brazil and well distributed in both tropical and sub-tropical regions of the world. In India, it covers an area of 10.6 lakh hectares with an annual nut production of 8.17 lakh tonnes with average productivity of 753 kg ha^{-1}. In India, it is grown in 17 states which include Kerala, Tamil Nadu, Maharashtra, Goa, Karnataka, Andhra Pradesh, Orissa, West Bengal, Chattisgarh, Jharkhand, Tripura, Meghalaya and Assam (Hubbali, 2019). In Andhra Pradesh, it is cultivated in an area of 1.85 lakh hectares with an annual nut production of one lakh tonnes and average productivity of 646 kg ha^{-1} (Hubbali, 2019). In Andhra Pradesh, cashew is mostly grown in Srikakulam, Vizianagaram, Vishakhapatnam, East Godavari, West Godavari, Krishna, Guntur, Prakasam and Nellore districts.

Cashew has commercial value for its nut and peduncle (false fruit), known as cashew apple. The production of cashew apple in India is about 65.4 lakh tones (Hubbali, 2019). The cashew apple, the pseudo-fruit, is fibrous, juicy and weighs approximately 6-8 times the nut. Cashew apples are quite nutritious, rich in polyphenols, minerals, organic acids, carbohydrates, pigments and vitamins (Chempakam, 1983). It has nutritional importance for its therapeutic properties and value-added products. Still, around 90 per cent of the harvest gets wasted (Azevedo and Rodriguez, 2000). The remaining 10 per cent of harvested apple is either consumed as fresh or processed industrially into a variety of products such as juices, syrups,

**Corresponding Author: umamahesh_horti@yahoo.com*

canned fruits, pickles, jams, chutneys, candies, toffees, ice creams, vinegar, marmalade and distilled products (Maciel *et al.,* 1986; Nanjundaswamy, 1984). Juice blending is one of the best methods to improve the nutritional quality of juice. It can improve the vitamins and mineral contents depending upon the kind and quality of fruits and vegetables used (Carvalho *et al*., 2007).

Requirements of the consumers considering convenience, food safety, health benefits, and sensory quality have increased demand for fruit juices. Still, most consumers require ready-to-use or easy-to-prepare products. Instant juice powders can meet consumer requirements being cheap to transport and with a prolonged shelf life, as reported by Cano-Chauca *et al*. (2005). Moreover, Shreshta *et al.* (2007) enumerated the benefits and economic potential of fruit juice powders over their liquid counterparts with reduced volume or weight, reduced packaging, easy handling and transportation and much longer shelf life. Besides, their physical state provides a stable, natural and easily dosable ingredient, which generally finds usage in many foods and pharmaceutical products as flavouring and colouring agents.

Materials and methods

Extraction of cashew apple juice

The ripened and blemish-free cashew apples were cut into pieces and fed to the mechanical juice extractor. The cut pieces were pressed out using a motor-operated screw type juice extractor, and the juice obtained was thus collected into a stainless steel container before clarification.

Clarification of juice

Cashew apple juice is highly perishable when fresh, often spoils within a day. The juice contains tannins, which causes astringency and should be removed to improve the quality of the juice. The cashew apple juice was strained through a muslin cloth and collected into a wide mouth stainless steel container. The clarifying agent, cooked sago @ 2 g + citric acid @ 2.5 g per litre of juice, was added slowly by stirring the juice in a circular motion till the entire juice formed into curd-like precipitate. The precipitate was allowed to stand for eight hours, and the clear supernatant was collected slowly without disturbing the residue. The clear juice obtained was strained through a muslin cloth and used in this experiment.

Preparation of different blended juices

The fruit juices prepared from mango, orange, pineapple and cashew apple were blended in the ratio of 75:25 *viz.,* cashew apple juice with other juice containing 40 treatments and observations were recorded for different parameters. The blended juice was prepared by addition of cashew apple juice with mango juice in the proportion of 75 mL + 25 mL, cashew apple juice with orange juice in the proportion of 75 mL + 25 mL, cashew apple juice with pineapple juice in the proportion of 75 mL + 25 mL and 100 per cent cashew apple juice alone.

Carriers

The carrier material used for micro-encapsulation was maltodextrin (MD), obtained from Himedia Laboratories Limited, India. Maltodextrin is a non-sweet, soluble, white to an off white coloured, slightly hygroscopic powder having 20 dextrose equivalence. MD was used because of its neutral colour, taste and relatively low cost. It is considered hydrolysed starch, and it is obtained by the action of either acids or enzymes. The addition of MD in food material before spray drying can reduce stickiness and agglomeration problems during the storage of the end product.

Addition of maltodextrin and homogenisation

The blended juice was mixed with maltodextrin @15 per cent, *i.e.,* 15 g for 100 mL of blended juice by proper homogenisation as reported by Rafeekher *et al*. (2015). Juice carrier concentration in the ratio of 40:60 based on total soluble solids of juice was subjected to spray drying by mixing 100 mL of juice and carrier material. After adding maltodextrin to the blended cashew apple juice, it was homogenised thoroughly using a glass rod as a stirrer and was used for powder preparation.

Production of blended juice powder

At specified inlet air temperature, water was fed into the nozzle atomiser by a peristaltic pump. The feed rate of water adjusted to maintain the outlet temperature of the air at 88 ± 2 ºC throughout the

drying process. When the inlet air temperature was the desired temperature, and the outlet air temperature was stabilised at 88 ± 2 ºC, the prepared feed mix was fed into the feed bowl. The feed mix after atomisation was mixed thoroughly with the hot air in the drying chamber and instantly converted into powder. The powder particles were collected in the conical bottom of the drying chamber and then carried by air into the cyclone separator. In the cyclone separator, powder particles from the air and get collected in a jar. The air was let out into the atmosphere. Loose powder remaining in the drying chamber also was collected by capping with a clean cloth. Powder form the cyclone separator and loose powder from the chamber was separately weighed and then mixed.

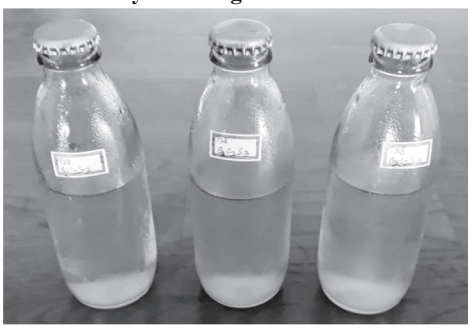
Spray-dried juice powder was collected in glass bottles and evaluated for their physical and chemical parameters. Statistical analysis was done based on a three-factor, completely randomised design and three best treatments were selected based on powder recovery from blended juice powder combinations and one from 100 per cent cashew apple juice powder.

