A STUDY ON IMPACT OF FRESH ALOE VERA *(ALOE BARBADENSIS)* JUICE INCORPORATION ON SENSORY AND PHYSICO- CHEMICAL CHARACTERISTICS OF CARROT – ORANGE JUICE BLEND

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Abstract
The present study was undertaken to see the impact of incorporation of aloe vera juice on the sensory and physico - chemical characteristics of juice blends. Aloe vera juice was incorporated into the best combination out of six different combinations of carrot - orange juice (CO) blends. Addition of aloe vera juice brought significant decrease in total solids, TSS, titrable acidity, reducing sugar and total sugar content of carrot orange - aloe vera juice (COA) blends. Ascorbic acid and beta carotene content of carrot - orange juice (CO) was found to be significantly higher than carrot orange - aloe vera juice (COA) blends. No significant difference was observed in the sensory attributes of CO and COA juice blends.

Keywords: aloe vera, carrot, orange, juice blends, physico chemical characteristics, sensory attributes

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1. INTRODUCTION

Plants have been associated with the health of mankind from time immemorial and also the important source of medicines. Among all the medicinal plants, Aloe Vera *(Aloe barbadensis)* is one of the most important medicinal plants which have been used for its medicinal value. Aloe vera is a perennial, drought resisting, and succulent plant belonging to the lily (Liliaceae) family. There are three portions of Aloe Vera leaves: yellow sap, internal gel matrix or the fillet and the rind which consist of outer rind, tip, base, and thorns. There are over 250 species of Aloe grown around the world. However only two species are grown today commercially *Aloe barbadensis* miller and *Aloe aborescens*. (Chauhan *et al.*, 2007). In recent times, the use of Aloe vera has reached a level of concern, since some herbalists and organizations are promoting oral consumption of it as a prophylaxis and treatment to alleviate a variety of unrelated systemic conditions. Aloe vera is promoted for constipation and gastrointestinal disorders and for immune system deficiencies (Grewal, 2000). The leaves of aloe vera is a treasure house of more than 200 bioactive compounds which includes vitamins, minerals, enzymes, amino acids, sterols, lignins, saponins, sugars and salicyclic acids (Vogler and Ernst, 1999). The fresh leaves eaten as salad help in the treatment of indigestion and constipation. (Singh, 2007). Now a days aloe vera can be used as a potential source to develop a wide variety of food products. It can also be incorporated in other food products to enhance their nutritional value. Present market is flourishing with lots of medicinal and cosmetic products containing aloe vera extracts as a functional ingredient. In food sector aloe has been utilized as a functional ingredient especially used in the preparation of jam (Niramon *et al.* 1996), Yoghurts (Shin *et al.*,1995), jelly (Kongkarn Angsupanich, 1993), healthy baby infant formula beverages and healthy baby toddler formula beverages (Benward and Benward 2000), meat products(Erdmann 2004), chewing gums (Jenkins 2003), dairy and beverages sectors (Neall 2004).

The potential use of *Aloe vera* products often involves some types of processing, e.g. heating, dehydration which may cause irreversible modifications to the active substances, affecting their original structures, which may in turn promote important changes in the

proposed physiological and pharmacological properties of these components (Thibault *et al*., 1992). Heating process promotes thermal degradation of polysaccharide of *Aloe vera* gel juice at higher temperature ranging from 80^0 C to 90^0 C, and mainly enzymatic hydrolysis at lower temperature from 50^0 C to 60^0 C. Since heat processing may be detrimental to the active ingredients in aloe gel, it was justified to consider developing products incorporating untreated, fresh aloe gel. Beside this, due to bitter taste and slimy nature, aloe vera juice is seldom consumed. Hence blending of aloe vera juice with carrot-orange juice was done to gain health benefits and improve nutritional status of the beverage. The study was undertaken to study the changes in sensory and physico - chemical characteristics brought about by the incorporation of aloe vera juice in fresh carrot – orange juice blend.

