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Research Article

Preparation and quality evaluation of ready to serve beverage (RTS) from orange juice and *Aloe vera* gel during storage

Tusneem Kausar*, Farhat Shamim, Faiza Iftikahr Gorsi and Ammara Ainee

Institute of Food Science and Nutrition, University of Sargodha, Sargodha, 40100-Pakistan
**Corresponding author's email: tusneem.kausar@uos.edu.pk*

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Abstract

The demand of health beverage is growing in the soft drink industry. The functional properties and health benefits of Aloe vera are known worldwide. So, present study aimed to develop orange-Aloe vera ready to serve (RTS) beverage by adding 0, 5, 10, 15, 20% Aloe vera gel in orange juice. For all the treatments, physicochemical characteristics, microbiological count, phytochemical content as well as organoleptic attributes were evaluated at an interval of 0, 45 and 90 days of storage at refrigerated temperature. Addition of Aloe vera showed little effect on physicochemical parameters, reduce total plate count, improve total phenolic content, antioxidant activity and reducing power, significantly. In sensory attributes, T_1 (Orange juice with 5% Aloe vera gel) was found to be acceptable even after 90 days. It was also found that RTS beverage can be successfully store at refrigerated temperature without significant changes in chemical, microbial and senatorial quality profile and recommended for commercial use and for production on large scale.

Keywords: Aoe vera gel; Microbial load; Orange juice: Physicochemical properties; Phytochemical analysis; Sensory evaluation

Introduction

Aloe vera (*Aloe barbadensis* Miller) traditionally being utilized as contemporary folk remedy belongs to Lileacea family **[1]**. More than 250 species of Aloe vera are reported around the globe, however, only two species viz. *A. barbendensis* Miller and *A. aborescent* are the considered important for their medicinal value **[2]**. Fresh Aloe vera leaves are composed of two components, first the bitter yellow latex, called Aloe vera sap and second the mucilaginous gel. Gel is found to possess various biological activities and functional properties and so, its use has been increased in cosmetics and health care **[3]**. It is also considered as a value able ingredient for food application due to its biological activities and functional properties **[4]**. Various studies have revealed that Aloe vera possesses many pharmaceutical activities including antimicrobial **[5]**, antioxidant **[6]**, anticancer **[7]**, antiulcer **[8]**,

hepatoprotective [9], antidiabetic [10], Immunomodulatory [11, 12] and many more which are attributed to polysaccharides contained in the gel of leaves [13]. Problem is the bitter taste of raw Aloe vera which make in unpleasant to consume. Different experiments are done to make it palatable by adding in other food products specially fruit juices.

Orange is a citrus fruit having pleasant taste and rich in phytochemicals that can protect health. It is good source of vitamin C along with folic acid, potassium and pectin. Phenolic content, flavonoids and antioxidant properties of citrus has been reported for their biological properties which can prevent various diseases in human being [14-20].

Fruit intake in the form of beverages is well enjoyed by all age groups of the society [21]. Ready to serve beverage using blend of two or more fruits are good alternative for development of new product and benefited in terms of sensory, nutrition as well as health properties. To mask the bitter taste of Aloe vera geI, formation of a blended beverage is a suitable option. Hence, current research was carried out to incorporate Aloe vera gel in orange juice for the preparation of blended ready to serve beverage with desirable physicochemical, microbial and organoleptic quality characteristics.