Reconstitution of the blended cashew apple juice powder for RTS beverage along with sugandi

The four best treatments were selected based on the blended juice powder recovery by the spray drying technique used. The same was prepared for the reconstitution of the powder for the preparation of RTS beverage with sugandi with the following treatments.

B_1	75% cashew apple juice + 25% pineapple juice at 170 ºC for 10 mL min^{-1}
B_2	75% cashew apple juice + 25% pineapple juice at 160 ºC for 10 mL min^{-1}
B_3	75% cashew apple juice + 25% pineapple juice at 150 ºC for 10 mL min^{-1}
B_4	100% cashew apple juice at 150 ºC for 10 mL min^{-1}
C_1	Ambient condition
C_2	Refrigerated condition
S_1	0 day (initial day)
S_2	15th day of storage
S_3	30th day of storage
S_4	45th day of storage
S_5	60th day of storage

At initial day of storage



At 15th day of storage

At 30th day of storage

At 45th day of storage

View of Blended RTS beverage prepared along with *sugandi* at initial, 15th and 30th day of storage under refrigerated condition

Factor-I (Blended juice treatment combinations)

B1-75% cashew apple juice +25% pineapple juice at 170 ºC inlet temperature with flow rate of 10 mL min^{-1}

B_2 -75% cashew apple juice +25% pineapple juice at 160 ºC inlet temperature with flow rate of 10 mL min^{-1}

B_3- 75% cashew apple juice +25% pineapple juice at 150 ºC inlet temperature with flow rate of 10 mL min^{-1}

B_4 -100% cashew apple juice at 150 ºC inlet temperature with flow rate of 10 mL min^{-1}

Factor-II (Storage condition)

C_1- Ambient condition

C_2- Refrigerated condition

Factor-III (Days of storage)

S_1: 0 day

S_2:15th day of storage

S_3: 30th day of storage

S_4: 45th day of storage

S_5: 60th day of storage

Procedure for preparation of sugandi root extract

The roots of the sugandi (Swallow root - *Decalepsis hamiltonii*) were collected and cleaned thoroughly, and the central white portion of the roots was discarded. The dark outer portion of the roots was collected (250 g) and sun-dried for a day. These roots were soaked in 2 litres of water overnight. On soaking, the liquid turns a dark colour. The next morning, the roots were boiled along with the soaked water until it reduced to half of its original quantity. The liquid was strained with a double-layered cheese cloth so that no particles trickled down. The strained liquid was poured into another clean heavy bottomed vessel. To this liquid, added one kg of sugar and heated till it turns slightly thick and sticky, approximately for 15 min on low, medium flame. Then it was cooled and stored the dark brown liquid in a clean bottle.

Preparation of ready to serve (RTS) beverage

Blend combination B_1 contains one gram of spray-dried, blended cashew apple juice powder (75% cashew apple juice + 25% pineapple juice spray-dried at 170 °C with a flow rate of 10 mL min^{-1}) added with 2.5 g of sugar along with 2.5 mL of sugandi concentrate and 94 mL of water and prepared 100 mL RTS. The blend combination B_2 contains one gram of spray-dried blended cashew apple juice powder (75% cashew apple juice + 25% pineapple juice spray-dried at 160 °C with a flow rate of 10 mL min^{-1}) added with 2.5 g of sugar along with 2.5 mL of sugandi concentrate and 94 mL of water and prepared 100 mL RTS. The blend combination B_3 contains one gram of spray-dried blended cashew apple juice powder (75% cashew apple juice + 25% pineapple juice spray-dried at 150 °C with a flow rate of 10 mL min^{-1}) added with 2.5 g of sugar along with 2.5 mL of sugandi concentrate and 94 mL of water and prepared 100 mL RTS. The blend combination B_4 contains one gram of spray-dried cashew apple juice powder (100% cashew apple juice spray-dried at 150 °C with a flow rate of 10 mL min^{-1}) added with 2.5 g of sugar along with 2.5 mL of sugandi concentrate and 94 mL of water and prepared 100 mL RTS. These were hot filled in sterilised bottles of 200 mL size and crown corked and heat processed in boiling water at 65°C for 30 min then cooled and stored (Srivastava and Kumar, 2002).

Storage of RTS beverage

The RTS beverage prepared from different treatments of the experiment were hot-filled in a sterilised bottle of 200 mL size and crown corked and heat processed in boiling water at 65 °C for 30 min then cooled. These were stored at two storage conditions. Hot filled bottles were stored under the ambient condition at room temperature at 30 °C for up to 60 days and recorded the physico-chemical properties of RTS at 15 days interval. Hot filled bottles were stored under the refrigerated condition at 4 °C for up to 60 days, and the physico-chemical properties of RTS were recorded at 15 days interval.

The RTS beverages of different treatments were stored in ambient and refrigerated conditions. The quality parameters of the beverage were studied at different days of storage, *i.e.,* 0, 15, 30, 45 and 60 days after storage. The experiment was designed in 3-factorial CRD with two replications comprising 40 treatments.

Results and discussion

The study describes the utilisation of cashew apple juice blended with other fruit juice powder. The blended juice powder prepared with pineapple combination, which found to be the best and best treatment of 100% cashew apple juice powder by spray drying technique, is used to prepare RTS beverage and sugandi.

pH

Among the blended juice treatment combinations, the highest pH of 3.45 was recorded in B_3, and the lowest (3.43) was recorded in B_2. Among the different storage conditions, the highest pH of 3.45 was recorded in C_2 (refrigerated condition), and the lowest of 3.42 was recorded in C_1 (ambient condition). Among the different days of storage, the highest pH of 3.53 was recorded in S_1 (0 days of storage), and the lowest of 3.38 was recorded in S_5 (60^{th} day of storage) (Table 1).

The pH of different blended juice treatment combinations varied from 3.51 to 3.54 on the initial day of storage. Among the interaction effect of blended juice treatment combinations, storage conditions, and days of storage recorded, the highest pH in treatment combination of $C_1B_2S_2$ and the lowest was recorded in (Table 3).

The mean value of pH significantly increased from the initial day to the 60^{th} day of the storage period. Nath *et al*. (2005) observed similar results for kinnow ginger blended squash. Maia and Cecilia (2002) observed that pH increased in apple juice during storage due to the reduction of titrable acidity because both pH and titrable acidity were inversely proportional to each other. Rehman *et al.* (2014) described that the possible reason for increased pH with prolonged storage of kinnow juice might be the acid hydrolysis of the polysaccharides into mono-saccharine disaccharides, which are responsible for the increase in sweetness and decrease in sourness. These results conform to Muhammad *et al*. (2018), who worked with orange date blended squash.

