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Studies on Aloe Juice Supplemented Kinnow Nectar

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Abstract

Aloe vera's health benefits have led to its potential utilization in processed food products. Therefore, the present investigation aims to study optimization and supplementation of aloe juice in kinnow nectar and to investigate the physico-chemical changes occurring during storage of supplemented kinnow nectar. It was found that aloe juice was a good source of crude fibre, ash and total phenolic content. Among the treatment, unblanched aloe juice was found to have more crude fiber (0.15%), ash (0.2%) and phenolic content (20 mg, %) compared to juice prepared from blanched aloe. Sensory evaluation method was chosen to determine optimum supplementation level of aloe juice in kinnow nectar and it was found that aloe juice could be supplemented up to 4 per cent level without adversely affecting the overall quality of kinnow nectar. Physico-chemical composition of supplemented kinnow nectar showed higher mean values for crude fibre (0.03%), ash (0.11%) and total phenolic content (6.87 mg, %) as compared to control (0.02%, 0.09% and 6.67 mg, % respectively). Statistical analysis showed negligible effect of treatment and storage period on crude fibre, ash and carotenoid content of supplemented kinnow nectar during 6 months of storage. Hence, aloe juice can be used as an ingredient to enhance nutritional quality of beverages by increasing the levels of minerals and fibres.

Keywords: Aloe juice, kinnow nectar, supplementation, storage.

Introduction

Medicinal and therapeutic properties offered by aloe vera have led to its use for several thousands of years and has been designated as a plant of immortality. Production statistics reveal that total production of aloe in India is about 1 Lac tonne per year and annual consumption of aloe extract by the Indian pharmaceutical industries is 200 tonne. Ayurvedic pharmacies are using only 1 per cent of total production[1]. The therapeutic property of aloe is ascribed to the colourless gel which forms inside portion of aloe and contains about 99 per cent water. The remaining portion of aloe consists of more than 45 different ingredients such as vitamins, minerals, enzymes, phenolic compounds, lignin, saponin, sterols, polysaccharides and salicylic acid[2].

Aloe vera is basically used in various forms such as fresh gel, juice and other formulations for health, medicinal and cosmetic purposes. Chicago-based Mintel's Global New Products Database (GNPD) reports that more than 225 beverages containing *aloe vera* were launched in various locations around the world in the year 2013. *Aloe vera* drinks are gaining popularity internationally due to various health effects offered by *aloe vera*. Many of the work has been done by food scientists to incorporate Aloe vera as an ingredient for supplementation in various products such as tea, sparkling water, flavoured water and juice. According to Korean Food and Drug administration (KFDA) functional health foods containing aloe when taken orally support immune function. People have become more health conscious and are viewing diet as a component for achieving good health, maintenance and possible body improvement. Fruits and vegetables and their products are extremely important in human nutrition. Fruit beverages are a major segment of food industry. These serve as dietary supplements and are rich in vitamins, minerals, vital micronutrients with many potential health benefits. Reports are available on the blending of two or more fruit juices/pulps to prepare most acceptable drinks with health benefits. In some beverages, vitamins, especially vitamin C and certain minerals have been fortified to make a balanced drink. In a recent study apple juice concentrate powder has been made that serves as a significant source of iron and it was found that as the percentage of ash increased, the content of iron increases proportionately[3]. Also, aloe juice being a potential source of crude fibre, ash and phenolic compounds could be used to supplement beneficial attributes and develop nutritionally balanced health products.

Kinnow nectar is one of the frequently consumed beverages among the consumers, therefore could be used as a good carrier for supplementation, value addition and feeding at mass scale. Thus, the present investigation has been undertaken to study the incorporation of aloe juice in kinnow nectar and to evaluate the quality of prepared product.