2. MATERIALS AND METHODS

Preparation of Carrot -orange juice

Carrots (Daucus carota) and orange (Citrus reticulata) were purchased from the local market of Pantnagar, Uttarakhand. The fresh and disease - free carrots of uniform size, color, maturity and firm texture were washed under running tap water in order to remove dust and dirt particles, then stems, tips and other undesirable parts were exercised using sharp stainless steel knife and peeled using peeler to remove dirty skin, undesirable hair and end ones and again washed. These were then cut half vertically. The juice was extracted with the help of Glan domestic automatic juicer. Oranges were also washed under running tap water and then peeled manually. They were then cut half transversely and seeds were removed manually using tip of stainless steel knife. The juice was extracted with the help of Glan domestic automatic juicer.

Preparation of aloe vera juice

Aloe vera (Aloe barbadensis) leaves were procured from Central Institute of Medicinal and Aromatic Plants (C.I.M.A.P), Pantnagar, Uttarakhand. Healthy large sized, fleshy and undamaged leaves of aloe vera plant were selected for the extraction of juice. One to two inch of lower base of leaf and two to five inch of leaf top was removed by using a sharp stainless steel knife. The leaves were cut into about five inch pieces. The short sharp spikes located along the leaf margin were removed. The top rind was removed by introducing the knife into the mucilage layer below the green rind avoiding the vascular bundles. The internal fillet (transparent mass) was then scooped out and cut into pieces. Aloe vera juice was obtained by grinding these pieces in an electrically operated mixi-grinder (Kenstar).

Preparation and standardization of carrot-orange (CO) juice blends

Six types of carrot - orange juice blends were prepared by combining carrot and orange juice in the proportions of 150:0, 125:25, 100:50, 75:75, 50:100 and 25:125. Sensory evaluation of all juice blends were done by a panel comprising of 15 semi trained judges drawn from faculty members and post graduate students of Department of Foods and Nutrition. Nine Point Hedonic rating scale for selection of highly acceptable blend and Score card method for rating the various attributes like colour, appearance, flavour, taste, consistency and overall acceptability as described by Amerine et al., (1965) were used to choose the optimized blend of carrot – orange (CO).

Preparation of carrot orange- aloe vera (COA) juice blends

From the optimized blend of CO juice, 30ml of CO juice was replaced by 30 ml of aloe vera juice in such a way so as to maintain the total volume of 150 ml of carrot orange- aloe vera (COA) juice blend.

Sensory evaluation of carrot orange – aloe vera (COA) juice blend

Sensory attributes viz. colour, appearance, flavour, taste, consistency and overall acceptability of carrot orange- aloe vera juice (COA) was then compared with that of carrot-orange juice blend using Nine Point Hedonic rating scale and Score card method.

Chemical analysis of carrot- orange (CO) juice blend and carrot – orange- aloe vera juice (COA) blend

Physico chemical characteristics of juices viz. carrot juice, orange juice, aloe vera juice, carrot – orange (CO) juice blend and carrot orange-aloe vera (COA) juice blend were analyzed. Moisture, total solids, TSS, pH, titrable acidity were determined following AOAC (1995) methods. Total sugar and reducing sugar were estimated following Lane and Eynon method (AOAC, 1997) as described by Ranganna (2007). Ascorbic acid was estimated using 2,6- dichlorophenol indophenol titration method (Ranganna, 2007) with slight modification given by Hawk (1965), beta carotene by method described by Ranganna (2007) with modification in column packing as described by Goodwin (1955). All estimations were carried out in triplicates. Analysis of variance (ANOVA) was used for juice blends.

3. RESULTS AND DISCUSSION

Sensory evaluation of carrot orange juice blends using Nine Point Hedonic rating scale

Data regarding evaluation of carrot - orange juice blend for sensory quality by Nine Point Hedonic scale with varying levels of carrot and orange juice as shown in Table 1 revealed that among six juice blends of carrot and orange juice 54.66 percent preferred blend having carrot and orange in the ratio of 100:50 and rated liked very much. Blend having carrot and orange juice in the ratio of 150:0, 125:25 and 75:75 were rated liked moderately by 48.86%, 49.73% and 48.40 % panelists respectively. The blend with carrot and orange juice in the ratio 50:100 was liked slightly by 44.00 percent. The blend having highest level of orange juice 25:125 was rated neither liked nor disliked by 36.4 percent panelists.

