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Studies on the Process Development and Shelf Life of Low Calorie Therapeutic *Aloe vera* RTS Beverage by Using Artificial Sweetener

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Research work was undertaken to develop *Aloe vera* based low calorie therapeutic ready-to-serve (RTS) beverages by using artificial sweetener. *Aloe vera* juice was utilized at various combinations with sugar and saccharine for the preparation of low calorie therapeutic RTS beverages, evaluated for physicochemical and sensory attributes during storage for 60 days. The study revealed *Aloe vera* RTS beverages prepared by using sugar and saccharine had desired physiochemical and sensory scores revealing overall acceptability.

Key words: Low calorie, Therapeutic beverages, RTS, ***Aloe vera***

Recent scientific investigations on medicinal and therapeutic properties of *Aloe vera* made it a novel and valuable ingredient for food, cosmetic and pharmaceutical industry (Pugh *et al*., 2001). In food industry, it has been used for the development of functional foods and production of health drinks (gel/ juice) energy drinks and different type of beverages. In the cosmetic industry, it is used as the base for creams, lotions, soaps, shampoos, facial cleansers and other products (Ramachandra and Rao, 2008). *Aloe vera (Aloe barbadensis* Miller*)* is utilized as a contemporary folk remedy (Akinyele and Odiyi 2007). There are over 250 species of *Aloe vera* grown around the world. However, only two species *viz*. *A. barbadensis* Miller and *A. aborescens* are considered as the most important ones for processing (Srivastava and Kumar, 2004). Fresh *Aloe vera* leaves are used to obtain a bitter yellow latex from peripheral bundle sheath and a mucilaginous gel from the parenchymatous tissue. The interest to use gel has increased dramatically in the field of health care and cosmetics (Davis, 1997). Aloe gel can be utilized as a valuable ingredient for food preparations due to its biological activities and functional properties (Reynolds and Dweck 1999). *Aloe vera* gel has a bitter taste in raw state and its palatability could be enhanced with addition of other fruit juices.

Artificial sweeteners are attractive alternatives to sugar in processed food because they add virtually no calories to the diet. Therapeutic RTS based blend of *Aloe vera* and fruit juice extracts continue to receive considerable amount of attention. These beverages have high nutritional quality and increased energy value, especially show therapeutic properties. These could be particularly used in place where, there is improper nutrition (Hamman 2008). Development of any process for economical utilization would be of great benefit to the therapeutic beverage industry.

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Materials and Methods

Preparation of low calorie therapeutic RTS beverages

Aloe vera gel was extracted using cold extraction method and processed into juice as per the method reported by Satwadhar *et al*., (2011). Freshly harvested *Aloe vera* leaves were dipped into 500 ppm of potassium metabisulphite (KMS) and washed thoroughly with tap water, kept for flash cooling to 5°C for gel stabilization. The leaves were cut vertically into two halves and the gel was separated out using stainless steel knife. It was allowed to settle for 12h and homogenized using mixer grinder and treated with 1% pectolytic enzyme at 50°C for 20 min. Then the gel was filtered and pH adjusted to 3.0 by adding citric acid (0.5%) and ascorbic acid (0.01%) to control browning, while in high heat treatment. Further, it was decanted, pasteurized, flash cooled and stored. During pasteurization pectolytic enzyme was inactivated. The finally obtained in juice was stored refrigerated condition until further use.

Standardization of Aloe vera RTS beverage

Low calorie therapeutic RTS beverages were prepared using *Aloe vera* gel @ 10% of total volume and sugar was added at different preparation *i.e.* control sample using only sugar 150g, sample A sugar and saccharine 27g:0.005g, sample B sugar and saccharine 20:0.010g, sample C sugar and

saccharine 18g: 0.015g and sample D sugar and saccharine 15g: 0.02g, respectively with 3g of citric acid and 1g of sodium benzoate added in one litre of final beverage.