Total soluble solids (^{o}Brix)

Among the blended juice treatment combinations, the highest total soluble solids of 10.45 ^{o}Brix were recorded in B_4 followed by B_3 (10.33 ^{o}Brix) and the lowest was recorded in B_1. Among the different storage conditions, the highest total soluble solids was recorded in C_1 (10.41 ^{o}Brix), and the lowest was recorded in C_2. Among the different storage days, the highest total soluble solids were recorded in S_5, and the lowest was recorded in S_1 (Table 1).

The total soluble solids of different blended juice treatment combinations varied from 10.00 to

Table 1. Effect of blended juice powders obtained from spray drying on storage conditions and days on quality parameters of RTS beverage mixed with *sugandi*.

Treatments	pH	TSS (p brix)	Titrable acidity (%)	Reducing sugars (%)	Total sugars (%)	TSS/Acid ratio	Ascorbic acid (mg 100 mL^{-1})	Tannins (mg mL^{-1})
B1	3.44	10.24	0.49	3.22	8.92	21.43	147.15	1.018
B2	3.43	10.33	0.47	3.25	9.00	22.14	150.31	0.995
B3	3.45	10.42	0.48	3.29	9.09	21.99	152.05	0.990
B4	3.43	10.45	0.74	3.37	9.23	13.99	196.98	1.161
SEm±	0.005	0.01	0.003	0.005	0.004	0.03	0.42	0.002
CD (0.05)	0.014	0.04	0.008	0.013	0.012	0.10	1.21	0.007
C1	3.42	10.41	0.54	3.27	9.06	20.11	161.18	1.039
C2	3.45	10.31	0.55	3.30	9.06	19.67	162.06	1.043
SEm±	0.003	0.01	0.002	0.003	0.003	0.02	0.30	0.002
CD (0.05)	0.010	0.03	0.006	0.009	NS	0.07	0.85	NS
S1	3.53	10.10	0.60	3.09	8.98	17.35	169.73	1.093
S2	3.50	10.20	0.57	3.18	9.02	18.55	165.16	1.067
S3	3.45	10.32	0.55	3.30	9.04	19.36	161.39	1.044
S4	3.38	10.44	0.53	3.41	9.10	20.56	157.68	1.010
S5	3.35	10.74	0.47	3.44	9.14	23.63	154.15	0.990
SEm±	0.005	0.02	0.003	0.005	0.005	0.04	0.42	0.003
CD (0.05)	0.016	0.04	0.009	0.015	0.013	0.11	1.19	0.008

Table 2. Effect of blended juice powders obtained from spray drying on storage conditions and days on quality parameters of RTS beverage mixed with *sugandi*.

Treatments	Colour	Flavour	Taste	Overall acceptability
B1	7.76	7.37	6.96	7.06
B2	8.00	7.63	7.31	7.38
B3	7.59	7.14	7.14	7.06
B4	7.71	7.27	6.89	7.12
SEm±	0.05	0.05	0.04	0.07
CD (0.05)	0.14	0.14	0.13	0.20
C1	7.61	7.06	6.70	6.63
C2	7.92	7.62	7.45	7.67
SEm±	0.03	0.03	0.03	0.05
CD (0.05)	0.09	0.10	0.09	0.13
S1	8.68	8.35	8.15	8.37
S2	8.11	7.80	7.59	7.69
S3	7.79	7.32	7.12	7.14
S4	7.33	6.76	6.43	6.50
S5	6.91	6.47	6.08	6.06
SEm±	0.05	0.05	0.05	0.07
CD (0.05)	0.15	0.16	0.14	0.21

10.15 °Brix at the initial day of storage. Among the interaction effects of blended juice treatment combinations, storage conditions and days of storage recorded the highest total soluble solids in the treatment combination of $C_1B_4S_5$ with 11.15 °Brix followed by $C_1B_3S_5$ with 11.00 °Brix and the lowest was recorded in $C_1B_1S_2$ with 10.10 °Brix (Table 3).

The mean value of TSS has significantly increased from the initial day to 60th day during the storage. Prasad and Mali (2000) observed the least increase in TSS under refrigerated storage of kinnow juice, and they reasoned the same due to reduced hydrolysis of polysaccharides and acids. Bhardwaj and Nandal (2014) had also reported similar findings, which showed that TSS of blended kinnow juice directly correlated with storage duration of storage and increase in TSS was higher at ambient condition due to the high rate of solubilisation or hydrolysis of acid into sugars. Similar findings have been reported by Deka and Sethi (2001) in mixed fruit juice spiced beverage, Singh and Mathur (1953) in cashew apple juice and Bhardwaj and Mukherjee (2012) in Kinnow juice. The hydrolysis of polysaccharides (starch and pectin) into simpler substances was responsible for the increase in TSS of mandarin ginger blended squash during storage (Nath *et al*., 2005). Sindumathi and Premalatha (2015) studied and observed the initial TSS content of flavoured papaya-pineapple blended RTS beverage was 15.0 °Brix which was increased to 18.0 °Brix at 120 days of storage. Sasi Kumar (2015) studied the RTS made from a blend of *Aloe vera* and aonla fruit juice and revealed that total soluble solids increased gradually during storage.

Titrable acidity (%)

Among the blended juice treatment combinations, the highest titrable acidity of 0.74 per cent was recorded in B_4, and the lowest was recorded in B_2. Among the different storage conditions, the highest titrable acidity (%) was recorded in C_2 of 0.55 per cent, and the lowest was recorded in C_1. Among the different days of storage, the highest titrable acidity (%) was recorded in S_1 of 0.59 per cent, and the lowest was recorded in S_5 of 0.47 per cent (Table 1)

The titrable acidity of different blended juice treatment combinations varied from 0.53 to 0.79 per cent on the initial day of storage. Among the interaction effects of blended juice treatment combinations, storage conditions and days of storage, the highest titrable acidity was recorded in the treatment combination of $C_1B_4S_2$ of 0.78 per cent followed by $C_1B_4S_2$ (0.77 per cent) and the lowest was recorded in $C_2B_3S_5$ (0.39 per cent) (Table 3).

The mean value of titrable acidity has significantly decreased from the initial day to 60th day during the storage period. Due to the co-polymerisation of organic acids with amino acids and sugar, the percent acidity was decreased (Malav *et al*., 2014). Similar results were observed in lime aonla blended squash by Harshavardhan and Chikkasubbanna (2008), Muhammad *et al*. (2018) in orange date blended squash during the storage period. The decrease in the acidity of the squash prepared by blending kinnow mandarin juice and ginger juice were observed with an increase in storage period at room temperature by Nath *et al.* (2005).

