Himachal Journal of Agricultural Research 35 (1):67-71, 2009

Formulation and quality evaluation of squash prepared from cheese whey and soy-whey

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Abstract

Fruit juice beverages are becoming popular due to their pleasing flavour and nutritional characteristics and have been increasingly gaining popularity throughout the country. The recipes for squash were standardized by various permutation and combination of basic raw ingredients *viz.* whey, sugar, citric acid and pulp. Five combinations of each squash were prepared by cheese-whey and soy-whey and evaluated for pH, TSS, acidity and ascorbic acid, total sugars, reducing sugars and non-reducing sugars. The value for pH was found highest in jamun squash (4.35), TSS in bael squash (47.33), per cent acidity in pear squash (1.93), ascorbic acid was highest in papaya squash (50.18). The addition of fruits pulp with whey not only increases the nutritional value but also make profitable utilization of whey.

Key words: Squash, cheese whey, soy whey, quality evaluation.

Introduction

Whey contains about 40 per cent of the milk solids which include lactose, minerals, water-soluble vitamins and about 20 per cent of milk proteins. Whey proteins have a high biological value and protein digestibility. In India, about 3 million tonnes of whey is produced annually containing about 2 lakh tonnes of valuable milk nutrients. About 80-90 per cent of the initial volume of milk is removed as whey. There are about 6.0-6.5 per cent milk solids in *channa* and *paneer* whey, respectively. These whey solids are not utilized profitably and a huge quantity of whey is being drained out globally, which poses a serious threat to environmental safety because of its high biological oxygen demand (BOD) of 35,000 to 50,000 ppm. (Kumar and Manimegalai, 2005). A large population of India falls in the consumer's list of cold drinks, especially in summer season. Amongst the various types of cold drinks e.g. synthetic and aerated drinks, fruit beverages have an important place because of the sensory and nutritional value.

Jamun (*Syzygium cumini* Skeels) is a native of Indian sub-continent with distribution throughout tropical and sub-tropical areas. Its cultivation extends from India to Malaysia in South-East Asian continent. It is a large, evergreen tree, producing dark purple delicate fruits with prominent seeds. Various nutritional and therapeutic properties are attributed to bael (*Aegle marmelos*) (Anon 2001). Singh and Nath (2004) stated that different products can be made from bael like preserve, refreshing beverages, powder, leather and toffee. The fruits have been used to cure chronic diarrhoea and certain other gastrointestinal disorders since ages. India's climatic conditions are also highly suitable for the cultivation of papaya and it grows well around the year. The annual production of papaya in the world is 55 lakh tonnes. In India, it is estimated at about 4.5 lakh tonnes from an area of 40,000 hectares.

In pear (*Pyrus pyrifolia*), however, lack of attractive shape, size, colour and perishable nature of the fruit are serious constraints to increase its cultivation on a large scale in the North West hills region, which has ideal conditions for pear growing. Mango (*Mangifera indica* L.) is considered to be one of the best fruits in the world market due to its excellent flavour, beautiful colour, delicious taste and health giving properties (Doreyappa *et al.* 2004). In India, mango ranks first in both area and production among fruits and occupies 40.0 per cent of area under fruits. Since all these fruits are abundantly grown in Himachal Pradesh and can be utilized profitably by blending with whey (by-product of dairy industry) for the development of thirst quenching nutritious beverage.

Material and Methods

Raw material was purchased from local market and nearby, villages. Recipes were standardized by various permutation and combinations of basic raw ingredients *viz.* whey, sugar, citric acid and pulp as per FPO specifications. Different fruits viz. jamun, bael, papaya, pear and mango were used for the development of squash. Prepared products were

analysed for pH, TSS, acidity, ascorbic acid and sugars.

Extraction of pulps

Jamun: Jamun fruit was procured from local village. Fresh and ripe fruits free from blemishes were sorted out, steamed for one minute and mashed to obtain a smooth pulp. Thereafter, seeds were discarded, pulp stored into well sterilized jars and kept in freezer till further use.

Bael fruit: Bael fruit was procured from the local village and processed as per the method described by Roy and Singh (1979) with necessary modification and then the pulp was preserved.

Mango, pear and papaya: Fruits were procured from the local market. Fresh and ripe fruits free from blemishes were sorted out, washed and then pulp was extracted and stored.