Material and Methods

Processing of aloe gel into juice: Fresh *Aloe vera* leaves were procured from the Department of Agronomy, Punjab Agricultural University, Ludhiana. Top and bottom ends of aloe leaves were trimmed off and the spikes along the margins

were removed before slicing the leaves. Thereafter, stainless steel knives were used to separate epidermis (or skin) from the parenchyma. The sticking gel was then scooped and collected with the help of stainless steel scrapper. One lot of aloe gel was blanched for 2 minutes at 80^0C temperature while the other lot was kept unblanched. Blanched and unblanched aloe gel was passed through the juicer (Inalsa) to get aloe juice. The aloe juice was further filtered through muslin cloth to get juice free from coarse fibrous material. Sodium benzoate and potassium metabisulphite each was added @ 100 ppm in both the lots. Aloe juice was filled in clean, sterilized glass bottles (capacity 200ml), corked immediately and processed in boiling water for 20 minutes. After processing, bottles were cooled quickly to room temperature and stored for further studies.

Product Preparation: Fully developed healthy kinnow fruits were peeled manually and juice was extracted with the help of superfine pulper (Raylons, India). Extracted juice was further filtered through muslin cloth to get clarified kinnow juice. Juice was immediately analyzed for titratable acidity and ^{0}Brix. Various ingredients required were calculated to prepare nectar with 20 per cent juice, 15^0Brix and acidity as 0.25 per cent. Sugar and citric acid were dissolved in water during heating. Syrup was clarified by passing through muslin cloth and cooled to room temperature. Kinnow juice was mixed homogenously and rapidly with syrup. Kinnow nectar was heated to 80^0C. Orange colour and essence were added as per the requirement to make up the loss due to dilution. Hot kinnow nectar was filled into glass bottles (cap 200ml), corked immediately and processed in boiling water for 20 minutes. Bottles were cooled quickly to room temperature and stored at ambient conditions.

Optimization, packaging and storage: Blanched and unblanched aloe juice in kinnow nectar was added at the rate of 0, 1, 2, 3, 4 and 5 per cent. Then on the basis of sensory evaluation by semi-trained panel of 10 judges the most acceptable level of aloe juice in kinnow nectar was found out. Products with best level of aloe juice were screened and followed to prepare the final products for further studies. Kinnow nectar was packed and stored in glass bottles (cap 200ml). The packaged products were stored at ambient conditions for a period of six months. Stored products were analyzed for physico-chemical changes and sensory quality at a fixed interval of two months.

Analytical methods: Aloe gel, aloe juice and kinnow nectar were examined for total solids, TSS, ascorbic acid, total and reducing sugars, ash and crude fiber[4], total carotenoids[5], total phenols[6] and color by Lovibond Tintometer (Associated Instrument Manufacturing, India).

Statistical analysis: The data regarding the fresh and stored samples were statistically analyzed by ANOVA (Analysis of variance) using factorial design elucidated by Gomez and Gomez[7].

Results and Discussion

Aloe gel and juice composition: Processing of *aloe vera*'s leaf pulp is garnering attention of the large food industries due to its source as a functional food and as an ingredient in beverages. The physico-chemical composition of blanched and unblanched aloe gel and aloe juice is depicted in table-1. Among the treatments, blanching was found to have negligible effect on crude fibre content, but aloe juice had lower fibre content as compared to aloe gel. This was attributable to filtration and clarification step adopted during juice processing[8, 9]. However, blanched aloe gel was found to have lower ascorbic acid compared to unblanched aloe gel as ascorbic acid is vulnerable to oxidation during processing. Similarly, aloe juice had quite low ascorbic acid content (1.56 mg, %) as compared to gel (1.90 mg, %) which may be due to method adopted for preparation of aloe juice. The results are in accordance with Pierce[10] who found similar values for ascorbic acid in aloe extract.

Table-1
Physico-chemical composition of aloe gel and juice

Parameters	Aloe Gel		Aloe Juice	
	Blanched	Unblanched	Blanched	Unblanched
Moisture (%)	97.10	97.20	97.2	97.24
TSS (˚B)	2.2	2.0	2.0	2.0
Ascorbic acid (mg/ 100g)	1.7	1.90	1.23	1.56
Reducing sugars (dextrose, %)	0.25	0.25	0.21	0.20
Total sugars (dextrose, %)	0.73	0.71	0.71	0.70
Crude fibre (%)	0.26	0.26	0.13	0.15
Ash (%)	0.26	0.25	0.19	0.20
Total phenolics (mg/100g)	21.0	23.0	18.0	20.0
Total carotenoids (mg/100g)	0.003	0.003	0.003	0.003