Table 3. Interaction effect of blended juice combinations, storage conditions and days of storage on different parameters of RTS beverage along with sugandi prepared by spray drying method

Interactions	pH	TSS (^{0}Brix)	Titrable acidity (%)	Reducing sugars (%)	Total sugars (%)	TSS/Acid ratio	Ascorbic acid (mg 100 mL^{-1})	Tannins (mg mL^{-1})
$B_1C_1S_1$	3.53	10.00	0.54	3.06	8.88	18.91	155.15	1.060
$B_1C_1S_2$	3.49	10.10	0.49	3.09	8.90	21.12	147.84	1.030
$B_1C_1S_3$	3.41	10.20	0.48	3.19	8.92	21.78	145.75	1.033
$B_1C_1S_4$	3.29	10.35	0.46	3.28	8.98	23.17	143.75	0.983
$B_1C_1S_5$	3.25	10.75	0.44	3.25	9.03	25.61	141.75	0.978
$B_2C_1S_1$	3.54	10.10	0.53	3.05	8.92	18.88	156.82	1.050
$B_2C_1S_2$	3.54	10.20	0.49	3.14	9.02	20.96	154.29	1.018
$B_2C_1S_3$	3.44	10.30	0.48	3.26	9.04	21.58	150.85	0.983
$B_2C_1S_4$	3.36	10.45	0.46	3.38	9.06	23.49	148.70	0.968
$B_2C_1S_5$	3.28	10.85	0.40	3.45	9.08	27.97	144.25	0.948
$B_3C_1S_1$	3.54	10.15	0.54	3.12	9.02	18.82	158.67	1.035
$B_3C_1S_2$	3.48	10.15	0.52	3.19	9.04	19.87	156.38	0.995
$B_3C_1S_3$	3.46	10.45	0.49	3.29	9.06	21.53	149.71	0.983
$B_3C_1S_4$	3.39	10.55	0.48	3.40	9.12	22.65	144.75	0.968
$B_3C_1S_5$	3.37	11.00	0.41	3.50	9.14	26.01	143.75	0.948
$B_4C_1S_1$	3.51	10.15	0.79	3.12	9.12	12.79	208.29	1.228
$B_4C_1S_2$	3.49	10.35	0.77	3.23	9.16	13.34	201.27	1.213
$B_4C_1S_3$	3.43	10.36	0.75	3.43	9.16	13.73	197.60	1.188
$B_4C_1S_4$	3.39	10.69	0.71	3.50	9.25	13.10	192.88	1.115
$B_4C_1S_5$	3.36	11.15	0.62	3.56	9.27	16.88	181.25	1.065
$B_1C_2S_1$	3.53	10.00	0.54	3.06	8.88	18.91	155.15	1.060
$B_1C_2S_2$	3.52	10.20	0.53	3.20	8.85	19.68	148.65	1.030
$B_1C_2S_3$	3.42	10.29	0.51	3.29	8.90	20.20	146.65	1.010
$B_1C_2S_4$	3.32	10.19	0.49	3.38	8.94	21.28	144.25	1.008
$B_1C_2S_5$	3.30	10.36	0.44	3.45	9.02	23.67	142.58	0.990
$B_2C_2S_1$	3.54	10.10	0.53	3.05	8.92	18.88	156.82	1.050
$B_2C_2S_2$	3.50	10.20	0.51	3.18	8.93	20.10	151.75	1.010
$B_2C_2S_3$	3.44	10.26	0.49	3.29	8.98	21.11	149.23	0.990
$B_2C_2S_4$	3.38	10.36	0.44	3.37	9.02	23.19	146.10	0.978
$B_2C_2S_5$	3.34	10.52	0.42	3.37	9.04	25.28	144.28	0.960
$B_3C_2S_1$	3.54	10.15	0.54	3.12	9.02	18.82	158.67	1.035
$B_3C_2S_2$	3.49	10.29	0.51	3.21	9.05	20.19	156.85	1.010
$B_3C_2S_3$	3.48	10.37	0.49	3.31	9.07	21.28	154.70	0.978
$B_3C_2S_4$	3.39	10.47	0.45	3.43	9.18	23.38	149.34	0.978
$B_3C_2S_5$	3.35	10.66	0.39	3.36	9.21	27.37	147.70	0.968
$B_4C_2S_1$	3.51	10.15	0.79	3.12	9.12	12.79	208.29	1.228
$B_4C_2S_2$	3.49	10.15	0.78	3.26	9.21	13.12	204.28	1.230
$B_4C_2S_3$	3.42	10.35	0.76	3.38	9.23	13.71	196.65	1.188
$B_4C_2S_4$	3.40	10.46	0.75	3.52	9.27	14.24	191.65	1.088
$B_4C_2S_5$	3.34	10.65	0.67	3.61	9.31	16.26	187.67	1.068
SEm±	0.02	0.04	0.01	0.02	0.01	0.11	1.13	0.008
CD (0.05)	0.04	NS	0.03	0.04	NS	0.31	3.39	0.022
CV%	0.64	0.64	2.39	0.67	0.20	0.78	1.17	1.013

Table 4. Interaction effect of blended juice treatment combinations, storage conditions and days of storage on organoleptic score of RTS beverage along with sugandi prepared by spray drying method

Interactions	Colour	Flavour	Taste	Overall acceptability
$B_1C_1S_1$	8.78	7.95	7.70	7.80
$B_1C_1S_2$	7.90	7.90	7.75	7.80
$B_1C_1S_3$	7.70	7.50	6.55	6.65
$B_1C_1S_4$	6.58	7.25	5.80	5.80
$B_1C_1S_5$	6.00	6.85	5.35	5.45
$B_2C_1S_1$	8.90	8.55	8.05	8.64
$B_2C_1S_2$	8.28	7.60	7.35	7.30
$B_2C_1S_3$	7.95	7.30	7.00	6.50
$B_2C_1S_4$	7.30	7.05	6.10	5.65
$B_2C_1S_5$	6.75	6.85	5.75	5.15
$B_3C_1S_1$	8.43	8.25	8.85	8.65
$B_3C_1S_2$	8.00	7.35	7.20	6.65
$B_3C_1S_3$	7.58	6.85	6.85	6.70
$B_3C_1S_4$	7.15	5.55	5.75	4.95
$B_3C_1S_5$	6.50	5.00	4.90	4.95
$B_4C_1S_1$	8.63	8.65	8.00	8.40
$B_4C_1S_2$	8.03	7.40	7.75	7.55
$B_4C_1S_3$	7.73	6.85	7.20	6.85
$B_4C_1S_4$	7.28	5.40	5.25	6.50
$B_4C_1S_5$	6.80	5.05	4.80	4.70
$B_1C_2S_1$	8.78	7.95	7.70	7.80
$B_1C_2S_2$	8.35	7.90	7.45	7.55
$B_1C_2S_3$	8.18	7.10	7.40	7.50
$B_1C_2S_4$	7.88	6.80	7.05	7.30
$B_1C_2S_5$	7.45	6.50	6.85	6.90
$B_2C_2S_1$	8.90	8.55	8.05	8.64
$B_2C_2S_2$	8.55	8.10	7.90	8.35
$B_2C_2S_3$	8.05	7.65	7.80	8.06
$B_2C_2S_4$	7.85	7.35	7.65	7.90
$B_2C_2S_5$	7.45	7.30	7.45	7.60
$B_3C_2S_1$	8.43	8.25	8.85	8.65
$B_3C_2S_2$	7.85	8.00	8.00	8.40
$B_3C_2S_3$	7.65	7.55	7.15	7.60
$B_3C_2S_4$	7.25	7.40	7.05	7.05
$B_3C_2S_5$	7.08	7.20	6.80	6.95
$B_4C_2S_1$	8.63	8.65	8.00	8.40
$B_4C_2S_2$	7.90	8.15	7.35	7.90
$B_4C_2S_3$	7.53	7.75	7.00	7.25
$B_4C_2S_4$	7.33	7.30	6.80	6.85
$B_4C_2S_5$	7.25	7.00	6.70	6.80
SEm±	0.15	0.15	0.14	0.21
CD (0.05)	NS	0.44	0.40	0.62
CV%	2.76	3.09	2.85	4.33