Preparation of squash

Whey (50 ml) and pulp (50 ml)

↓

Addition of sugar (50g) and citric acid (2.5g)

↓

Heated the mass for 2-3 minutes (stirred continuously)

↓

Removed scum (with the help of a ladle)

↓

Cooled, and added 50 ml fruit juice (mixed thoroughly)

↓

Added sodium benzoate @ 0.25 g/100 ml (added in a small portion of squash)

↓

Packed in sterilized bottles

↓

Stored in a cool and dry place

Flow chart for the preparation of squash

Results and Discussion

Chemical parameters of fruits

Quality evaluation of fruits was also affirmed on the basis of chemical analysis of various parameters viz crude protein, pH, acidity, TSS, reducing sugars, non-reducing sugars, vitamin C, pectin and β carotene.

Total Soluble Solids (TSS)

In fruits, total soluble solids consist of sugars and acids. It is also an index of the maturity of raw fruits and vegetables. The data in Table 1 reveals that the values for TSS in different fruits viz jamun, bael, papaya, pear and mango were recorded to the tune of 12.1, 15.1, 13.0, 8.0 and 8.1^0 Brix respectively. The variation in TSS might be due to basic nature of the fruit. A very close value of 12-13^0 Brix has been reported by Dinesh and Yadav (1998) in papaya fruit. Whereas, Gurbachan and Peter (1998) reported a higher degree of 12-15^0 Brix in pear fruit. These higher values could be due to varietal differences and topography of the cultivated land. Similar results are also reported reported by Katoch (2004) thus corroborates the present findings.

pH

A perusal of data given in Table 1 reflects the pH recorded in the five different fruits of jamun, bael, papaya, pear and mango as 3.90, 3.71, 3.86, 3.90 and 3.61 respectively. However, pear and jamun fruits received a higher range of pH as compared to mango, pear and bael fruits. pH recorded in five fruits viz mango, pear, bael, jamun and papaya were on the acidic side. Pear and jamun received a higher range of pH as compared to mango, papaya and bael.

Table 1 Chemical parameters of fruits

Fruits	TSS ^{0}Brix	pH	Acidity (%)	Ascorbic acid (mg/100g)	Proteins (%)
Jamun	12.1	3.90	0.32	17.93	0.7
Bael	15.1	3.71	0.42	7.63	1.7
Papaya	13.0	3.86	0.12	56.50	0.6
Pear	8.0	3.90	0.78	0.37	0.5
Mango	8.1	3.61	0.15	15.64	0.6

This supports their less acidic nature. The observed differences in pH might be due to variation in cultivars, stage of maturity, seasonal variation due to growing conditions, geographical areas and handling practices prior to processing. A close value of 3.82 has been reported by Kaushal *et al.* (2004) in pear fruit and Kudachikar *et al.* (2003) in mango fruit. Katoch (2006) also reported a close value in jamun. Whereas, slight differences could also be due to inherent acidity of different conditions.

Acidity

The different fruits *viz.* jamun, bael, papaya, pear and mango were found to contain 0.32, 0.42, 0.12, 0.78 and 0.15 per cent acidity, (Table 1), whereas, pear reported higher acidity to the order of 1.6 per cent. The reasons for the variation in values among different fruits could be

due to the genetic make up of the fruits and varying agro- climatic conditions. Similarly Prakash and Nautiyal (1996) also reported a very close value in pear fruit. A very close value has been reported by Katoch (2006) in jamun and bael fruit.

Ascorbic acid

A critical look at the data in table 1 reveals 17.93 mg/100g of ascorbic acid in jamun whereas, for bael, papaya, pear and mango the values recorded were 7.63, 56.50, 0.37 and 15.64 mg/100g. Fruits are important sources of ascorbic acid. It is readily soluble in water and is a strong reducing agent. It is comparatively stable in acidic medium but is destroyed by the action of heat. It helps the body to build resistance to infection and increase the bio-availability and absorption of calcium and iron. The variations might be due to the difference in climatic conditions of fruits. The value of ascorbic acid i.e. 12.00 mg/100g are supported by Shukla *et al.* (2004) in mango fruit. Whereas, Katoch (2004) also supports the present findings in jamun and bael fruit.