Table 1. Sensory evaluation of Carrot- Orange juice blends

Carrot: Orange	Color	Appearance	Flavor	Taste	Consistency	Overall acceptability	Preference
150:0	8.16 ± 1.09	8.13 ± 1.16	7.12 ± 0.88	7.16 ± 0.83	7.86 ± 0.83	7.18 ± 0.89	48.86 % LM
125:25	8.52 ± 0.77	8.13 ± 0.91	7.39 ± 0.86	7.81 ± 0.88	7.66 ± 0.92	8.01 ± 0.94	48.93 % LM
100:50	8.84 ± 0.50	8.79 ± 0.48	8.59 ± 0.50	8.73 ± 0.48	8.32 ± 0.59	8.86 ± 0.51	54.66 % LVM
75: 75	7.83 ± 0.79	8.06 ± 0.79	8.13 ± 0.74	7.89 ± 0.83	7.74 ± 0.89	8.81 ± 0.73	48.40 % LM
50: 100	7.05 ± 0.97	7.14 ± 0.83	7.83 ± 1.08	6.48 ± 1.08	7.36 ± 1.03	7.41 ± 1.08	44.00 % LS
25:125	6.33 ± 1.16	6.76 ± 0.96	6.47 ± 1.09	6.33 ± 1.23	7.24 ± 1.18	6.46 ± 1.12	36.40 % NLND
S.Em	0.235	0.228	0.228	0.240	0.234	0.234	
CD at 5%	0.663	0.641	0.641	0.675	0.674	0.659	

*Mean of 15 observations ± SD — Maximum score = 10
LM- Liked moderately — LVM- Liked very much
LS- Liked slightly — NLND- Neither liked nor disliked

Sensory evaluation of carrot- orange juice blend for acceptability by score card method

Carrot- orange juice blends having varying levels of carrot and orange juice were analyzed for various sensory characteristics viz color, appearance, taste, flavour, consistency and overall acceptability and data are presented in Table 1. The mean sensory score for color was found to be highest (8.84) for the blend having carrot – orange juice in ratio of 100:50. Initial incorporation of orange juice showed no significant difference in color of carrot – orange juice blends of 100:0 and 125:25 ratios. But as the level of orange juice was increased a significant difference in the acceptability of color of juice blends was observed. A decrease trend was seen in the acceptability of color of juice blends with carrot – orange ratio 100:50 to 25:125. The highest mean sensory score for appearance was observed as 8.79 for blend having carrot orange juice in the ratio of 100:50. CO blend of 125:25 showed no significant difference in appearance as compared to 150:0 (control). It was further noted that as the level of orange juice was increased beyond 100:50, significant difference was observed in appearance of blends. The acceptability for appearance of juice blend decreased from 100:50 to 25:125. The mean sensory score for the flavor of carrot - orange juice blends was found to be ranged from 6.47 to 8.59. The mean sensory score of 150:0 was found to be 7.12 and showed significant difference with all the blends of carrot and orange juices except with 125:25. The highest mean sensory score was found to be 8.59 for blend having carrot- orange juice in the ratio of 100:50. Among the blends, no significant difference in the flavour was observed between blend 100:50 and 75:75, and 50:100. However, 100:50 and 50:100 CO blends showed significant difference. The mean sensory score for flavour decreased as the level of orange juice was increased. Thus showing decreasing trend in acceptability of flavour of juice with increased level of orange juice upto the certain level (100:50). The highest mean sensory score for taste was observed as 8.73 while lowest as 6.33 for blend having carrot and orange juice in the ratio of 100:50 and 25:125 respectively. Mean sensory score of the juice blends showed a decreasing trend in acceptability for taste with increase in the level of orange juice. Significant difference was seen between the control and blends having varying proportion of carrot and orange juice. Among blends, no significant difference for taste was observed between 50:100 and 25:125, and 125:25 and 75:75 CO juice blends. The data regarding the consistency of various juice blends of carrot and orange revealed that the CO juice blend 100:50 had highest mean sensory score of 8.32 while 25:125 had lowest value of mean sensory score (7.24). No significant difference in the consistency of 150:0 and other juice blends was seen. However, a decreasing trend in the mean sensory score of juice blends having carrot and orange juice in varying proportions was observed. Among blends, significant difference was observed in the consistency of 100:50 and 50:100, and 100:50 and 25:125 CO juice blends. The highest mean sensory score for the overall acceptability of carrot and orange juice blends was found to be 8.86 for CO juice blend 150:0 while lowest mean sensory score was found 6.46 for 25:125 CO juice blend. The mean sensory score decreased with increase in level of orange juice up to the ratio of 100:50. Significant difference between the control i.e 100:0 and other carrot orange juice blend was seen except for ratio 50:150. Among blends, no significant difference was observed between the blends having carrot orange juice in the ratio of 125:25 and 75:75 respectively. Shiv Kumar *et al.*, (2009) reported that addition of orange juice in tomato juice at 10%, 20% and 30% brought about increase in mean sensory score for appearance, color, flavour, taste and overall acceptability to a certain limit and then the scores declined, which was found to be in accordance with result of present study. The blend having carrot orange- juice in the ratio of 100:50 had highest preference and the mean sensory scores and therefore further analyzed and used for the preparation and evaluation of aloe vera incorporated carrot orange- aloe vera juice blend (COA).