Physiochemical analysis

The proximate analyses of sample beverages were carried out for total soluble solids (TSS) by Refractometer (Abbe Refractometer Model 2WAJ) for two months at 15 days interval. A few drops of well homogenized sample were taken on prism of refractometer and direct reading was taken by reading the scale in meter as described in AOAC (1990). The pH of each sample was determined with digital pH meter (InoLab 720, Germany). A sufficient quantity (50mL) of Beverage was taken in 100mL beaker and pH meter was used to record pH according to the method explained in AOAC (1990). The acidity in each sample was determined according to standard procedure given in AOAC (1990). 10mL of Beverage along with 100mL of water was taken and then titrated with 0.1 N NaOH using phenolphthalein as an indicator (1-2 drops) till light pink colour was achieved (Ranganna, 2001).

Organoleptic evaluation

Sensory quality attributes *viz*. colour and appearance, consistency, flavour, taste and overall acceptability of the samples were evaluated using a 9-point hedonic rating by a panel.

Statistical analysis

Statistical procedures as described by Snedecor and Cochran (1977) were used to analyse the data for the interpretation of results.

Result and Discussion

Physicochemical characteristics of low calorie Aloe vera RTS Beverages

Physicochemical and sensory properties of low calorie therapeutic *Aloe vera* RTS beverages were studied for a period 60 days. Addition of sugar and an artificial sweetener with various proportions into *Aloe vera* extract and the effect of storage time on pH, TSS, titratable acidity and ascorbic acid was estimated.

Table 1. Physiochemical and sensory characteristics of low calorie therapeutic *Aloe vera* RTS beverages on 0 day

Sample	Physiochemical properties				Sensory parameters				
	pH	TSS (0Brix)	Titratable acidity (%)	Ascorbic acid content (%)	Colour and appearance	Flavour	Taste	Consistency	Overall acceptability
Control	3.51	12.20	0.30	6.20	7.50	7.00	7.50	7.00	7.00
A	3.22	8.10	0.36	7.10	7.50	7.50	8.00	7.50	7.50
B	3.20	7.20	0.37	8.20	8.00	8.00	8.00	8.50	8.00
C	3.10	6.50	0.38	9.50	8.50	9.00	9.00	9.00	9.00
D	3.10	5.40	0.38	10.40	8.00	8.50	8.50	9.00	8.50

*Control Sample using only Sugar 100%, Sample A Sugar 40% and Saccharin, Sample B Sugar 30% and Saccharine, Sample C Sugar 20% and Saccharine and Sample D Sugar 10% and Saccharine

Effect of storage

Storage studies exposed the fact that pH decreased significantly over the period of storage from 0 to 60 days (Table 2). Freshly prepared RTS beverage samples of control, A, B, C and D exhibited pH values 3.51, 3.22, 3.10 and 3.10, respectively. Among the four samples, the minimum decrease in pH was observed in C and D, which decreased from 3.10 to 3.06 after 60 days (Table 2). Similar trends were reported by Eshun (2003). This gradual decrease in pH has a significant effect as lower pH does not allow pathogenic microorganisms to grow and hence, acts as a preservative.

In the statistical analysis, it was found that the data are significant for different treatments and storage periods. The combined effect of treatment

Table 2. Effect of storage period on pH and TSS of low calorie therapeutic *Aloe vera* RTS beverages

Storage period (days)	pH						TSS					
	Control	A	B	C	D	Mean	Control	A	B	C	D	Mean
0	3.51	3.22	3.20	3.10	3.10	3.22	12.20	8.10	7.20	6.50	5.40	7.80
15	3.49	3.20	3.19	3.10	3.09	3.21	12.25	8.20	7.30	6.60	5.60	8.00
30	3.48	3.19	3.18	3.09	3.09	3.20	12.30	8.35	7.40	6.75	5.70	8.10
45	3.46	3.17	3.16	3.07	3.06	3.18	12.35	8.40	7.50	6.90	5.80	8.20
60	3.44	3.15	3.14	3.06	3.06	3.17	12.40	8.50	7.60	7.00	5.95	8.30
Mean for A	3.48	3.19	3.17	3.10	3.10	3.2	12.30	8.30	7.40	6.70	5.70	8.10
Effect			CD(0.01)					CD(0.01)				
Treatment (A)			0.8461					0.8461				
Storage (B)			0.9460					0.9460				
AXB			0.1892					0.1892				