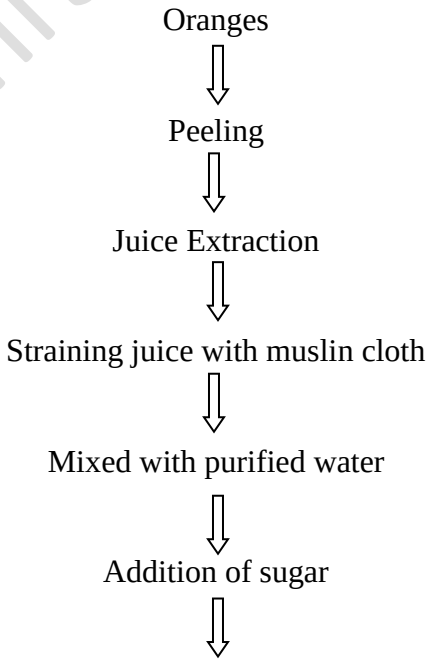
Materials and methods

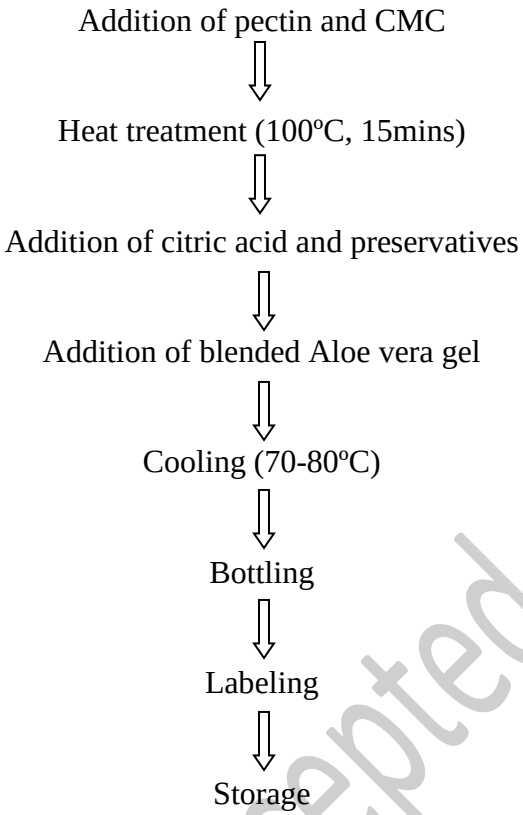
Raw material

Fresh and superior quality oranges were bought from the local market, washed, peeled off, cut into halves, seeds were removed and extraction was done using juice extraction machine. The juice was filtered using muslin clothe to remove unwanted particles stored at refrigerated temperature until use. Fresh aloe vera leaves were collected from local nursery and washed with tap water. Gel was separated by cutting leaves vertically and blended in a juice blender to make smooth and homogenized mixture, filtered and stored at refrigerated temperature until use. Orange juice and aloe vera gel was analyzed for pH, brix and titratable acidity according to the methods described in AOAC [22].

Blended orange-*Aloe vera* beverage preparation

Blended orange-aloe vera RTS (ready to serve) beverage was prepared replacing 0, 5, 10, 15 and 20% of Aloe vera gel in orange juice.





Flowchart for preparation of orange-Aloe vera blended RTS beverage

Physico-chemical analysis of orange-*Aloe vera* RTS

pH, total soluble solids (TSS), titratable acidity, sugar/acid ratio were determined by methods explained in AOAC [22].

Phytochemical analysis of orange-*Aloe vera* RTS

Total phenolic content was estimated by using Folin Ciocalteu reagent according to [23] and results were expressed as gallic acid equivalents (GAE) per 100 g of sample. Total antioxidant action of the samples was checked by using technique illustrated by [24]. Standard calibrated curves were made by ascorbic acid and trolox and results are shown as µg of ascorbic acid per gram of sample. Reducing power was determined by method described by Hegazy and Ibrahim [25] and results were shown as mg of ascorbic acid equivalent per 100 g of sample.

Microbial study

For microbiological analysis, total plate count (TPC) was performed by following the method described by Kumar et al. [26].

Sensory evaluation

Sensory evaluation of orange-Aloe vera RTS were carried out by using 9-point Hedonic scale on 0, 45 days and 90 days of storage [27] for color, flavor, taste, consistency and overall acceptability.

Statistical analysis

The data obtained were analyzed statistically using analysis of variance technique (ANOVA) to determine statistical significance of treatments. Mean separation was done by Duncan Multiple Range test.