Crude protein content

The mean values for protein content of five fruits are illustrated in table 1. From the table it is clearly observed that the highest value of 1.7 per cent protein was observed in bael fruit, followed by 0.7 per cent in jamun; 0.6 per cent in papaya and mango and 0.5 percent in pear fruit. Proteins are larger molecules formed from the combination of a large number of simpler substances and play an important role in many biochemical, bio-physical and physiological processes in the body. It is nitrogen containing organic compounds required by the body to promote growth. The mean values for protein content for five fruits are illustrated in table 2. The values of proteins are supported by Gopalan *et al.* (2000). A close value of crude protein content is also supported by Katoch (2004) in jamun and bael fruit.

Nutritional parameters of fruits

The fruits were analyzed for various nutritional parameters as per cent total sugars, reducing sugars, non-reducing sugars, β carotene and pectin.

Sugars

Sugars or carbohydrates play an important role in biological systems and in foods. A glance of table 2 shows that total sugars, reducing and non-reducing sugars are present in the range of 7.68 to 16.18; 3.53 to 11.24 and 1.06 to 9.47 per cent, respectively in fruits under study. The total sugars, reducing sugars and non-reducing sugars in jamun fruit were observed to be 8.95, 8.60 and 0.35 per cent, respectively. The values of bael fruit calculated were as 16.18, 11.24, 4.93 per cent of total sugars, reducing sugars and non-reducing sugars. The papaya fruit attained the values for the same constituents as 7.68 and 5.68, whereas, it contained non-reducing sugars as 2.00 per cent respectively. On the other hand the values of pear fruit for total sugars, reducing sugars and non-reducing sugars were calculated as 10.97, 9.90 and 1.06 per cent respectively. However, the values of total sugars, reducing sugars and non-reducing sugars of mango fruit were 12.97, 3.53 and 9.47 per cent respectively. The result in Table 3 shows the total sugars, reducing sugars and non-reducing sugars of five different fruits. i.e. jamun, bael, papaya, pear and mango. The difference in the constituents might be due to stage of harvesting. Kaushal *et al.* (2004) reported total sugars of 9.06 per cent in pear fruit respectively. Doreyappa and Huddar (2004) also reported reducing and non-reducing sugars which supports present findings. Katoch (2004) reported a close value of reducing and non-reducing sugars in jamun and bael fruit.

Table 2. Nutritional parameters of fruits

Fruits	Total sugars (%)	Reducing sugars (%)	Non reducing sugars (%)	β carotene (mg/ 100g)	Pectin (%)
Jamun	8.95	8.60	0.35	NIL	2.26
Bael	16.18	11.24	4.93	4.68	3.10
Papaya	7.68	5.68	2.00	4.26	1.66
Pear	10.97	9.90	1.06	3.25	3.63
Mango	12.97	3.53	9.47	4.96	0.60

β carotene / total carotenoids

The total carotenoid content in terms of β-carotene for the five fruits was estimated and the results are reported in table 2. The values recorded were to the order of 4.68, 4.26, 3.25 and 4.96 (mg/100g) in fruits of bael, papaya, pear and mango respectively. The variation obtained might be due to the varietal differences. Gurbachan and Peter (1998) also supported the present findings by giving close values to the present ones.

Pectin

As is evident from the same table, the values for pectin in pear was 3.63, followed by bael (3.10), jamun (2.26); papaya (1.66) and mango (0.60) per cent respectively. This variation might be due to varietal differences. The pectin content values reported by Shukla *et al.* (2004) for mango fruit are somewhat close to that obtained in present study.

Physico-chemical characteristics of squash

pH

pH determines the acidity or alkalinity of a sample thereby, affecting the colour, taste and consistency of foods. A perusal of data in Table 3 reflects that pH recorded in five squashes viz; mango, pear, bael, jamun and papaya were on the acidic side. Pear and jamun recorded a higher range of pH as compared to mango, papaya and bael. This supports their less acidic nature. The observed differences in pH might be due to variation in cultivars, stage of maturity, seasonal variation due to growing conditions, geographical areas and handling practices prior to processing. The pH value of beverages recorded are in the range as reported by Singh and Nath (2004), whereas, slight differences could also be due to inherent acidity of different conditions.

Total soluble solids (TSS)

Total soluble solids consist of sugars and acids and reflect as an index of the maturity of raw fruits and vegetables. The TSS in cheese-whey is also maximum among all squashes. The variation in TSS in different squash is due to the nature and soluble solid content of the fruit and however, soy based TSS in fruit squash is lower side as compared to cheese-whey due to high TSS content of cheese-whey.