Aloe gel showed absence of carotenoids[11] whereas Coats and Ahola[12] indicated small amounts of beta-carotene in aloe gel and juice. However, the carotenoid content of aloe gel and juice recorded in present studies was 0.003 mg per cent. Total phenolic content of unblanched and blanched aloe gel were noted as 23.0 and 21.0 mg per cent respectively. Lower total phenolic values were found in blanched aloe gel due to high volatility and oxidation nature of phenolic compounds. Processing of aloe gel into juice further resulted in reduction of phenolic compounds. Zheng and Wang[13] noted similar values for total phenolic content in aloe extract. Hence, from the results we can conclude that aloe juice is a valuable source of crude fiber, ash and phenolic compounds and thus can be used as a valuable source of natural antioxidants due to presence of phenolic compounds.

Optimization of aloe juice in kinnow nectar: Data pertaining to the effect of different supplementation levels of aloe juice on overall acceptability of kinnow nectar have been presented in figure-1. The overall acceptability and flavor scores were significantly affected with the supplementation of aloe juice from 1 to 5 per cent in kinnow nectar. The organoleptic parameters of aloe juice supplemented kinnow nectar secured highest overall acceptability scores at 4 per cent level of juice from blanched (8.1) and unblanched (8.2) aloe and found optimum and most acceptable. Hence, supplementation of kinnow nectar with 4 per cent aloe juice was selected for carrying out further studies.

Physico-chemical composition of kinnow mandarin juice and kinnow nectar (4% aloe juice supplemented): Data regarding the composition of kinnow mandarin juice have been presented in table-2. Kinnow juice was found to have 13.5^0B TSS, 14.5 per cent total solids, 20.4 mg per cent ascorbic acid, 6.98 per cent total sugars, 0.34 per cent ash and 0.24 mg per cent carotenoids. These results were in close association with the findings reported by Ranote *et al*[14] and Sandhu and Singh[15] for kinnow mandarin juice. TSS of control, blanched and unblanched aloe juice supplemented kinnow nectar were noted as 15^0B and total solids were found to be 13.85%, 13.76% and 13.74% respectively. Ascorbic acid content in control kinnow nectar was slightly less followed by blanched and unblanched aloe juice supplemented kinnow nectar. Reducing sugar content of blanched and unblanched aloe juice supplemented kinnow nectar was recorded to be same as 6.67% whereas control samples had 6.65% of reducing sugars. Aloe juice supplemented blanched and unblanched kinnow nectar had slightly higher ash content of 0.11% compared to control samples having 0.09% ash content. Total carotenoids were found to be highest in unblanched samples (0.07 mg/100g) followed by blanched and control samples which had same carotenoid content (0.06 mg/100g). It was apparent from the data that there was no effect of supplementation of aloe juice on the overall values of tintometer colour units in the kinnow nectar. Non-significant variation in the colour units was observed in the products supplemented with aloe juice from blanched and unblanched aloe when compared with control.

Effect of storage condition on quality of aloe supplemented kinnow nectar Crude fibre: There was not much effect of supplementation of aloe juice on the overall values of crude fibre content in the kinnow nectar as shown in table-3. A slight variation in the fibre content from the initial value of 0.03 to 0.02 per cent was observed in the products supplemented with aloe juice from blanched and unblanched aloe when compared with control. However, storage period had insignificant effect on the crude fibre content of the kinnow nectar supplemented with aloe juice. Hence, the products exhibited much stability in respect of crude fibre content till the termination of storage period. Statistically, treatment and storage period exhibited non-significant effect ($p \leq 0.05$) on crude fibre content of the aloe juice supplemented kinnow nectar.