Reducing sugars (%)

Among the blended juice treatment combinations, the highest reducing sugars of 3.37 per cent were recorded in B_4 followed by B_3 (3.29 %) and the lowest was recorded in B_1 (3.22 %). Among the different storage conditions, the highest reducing sugars (%) was recorded in C_2 (3.30), and the lowest was recorded in C_1 (3.27%). Among the different days of storage, the highest reducing sugars (%) was recorded in S_5 (3.44 %), and the lowest was recorded in S_1 (3.09 %) (Table 1).

The reducing sugars of different blended juice treatment combinations varied from 3.05 to 3.12 on the initial day of storage. Among the interaction effect of blended juice treatment combinations, storage conditions and days of storage revealed the highest reducing sugars (%) was revealed in the treatment combination of $C_2B_4S_5$ (3.61 %) followed by $C_1B_4S_5$ and the lowest was recorded in $C_1B_2S_2$ (Table 3).

The mean value of reducing sugars significantly increased from the initial day to 60th day during storage. The rising temperature during storage also accelerated the hydrolysis of acids and poly-polysaccharides into simple sugars (Bhardwaj and Nandal, 2014). Sarmah *et al.* (1981) observed a considerable increase in reducing sugar content in single strength kinnow mandarin juice in the samples at room temperature than those kept at low temperatures. According to Kotecha and Kadam (2003) and Sahu *et al.* (2005), the total and reducing sugar was increased in tamarind syrup and mango lemongrass beverages, respectively, during storage which might be due to the breakdown of polysaccharides into monosaccharides. Muhammad *et al*. (2018) studied the orange date blended squash at different ratios and observed that the mean value of reducing sugar significantly increased from 16.50 to 17.76 per cent during storage.

Total sugars (%)

Among the blended juice treatment combinations, the highest total sugars of 9.23 per cent were recorded in B_4 followed by B_3 and the lowest was recorded in B_1. The difference observed at different storage conditions for total sugars (%) was non-significant. Among the different days of

storage, the highest total sugars (%) was recorded in S_5 (60th day of storage) as 9.14 per cent, and the lowest was recorded in S_1 (0 days of storage) as 8.98 per cent. The differences observed for the interaction effect of blended juice treatment combinations, storage conditions and days of storage for total sugars (Table 3) were non-significant.

An increase in the total sugars from the initial day to the 60th day of the storage period was observed. The fruit juice contains various reducing and non-reducing sugars, which tend to change during storage due to various interconversion processes. The increase in total sugars could result from the hydrolysis of polysaccharides like pectin, cellulose and starch into simple sugars, as reported by Singh and Mathur (1953) in cashew apple juice. Similar results were observed by Sindumathi and Premalatha (2015) in flavoured papaya-pineapple blended RTS beverage.

TSS/Acid ratio

Among the blended juice treatment combinations, the highest TSS/acid ratio of 22.14 was recorded in B_2 followed by B_3 and the lowest was recorded in B_4. Among the different storage conditions, the highest TSS/acid ratio was recorded in C_1, and the lowest was recorded in C_2) of 19.67. Among the different days of storage, the highest TSS/Acid ratio was recorded in S_5 as 23.63, and the lowest (17.35) was recorded in S_1 (Table 1).

The TSS/acid ratio of different blended juice treatment combinations varied from 12.79 to 18.91 on the initial day of storage. Among the interaction effects for blended juice treatment combinations, storage conditions and days of storage recorded the highest TSS/acid ratio (27.97) in the treatment $C_1B_2S_5$ followed by $C_2B_3S_5$ of 27.37 and the lowest was recorded in $C_2B_4S_2$ (100% cashew apple juice at an inlet temperature of 150 °C with a flow rate of 10 mL min^{-1} under the refrigerated condition at 15th day of storage) of 13.12 (Table 3).

An increase in TSS/ acid ratio was observed during the storage period from the initial day to the 60th day. It might be due to an increase in the TSS and a decrease in the acidity during the storage period. The cashew apple RTS, squash, syrup, blended syrup of cashew apple with kokum and karonda, prepared from all the varieties of cashew apple under study, exhibited a significant increase in °Brix: acid ratio during the storage period of 12 months (Manjarekar, 2005).

Ascorbic acid

Among the blended juice treatment combinations, the highest ascorbic acid of 196.98 mg 100 mL^{-1} was recorded in B_4 followed by B_3 as 152.05 mg 100 mL^{-1}, and the lowest (147.15 mg 100 mL^{-1}) was recorded in B_1. Among the different storage conditions, the highest ascorbic acid ratio (162.06 mg 100 mL^{-1}) was recorded in C_2, and the lowest was recorded in C_1 as 161.18 mg 100 mL^{-1}. Among the different days of storage, the highest ascorbic acid was recorded (169.73 mg100 mL^{-1}) in S_1, and the lowest was recorded in S_5 of 154.15 mg 100 mL^{-1} (Table 1).

The ascorbic acid content of different blended juice treatment combinations varied from 155.15 to 208.29 on the initial day of storage. Among the interaction effect of blended juice combination, storage conditions and days of storage recorded the highest ascorbic acid (204.28 mg 100 mL^{-1}) of $C_2B_4S_2$ followed by $C_1B_4S_2$ with 201.27 mg 100 mL^{-1}, and the lowest (141.75 mg per 100 mL) was recorded in $C_1B_1S_5$ (Table 3).