Results and discussion

Chemical properties of orange juice and *Aloe vera* gel

Orange juice and Aloe vera gel were analyzed for different chemical properties such as pH, titratable acidity and total soluble solids and

results are presented in (Table 1). Total soluble solid of orange juice was observed to be 12.33 °Brix. It could be observed that orange juice contribute total solid contents of the final beverage mainly. These results are in close agreement with the results of [28-30].

Physico-chemical attributes of orange-*Aloe vera* RTS during storage

Freshly prepared orange-Aloe vera RTS samples exhibited non-significant change in pH within treatments and during storage (Table 2). Although, there was slight increase in pH from T_0 (4.01) to T_4 (4.06) and decrease during storage from 0 day (4.05) to 90 days (3.99), however, statistically results are not significant. Various studies showed that pH of blended drink decrease during storage [28, 31-33]. During storage, increase in total soluble solids was observed. Increase in TSS might be attributed in conversion of polysaccharides and other constituents of juice into sugar [30, 34]. The ratio of the TSS and titratable acidity contribute to the flavor and taste of the fruits and juice. The TSS is directly proportional to sweetness index (ratio of TSS and titratable acidity) [35]. The increased TSS values during the storage period have a great role in conserving the taste and flavor of the RTS blends during the storage period. Similar findings have been reported in the case of lime blended amla squash by [36], in aloe vera and sapota drink by [37], in aloe melon juice by [38], in prebiotic beverage made from aloe vera, honey and soy milk by [39].

Phytochemical properties of orange-*Aloe vera* RTS during storage

Total phenolic contents are the most commonly found phyto-constituents present in medicinal plants with enormous biological activity. Addition of Aloe vera increase the total phenolic content in orange-Aloe vera blended RTS. It is an indicator of the antioxidant capacity of natural product. Results regarding reducing power of orange-aloe vera RTS showed that addition of Aloe vera increased the reducing power from 207 to 334 (Table 3). This may be due to the presence of more antioxidant constituents in Aloe vera than orange. The storage study showed that reducing power decreased with increase in storage time. These results were in accordance with the results of [40] who witnessed a remarkable decrease in reducing ability of different fruits and vegetable during storage at refrigeration temperature.

Microbial load of orange-*Aloe vera* RTS during storage

Total plate count of orange-Aloe vera RTS was performed at 0, 45 and 90 days of storage at 10^{-2} dilution (Table 4). Maximum bacterial count was found in T_0 at 90 days storage and minimum contamination occurred in sample T_4. It is clear from the results that addition of *Aloe vera* gel reduces the bacterial growth as Aloe vera is reported to exhibit antibacterial and antioxidant properties [41]. However, microbial load in all samples increased with storage time.

Sensory properties of orange-*Aloe vera* RTS during storage

Sensory properties of Orange-aloe vera RTS was assessed for color, flavor, taste, consistency and overall acceptability on a 9-point hedonic scale. Addition of *Aloe vera* and storage period significantly decreased the color ratings of the beverage. Initial score for the color were 7.2, 7.0, 7.0, 6.6 and 6.6 in samples respectively. After 90 days, the final score of color for the samples decreased to 6.2, 6.3, 6.1, 5.8 and 5.9 respectively. Same trend was found in other sensory parameters (Table 5). Addition of *Aloe vera* gel at concentration of 5% (T_1) improves flavor, taste, consistency and overall acceptability of RTS while further increase resulted in drastic reduction in sensory scores. From sensory parameters, it was observed that T_1 was preferred by judges. During storage, it was determined that overall sensorial profile of orange-*Aloe vera* RTS beverage maintained up to 45 days and then decreased during

further storage significantly up to 90 days. Decrease in sensory parameter of RTS beverage during storage is also reported in other investigations **[28-30, 33, 42-43]**.

