



Ready to Serve *Aloe vera* Gel Blended Functional Cashew Apple Beverage for Improved Nutritional and Sensory Qualities

Shymi Cherian and P R Geetha Lekshmi

Department of Post Harvest Technology, Kerala Agricultural University,
College of Agriculture, Vellayani, Thiruvananthapuram 695522 (Kerala)

ABSTRACT

Fruit beverages serve as dietary supplements that are rich in vitamins, minerals and vital micronutrients with many potential health benefits. Functional beverages are the fastest growing product category for delivery of a range of functional ingredients that contribute to human health. Cashew is an important commercial crop and is designated as Dollar earning crop of the country. During the cashew processing, the nutritionally rich cashew apple is wasted which has good potential in fruit beverage industry. *Aloe* has been recognized internationally as a functional food resource especially for the preparation of health drinks. In the present study, development of functional cashew apple ready to serve (RTS) beverage with different levels of aloe gel supplementation was done and assessed the storage stability at room temperature. Biochemical, sensory and microbial analyses were conducted periodically during the storage. The RTS formulation supplemented with 10 per cent osmo-dehydrated aloe gel cubes recorded the highest TSS (13.00°Brix), reducing sugar (4.92%), total sugar (7.95%), ascorbic acid (20.84mg /100g), antioxidant activity (80.72%), total phenols (90.51 µg /g) and crude fiber content (0.99 %) with the highest sensory scores for appearance, colour, flavour, taste and overall acceptability. The formulation was acceptable for sensory and biochemical qualities and microbiologically safe up to three months of storage.

Key Words: *Aloe vera*, Cashew apple, Functional beverage, Osmo dehydration.

INTRODUCTION

Fruit beverages are major segment of food industry and enjoyed by all age groups of the society. Advanced research in food technology and nutritional sciences had paved the way for development and marketability of novel food products. Now people are more health conscious and food or beverage which provides extra benefits beyond basic nutrition are preferred. Blended beverages are an alternative for the development of novel products which provide benefit of taste, nutrition as well as medicinal properties.

Aloe vera (*Aloe barbadensis* Miller) is a medicinal plant and has been used as a natural product with medicinal and therapeutic properties in food, cosmetic, pharmaceutical and toiletry industry. In food industry aloe gel is recognised as

an ingredient for functional foods, development and production of gel containing health drinks due to its biological activities and functional properties.

Osmotic dehydration is the partial removal of water from fruit as a pre-treatment before further processing or to obtain product of intermediate moisture by means of an osmotic agent, usually either sugar or salt solution. It's a low energy dehydration method at low temperature and provides high retention of colour, aroma, nutritional constituents, and flavour compounds. Palatability of aloe gel can be improved with osmotic dehydration techniques which also help in gel stabilisation.

Cashew apple, a tropical fruit rich in sugars, vitamin C, thiamine, niacin, riboflavin, precursors of vitamin A is a good source of minerals such as copper, zinc, sodium, potassium, calcium,

iron, phosphorous and magnesium has good market potential. But this nutritious cashew apple is wasted during the processing and can be exploited in food industry as blended beverage with enhanced sensory and nutritional quality. The development of nutritionally value-added product could therapeutically help on improving the health of consumers, benefits of taste, nutrition as well as medicinal properties and Ready to-Serve beverages are one of the best and commonly acceptable fruit beverages (Tiwari and Deen, 2015). Sobhana and Mathew (2014) reported the acceptability of carbonated cashew apple juice and Sobhana *et al* (2015) found that cashew apple juice blended with fruit juices of pineapple and passion fruit showed better acceptance. Das and Arora (2017) reviewed cashew apple and opined that despite being highly nutritious; its potential has not yet been exploited. The present study was carried out to develop cashew apple RTS beverage with optimized aloe gel supplementation for blended functional beverages.

MATERIALS AND METHODS

Aloe leaves of 30 and 50 cm length, uniform size, free from pests, diseases and mechanical damages procured from farmer's field were taken for the study. The leaves were washed under tap water to remove adhering impurities. The spikes along the margins were removed and the leaves were steam blanched for two minutes. After air drying of the blanched leaves, top and bottom rind of aloe leaves were removed using sharp knife and the gel was extracted using hand filleting method. The extracted gel was made into cubes of 1 cm³ size and was osmo-dehydrated in 50^oB sucrose syrup for 4h. For total aloe juice extraction, the aloe gel was scooped out and blended in mixer to obtain aloe juice. Cashew apple juice extracted from the ripened cashew apple of variety Dhana was used for the preparation of cashew apple RTS.