Table 2. Sensory evaluation of Carrot –Orange (CO) and carrot – orange aloe vera juice blends (COA)

Sensory characteristics	CO (100:50)	COA (120:30)	S. Em	CD at 5%
Color	8.26±0.59	8.20 ± 0.77	0.194	0.563
Appearance	8.20 ± 0.56	8.13 ± 0.63	0.155	0.449
Flavour	7.93 ± 0.88	7.53 ± 0.51	0.186	0.541
Taste	7.86 ± 0.63	7.46 ± 0.91	0.203	0.590
Consistency	7.86 ± 0.51	7.33 ± 0.89	0.189	0.548
Overall acceptability	8.13 ± 0.63	7.93 ± 0.70	0.173	0.503
Hedonic scale preference	52.86 % LVM	51.06 % LM		
CO- Carrot-orange juice blend		COA- Carrot orange-aloe vera juice blend		
*Mean of 15 observations ± SD		Maximum score = 10		
LM- Liked moderately		LVM- Liked very much		

Table 3. Physico chemical characteristics of single strength juice of carrot, orange and aloe vera

Parameters	Carrot	Orange	Aloe vera
Moisture (%)	91.42 ± 0.12	88.88 ± 0.16	99.34 ± 0.23
Total solids (%)	8.56 ± 0.13	11.11 ± 0.16	0.65 ± 0.23
TSS (^{0}brix)	7.53 ± 0.25	11.36 ± 0.25	0.50 ± 0.30
pH	6.29 ± 0.06	3.52 ± 0.09	4.44 ± 0.03
Titrable acidity (%)	0.13 ± 0.01	0.53 ± 0.18	0.11 ± 0.03
Brix acid ratio	58.87 ± 10.44	23.53 ± 9.65	4.44 ± 1.50
Reducing sugar (%)	2.48 ± 0.02	5.29 ± 0.02	0.170 ± 0.003
Non reducing sugar (%)	3.04 ± 0.05	4.25 ± 0.08	0.14 ± 0.01
Total sugar (%)	5.53 ± 0.03	9.55 ± 0.05	0.31 ± 0.01
Ascorbic acid (mg/100ml)	8.74 ± 0.94	23.50 ± 1.89	0.80 ± 1.35
Beta carotene (mg/100ml)	7.2 ± 1.11	4.31 ± 0.21	ND
* Mean of triplicate observations ± S.D ND – Not detected			

Sensory evaluation of carrot orange- juice (CO) and carrot orange aloe (COA) juice