Acidity

The value for acidity in cheese-whey squash prepared from jamun, bael, papya, pear and mango were recorded in the range of 1.19, 0.63, 0.19, 1.93 and 0.32 with the mean value of 0.85. Whereas, in case of soy-whey based squash was recorded to be range 1.17, 0.61, 0.17, 1.90 and 0.30. The values for same component in soy-whey based whey was on the lower side in comparison to cheese-whey might be due to curdling of cheese-whey with citric acid. Similarly Prakash and Nautiyal (1996) also reported a very close value in pear fruit.

Ascorbic Acid

The ascorbic content in papaya cheese-whey squash was obtained to be highest i.e. 50.18% whereas, pear based squash contained maximum value to the extent of 0.19 mg/100g. Whereas, in case of soy-whey based again same trend was observed. This might be due to the highest ascorbic acid content in papaya fruit and the low ascorbic acid content observed for soy-whey based squash is due to the negligible amount of ascorbic acid in soybean. The value of ascorbic acid i.e. 12.00 mg/100g are supported by Shukla *et al.* (2004)

Nutritional parameters

Sugars

The results in table 4 showed the total sugars, reducing sugars and non-reducing sugars of five different squashes i.e. jamun, bael, papaya, pear and mango.Total sugars are lowest in papaya cheese-whey squash viz 37.15. Whereas, reducing sugars are highest in mango cheese-whey squash i.e. 28.88 and lowest in non-reducing sugars in soy-whey papaya squash was 6.16. The difference in the constituents might be due to stage of harvesting. Doreyappa and Huddar (2004) also reported reducing and non-reducing sugars which supports present findings.

Table 3. Chemical parameters of squashes

Treatments	Parameters	Jamun	Bael	Papaya	Pear	Mango	Mean
Cheese whey	pH	4.35	4.10	4.30	4.33	4.05	4.23
Soy whey		4.30	4.08	4.28	4.31	4.03	4.20
Mean		4.32	4.09	4.29	4.32	4.04	4.21
CD (P=0.05)		0.88	0.12	0.94	0.12	0.80	
Cheese whey	TSS	46.43	47.33	43.50	44.37	43.43	45.01
Soy whey	^{0}Brix	45.40	46.00	42.67	43.47	43.30	44.17
Mean		45.91	46.67	43.08	43.92	43.37	44.59
CD (P=0.05)		0.32	0.45	0.54	0.52	0.53	
Cheese whey	Acidity	1.19	0.63	0.19	1.93	0.32	0.85
Soy whey	(%)	1.17	0.61	0.17	1.90	0.30	0.83
Mean		1.18	0.62	0.18	1.91	0.31	0.84
CD (P=0.05)		0.35	0.42	0.32	0.23	0.23	
Cheese whey	Ascorbic acid (mg/100g)	11.52	5.06	50.18	0.19	19.88	17.37
Soy whey		10.41	4.87	49.07	0.16	18.84	16.67
Mean		10.96	4.97	49.62	0.18	19.36	17.02
CD (P=0.05)		0.60	0.42	0.66	0.21	0.13	

Table 4. Nutritional parameters of squashes

Treatments	Parameters	Jamun	Bael	Papaya	Pear	Mango	Mean
Cheese whey	Total sugars	39.94	43.73	37.15	40.21	37.77	39.76
Soy whey	(%)	36.57	35.01	26.64	32.90	36.60	33.54
Mean		38.26	39.37	31.89	36.56	37.18	36.65
CD (P=0.05)		0.24	0.23	0.21	0.30	0.27	
Cheese whey	Reducing	20.21	14.46	20.46	22.11	28.88	21.22
Soy whey	sugars	20.48	14.43	20.48	22.07	27.73	21.04
Mean	(%)	20.35	14.44	20.47	22.09	28.30	21.13
CD (P=0.05)		0.27	0.47	0.10	0.64	0.18	
Cheese whey	Non-reducing	19.72	29.27	16.69	18.10	8.89	18.53
Soy whey	sugars	16.09	20.58	6.16	10.83	8.87	12.51
Mean	(%)	17.90	24.92	11.42	14.46	8.88	15.52
CD (P=0.05)		0.16	0.21	0.21	0.39	0.17	

Inferences

From the foregoing discussion it is observed that nutritious squash can be prepared by blending fruit pulp with cheese-whey as well as soybean whey. Although the overall nutritional values are recorded higher in both cases yet cheese-whey based squash significantly better than soy-whey.

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