Preparation of functional cashew apple RTS formulations

Cashew apple RTS was prepared according to FSSAI specifications with 15 per cent juice,

minimum TSS of 12^oBrix and a maximum acidity of 0.3 per cent. Three levels of aloe gel supplementation were done for the development of functional cashew apple RTS and were S₁- cashew apple RTS + osmo dehydrated aloe gel 5%, S₂- cashew apple RTS + osmo dehydrated aloe gel 10%, S₃- cashew apple RTS + total aloe juice 5%, and S₄- cashew apple RTS without aloe (control). The best RTS formulation was selected based on the biochemical and sensory analysis and was PET bottled and kept under room temperature for storage stability studies. Biochemical, sensory and microbiological analyses were conducted at fortnight interval for three months.

Biochemical analysis

Total Soluble Solids (TSS) was recorded by using digital refractometer (Atago - 0 to 53%) and expressed in ^oBrix and pH was measured by using pocket pH tester (HANNA instruments). Titratable Acidity (%), Reducing Sugar (%), Total Sugar (%) and Ascorbic Acid (mg/100g) were determined by titrimetric method. Crude fiber content was estimated using Muffle furnace. Total antioxidant activity was using 2, 2- diphenyl-1-picrylhydrazyl (DPPH) radical scavenging assay and Total phenol content were assessed using spectrophotometry with standard curve.

Sensory evaluation

RTS formulations were evaluated for sensory characteristics *viz.*, appearance, colour, flavour, taste and texture by 32 member semi trained panel. The panel was asked to score the appearance, colour, flavour, taste and texture of the sample using 9-point hedonic scale.

Microbiological studies

The quantitative assay of the fungal and bacterial flora in stored RTS beverage was carried out by serial dilution spread plate techniques. Nutrient agar and Rose Bengal agar medium were used for the enumeration of bacterial and fungal population of the RTS beverages respectively.

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Statistical Analysis

The data generated from experiments were statistically analyzed in Completely Randomized Design (CRD) using SAS 9.1. Sensory parameters were statistically analysed using Kruskal – Wallis Chi-square test.

RESULTS AND DISCUSSION

Effect of aloe gel supplementation on biochemical properties of cashew apple RTS beverage

Total Soluble Solids (TSS)

The formulation S₂ recorded the highest Total Soluble Solids (TSS) of 13.00^oBrix followed by S₁ with 12.67^o Brix (Table 1). Cashew apple RTS prepared without aloe (S₄) recorded the lowest TSS of 12.10^o Brix. TSS increased with percentage of aloe gel supplementation. The highest percentage of reducing and total sugar was recorded in S₂ as 4.92 and 7.95 per cent, respectively followed by S₁ formulation as 4.76 and 7.74 per cent, respectively. Cashew apple RTS without aloe (S₄) recorded the lowest reducing sugar of 4.26 per cent and total sugar of 7.11 per cent. The S₃ recorded only a slight increase in reducing as well as total sugar as compared to supplementation of osmo-dehydrated aloe gel. The increase in reducing sugar, total

sugar and TSS of cashew apple RTS formulations supplemented with osmo-dehydrated aloe gel can be due to the increased solid gain (sugar) of osmo-dehydrated aloe gel in sucrose syrup where as S₁ was not enough to increase the sugar content of the blended cashew apple RTS. These results were in accordance with the increase in TSS, reducing sugar and total sugar in aloe- mango nectar with 25 per cent aloe gel supplementation (Elbandy *et al*, 2014), kinnow nectar supplemented with 4 per cent blanched and unblanched aloe juice (Shubhra *et al*, 2014), aloe- bael fruit juice with 60 per cent aloe gel incorporation (Sasikumar, 2015b) and aloe - pear RTS with 20 and 30 per cent aloe juice (Talib *et al*, 2016).

pH

Cashew apple RTS without aloe (S₄) recorded maximum pH of 4.17 with the lowest acidity of 0.25 per cent while the S₃ formulation recorded the maximum acidity of 0.28 per cent with a pH of 3.83. Aloe gel supplementation increased the acidity of cashew apple RTS and total aloe juice incorporation recorded the highest increase which might be due to the acids present in aloe gel and osmo- dehydration resulted in decreased acidity of aloe gel. Decrease in pH and increase in acidity was reported in other aloe blended fruit beverages.

Table 1. Effect of aloe supplementation on biochemical properties of cashew apple RTS beverage.

