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Development of Vitamin C enriched Amla Whey drink

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Abstract

Chhana whey is a nutritious by product of dairy industry and its usage for formulation of whey beverages will facilitate its economic utilisation and prevent environmental pollution. Amla or Aonla is the richest source of vitamin C with many health benefits. In the present study Amla juice was used to enrich vitamin C content and enhance nutritional value of chhana whey. Amla whey drink was prepared by blending amla juice at 5, 10 and 15 per cent of chhana whey. Sugar was added at 10 per cent. Based on sensory evaluation and physico- chemical characteristics like pH, acidity, ascorbic acid, total soluble solids, total solids, viscosity the best level was selected. The effect of different heat treatments like 63°C/30 min, 72°C/1 min, 80°C/5 min on sensory characteristics and vitamin C stability of Amla whey drink was also analysed. The beverage prepared from 10 per cent blend had highest overall acceptability scores (8.27). There was 5 times increase in ascorbic acid content of whey when amla juice was added at 10 per cent. The heat treatment at temperature of 72°C /1min was found to be the best as it retained more ascorbic acid.

Keywords: *Amla juice, chhana whey, vitamin C, whey beverage*

Whey is a nutritious by-product obtained during the manufacture of cheese, paneer, chhana, casein etc. It contains about 45-50 per cent of total milk solids, 70 per cent of lactose, 20 per cent of milk proteins, 70-90 per cent of minerals and almost all the water-soluble vitamins (Devi *et al*., 2017). In India, mostly whey is obtained during chhana and paneer preparation and about 100 million kg of whey is annually derived as a by-product, which may cause substantial loss of about 70,000 tonnes of nutritious whey solids (Parekh, 2006). Due to high biological oxygen demand level in whey, it can cause environmental problems, when being drained off. Hence, the conversion of whey into a beverage is a good choice on a commercial scale as the whole quantity is being used and there are no problems of left over residues (Shendurse *et al.*, 2009). Whey fruit beverages are refreshing, thirst quencher, healthful and nutritious when compared to other drinks (Sarvanakumar,

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2005). Formulation of beverage using chhana whey would permit economic utilisation of whey and prevent environmental pollution.

Aonla or Indian gooseberry (*Emblica officinalis* syn. *Phyllanthus emblica*) commonly known as amla, and in South India as "nelli" belongs to family *Euphorbiacaea*. It is the richest known natural source of vitamin C and total phenolics. It is also known for its therapeutic role in 'Ayurvedic' and in 'Unani' system of medicine (Pathak, 2003) and is considered as "Wonder fruit for health" (Ganachari *et al*., 2010). Various research works have been reported in utilisation of aonla fruits for preparation of vitamin C rich beverages (Jain *et al.,* 2006).

Amla juice has 20 times more vitamin C than orange juice (Mobasseri, 2004; Thakur *et al*., 2018). According to Tuohy *et al.* (1988) acid whey is most suitable for blending with fruit juice to produce cloudy fruit drinks. The acid whey flavour is most compatible with citrus flavours. Beverages with citrus flavour have high consumer acceptability (Holsinger *et al.,* 1974). Mehta and Rathore (1976) found that there was more loss of ascorbic acid in amla juice when processed at 80°C for 20 min as compared to 90°C for one min. Keeping in view the significance of whey and amla, study was designed to utilise channa whey and amla juice for preparation of palatable refreshing vitamin C enriched beverage.

Materials and methods

Preparation of chhana whey

Cow milk was procured from Students Experimental Dairy Plant (SEDP), Dairy Science College, Hebbal, Bangalore. Amla juice manufactured by Aamlika Food Products marketed by Apollo Pharmacy was used for preparation of amla whey drink**.** The ingredients like sugar and food grade citric acid were procured from the local market. Cow milk was taken in required quantities in a stainless-steel vessel and heated to boil. Citric acid solution of 2 per cent was added at 70°C. As the coagulum started forming, slow stirring was done. Then chhana (curd) was separated from whey using muslin cloth and whey was collected (De, 1991).

Addition of amla juice and sugar

Amla juice was added at 5, 10 and 15 per cent of chhana whey by weight viz. amla juice was blended with chhana whey at 5:95, 10:90 and 15:85 levels. Sugar was added at 10 per cent by weight. Whey drink thus prepared was subjected to sensory evaluation by panel of expert judges.