The mean value of ascorbic acid has significantly decreased from the initial day to 60th day during storage. According to Jain *et al*. (2003) decrease in ascorbic acid might be because it gets easily oxidised by both enzymatic and non-enzymatic catalyst in the presence of oxygen, as it is sensitive to light, heat and oxygen. Carvalho *et al.* (2007) reported the decreasing trend in vitamin C content in cashew apple juice blended with coconut water during storage. A similar trend was also reported in cashew apple juice by Costa *et al.* (2003). Kabasakalis *et al.* (2000) had found 29 to 41 per cent of ascorbic acid loss after four months when fruit juices were stored at room temperature, while Burdulu *et al.* (2006) found 27.3 to 45.3 per cent loss in ascorbic acid when orange juice was stored at 28^{0}C for two months. Majumdar *et al.* (2009) reported 74 per cent loss in ascorbic acid in cucumber + litchi + lemon blended juice stored for six months. Amaravathi *et al*. (2014) observed a

decrease in the ascorbic acid content of the spiced pineapple RTS beverages during storage. Muhammad *et al*. (2018) also reported decreasing ascorbic acid in orange date blended beverage during three months of storage.

Tannins

Among the blended juice treatment combinations, the lowest tannin of 0.990 mg mL^{-1} was recorded in B_3. B_2 recorded the tannin content of 0.995 mg mL^{-1}. The highest tannin content (1.161 mg mL^{-1}) was recorded in B_4. There was no significant difference in different storage conditions with respect to tannin content. Among the different days of storage, the lowest tannin content (0.990 mg mL^{-1}) was recorded in S_5, and the highest (1.093 mg mL^{-1}) was recorded in S_1.

The tannins of different blended juice treatment combinations varied from 1.035 to 1.228 on the initial day of storage. Among the interaction effect of blended juice combinations, storage conditions and days of storage, the lowest tannin in $C_1B_2S_5$ and $C_1B_3S_5$ with a value of 0.948 mg mL^{-1} and the highest (1.228 mg mL^{-1}) was recorded in $C_2B_4S_1$ (Table 3).

A gradual decrease in tannin content was observed during storage from the initial day to the 60^{th} day. The same results were observed by Deka *et al*. (2004) in mango-pine apple spiced RTS beverages during storage.

Organoleptic evaluation

Colour

Among the blended juice treatment combinations, the highest organoleptic score for the colour of 8.00 was recorded in B_2 followed by B_1 (7.76) and the lowest was recorded in B_3 (7.59). Among the different storage conditions, the highest organoleptic score of colour was recorded in C_2 (7.92), and the lowest was recorded in C_1 (7.61). Among the different days of storage, the highest organoleptic score for colour (8.68) was recorded in S_1, and the lowest (6.91) was recorded in S_5 (Table 2).

There were no significant differences in the interaction effect of blended juice treatment combinations, storage conditions, and storage days for organoleptic score for colour (Table 4). The mean organoleptic score for colour was decreased from 8.9 to 6.0. Bezman *et al*. (2001) reported that beverage colour decreased during storage of orange juices, and it might be due to the presence of 2 methyl 3 furanthiol and methanol. A similar colour score was also observed in orange and pineapple blended squash (Akusu *et al*., 2016). Similar results were reported by Muhammad *et al*. (2018) in orange date blended squash at different ratios. The mean score of judges for colour and flavour had decreased from 7.6 to 5.8 and 7.9 to 6.2, respectively. Rita and Virendra (2012) observed that the colour of the custard apple lime blended beverage in the ratio of 3:1 decreased from 5.08 to 4.70 during six months of storage.

Flavour

Among the blended juice treatment combinations, the highest organoleptic score for flavour of 7.63 was recorded in B_2 followed by B_1 (7.37) and the lowest (7.14) was recorded in B_3. Among the different storage conditions, the highest organoleptic score of flavour (7.06) was recorded in C_2 (7.62), and the lowest was recorded in C_1. Among the different days of storage, the highest organoleptic score for flavour was recorded in S_1 (8.35), and the lowest (6.47) was recorded in S_5 (Table-2).

The organoleptic score for flavour of different blended juice treatment combinations varied from 7.95 to 8.65 on the initial day of storage. Among the interaction effects for blended juice treatment combinations, storage conditions, and days of storage, $C_2B_4S_2$ has recorded the highest (8.15) organoleptic score for flavour, followed by $C_2B_2S_2$ (8.10), and the lowest (5.00) was recorded in $C_2B_3S_5$ (Table 4).

The mean score for flavour has progressively decreased from 8.65 to 5.00. Jain *et al*. (2003) reported that significant changes in the flavour of mix fruit squash might be due to enzymatic and non-enzymatic reactions and oxygen. Similarly, Paracha *et al.* (2004) observed that during three months of storage interval, the flavour of guava squash was decreased, and Kathiravan *et al*. (2014) reported that the sensory score was significantly reduced blended coconut-nannari beverage during storage.

Taste

Among the blended juice treatment combinations, the highest organoleptic score of 7.31for taste was recorded in B_2 followed by B_3 (7.14) and the lowest (6.89) was recorded in B_4. Among the different storage conditions, the highest organoleptic for taste was recorded in C_2 (7.45), and the lowest (6.70) was recorded in C_1.

Among the different days of storage, the highest organoleptic score for taste was recorded in S_1 as 8.15, and the lowest (6.08) was recorded in S_5.

The organoleptic score for taste of different blended juice treatment combinations varied from 7.70 to 8.85 on the initial day of storage. Among the interaction effect of blended juice treatment combinations, storage conditions and days of storage, the highest organoleptic score for taste was recorded in the treatment combination of $C_2B_3S_2$ as 8.00, followed by $C_2B_2S_2$ with a value of 7.90 and the lowest (4.80) was recorded in $C_1B_4S_5$ (Table 4).

The taste of the RTS beverage decreased gradually during the storage. The RTS beverages prepared from tamarind juice and ginger, mint, cardamom, pepper and mixed spices were highly acceptable even after storing for six months at room temperature without deteriorating the taste (Manjula *et al.*, 2003).

Overall acceptability

Among the blended juice treatment combinations, the highest organoleptic score for overall acceptability of 7.38 was recorded in B_2 followed by B_4 with a value of 7.12 and the lowest of 7.06 was recorded in B_3 B_1. Among the different storage conditions, the highest organoleptic score of overall acceptability (7.67) was recorded in C_2, and the lowest was recorded in C_1 of 6.63. Among the different days of storage, the highest organoleptic score for overall acceptability was recorded in S_1 of 8.37, and the lowest was recorded in S_5 of 6.06. (Table 2).