Treatment	TSS (°Brix)	pH	Acidity (%)	Reducing sugar (%)	Total sugar (%)	Ascorbic acid (mg/100g)	Antioxidant activity (%)	Total phenol (µg/g)	Crude fiber (%)
S ₁	12.67	3.77	0.27	4.76	7.74	18.06	79.52	89.47	0.79
S ₂	13.00	3.77	0.27	4.92	7.95	20.84	80.72	90.51	0.99
S ₃	12.37	3.83	0.28	4.38	7.17	18.06	78.31	88.52	0.033
S ₄	12.10	4.17	0.25	4.26	7.11	16.67	77.11	74.14	0.003
CD (0.05)	0.064	0.061	0.006	0.075	0.119	2.242	0.472	0.350	0.008

S₁ – Osmo dehydrated aloe gel 5%, S₂ – Osmo dehydrated aloe gel 10%, S₃ - Total aloe juice 5%, S₄ - Without aloe (control)

Table 2. Effect of storage on biochemical properties of aloe - cashew apple RTS beverage.

Days after storage	TSS (°Brix)	pH	Acidity (%)	Reducing sugar (%)	Total sugar (%)	Ascorbic acid (mg/100g)	Antioxidant activity (%)	Total phenol (µg/g)	Crude fiber (%)
0	12.80	3.97	0.25	4.84	7.74	20.84	81.12	90.83	0.99
15	13.57	3.63	0.27	5.36	8.82	19.45	78.71	89.27	0.99
30	14.53	3.37	0.29	6.46	10.51	15.25	77.51	86.53	0.99
45	15.30	2.87	0.34	7.50	12.42	13.89	72.29	84.99	0.98
60	15.87	2.43	0.39	8.83	14.71	12.50	69.07	83.61	0.98
75	16.57	1.97	0.47	10.91	19.15	11.11	66.26	81.37	0.98
90	17.17	1.73	0.55	13.97	23.84	9.72	58.64	79.26	0.98
CD (0.05)	0.041	0.047	0.004	0.117	0.324	1.349	0.350	0.198	NS*

*NS-Non-significant

Ascorbic acid

The ascorbic acid of 20.84 mg/100g was recorded for osmodehydrated aloe gel at 10 per cent (S₂) followed by 18.06 mg/100g for both S₁ and S₃ formulations. Antioxidant activity, expressed as radical scavenging activity, of cashew apple RTS supplemented with osmo- dehydrated aloe gel 10 per cent (S₂) recorded the highest percentage of 80.72 followed by 79.52 per cent for S₁ and the control (S₄) recorded the lowest antioxidant activity of 77.11 per cent. The highest phenol content of 90.51 µg/g was for S₂ and 89.47 µg/g for S₁ and the control recorded the lowest phenol content of 74.14 µg/g. Supplementation of aloe gel in RTS beverage increased the ascorbic acid content, phenol content which might have contributed to the antioxidant activity also. Similar results were reported by Shubhra *et al* (2014), Hamid *et al* (2014), Kausar *et al* (2020) in fruit juices supplemented with aloe gel.

Crude fiber

Crude fiber content of cashew apple RTS beverages increased with aloe supplementation.

The formulation S₂ recorded the highest crude fiber of 0.99 per cent and 0.79 per cent for S₁ whereas S₄ recorded the lowest crude fiber of 0.003 per cent. The biochemical profiling of aloe supplemented cashew apple RTS revealed that RTS formulation supplemented with 10 per cent osmo- dehydrated aloe gel was superior in quality attributes.

Effect of aloe gel supplementation on sensory qualities of cashew apple RTS beverage

The sensory quality profile is a prime factor to consider the marketability of any product. On sensory analysis (Fig. 1), The S₂ formulation recorded the highest mean score for appearance (8.38), colour (8.34), flavour (8.41), taste (8.38) and overall acceptability (8.34). Sensory score of blended beverages increased and 60 per cent aloe supplemented bael juice recorded the highest mean score for sensory attributes (Sasikumar, 2015b). Talib *et al* (2016) reported that pear juice with 20 per cent aloe supplementation recorded highest sensory scores for flavour, taste, appearance and overall acceptability and Kausar *et al* (2020) in orange juice. Based on the biochemical and sensory analyses, cashew apple RTS formulation with 10

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% osmo dehydrated aloe gel supplementation was found superior and selected for the storage stability analysis.