Heat treatment of amla whey beverage

The amla whey drink was prepared with most acceptable level of amla juice and sugar. The beverage was heat treated to different pasteurization time temperature combination *viz.,* 63°C/ 30 min, 72°C/1 min, 80°C/5 min and then cooled to 4°C. The whey drink was served under chilled condition to an in-house panel of judges. On basis of sensory score and vitamin C stability the best one was selected. The developed drink was filled into glass bottles (amber coloured) then sealed by crown corking and stored under refrigerated condition.

Sensory evaluation

A panel of five judges evaluated the organoleptic quality of amla whey drink using nine-point hedonic scale. Each judge was provided with a score card to assess the quality of product with respect to various attributes such as flavour, colour and appearance, consistency and overall acceptability.

Physico chemical analysis

The pH of samples was measured using a microprocessor digital pH meter (Elico make) as per the method described in IS: SP: 18 (Part XI) 1981. Acidity was measured by titrating 10 ml of sample against 0.1 N NaOH using phenolphthalein as indicator as per the method described in IS: SP: 18 (Part XI) 1981. Total Soluble Solids (TSS) content in amla whey drink was determined as per the method described by Ranganna (2004) with an ERMA hand refractometer (0-32°). Viscosity was determined using Ostwald Viscometer as per the method described by Ghatak and Bandyopadhyay (2007). Total solids content was estimated by gravimetric method as per

IS: SP: 18(Part XI) 1981. The ascorbic acid was estimated by 2, 6- dichlorophenol indophenol titrimetric method as described by Ranganna (2004).

Statistical analysis

The results were the average of three replications and were statistically analyzed using ANOVA technique for one-way analysis of variance as per Sundararaj *et al*. (1972). The level of significance used was at 5 per cent level i.e., $p < 0.05$.

Results and discussion

Chhana whey was blended with different levels of amla juice along with sugar followed by pasteurisation to develop amla whey drink. The level of blending was optimized based on sensory, physical and chemical characteristics.

Effect of blending amla juice with chhana whey on sensory characteristics of amla whey drink

The effects of blending of amla juice at levels 5, 10 and 15 per cent of chhana whey on the sensory characteristics of developed amla whey drink are represented in Table 1.

Flavour

The flavour scores for control (whey with no amla juice) and amla juice blended to chhana whey at levels 5, 10 and 15 per cent were 7.08, 7.23, 8.08 and 7.28, respectively. The addition of amla juice at 10 per cent significantly improved the flavour compared to control and other level blends. The bland taste of control (whey) could be removed by addition of amla juice. Flavour of amla whey drink was influenced by the level of amla juice. At lower level of amla juice (5%) judges criticized that the drink had bland flavour and at higher levels (15%) the drink had bitter or sour flavour. The current findings were in agreement with Holsinger *et al.* (1974), Tuohy *et al*. (1988) and Khamrui (1998) who reported that acid whey flavour was most compatible with citrus flavours. Djuric *et al*. (2004) reported that citrus-flavoured drinks and drinks with addition of tropical fruits like mango, banana or papaya proved to be very efficient in covering up the undesirable odour of cooked milk and salty-sour flavour of fresh whey.

Colour and appearance

The colour and appearance scores of controls and amla juice blended whey at levels 5, 10 and 15 per cent were 7.28, 7.73, 7.93 and 7.52, respectively. The highest score was awarded for 10 per cent amla juice blend. The statistical analysis confirmed that there was no significant effect in colour and appearance on addition of amla juice.

Consistency

Addition of amla juice at different levels showed no significant difference in consistency of amla whey drink. Among all the blends, 10 per cent level showed highest score.