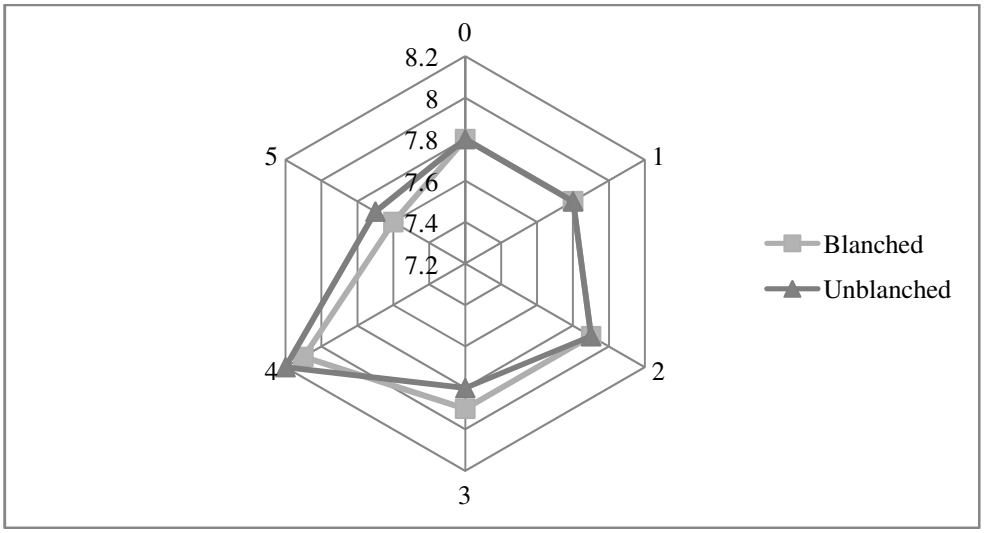

Figure-1
Effect of different supplementation levels of aloe juice on overall acceptability of kinnow nectar

Table-2
Proximate composition of kinnow juice and supplemented kinnow nectar (aloe juice 4%)

Parameters	Kinnow juice	A	B	C
TSS (^{0}B)	13.50	15	15	15
Total solids (%)	14.50	13.85	13.76	13.74
Ascorbic acid (mg, %)	20.40	2.50	2.52	2.53
Reducing sugars (dextrose, %)	3.29	6.65	6.67	6.67
Total sugars (dextrose, %)	6.98	10.87	10.91	10.93
Ash (%)	0.34	0.09	0.11	0.11
Total carotenoids (mg/100g)	0.24	0.06	0.06	0.07
Tintometer colour units				
Yellow	50	3.2	3.2	3.2
Red	3	1.4	1.4	1.4
Blue	0.2	0.5	0.5	0.5

A-Control; B- Juice from blanched aloe (4%); C- Juice from unblanched aloe (4%)

Table-3
Effect of treatment and storage on crude fibre and ash content (%) of aloe juice (4%) supplemented kinnow nectar

Storage period (months)	Crude fibre (%)			Ash (%)		
	A	B	C	A	B	C
0	0.02	0.03	0.03	0.09	0.11	0.11
2	0.01	0.03	0.02	0.09	0.11	0.10
4	0.02	0.02	0.03	0.08	0.10	0.10
6	0.01	0.02	0.02	0.08	0.09	0.10
LSD ($p \leq 0.05$)	0.01	0.01	0.01	0.01	0.01	0.01

A-Control; B- Juice from blanched aloe (4%); C- Juice from unblanched aloe (4%)

Ash: The ash content is an index of the total amount of minerals present in a food [16]. Hence, presence of high amount of ash is of great significance. Results of the studies in respect of ash content have been listed in table-3. Aloe juice supplemented kinnow nectar contained higher amount of ash (0.11 %) as compared to control (0.09 %) where no aloe juice was supplemented. Juice from blanched and unblanched aloe had similar values for the ash content of kinnow nectar. Aloe juice supplemented kinnow nectar from blanched and unblanched aloe showed better stability in the values of ash content when compared with control after completion of the storage period of 6 months. Minor decline in ash content with the progression of storage period might be attributed to the binding of certain minerals with organic substances[17]. Statistical analysis showed a non-significant effect ($p \leq 0.05$) of treatment and storage on ash content of the aloe juice supplemented kinnow nectar.

