RESEARCH PAPER | Food Science | Volume : 3 | Issue : 11 | Nov 2013 | ISSN - 2249-555X

Development and Quality Evaluation of Kiwi- Apple Juice Concentrate

KEYWORDS: Kiwi fruit, apple, juice, concentrate, processing

Surabhi Sharma	Devina Vaidya	Neerja Rana
Teaching Research Personnel, VCSG College of Horticulture, Uttarakhand University of Horticulture and Forestry, Bharsar, Pauri, Uttarakhand, 246 123	Scientist, Department of Food Science and Technology, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh 173 230	Assistant Professor, Department of Basic Sciences, Dr Y S Parmar University of Horticulture and Forestry, Nauni, Solan, Himachal Pradesh 173 230

ABSTRACT *The concentration of fruit juices is industrially performed in order to reduce storage, packaging, handling and shipping costs. This paper describes the research efforts to develop and optimise the fortification of apple juice with naturally enriched Vit. C source i.e. kiwifruit, on laboratory scale, for the production of nutritionally ascorbic acid enriched juice concentrate. Preparation of blends of kiwi juice with apple juice for the utilization into concentrates is another outlet for its economic consumption. Apple juice is rich in nutrients but has very low vitamin C content. However, kiwifruit has the highest level of vitamin C (3–5 times more than citrus fruits) and it is a good source of dietary fiber, vitamin E, folic acid and minerals (P, K, Ca, Mg, Mn). On the basis of these characteristics kiwifruit offers benefits for specific health conditions and, consequently, it has a great potential for industrial exploitation. Fresh depectinated apple and kiwifruit juice was blended in the ratio of 50:50. The ascorbic acid content increased significantly after blending of the juices (6.64 to 59.63 mg/100g). However, ascorbic acid was found to be retained during evaporative concentration of the juices to 50OB. The blended juices and concentrates were successfully stored after pasteurization for a period of six months with non-significant changes in the quality parameters. The cost of production on laboratory scale of blended juice and 50OB concentrate was Rs 36 and Rs 106 respectively per 650ml bottle.*

The fruit of *Actinidia deliciosa*, commercially known as kiwifruit, is characterized by significant amounts of biologically active compounds, including ascorbic acid, and by impressive antioxidant capacity due to the presence of phytonutrients including carotenoids, lutein, phenolics, flavanoids and chlorophyll (Beever and Hopkirk, 1990). Besides these compounds, kiwifruit also contains potassium, vitamin A & E, folic acid and soluble and insoluble fibres. They are also rich in antioxidants, which are known to reduce the risk of cardiovascular diseases, cancer and help to slow the aging process. However, apple fruit is bestowed with an attractive colour, flavor and taste and is relished for table purpose. It is a rich source of carbohydrates, vitamins, minerals and dietary fibres. In India, a substantial part is consumed as dessert and about 30 per cent of the crop is utilized in the production of apple juice, apple juice concentrate and partly as jam, jelly, apple rings, cider, vinegar and apple pie (Sharma *et al.*, 1989; Bhasin and Bhatia, 1981; Kaushal and Sharma, 1995).

Fruit juices and beverages are consumed by people of all age groups to quench thirst as a social drink, for health conscious and medicinal value (Sadana and Khanna, 1998, Wakeil *et al.*, 1974). However, apple juice concentrate is getting more popularity in the market but the major limitation is its poor sugar-acid blend on reconstitution and has low amount of Vitamin C content. Fruit juice concentrates are valuable semi-finished products for use in the production of juices, fruit juice beverages and fruit juice powders (Sulc, 1984). As sugar-acid blend is the most important factor deciding the acceptability of the product, if this apple juice concentrate is blended with other fruit juice of strong flavor, acidity and/or appealing colour, it may improve its overall quality, as well as consumer acceptance. The high level of ascorbic acid and acidity in kiwifruit can be utilized for blending it with the sweetness of apple juice. Thus, keeping in view, the health benefits and high nutritive value, there is a great scope to utilize kiwifruit and apple for the preparation of some value added products such as blended fruit juice concentrates. The investigation was undertaken to optimize the technology for the development of kiwi - Apple juice concentrate.