and storage were found to be non-significant (Table 2). The interactive effect of *Aloe vera* juice and storage period had a significant effect on pH decrease due to the presence of flavonoids and terpenoids (Sikder *et al*.,2001). TSS (Total Soluble Solid) significantly increased during the storage period from 0 to 60 for all five samples *viz.*, control, A, B, C and D (Table 2). Maximum increase in TSS was observed in control sample, which increased from 12.20 to 12.30 ºBrix and minimum TSS was observed in sample D (5.40ºBrix) and increased after 60 days (5.70 ºBrix). The increase in TSS during storage was also reported in RTS developed from guava nectar by Kalra *et al.* (1991). This increase in TSS might be due to conversion of insoluble polysaccharides into reducing sugars. The increase in reducing sugars can also be attributed to hydrolysis of sugars by acid, which might have resulted in degradation of disaccharides to monosaccharides. (Barwal *et al*., 2005).

Table 3. Effect of storage period on titratable acidity and ascorbic acid content of *Aloe vera* RTS beverages

Storage period (days)	Titratable acidity (%)						Ascorbic acid content (mg/100ml)					
	Control	A	B	C	D	Mean	Control	A	B	C	D	Mean
0	0.30	0.36	0.37	0.38	0.38	0.36	6.20	7.10	8.20	9.50	10.40	8.28
15	0.36	0.37	0.38	0.39	0.40	0.38	6.18	7.07	8.18	9.48	10.38	8.26
30	0.37	0.39	0.40	0.41	0.41	0.39	6.16	7.05	8.16	9.45	10.36	8.23
45	0.38	0.40	0.41	0.42	0.42	0.40	6.14	7.02	8.14	9.43	10.33	8.21
60	0.39	0.42	0.43	0.44	0.45	0.42	6.11	7.00	8.11	9.40	10.30	8.18
Mean for A	0.36	0.38	0.39	0.40	0.41	0.39	6.16	7.04	8.16	9.45	10.35	8.23
Effect			CD(0.01)					CD(0.01)				
Treatment (A)			0.8461					0.1233				
Storage (B)			0.9466					0.1377				
AXB			0.1893					0.2754				

Statistical analysis reveals that the data are significant for different treatments and storage period (Table 2). This may be due to higher starch content in *Aloe vera* RTS beverages with sugar, which undergoes hydrolysis monosaccharide and other soluble sugars during storage. From table 3, it is explicit that the titrable acidity had significantly increased with storage time for all five samples including control. Among the five samples, the minimum acidity was observed in control, which increased from 0.30 to 0.36%. The maximum increase in acidity was observed in sample D, which increased from 0.38 to 0.41 %. This can be attributed partly to the contribution of the inherent acid naturally present in the beverage and partly due to the citric acid added to the beverage. Similar trends were reported by Femenia *et al.,* (2001). The increase in acidity was observed in all treatments due to the formation of organic acids by ascorbic acid present in *Aloe vera* juice. The rise in acidity with increased storage time can also be attributed to degradation of polyphenol content. Rapid conversion of proteins to amino acids also might have been responsible for increases in titrable acidity in *Aloe vera* RTS. In pure *Aloe vera* juice, ascorbic acid content is less (6.20 mg/100 ml). However, it showed a decreasing

Table 4. Effect of storage time on sensory attributes of low calorie therapeutic *Aloe vera* RTS beverages

Storage period (days)	Colour & appearance						Flavour						Taste					
	Cont	A	B	C	D	Mean	Cont	A	B	C	D	Mean	Cont	A	B	C	D	Mean
0	7.50	7.50	8.00	8.50	8.00	7.90	7.00	7.50	8.00	9.00	8.50	8.00	7.50	8.00	8.00	9.00	8.50	8.20
15	7.30	7.40	7.90	8.30	7.90	7.70	6.90	7.40	7.90	8.90	8.40	7.90	7.40	7.90	7.90	8.90	8.40	8.10
30	7.10	7.20	7.70	8.10	7.70	7.50	6.80	7.30	7.80	8.80	8.20	7.70	7.20	7.70	7.70	8.80	8.20	7.90
45	6.90	7.00	7.50	8.00	7.50	7.30	6.70	7.00	7.60	8.60	8.00	7.50	6.90	7.50	7.40	8.60	8.00	7.60
60	6.70	6.90	7.20	7.80	7.30	7.10	6.50	7.80	7.30	8.30	7.70	7.50	6.60	7.20	7.30	8.40	7.70	7.40
Mean for A	7.10	7.20	7.60	8.10	7.60	7.50	6.70	7.40	7.70	8.70	8.10	7.70	7.10	7.60	7.60	8.70	8.10	7.80
Effect		CD(0.01)						CD(0.01)						CD(0.01)				
Treatment (A)		0.1231						1.1037						1.4784				
Storage (B)		0.1376						1.2340						1.6529				
AXB		0.2752						2.4680						3.3058				