Addition of aloe vera juice in carrot- orange juice blend (CO) in the ratio of 120:30 (carrot-orange juice: aloe vera juice) showed no significant difference in the organoleptic attributes of carrot orange juice (CO) and carrot –orange- aloe vera (COA) juice blend as shown in Table 2. The mean sensory score for color and appearance of CO juice was found to be 8.26 and 8.20 respectively while for COA juice blend it was 8.20 and 8.13 respectively. There was no significant difference. The mean sensory score for flavour, taste, consistency and overall acceptability of CO juice blend was found to be 7.93, 7.86, 7.86, and 8.13 respectively and of COA juice blend the score was 7.53, 7.46, 7.33, and 7.93 respectively. About 52.86 per cent panelists rated CO juice blend as liked very much while 51.06 per cent rated COA juice blend liked moderately on Nine Point Hedonic scale.

Physico-chemical characteristics of carrot orange- juice (CO) and carrot orange aloe (COA) juice

Table 3 shows the physico- chemical characteristics of single strength juice of carrot,

orange and aloe vera juice. Table 4 shows the effect of incorporation of aloe vera juice on the physico-chemical characteristics of fresh juice of carrot-orange juice blend.

The moisture content of COA juice blend (91.98 %) was found to be significantly higher than CO juice blend (89.97 %). This might be due to higher moisture content of aloe vera juice (99.34 %) than corresponding carrot (91.42 %) and orange juice (88.88 %). Higher total solid content of carrot (8.56 per cent) and orange (11.11 per cent) than aloe vera juice (0.65 per cent) resulted in higher total solid content of CO juice blend (10.02 per cent) than COA juice blend (8.01 per cent). The TSS content of CO and COA juice blend was observed to be 8.33 and 7.43^0 brix respectively. Addition of aloe vera juice was found to lower the TSS content of COA juice blend which might be due to low TSS content of aloe vera juice (0.68˚ brix) than carrot (7.53˚ brix) and orange (11.36˚ brix). Sahota et al. (2009) reported that increase in % of aonla juice having TSS of 6˚ brix in carrot juice having TSS 8.5˚ brix lowered the TSS from 3 to 2˚ brix of carrot- aonla blend. The pH of CO juice and COA juice blend was found as 5.63 and 5.62 respectively. The pH of COA juice blend was found to be slightly lower than CO juice blend. No significant difference was observed. Dhaliwal and Hira (2001) reported that addition of beetroot juice to carrot juice at different level brought about decrease in pH from 3.80 to 3.60. Addition of aloe vera juice to CO juice blend decreased the titrable acidity significantly. The titrable acidity of CO juice and COA juice blend was found to be 0.45 and 0.35 per cent respectively in terms of citric acid. Shiv Kumar et al. (2006) reported that increase in addition of orange juice in tomato juice decreased the titrable acidity from 0.66 to 0.63 per cent. Garg et al. (2008) reported that increase in percentage of apple juice in aonla-apple- ginger fruit drink decreased the titrable acidity from 0.33 to 0.32 per cent. They further reported that same trend was observed in aonla-pear- ginger fruit drink in which increase in per cent of pear juice brought about decrease in titrable acidity from 31 to 29 per cent. The brix acid ratio of CO juice blend and COA juice blend was found to be 18.24 and 21.24 respectively. Brix acid ratio of COA was found to be higher than CO juice, however, no significant difference was found in brix acid ratio of two juice blends. The reducing sugar content of CO juice (3.44 %) was found to be higher than aloe vera incorporated juice blend (2.73 %). There was significant difference in the reducing sugar content of both juice blends. This might be due to higher reducing sugar content of carrot (2.48 %) and orange juice (5.29 %) than aloe vera juice (0.17 %). Dhaliwal and Hira (2001) reported that addition of beetroot juice to carrot juice at varying proportions brought about reduction in reducing sugar from 3.16 to 2.52 %. The non - reducing sugar content of COA juice blend (3.25 %) was found to be significantly lower than non - reducing sugar content of CO juice blend (2.77 %). This might be due to low non - reducing sugar content of aloe vera juice (0.14 %) than carrot (3.04 %) and orange (4.25 %) juice. Dhaliwal and Hira (2004) reported that non - reducing sugar content of carrot-pineapple juice blend decreased with increase in addition of pineapple juice. The total sugar content of CO juice and COA juice blend was found to be 6.76 %and 5.50 % respectively. Significant difference was observed in the total sugar content of both the juice blends. This might be due to higher total sugar content of carrot (5.53 %) and orange (9.55 %). Deka et al. (2000) reported that higher total sugar content in grape - mango RTS might be due to higher sugar content in grape juice (15.19 %) and mango pulp (13.97 %) as compared to other fruit. Dhaliwal and Hira (2001) reported that increase in the level of incorporation of black carrot juice to carrot juice decreased the total sugar content from 7.46 to 7.25 %. Dhaliwal and Hira (2004) further reported the same trend when pineapple juice was added to carrot juice and total sugar content decreased from 7.04 to 6.85 %. The ascorbic acid (mg/100ml) content of COA juice blend (9.29) was found to be significantly lower than CO juice blend (10.11).