MATERIAL AND METHODS

The kiwi fruits at optimum maturity were obtained from the kiwi orchard of the Department of Fruit Science, University of Horticulture and Forestry, Nauni, Solan (HP). The fruit after thorough washing were peeled and pulping was done with the help of Fruit Mill. The pulp was treated with three enzymes i.e. pectinolytic enzyme and amylase (CDH) 0.025 g/kg and mash enzyme 0.06g/kg. The enzyme treatment of the kiwifruit pulp was carried out at 50±2°C.The reaction was terminated by immersion of the different enzyme treated kiwi fruit pulp samples in hot water (85±1°C) for 5 min to inactivate enzymes before juice extraction by hydraulic press and then filtered through a filter press (Pharma Lab). Volume of the filtered kiwi fruit juice was expressed as yield in per cent. The clarified kiwi juice was packed in pre sterilized bottles, corked and then pasteurized for 25 min at 85±1°C.

The apple juice was purchased from HPMC, Parwanoo, Himachal Pradesh as the method of apple juice extraction has already been standardized and commercialized. The apple juice and kiwi juice were blended in different ratios, however, the ratio of 50:50 was adjudged best by the panelists and this blend was further utilized for the preparation of fruit juice concentrate by the process of evaporative concentration. The best adjudged kiwi - apple blended juice along kiwi juice and apple juice were filtered by passing through a filter press (8 silicon Plates 'SARDAR', Engineering Company, Kanpur, India) for further concentration of the juice in a rotary type vacuum evaporator of one liter capacity (Khera instruments, New-Delhi, India). Evaporation was carried out in a hot water bath at 50±2°C under vacuum (28±2" Hg). In order to achieve fast condensation of vapours, the temperature of water circulating water bath (Vikrant Scientific Work Pvt. Ltd. Bahadurgarh, Haryana) was kept between 0 to 5°C. The condensate was collected in a round bottom flask attached to the apparatus. The concentrates of 50° Brix were prepared from apple- kiwi blended juice, pure apple juice and pure

Volume : 3 | Issue : 11 | Nov 2013 | ISSN - 2249-555X

kiwi juice and packed in pre-sterilized glass bottles which were pasteurized and were analyzed for various physic-chemical and sensory characteristics as fresh and during storage.

The following analyses were carried out for the fresh fruit juices and concentrates. Total soluble solids (°Brix) by hand refractometer, titratable acidity of the apple juice expressed as malic acid and kiwifruit juice expressed as percent citric acid (Ranganna, 1997). The percent sugar in the juice was determined (Lane and Eyon's, 1923), and ascorbic acid (mg/100 ml) by 2,6-dichlorophenol-indophenol titration method (Ranganna, 1997). Non-enzymatic browning (Ranganna, 1997) involved measuring of absorbance of alcoholic extracts of centrifuged sample (2000 rpm) at 440 nm through Bausch and Lomb Spectronic-20 Spectrophotometer using 60 per cent ethanol as blank. Colour intensity (Ranganna, 1997) was determined by recording the absorbance of 2 per cent aqueous solution at 420 nm wavelength.

Sensory evaluation of concentrates was conducted on the basis of colour /appearance, flavour/aroma and overall acceptability on a 9 point hedonic scale.

RESULTS AND DISCUSSION

Quality evaluation of pure juices

The pure kiwi juice has high ascorbic acid content and acidity i.e. 167 mg/100g (Fig 1) and 1.32 percent respectively. However, apple juice had a high total soluble solid content (13.2^{0}B) with low titratable acidity which was found to be 0.73 per cent (Table 1) while ascorbic acid was found significantly lower in pure apple juice (Fig 1). These parameters can be successfully used to blend the kiwi juice with apple juice to have a blended juice concentrate of high acceptability.