The organoleptic score for taste of different blended juice treatment combinations varied from 7.80 to 8.65 on the initial day of storage. Among the interaction effects of blended juice treatment combinations, storage conditions and days of storage recorded the highest organoleptic score for overall acceptability (8.40) in treatment combination of $C_2B_3S_2$ followed by $C_2B_2S_2$ with a value of 8.35, and the lowest (4.70) was recorded in $C_1B_4S_5$ (Table 4).

According to Deeba and Saqib (2015), the overall acceptability of ashwagandha-fortified blended beverage and makoi fortified blended beverage with orange was higher on the 90th day of storage, demonstrating the beneficial effect of herbal extract addition in maintaining the stability of the developed beverage. It might be due to the high antioxidant activity of both the herbal extracts, which, to a greater extent, could prevent time-dependent hydrolysis of sugars and increase in acidity of the blends.

The overall acceptability of squash decreases with increasing days of storage period. Overall qualities were affected by temperature and storage (Hye *et al*., 2000). Sobhana *et al*. (2015) observed the organoleptic scoring of RTS beverage and squash; they revealed that sample prepared with cashew apple juice and pineapple juice in equal proportion along with ginger drops, followed by cashew apple juice blended with pineapple was found to have better acceptability.

Microbial load (CFU)

Microbial load (CFU) was not observed in refrigerated condition up to the 60th day of storage. Bacterial colonies were not found under ambient condition up to the 45th day of storage. Yeast and moulds were observed from the 45th day of storage. However, the bacterial colonies were found under ambient conditions on the 60th day of storage (Fig. 1).

The RTS beverages, along with sugandi stored under refrigerated condition, were free from microbial proliferation till the end of the storage period (60th day of storage), indicating their fitness for consumption. This could be attributed to the effective pasteurisation treatment, addition of citric acid, which acts as a preservative, and the addition of sugandi root extract, which is well known to possess good antimicrobial activity (Girish *et al.,* 2006; Deeba and Saqib, 2015). The growth was highest on the 45th day of the storage period,

which might be attributed to the chemical changes, specifically alterations in the pH of the system that would take place resulting from the presence of the chemical preservatives in the samples. Thakur *et al*. (2000) also studied on physicochemical and microbiological qualities of bittered kinnow juice. They concluded that low microbial count was detected in the concentrate initially, which increased with the advancement of storage during the six months of storage. Sindumathi (2002) also did not detect any bacterial load in papaya based blended RTS beverages up to 80 days of storage. However, bacterial growth was observed in the beverages during the 100th day, which again increased on the 120th day of storage.

Conclusion

Among the interaction effect of blended juice treatment combinations, storage conditions and days of storage, the highest organoleptic score for taste and organoleptic score for overall acceptability was recorded in treatment combination of $C_2B_3S_2$, *i.e.,* 8.00 and 8.40, respectively. The RTS beverages, along with sugandi stored under refrigerated condition, were free from microbial proliferation till the end of the storage period (60th day of storage), indicating its fitness for consumption with maximum flavour, taste and overall acceptability at 75 per cent cashew apple juice + 25 per cent pineapple juice at an inlet temperature of 150 °C with a flow rate of 10 mL min^{-1} under refrigerated condition up to 60th day of storage.

References

Akusu, O.M., Kiin-Kabari, D.B. and Ebere, C.O. 2016. Quality characteristic of orange/pineapple fruit juice blends. *American Journal of Food Science and Technology* **4**(2): 43-47.

Amaravathi, T.P., Vennila, P., Hemalatha, G. and Parimalam. P. 2014. Spiced pineapple ready-to-serve beverages. *Indian Journal of Science and Technology* **7**(11): 1827-1831.

Azevedo, D.C.S. and Rodrigues, A.E. 2000. Obtainment of high -fructosesolutions from cashew (*Anacardium occidentale L.*) apple by SMB chromatography. *Separation Science and Technology.* **35**: 2561-2581.

Bezman,Y., Russell, R.L. and Naim, M. 2001. 2-Methyl-3-furanthiol and methional are possible off-flavors in stored orange juice. *Journal of Agriculture Food Chemistry* **49**: 5425-5432.

Bhardwaj, R.L. and Mukherjee, S. 2012. Studies on physico-chemical, sensory and microbiological quality of kinnow juice blends under refrigerated storage. *Journal of Horticultural Science.* **7**: 166-173.

Bhardwaj, R.L. and Nandal, U. 2014. Effect of storage temperature on physico-chemical and sensory evaluation of kinnow mandarin juice blends. *Journal of Food Processing and Technology.* **5**(8):1-4.

Burdulu, H.S., Koca, N. and Karadeniz, F. 2006. Degradation of vitamin C in citrus juices concentrates during storage. *Journal of Food Engineering*. **74**: 211-216.

Cano-Chauca, M., Stringheta, P.C., Ramos, A.M. and Cal-Vidal, I. 2005. Effect of the carriers on the microstructure of mango powder obtained by spray drying and its functional characterisation. *Innovative Food Science and Emerging Technologies* **6**(4): 420-428.

Carvalho, J.M.D., Maia G.A. and Figueredo R.W.D 2007. Development of a blended non-alcoholic beverage composed of coconut water and cashew apple juice containing caffeine. *Journal of Food Quality* **30**: 664-681.

Costa, M.C.O., Maia, G.A., Figuiredo, R.W., Souza Filho, M.S.M. and Brasil, I.M. 2003. Storage stability of cashew apple juice by hot fill and aseptic processes. *Ciênciae Tecnologia de Alimentos* **23**: 106-109.

Chempakam, B. 1983. Distribution of ascorbic acid and ascorbic acid oxidase activity in the developing cashew apple (*Anacardium occidentale* L.). *Journal of Horticultural Science* **58**(3); 447-448, DOI: 10.1080/00221589.1983.11515141.

Deka, B.C., Sethi, V., Sunija, P. and Srivasthava, V.K. 2004. Physicochemical changes of lime- aonla spiced beverages during storage. *Journal of Food Science and Technology* **41**: 329-332.

Deka, B.C. and Sethi, V. (2001). Preparation of mixed fruit juice spiced RTS beverages. *Indian Food Packer* **42**(3): 58-61.

Deeba, S.J. and Saqib, Q. 2015. Fortification of orange juice with *Withania somnifera* and *Solanum nigrum* extract - a potential functional fruit beverage and its quality evaluation. *Pakistan Journal of Food Science* **25**(2): 58-65.

Girish, K.S., Machiah, K.D., Ushanandini, S., Kumar, H., Nagaraju, K.S., Govindappa, Vedavathi, M. and Kemparaju,

K. 2006. Antimicrobial properties of a non toxic glycoprotein (WSG) from *Withania somnifera* (Aswagandha). *Journal of Basic Microbiology* **46**: 365-374.

Hubbali, V.N. 2019. Cashew productivity enhancement and value addition for doubling of farmers income. *The Cashew and Cocoa Journal* **3**(2): 13.