Table 1. Chemical properties of orange juice and *Aloe vera* gel

Parameters	Orange juice	*Aloe vera* gel
pH	4.29	4.9
Titratable acidity	0.28	0.06
Total Soluble Solids	12.23 ^{o}Brix	0.09 ^{o}Brix

Table 2. Physico-chemical analysis of orange-*Aloe vera* RTS during storage

Parameters	Storage period (days)	Treatments					Mean
		T_0	T_1	T_2	T_3	T_4	
pH	0	4.04	4.06	4.04	4.05	4.07	4.05^{a}
	45	4.05	4.04	4.02	4.03	4.05	4.04^{a}
	90	3.98	4.00	3.98	4.01	4.01	3.99^{a}
Mean		4.01^{a}	4.03^{a}	4.03^{a}	4.05^{a}	4.06^{a}	
Total Soluble Solids	0	17.02	15.06	15.02	15.01	12.53	14.93^{c}
	45	17.17	15.69	15.39	15.39	14.84	15.69^{b}
	90	17.63	15.93	15.81	15.55	15.01	15.99^{a}
Mean		17.28^{a}	15.57^{b}	15.41^{c}	15.32^{c}	14.13^{d}	
Acidity	0	0.03	0.03	0.03	0.02	0.03	0.03^{a}
	45	0.04	0.04	0.03	0.03	0.03	0.04^{a}
	90	0.05	0.04	0.04	0.05	0.04	0.05^{a}
Mean		0.03^{a}	0.03^{a}	0.03^{a}	0.03^{a}	0.03^{a}	
Solid/acid ratio	0	39.31	29.95	37.89	39.67	28.66	35.09^{a}
	45	30.19	28.21	32.15	29.94	26.88	29.43^{b}
	90	24.52	23.12	21.06	18.82	20.98	21.70^{c}
Mean		31.34^{a}	27.09^{c}	30.37^{ab}	29.40^{b}	25.50^{c}	

$^{a-d}$Mean values followed by the same superscript are not significantly different ($p<0.05$)
T_0: RTS prepared without Aloe vera gel
T_1: RTS prepared with 95% orange juice and 5% Aloe vera gel
T_2: RTS prepared with 90% orange juice and 10% Aloe vera gel
T_3: RTS prepared with 85% orange juice and 15% Aloe vera gel
T_4: RTS prepared with 80% orange juice and 20% Aloe vera gel

Table 3. Phytochemical analysis of orange-*Aloe vera* RTS during storage

Parameters	Storage period (days)	Treatments					Mean
		T_0	T_1	T_2	T_3	T_4	
Total phenolic content (mg GAE/100 g)	0	593.33	669.33	662.67	677.67	703.00	641.87[a]
	45	465.33	522.33	575.00	639.00	645.00	559.13[b]
	90	402.67	402.67	490.00	492.67	503.67	487.87[c]
Mean		512.44[b]	536.11[b]	575.89[a]	606.78[a]	583.56[a]	
Antioxidant activity (µg ascorbic acid/g)	0	2554.40	2707.80	2921.10	2963.30	3290.00	2887.30[a]
	45	1023.30	1157.80	1203.30	1247.80	1291.10	1184.70[b]
	90	370.00	378.90	397.80 0	571.10	667.80	477.10[c]
Mean		1318.90[b]	1536.70[a]	1512.20[a]	1541.10[a]	1673.00[a]	
Reducing power (mg AAE/ 100g)	0	207.91	256.19	266.00	276.38	334.76	268.25[a]
	45	171.24	180.29	211.91	250.29	273.52	217.45[b]
	90	121.62	148.76	222.10	215.43	220.57	185.70[c]
Mean		166.92[b]	195.08[b]	233.33[a]	266.83[a]	256.83[a]	

[a-c]Mean values followed by the same superscript are not significantly different ($p<0.05$)
T_0: RTS prepared without Aloe vera gel
T_1: RTS prepared with 95% orange juice and 5% Aloe vera gel
T_2: RTS prepared with 90% orange juice and 10% Aloe vera gel
T_3: RTS prepared with 85% orange juice and 15% Aloe vera gel
T_4: RTS prepared with 80% orange juice and 20% Aloe vera gel