Effect of concentration on the quality characteristics of Juices

Table 1 and Fig 1 shows the different characteristics of pure juice, blended juices and their concentrates. The apple juice which has high sugar content (11.71%) and low in ascorbic acid was blended with kiwi fruit juice which had high ascorbic acid and titratable acidity and was further concentrated to 50^{O}B to adjudge the reconstituted juice from the pasteurized concentrate. However, the sensory scores depicted that the kiwi-apple 50^{O}B concentrate had higher acceptability than the pure apple and kiwi concentrates. Wilson and Burns (1983) also found the feasibility of blending kiwi juice with apple juice because of acidic nature of kiwi fruit juice. Tressler and Joslyn (1961) reported that apple juice could be blended with juices of higher acidity. Vaidya *et al*. (1998) prepared mixed fruit juice beverages of ber, pomegranate and guava on the basis of sensory properties of RTS beverage.

Table 1: Effect of concentration on the physico-chemical characteristics of Apple juice, Kiwi Juice and Apple-Kiwi blended Juice

Parameters	Kiwi juice	Kiwi concentrate	Apple Juice	Apple Concentrate	Kiwi-apple Juice	Kiwi-Apple concentrate
Ascorbic acid (mg/100 g)	167	90.37	6.64	3.45	59.63	35.44
TSS (°B)	14.67	50.43	13.2	50.28	13.33	50.00
Titratable acidity (%)	1.32	6.62	0.73	0.94	0.98	4.73
Brix Acid Ratio	10.99	7.61	17.33	53.69	12.98	10.57
Total sugars (%)	12.07	42.41	11.71	39.6	11.22	47.26
Reducing sugars (%)	8.93	25.87	7.76	24.83	7.98	22.96
Non-reducing sugars (%)	3.14	16.55	3.95	14.77	3.29	24.35
Colour (OD_{420nm})	0.01	0.137	0.013	0.13	0.01	0.137
Non Enzymatic browning (OD_{440nm})	0.01	0.04	0.01	0.07	0.01	0.05
Folds of concentration	-	4.17	-	4.3	-	4.42

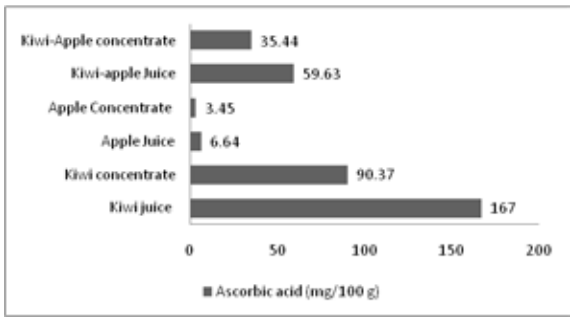

Fig 1: Effect of Blending on the ascorbic acid content of juice and concentrates

Effect of storage on quality characteristics of kiwi-apple blended juice concentrate (50^{O}B).

The vitamin C enriched apple juice concentrate was packed in bottles after pasteurization and stored at two different temperatures i.e. room temperature and refrigerated temperature. The concentrates were analyzed for the changes in the physico-chemical characteristics at periodic intervals of 0, 3 and 6 months.

Table 2: Effect of storage on physico-chemical characteristics of Apple-kiwi blended concentrate (50^{0}B)

Quality Characteristics	Storage Interval				
	0	3 months		6 months	
Ascorbic acid (mg/100 g)	35.44	30.42	32.91	26.48	30.76
TSS (°B)	50	50.13	50.05	50.14	50.08
Titratable acidity (%)	4.73	4.62	4.71	4.67	4.7
Brix Acid Ratio	10.57	10.69	10.62	10.74	10.66
Total sugars (%)	47.26	45.09	47	44.81	46.82
Reducing sugars (%)	22.96	22.53	23.05	23.86	23.34
Non-reducing sugars (%)	24.35	21.56	23.95	20.95	23.48
Colour (OD_{420nm})	0.137	0.267	0.207	0.37	0.24
Non Enzymatic browning (OD_{440nm})	0.05	0.08	0.06	0.16	0.11