Overall acceptability

The overall acceptability may be regarded as general criteria for acceptance and marketability of the product from the

Table 1. Effect of blending amla juice with chhana whey on sensory characteristics of amla whey drink

Amla juice: whey	Flavour	Colour & appearance	Consistency	Overall acceptability
	Scores on 9-point hedonic scale			
Control (chhana whey)	7.08	7.28	7.15	7.23
5:95	7.23	7.73	7.31	7.43
10:90	8.08	7.93	7.82	8.27
15:85	7.28	7.52	7.33	7.10
CD	0.678	NS	NS	0.8

All the values are average of three trials NS – not significant CD-Critical Difference

consumer's point of view. The blending of amla juice at 10 per cent significantly improved the overall acceptability scores compared to control and other level blends. The highest overall acceptability score of 8.27 was recorded for 10 per cent blend owing to its sensory characteristics i.e., optimum flavour, colour and appearance and consistency. The drink with 5 per cent blend had bland flavour, thin consistency and dull appearance whereas 15 per cent blend had bitter flavour. The current findings were in agreement with Singh and Kumar (1995) who reported increasing aonla pulp beyond 10 per cent reduced organoleptic quality of aonla ready to serve beverage.

Effect of blending amla juice with chhana whey on physico-chemical characteristics of amla whey drink

The effect of blending of amla juice at 5, 10 and 15 per cent level of whey on physico-chemical characteristics of amla whey drink are depicted in Table 2.

pH

The average values of pH for control (chhana whey) and amla juice blended at 5, 10 and 15 per cent of whey were 5.49, 5.19, 4.89 and 4.54, respectively. There was significant difference in pH values of control with 5, 10 and 15 per cent level blends of amla juice. Addition of amla juice significantly decreased the pH of whey. The fresh aonla pulp had pH of 2.5 (Goyal *et al.,* 2008). So, the pH of sample on addition of amla juice was less than the control and there was significant decrease in pH of amla whey drink.

Acidity

The average values of acidity for control and amla juice blended at 5, 10 and 15 per cent of whey were 0.24, 0.31, 0.37and 0.42 per cent lactic acid, respectively. There was significant difference in acidity of control with 5, 10 and 15 per cent level blends of amla juice. On addition of amla juice there was significant increase in acidity of amla whey drink. Amla being a citrus fruit increases the acidity of the product on addition. Fresh aonla pulp had an acidity of 2.24 per cent citric acid (Goyal *et al.,* 2008).

Ascorbic acid

The ascorbic acid content for control and amla juice blended at 5, 10 and 15 per cent of whey were 2.01, 6.33, 11.6 and 13.8 mg/100 ml, respectively. Amla is richest source of vitamin C. The pulp of fresh fruit contains 200-900 mg of vitamin C (Kalra, 1988). There was increase in vitamin C content of whey by five times when amla juice was blended at 10 per cent of whey. Hence as the level of addition of amla juice increased there was significant increase in ascorbic acid content of amla whey drink. The results obtained are in agreement to the findings of various workers (Jain and Khurdiya, 2004; Jain *et al.,* 2006) who reported that aonla fruits can be used in the preparation of vitamin C rich beverages.

Table 2. Effect of blending amla juice with chhana whey on chemical characteristics of amla whey drink

Amla juice: whey	pH	Acidity (%)	Ascorbic acid (mg/100 ml)	Total soluble solids (°Brix)	Total solids (%)	Viscosity (cp)
Control (chhana whey)	5.49	0.24	2.01	7.2	6.31	1.4
5:95	5.19	0.31	6.33	10.2	15.11	1.68
10:90	4.89	0.37	11.6	10.0	14.53	1.77
15:85	4.54	0.42	13.8	9.8	14.26	1.90
CD	0.24	0.05	0.90	0.18	0.21	NS

All the values are average of three trials NS – not significant CD-Critical Difference

Total soluble solids

The average values of total soluble solids for control and amla juice blended at 5, 10 and 15 per cent of whey were 7.2, 10.2, 10 and 9.8°Brix, respectively. There was significant difference in total soluble solids of control with 5, 10 and 15 per cent level blends of amla juice. On increasing the level of amla juice there was significant increase in total soluble solids of amla whey drink.

Total solids

The Total solids per cent of control and amla juice blended whey at 5, 10 and 15 per cent of whey were 6.31, 15.11, 14.53 and 14.26, respectively. The total solids of whey increased from 6.31 to 15.11 per cent on addition of 5 per cent amla juice. The increase in total solids was due to addition of sugar (10 %) and amla juice. But with increase in level of amla juice from 5 to 15 per cent, the total solids of amla whey drink decreased. This result was contrary to findings of Bhavsagar *et al.* (2010) who reported that with increase in level of pineapple pulp from 5 to 15 per cent in whey there was an increase in total solids content of beverage.