trend with increased storage time (Table 3). The ascorbic acid content in fresh *Aloe vera* RTS samples (control, A, B, C and D) was 6.20, 7.10, 8.20, 9.50 and 10.40, respectively. After a storage period of 60 days, the final ascorbic acid content in the respective samples (control, A, B, C and D) decreased to 6.16, 7.04, 8.16, 9.45 and 10.35 (Table 3). The minimum decrease was observed in control and sample B, which decreased from 6.20 to 6.16 mg/ 100 ml and 8.20 to 8.16 mg/100 ml, respectively

Table 5. Effect of storage time on sensory attributes of *Aloe vera* RTS beverages

Storage period (days)	Consistency						Overall acceptability					
	Control	A	B	C	D	Mean	Control	A	B	C	D	Mean
0	7.00	7.50	8.50	9.00	9.00	8.20	7.00	7.50	8.00	9.00	8.50	8.00
15	6.90	7.40	8.40	8.90	8.90	8.10	7.90	7.40	7.90	8.90	8.40	8.10
30	6.70	7.20	8.20	8.80	8.70	7.90	6.70	7.20	7.70	8.60	8.20	7.60
45	6.50	6.90	8.00	8.60	8.40	7.60	6.50	7.00	7.50	8.40	8.00	7.40
60	6.20	6.60	7.70	8.30	8.10	7.30	6.20	6.70	7.20	8.20	7.80	7.20
Mean for A	6.60	7.10	8.10	8.70	8.60	7.80	6.80	7.10	7.60	8.60	8.10	7.60
Effect			CD(0.01)					CD(0.01)				
Treatment (A)			0.1231					1.1037				
Storage (B)			0.1376					1.2340				
AXB			0.2752					2.4680				

and the maximum decrease was observed in sample A, which decreased from 7.10 to 7.04 mg/ 100 ml.

The reduction in ascorbic acid during storage could be due to its oxidation to dehydro ascorbic acid (Damame *et al.*,2002)**.** The degradation of ascorbic acid increased with storage time and this is attributed to an increase in moisture content with time. Increased moisture content leads to dilution of ascorbic acid and decreases its concentration. Similar results were reported by Davis, (1997). The combined effect of treatment and storage was found to be significant (Table 3). The increase in reducing sugar due to inversion of non-reducing sugar under acidic conditions, which correlates with earlier findings (Gomez, and Saji Khurdiya 2005)

Effect of storage period on sensory attributes

Table 4 and 5 represents the effect of storage period on sensory attributes *viz*., colour and appearance, taste, flavour, consistency and overall acceptability of *Aloe vera* RTS on a 9-point hedonic scale. The storage period significantly decreased all the sensory attribute of the beverage and the mean values decreased during a storage period of 60 days. Reasons for the decrease in taste score may be attributed to the development of bitterness and acidity in the samples during storage.

Sensory score data clearly indicated that sample C was found to be the best among the five samples. The sensory score for consistency also decreased significantly during the storage period. Similarly, the score for overall acceptability also decreased significantly. Sensory evaluation showed the highest score (8) for overall acceptability in sample C and the lowest score (7) in control.

Conclusion

It is concluded that the sample with sugar 20% (18g) and saccharine 0.015g (artificial sweeteners) could be superior over the other samples in terms of physicochemical properties *viz*., pH, TSS, titratable acidity and ascorbic acid content as were as organoleptic qualities. The developed low calorie therapeutic *Aloe vera* RTS can be preserved at refrigerated condition with desirable consumer acceptability for up to 60 days. The product may serve as an excellent beverage owing to its functional and nutritional properties.

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