The total soluble solids experienced slight increase during storage in all the blended concentrates, which might be due to loss of moisture. The increase was lower under low temperature than room temperature storage. Similar to these observations, slight decrease in moisture contents has also been reported by Sharma (1996) in lemon and grape juice concentrates during storage upto six months at refrigerated conditions. Changes occurring in titratable acidity during storage of concentrate showed a decline (4.73 to 4.67%). Decrease in acid contents during storage of lemon juice of different varieties has also been reported by Palaniswamy and Muthukrishnan (1974). The decline in acidity might be attributed to the chemical interactions between organic constituents of the concentrates during storage.

The increase in reducing sugars of juices was comparatively less at low temperature (22.96 to 23.34%) than those at room temperature (22.96 to 23.86 %) during six months storage. The inversion of sucrose into reducing sugars during storage in presence of acidic environment might have cause this increase in reducing sugar contents of juice as has been re-

Volume : 3 | Issue : 11 | Nov 2013 | ISSN - 2249-555X

ported Lee and Nagy (1988) in grape juice. Similarly, Ewadah (1983) also established a linear relationship between sucrose losses and storage time in grape juice and its concentrates. Further slight decrease in total sugars of concentrates during storage might be attributed to the involvement of sugars in browning reactions and formation of hydroxmethyl furfural.

The ascorbic acid content decreased during six months storage (35.44 to 26.48 mg/100g). Similar to these findings, decrease in ascorbic acid during storage has also been reported by Kumar (1999) recorded the degradation of ascorbic acid in galgal juice concentrates to about half to two third under low temperature conditions of storage. Thakur *et al.*,(2000) in Kinnnow juice concentrates and Sharma (1996) in grape, lime and galgal juice concentrate have reported the same.

The colour changes during storage also become evident by measuring the colour absorbance at 420 nm in Spectronic -20 spectrophotometer which showed gradual increase in absorbance during storage. The degradation of sugar and their involvement in the formation of hydroxymethyl furfural and other browning compounds under acidic conditions probably justified the changes in colour and increase in non-enzymatic browning of juice concentrates. Cerrutti *et al.* (1985) reported that the reaction of glucose under acidic pH and high temperature to form hydroxymethyl furfural, which was similar to our investigations, the changes in colour and non-enzymatic browning were higher under room temperature. It is evident from table 2 that apple-kiwi blended juice concentrate of 50^{0}B can be successfully stored for six months under refrigerated condition with minimum changes in their quality parameters.

Sensory Evaluation

The Figure 1 shows the sensory evaluation of kiwi juice for colour, flavor, taste and overall acceptability. The colour scores were high for kiwi juice concentrate, however the flavor, taste and overall acceptability was adjudged best for the reconstituted juice of apple-kiwi blended juice concentrate of 50^{0}B.

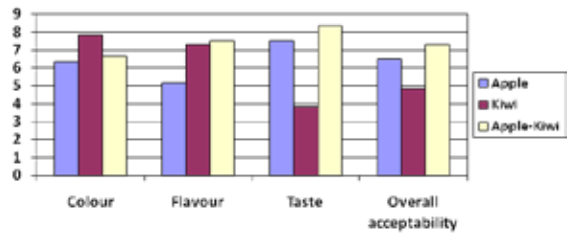

Figure2: Effect of blending on the Sensory scores of 50^{0}B concentrate

Blending of kiwifruit with apple juice were carried out in the ratio of 50:50, increasing the low acid content of apple juice and making the concentrate consumer friendly. The kiwi-apple blended juice concentrate of 50^{0}B can be successfully stored after pasteurization under refrigerated conditions for a period of 6 months as on reconstitution to the original degree brix it retained the same characteristics as that of juice.