Table 4. Physico chemical characteristics of carrot - orange juice and carrot – orange - aloe vera juice blend

Parameters	CO	COA	S.em	CD at 5%
Moisture (%)	89.97 ± 0.29	91.98 ± 0.20	0.14	0.57
Total solids (%)	10.02 ± 0.29	8.01 ± 0.20	0.14	0.57
TSS (° brix)	8.33 ± 0.35	7.43 ± 0.25	0.17	0.68
pH	5.63 ± 0.06	5.62 ± 0.05	0.032	0.12
Titrable acid (%)	0.45 ± 0.04	0.35 ± 0.03	0.02	0.09
Brix acid ratio	18.24 ± 1.14	21.24 ± 2.24	1.02	4.02
Reducing sugars (%)	3.44 ± 0.04	2.73 ± 0.02	0.02	0.08
Non- reducing sugars (%)	3.25 ± 0.05	2.77 ± 0.05	0.03	0.12
Total sugar (%)	6.76 ± 0.03	5.50 ± 0.02	0.02	0.08
Ascorbic acid (mg/100ml)	10.11 ± 3.31	9.29 ± 0.47	1.36	5.34
Beta carotene (mg/100ml)	7.58 ± 0.15	5.30 ± 0.08	0.07	0.27
CO- Carrot-orange juice blend COA- Carrot –orange-aloe vera juice blend * Mean of triplicate observations ± S.D C.D at 5% level of significance				

This might be due to low ascorbic acid content of aloe vera (0.80 mg/100ml) as compared to carrot (8.74 mg/100ml) and orange (23.50 mg/100ml) juice. Garg et al. (2008) reported that as the level of apple juice incorporation was increased the ascorbic acid content of fruit drink decreased from 78.9 to 10.6 mg/100ml. They further reported that incorporation of pear juice brought about decrease in ascorbic acid content of fruit drink from 79.4 to 70.3 mg/100ml. Shiv Kumar et al. (2009) observed that as the percentage of orange juice in tomato juice was increased the ascorbic acid (mg/100ml) decreased from 51.35 to 47.76 mg/100ml. The beta carotene content of aloe vera incorporated COA juice blend (5.30 mg/100ml) was found to be significantly lower than CO juice blend (7.58 mg/100ml). This might be due to higher beta- carotene content of carrot (7.2 mg/100ml) and orange (4.31 mg/100ml) than aloe vera juice. Gowda et al. (1995) observed that there was significant reduction in carotenoid content of watermelon juice due to addition of spices like ginger. Dhaliwal and Hira (2004) also reported that incorporation of pineapple juice to carrot juice brought about decrease in beta - carotene content of carrot- pineapple juice blend from 4.44 to 4.38 mg/100ml (Table 4).

4. CONCLUSIONS

From the result obtained it can be concluded that aloe vera juice can be effectively incorporated into carrot-orange juice in the ratio of 120:30 without affecting the sensory characteristics of COA juice blend. Although incorporation of aloe vera juice to carrot – orange juice blend brought about slight decrement in the physico chemical characteristics of blends, its precious medicinal and therapeutic values can not be ignored.

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