Ascorbic acid: Losses in ascorbic acid in fresh and processed fruits and vegetables and their products are well known. The vitamin is lost during storage due to the effect of light, interaction with metallic ions and prevailing high room temperature conditions. The ascorbic acid retention in aloe juice supplemented kinnow nectar with respect to treatment and different storage intervals have been presented in table-4. Ascorbic acid content decreased significantly from 2.5 to 0.5 mg per cent representing a loss of 80 per cent, both in blanched and unblanched aloe juice supplemented kinnow nectar after termination of storage period at ambient conditions. However, aloe juice supplemented kinnow nectar exhibited better ascorbic acid retention as compared to the control sample which might be due to the antioxidant properties of phenolic compounds present in aloe juice [13]. Losses of ascorbic acid during storage were attributed to oxidation of ascorbic acid to dehydroascorbic acid which is directly affected by temperature and light exposure. The results coincide with the findings as described by Ahmed *et al*[18] in mandarin RTS beverage and Kalra and Tondon [19] in guava nectar. Statistically, treatment and storage had significant effect ($p \leq 0.05$) on ascorbic acid content of the aloe juice supplemented kinnow nectar.

Total carotenoids: Aloe juice supplemented products did not differ much from control for total carotenoids content depicted in table-4. Decrease in carotenoid content of aloe juice supplemented kinnow nectar was attributed to the exposure to light and auto oxidation by reacting with residual oxygen present in the head space of the bottles[20]. Similar results were elucidated by Krishnaveni *et al* [21] in jack fruit RTS beverage. Statistically, treatment and storage had non-significant effect ($p \leq 0.05$) on total carotenoid content of the aloe juice supplemented kinnow nectar.

Total phenols: Fruits and vegetables are substantial source of phytochemicasl such as phenolic compounds, ascorbic acid, carotenoids and anthocyanins including vitamins and minerals.

Phenolic compounds are known for antioxidant properties mainly due to their redox potential, allowing them to act as reducing agents, hydrogen donors, singlet oxygen quenchers and metal chelators[22]. Keeping in view the importance of phenolic compounds and its richness in aloe, it was planned to supplement aloe juice in kinnow nectar drink to harvest the benefits. Results of the studies have been tabulated in table-4. The decrease in phenolic content from initial values were recorded as 9.6, 9.9 and 10.8 per cent in kinnow nectar supplemented with juice from unblanched, blanched aloe and without supplementation respectively, after storage period of 6 months. Hence, the kinnow nectar supplemented with aloe juice from unblanched aloe showed better retention of phenolic content as compared to blanched and control. Decrease in total phenolic content with the progression of storage period might be attributed to the volatile nature of phenolic compounds which get easily oxidized[5]. Statistically, the interaction between treatment and storage had significant effect ($p \leq 0.05$) on total phenolic content of the aloe juice supplemented kinnow nectar.

Tintometer color units: It was apparent from the data in table-5 that there was no effect of supplementation of aloe juice on the overall values of tintometer colour units in the kinnow nectar. Non-significant variation in the colour units was observed in the products supplemented with aloe juice from blanched and unblanched aloe when compared with control. Intensity of yellow colour unit decreased with the progression of storage period from 3.2 to 2.9, both in blanched and unblanched aloe juice supplemented kinnow nectar. There was insignificant decrease in red and blue colour units during storage. Yellow colour units were dominant in all the products, the decline might be due to oxidation of carotenoid pigments during storage. The results were in accordance with the findings reported by Wani [23] in plum juice during storage. Statistically, treatment and storage had non-significant effect ($p \leq 0.05$) on tintometer colour units of the aloe juice supplemented kinnow nectar.

Overall acceptability: Overall acceptability scores of aloe juice supplemented kinnow nectar have been presented in figure-2. Kinnow nectar supplemented with juice from unblanched aloe secured highest overall acceptability scores (8.2) followed by control (8.1) and blanched aloe juice supplemented kinnow nectar (8.0) for freshly prepared products. Overall acceptability scores decreased with the progression of storage period. The scores decreased from 8.0 to 7.6 in juice supplemented from blanched aloe and 8.2 to 7.8 in juice supplemented from unblanched aloe after termination of storage period. The gradual decrease in overall acceptability scores was due to the loss of flavor and colour of the kinnow nectar during storage. Statistical analysis showed a significant effect ($p \leq 0.05$) of treatment and storage on overall acceptability scores of the aloe juice supplemented kinnow nectar.