REFERENCE

Beever, D. J., & Hopkirk G. (1990). Fruit development and fruit physiology, In: Kiwifruit Science and Management, Ray Richards, in Association with New Zealand Society for Horticultural Science, Auckland, 97-122. | | Bhasin, U., & Bhatia, B.S.(1981). Recent advances in technology of pickles, chutneys and sauces. Indian Food Packer, 35(1), 39-58. | | Cerrutti, P., Rensnik, S. L., Seldes, A., and Fontan, C A. (1985). Kinetics of deteriorative reactions in model food systems of high water activity: glucose loss, 5- hydroxymethylfurfural accumulation and fluorescence development due to non enzymatic browning. Journal of Food Science, 50, 627-630,656. | Ewadah, E. H. (1983). Nutritive composition of Al-Nokel grape fragments and the potentiality of making evaporative concentrate. Food Chemistry, 46, 243-252. | Kaushal, B.B.L., & Sharma, P.C. (1995). Apple. In: Handbook of fruit science and technology: production, composition, storage and processing. Eds DK Salunke and SS Kadam, Marcel Dekker Inc Pub. | Kumar, S. (1999). Studies of the concentration of galgal (Citrus pseudolimon Tan.) juice and preparation of juice powder. M.Sc. Thesis, Dr. YS Parmar University of Horticulture and Forestry, Nauni-Solan (HP), India, 89 p. | Lee, H. S., & Nagy, S. (1988). Relationshiop of sugar degradation of detrimental changes in citrus juice quality. Food Technology, 42(1), 91-94. | Palaniswamy, K. P., & Muthukrishnan, C. R. (1974). Studies on the physico-chemical characters of lemon juices and squashes during storage. Indian Food Packer, 28(4), 37-41. | Ranganna, S. (1997). Hand Book of Analysis and Quality control for fruit and vegetable products, 2nd ed, Tata Mc Graw Hill Pub. Co. Ltd. New Delhi, India, 112. | | Sadana, B., & Khanna, M. (1998). Consumption pattern of beverages as fast foods among teenagers. Beverage and Food World, 25(2), 19-20. | Sharma, P. C. (1996). Studies on fortification and carbonation of fruit juice beverages. Ph.D. (Food Technol.) dissertation. Punjab Agricultural University, Ludhiana, India, 220p. | Sharma, R. C., Chopra, S. K., Dhar, R.P., & Chauhan, S.K. (1989). Enrichment of cookies and biscuits with dietary fibre from apple pomace of ginger residue. Abstract in National Seminar on recent advances in postharvest management of temperate fruits, vegetables and ornamentals plants. Sept 29-30, 1989, UHF, Solan | Sulc, C. (1984). Fruit juice concentration and aroma separation. Confructa, 28, 258-318. | Thakur, N. K., Kaushal, B. B. Lal, & Joshi, V. K. (2000). Effect of different conditions on storage of the physico-chemical and microbiological qualities of debittered kinnow juice concentrates. Journal Food Science and Technology, 37(4), 415-418. | Tressler, D. K., & Joslyn, M. A. (1961). Eds. Fruit and vegetable processing technology. AVI Publishers, Westport Conn. p. 499. | Vaidya, R. N., Kotecha, P. M., & Kadam, S. S. (1998). Studies on mixed fruit juice beverages based on Ber, Pomegranate and Guava. Beverage and Food World, 28(2), 41-47. | Wakeil, F. A., Hameed, H. G. E., Heikal, H., & Foda, I. O. (1974). Detection of accepted natural juices in carbonated beverage 2-studies with "Babli" oranges. Egypt. J. Food. Science, 2(1), 59. | Wilson, E. L., & Burns, D. J. W. (1983). Kiwifruit juice processing using heat treatment techniques and ultrafiltration, Journal of Food Science,48, 1101-1105. |