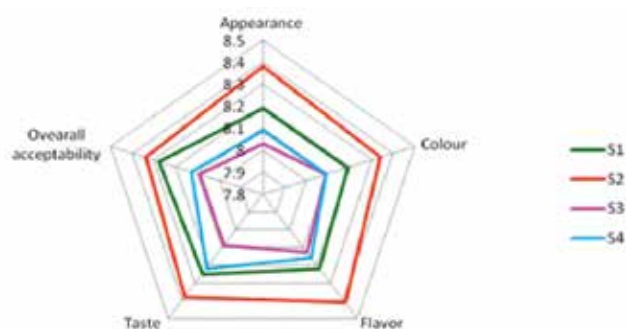


Figure 1. Sensory evaluation of aloe gel supplemented cashew apple RTS formulations

Like extremely- 9, Like very much- 8, Like moderately-7, Like slightly-6, Neither like or dislike- 5, Dislike slightly- 4, Dislike moderately- 3, Dislike very much- 2, Dislike extremely- 1

Effect of storage on biochemical properties of cashew apple RTS formulation

Change in biochemical qualities of functional cashew apple RTS formulation during storage is depicted in Table 2. Total Soluble Solids (TSS) is considered as one of the most important quality attributes used as an indicator of quality of food. During storage, TSS, reducing sugar and total sugar of aloe-cashew apple RTS formulation increased from 12.80⁰ Brix to 17.17⁰ Brix, 4.84 per cent to 13.97 per cent and 7.74 to 23.84 per cent respectively. Sasikumar (2015a); Sasikumar (2015b); Tiwari and Deen (2015); Talib *et al* (2016) reported that TSS and sugar content of the stored beverage increased during storage due to the conversion of polysaccharides into monosaccharide and oligosaccharides and other constituents of juice into sugar.

Acidity

Acidity is an indicator of spoilage and fermentation of food and pH of cashew apple RTS formulation decreased from 3.97 to 1.73 and acidity increased from 0.25 to 0.55 per cent during three

months of storage. Mishra and Sangma (2017) reported low pH arrest the microbial growth and it's a positive sign of the antimicrobial properties.

Ascorbic acid, a reflection of nutritional characteristics, of RTS formulation decreased with storage from 20.84 mg/100g to 9.72 mg/100g during the storage. Ascorbic acid content of fruit juice decreased during storage due to oxidation as ascorbic acid is sensitive to oxygen, light and heat by both enzymatic and non-enzymatic catalyst as reported in mango nectar (Elbandy *et al*, 2014), aloe supplemented kinnow nectar (Shubhra *et al*, 2014) and in bael-aloe gel blended beverage (Tiwari and Deen, 2015). Mishra and Sangma (2017) also reported decrease in vitamin C content of aloe based RTS formulations with storage which might be due to direct influence of temperature and light exposure on ascorbic acid which leads to oxidation of ascorbic acid to dehydroascorbic acid.

Antioxidant activity

Antioxidant activity of cashew apple RTS formulation decreased from 81.12 to 58.64 per cent during three months of storage and total phenol content decreased from 90.83 $\mu\text{g/g}$ to 79.26 $\mu\text{g/g}$ during 90 d of storage. Decrease in total phenolic content with the advancement in storage period can be attributed to the oxidation of volatile phenolic compounds. Crude fiber content of cashew apple RTS during storage exhibited stability and the result was supported by the findings of Shubhra *et al* (2014).

Effect of storage on sensory qualities of RTS beverage

The sensory quality profile of beverage is a prime factor to consider the marketability of product. Sensory analysis of stored RTS beverage revealed that mean score pertaining to appearance, colour, flavour, taste and overall acceptability showed slight reduction towards the end of three months storage. The findings were in conformity with various research reports stating that with the advancement of storage period, the sensory scores decreased.

Microbial analysis of stored cashew apple aloe RTS beverage

Stored RTS formulation of cashew apple was microbiologically safe up to 3 months of storage at room temperature and no bacterial and fungal colony forming units were detected during the storage. Reduced level of bacterial count was found in higher concentrations of aloe gel supplemented fruit beverages during storage which revealed the anti-bacterial property of aloe gel. Kausar *et al* (2020) reported a shelf life of 45 days for aloe – orange RTS beverage under room temperature and 90 days at refrigerated conditions.

Based on the biochemical and sensory and microbiological analysis cashew apple RTS supplemented with 10 percent osmo dehydrated aloe gel was superior in biochemical and sensory qualities and was acceptable and microbiologically safe up to three months of storage at room temperature. This technique can be used to formulate functional RTS beverage that has many potential health benefits.

CONCLUSION

Cashew apple, even though highly nutritious, is a colossal waste during processing of cashew nut and can be effectively exploited for the fruit beverage industry. Development of functional ready to serve beverage from cashew apple blended with osmo dehydrated aloe gel can pave the way for promotion in global fruit beverage market.

ACKNOWLEDGEMENT

The study formed a part of M.Sc. (Horticulture) programme of first author and financial support from Kerala Agricultural University is gratefully acknowledged.

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Received on 30/01/2021 Accepted on 15/03/2021