Table-4
Effect of treatment and storage on ascorbic acid, total carotenoids and total phenolic content (mg/100g) of aloe juice (4%) supplemented kinnow nectar

Storage period (months)	Ascorbic acid (mg/100g)			Total carotenoids (mg/100g)			Total phenols (mg/100g)		
	A A	B	C	A A	B	C	A A	B	C
0	2.50	2.52	2.53	0.06	0.06	0.07	6.67	6.85	6.90
2	0.89	0.95	0.97	0.04	0.04	0.05	6.46	6.68	6.72
4	0.72	0.81	0.84	0.03	0.04	0.04	6.20	6.41	6.46
6	0.41	0.50	0.52	0.02	0.03	0.02	6.00	6.20	6.24
LSD ($p \leq 0.05$)	0.04	0.04	0.04	0.03	0.03	0.03	0.20	0.20	0.20

A-Control; B- Juice from blanched aloe (4%); C- Juice from unblanched aloe (4%)

Table-5
Effect of treatment and storage on Tintometer colour units of aloe juice (4%) supplemented kinnow nectar

Storage period (months)	Yellow			Red			Blue		
	A A	B	C	A A	B	C	A A	B	C
0	3.2	3.2	3.2	1.4	1.4	1.4	0.5	0.5	0.5
2	3.0	3.1	3.1	1.3	1.3	1.3	0.3	0.3	0.4
4	2.9	3.0	3.0	1.3	1.3	1.3	0.4	0.3	0.3
6	2.8	2.9	2.9	1.2	1.3	1.3	0.3	0.3	0.3
LSD ($p \leq 0.05$)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

A-Control; B- Juice from blanched aloe (4%); C- Juice from unblanched aloe (4%)

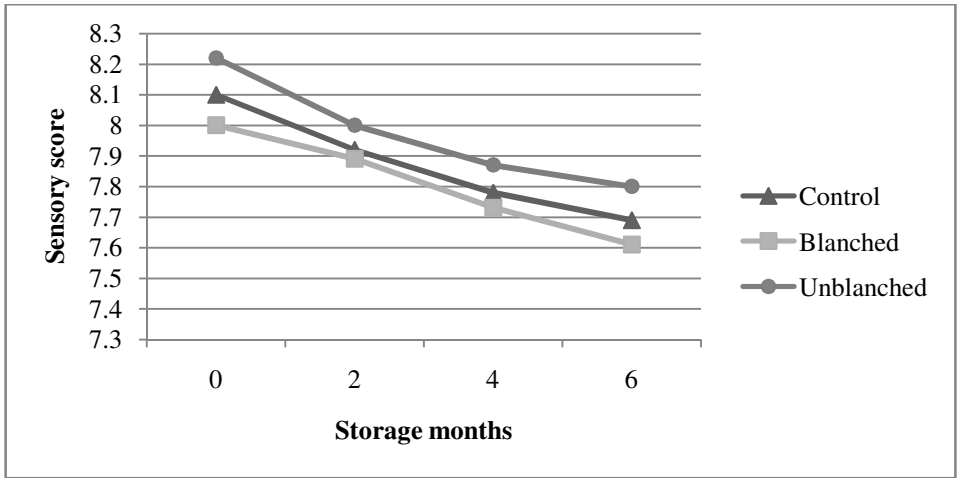

Figure-2
Effect of treatment and storage on overall acceptability of aloe juice (4%) supplemented kinnow nectar

The above studies followed by statistical analysis on the kinnow nectar supplemented with juice from unblanched aloe was better in all respects as compared to the product supplemented with juice from blanched aloe and control.

Conclusion

It was concluded from the present investigation that aloe juice could be supplemented up to 4 per cent level without affecting the overall quality of products. Supplementation of aloe juice resulted in considerable improvement in ash, crude fiber and phenolic content of products. Negligible effect of treatment and storage period on crude fiber, ash and carotenoid content of aloe supplemented kinnow nectar was observed during 6 months of storage. Among the treatments unblanched aloe supplemented kinnow nectar were found to be better than blanched aloe supplemented kinnow nectar. *Aloe vera*'s health benefits of promoting human well being has led to its potential utilization as an ingredient to supplement foods of common use, one of them being fruit beverages. Thus, future attempts can be made to further explore the utilization of aloe in different food products that caters to different sections of society.

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