Hye, W.Y., Streaker, C.B., Zhang. Q.H. and Min, D.B. 2000. Effect of pasteurised electric field on the quality of orange juice and comparison with heat pasteurisation. *Journal of Agricultural and Food Chemistry* **48**:4597-4605.

Harshavardhan, R.A. and Chikkasubbanna, V. 2008. Standardisation of recipe and storage behavior of lime blended amla squash. *The Asian Journal of Horticulture* **3**(2): 203-207.

Jain, S., Sankhla, A.P.K, Dashora, A. and Sankhla. A.K. 2003. Physiochemical and sensory properties of orange drink. *Journal of Food Science Technology* **40**: 656-659.

Kabasakalis, V., Siopidou, D. and Moshatou, E. 2000. Ascorbic acid content of commercial fruit juices and its rate of loss upon storage. *Food Chemistry* **70**: 325-328.

Kathiravan, T., Kumar, R., Lakshmana, J.H., Kumaraswamy, M.R. and Nadanasabapathi, S. 2014. Pulsed electric field processing of functional drink based on tender coconut water (*Cococus nucifera* L.)-nannari (*Hemidesmus indicus*) blended beverage *Croatian Journal of Food Science and Technology* **6**(2): 84-96.

Kotecha, P.M. and Kadam, S.S. 2003. Preparation of ready-to-serve beverage, syrup and concentrate from tamarind. *Journal of Food Science and Technology* **40**(1): 76-79.

Maciel, M.I., Hansen, T.J., Aldinger, S.B. and Laboes, J.N. 1986. Flavour chemistry of cashew apple juice. *Journal of Agricultural and Food Chemistry* **34**: 923-927.

Maia, G.A. and Cecilia, E. 2002. Storage stability of cashew apple juice preserved by hot fill and aseptic process. *Journal of Food Science Technology* **42**: 66-69.

Majumdar, T.K., Vasudish, C. R., Premavalli, K. S. and Bawa, A. S. 2009. Development and storage stability of cucumber-litchi-lemon Juice. *Journal Food Science and Technology* **46**: 269-270.

Malav, M., Gupta, R. and Nagar, T. 2014. Studies on biochemical composition of orange based blended RTS beverages. *Bioscience and Biotechnology Research Communication* **7**(1): 78-83.

Manjarekar, R.G. 2005. Studies on flowering behavior, maturity indices, integrated post-harvest handling and processing of cashew (*Anacardium occidentale* L.) cv. Vengurla-1, Vengurla-4, Vengurla-6 and Vengurla-7. *Ph. D. (Agri.) Thesis* submitted to Dr. B. S. Konkan Krishi Vidyapeeth, Dapoli (India).

Manjula, A., Kannan, S. and Banumathi, P. 2003. Studies on preparation and storage of spiced RTS beverages from tamarind fruit. *Souvenir*, 5th *International Food Convention,* 5-8 Dec. 2003. Mysore, p 201.

Muhammad, A.K., Majid, S.H., Ali, M.I., Muhammad, M.I., Haris, B. and Gul W. 2018. Development and storage study of orange date blended squash. *Sarhad Journal of Agriculture* **34**(3): 509-515.

Nanjundaswamy, A.M. 1984. Economic utilisation of cashew apple. *Cashew Causerie* **6**(2): 2-7.

Nath, A., Yadav, D.S., Sarma, P.B. and Dey, B. 2005. Standardisation of ginger-kinnow squash and its storage. *Journal of Food Science and Technology* **42**: 520-522.

Paracha, G.M.U., Khattak, A.B., Ashraf, C.M., Alam, Z. and Khalil, A.W. 2004. Development and storage stability of low caloric guava squash. *Advanced Food Science* **31**(3): 127-131.

Prasad, R.N. and Mali, D.C. 2000. Changes in physico-chemical characteristics of pomegranate squash during storage. *Indian Journal of Horticulture* **57**(1): 18-20.

Rafeekher, M, Mini, C., Sudheer, K.P. and Geethalekshmy, P.R. 2015. Optimisation of process parameters in spray drying of cashew apple juice. *International Journal of Tropical Agriculture* **33**(4): 2563-2573.

Rehman, M.A., Khan, M.R., Sharif, M.K., Ahmad, S. and Shah, F. H. 2014. Study on the storage stability of fruit juice concentrates. *Pakistan Journal of Food Science* **24**: 101-107.

Rita, M. and Virendra, S. 2012. Studies on microbial and sensory quality of custard apple RTS beverage. *The Asian Journal of Horticulture* **7**(2): 460-464.

Sahu, C., Patel, S. and Choudary, P.L. 2005. Technology for manufacturer of whey based mango-herbal (lemongrass) beverage. *Journal of Food Science and Technology* **42**: 421-424

Sarmah, U., Bains, G. S. and Kripal, S. K. 1981. Studies on the processing of Kinnow mandarin juice. *Punjab Horticulture Journal* **21**: 32-45.

Sasi Kumar, R. 2015. Preparation of therapeutic RTS beverage from *aloe vera* gel and aonla fruit juice and evaluation of storage stability. *Asian Journal of Dairy and Food Research* **34**(2): 151-155.

Shreshta, A.K., Ua-Aruk, T., Adhikari, B.R., Howes, T. and Bhandari, B.R. 2007. Glass transition behavior of spray dried orange juice powder measured by differential scanning calorimetry (DSC) and thermal mechanical compression test (TMCT). *International Journal of Food Processing* **10**(3): 661-673.

Sindumathi, G. 2002. Standardisation of blended and flavoured papaya RTS (Ready- To-Serve) beverages. M.Sc. (FS&N) thesis, Home Science College and Research Institute, Madurai, 89p.

Sindumathi, G. and Premalatha, M.R. 2015. Development and storage studies of naturally flavored papaya-pineapple blended ready-to-serve (RTS) beverages. *International Journal of Science and Research* **4**(2): 856-860.

Sobhana, A, Mathew, J, Ambili, A.A. and Mrudhula, R.C. 2015. Blending of cashew apple juice with fruit juices and spices for improving nutritional quality and palatability. *Acta Horticulturae* 369-375.

Srivastava, R.P. and. Kumar, S. 2002. *Fruits and Vegetable Preservation*: *Principles and Practices*. International Book Distributing Company, Lucknow. pp. 184-185.

Singh, K.K. and Mathur, P.B. 1953. Studies on cold storage of cashew apples. *Indian Journal of Horticulture* **10**: 115-121.

Thakur, N.K., LalKausal, B.B. and Joshu, V.K. 2000. Effect of different conditions of storage on physico-chemical and microbiological qualities of debittered kinnow juice concentrate. *Journal of Food Science and Technology* **37**(4): 415-418.