Table 4. Microbial analysis of orange-*Aloe vera* RTS during storage

Parameters	Storage period (days)	Treatments					Mean
		T_0	T_1	T_2	T_3	T_4	
Total plate count (10^{-2} dilution, CFU/ml)	0	2.19	2.15	2.06	1.95	1.88	2.04[c]
	45	2.24	2.17	2.12	1.99	1.93	2.09[b]
	90	2.32	2.25	2.22	2.06	1.98	2.16[a]
Mean		2.25[a]	2.19[b]	2.13[c]	2.00[d]	1.93[e]	

[a-e]Mean values followed by the same superscript are not significantly different ($p<0.05$)
T_0: RTS prepared without Aloe vera gel
T_1: RTS prepared with 95% orange juice and 5% Aloe vera gel
T_2: RTS prepared with 90% orange juice and 10% Aloe vera gel
T_3: RTS prepared with 85% orange juice and 15% Aloe vera gel
T_4: RTS prepared with 80% orange juice and 20% Aloe vera gel

Table 5. Sensory evaluation of orange-*Aloe vera* RTS during storage

Parameters	Storage period (days)	Treatments					Mean
		T_0	T_1	T_2	T_3	T_4	
Color	0	7.20	7.00	7.00	6.60	6.60	6.88[a]
	45	7.10	7.20	7.10	6.50	6.40	6.86[a]
	90	6.20	6.30	6.10	5.80	5.90	6.06[b]
Mean		6.83[a]	6.83[a]	6.73[ab]	6.30[b]	6.30[b]	
Flavor	0	6.70	6.80	6.80	5.70	5.20	6.24[a]
	45	6.70	7.20	7.00	6.10	5.70	6.54[a]
	90	5.80	6.30	6.00	5.30	4.90	5.66[b]
Mean		6.40[a]	6.77[a]	6.60[a]	5.70[b]	5.27[b]	
Taste	0	6.60	6.80	6.20	5.40	4.60	5.92[a]
	45	6.10	7.10	6.40	5.70	4.60	5.98[a]
	90	5.20	6.20	5.40	4.90	3.60	5.06[b]
Mean		5.97[b]	6.70[a]	6.00[b]	5.33[c]	4.27[d]	
Consistency	0	6.90	7.00	6.90	5.60	4.80	6.24[a]
	45	6.80	7.00	6.70	6.10	5.70	6.46[a]
	90	5.90	6.20	5.70	5.30	4.90	5.60[b]
Mean		6.53[a]	6.73[a]	6.43[a]	5.66[b]	5.13[c]	
Overall acceptability	0	6.90	7.10	7.10	5.40	4.60	6.22[a]
	45	6.90	7.10	6.55	6.10	5.00	6.33[a]
	90	6.00	6.30	5.60	5.30	4.00	5.44[b]
Mean		6.60[a]	6.83[a]	6.42[a]	5.60[b]	4.53[c]	

[a-c]Mean values followed by the same superscript are not significantly different ($p<0.05$)
T_0: RTS prepared without Aloe vera gel
T_1: RTS prepared with 95% orange juice and 5% Aloe vera gel
T_2: RTS prepared with 90% orange juice and 10% Aloe vera gel
T_3: RTS prepared with 85% orange juice and 15% Aloe vera gel
T_4: RTS prepared with 80% orange juice and 20% Aloe vera gel

Conclusion

Orange-*Aloe vera* RTS was prepared in this research by adding 0, 5, 10, 15 and 20% Aloe vera gel in orange juice and various analysis were performed to check its acceptability up to 90 days of storage at refrigerator temperature. The study revealed that all the treatments were suitable up to 45 days of storage by physicochemical and sensory attributes analysis and remains

microbiologically safe. Thus, development of blended orange-Aloe vera RTS is an effective way of delivering the bioactive benefits of *Aloe vera* in a tasty and refreshing way to the consumers.

Authors' contributions

Conceived and designed the experiments: F Shamim & T Kausar, Performed the experiments: FI Gorsi & F Shamim, Analyzed the data: F Shamim, Contributed reagents/ materials/ analysis tools: F lftikhar, Gorsi, T Kausar & A Ainee, Wrote the paper: F Shamim & T Kausar.

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