Viscosity

The mean values of viscosity for control and amla juice blended whey at levels 5, 10 and 15 per cent were 1.4, 1.68, 1.77 and 1.9 centipoise, respectively. There was no significant difference in viscosity on addition of amla juice at different levels to whey.

Effect of various heat treatments of amla whey beverage on stability of vitamin C

Amla whey drink was subjected to different heat treatments i.e., 63°C/ 30 min (T1), 72°C/1 min (T2), 80°C/5 min (T3) and then cooled to 4°C. The control sample was prepared only by addition of 10 % amla juice and 10 % sugar with no heat treatment. The best heat treatment was adjudged based on sensory score and vitamin C stability. The effect of different heat treatments on sensory characteristics of amla whey drink is given in Table 3.

Flavour

The mean scores awarded for flavour for control, T1, T2 and T3 were 7.4, 6.9, 8.4 and 7.6, respectively. The treatment T2 (72°C/1min) had the highest score and was significantly different from control. The statistical analysis confirmed the significant effect of heat treatments on the flavour attribute of amla whey drink. At lower temperature T1 (63°C), change in flavour was noticed due to more holding time (30 min) for heating. Temperature of 72°C/1min was ideal for heat treatment of amla whey drink with respect to flavour.

Colour and appearance

There was significant difference in colour and appearance due to different heat treatments of amla whey drinks. The scores pertaining to colour and appearance of control, T1, T2 and T3 were 7.6, 7.1, 8.1 and 7.9, respectively. At lower temperature of heating, dull colour was noted in the product and the appearance was not pleasing. Pasteurisation temperature of 72°C/1min (T2) was seen as ideal for heat treatment of amla whey drink with respect to colour and appearance.

Table 3. Effect of various heat treatments on sensory characteristics of amla whey drink

Treatments	Flavour	Colour & Appearance	Consistency	Overall acceptability
	Scores on 9-point hedonic scale			
Control (no heat)	7.4	7.6	7.3	7.3
63°C/30 min (T1)	6.9	7.1	7.1	7.1
72°C/1 min (T2)	8.4	8.1	7.8	8.6
80°C/5 min (T3)	7.6	7.3	7.5	7.9
CD	0.61	0.63	0.53	0.48

All the values are average of three trials CD-Critical Difference

Consistency

The scores for consistency of control, T1, T2 and T3 were 7.3, 7.1, 7.8 and 7.5, respectively. The statistical analysis confirmed that there was significant effect of heat treatments on consistency of amla whey drink. Pasteurisation temperature of 72°C/1min showed good consistency score for amla whey drink.

Overall acceptability

The mean scores awarded for overall acceptability for control, T1, T2 and T3 were 7.3, 7.1, 8.6 and 7.9, respectively. There was significant effect of various heat treatments on organoleptic quality of amla whey drink. Highest overall acceptability score was noted for heat treatment at 72°C/1min. At lower temperature (T1) the colour, appearance and flavour were not acceptable. The result was in agreement with the findings of Divya and Kumari (2009) who reported that whey-guava beverages pasteurised at 70°C for 35 minutes was found to be best in terms of sensory quality.

Effect of various heat treatments on vitamin C stability of amla whey drink

The effect of various heat treatments i.e., 63°C/ 30 min (T1), 72°C/1min (T2), 80°C/5 min (T3) of amla whey drink on vitamin C stability was presented in Table 4.

The average values for ascorbic acid (mg/100ml) for control, T1, T2 and T3 treatments were 12.08, 7.19, 10.93 and 9.88 respectively. The statistical analysis revealed that there was significant difference between heat treatments on vitamin C stability. Compared to control there was significant loss of vitamin C in all the treatments. Heat treatment at 72°C /1min (T2) retained more ascorbic acid of 10.93 mg/100 ml indicating that the loss of ascorbic acid at this heat treatment was less when compared to other treatments. Higher loss in ascorbic acid was found at 63°C/ 30 min due to more holding time. Mehta and Rathore (1976) have reported considerable loss of ascorbic acid in amla juice during heating. This loss was more by processing at 80°C for 20 min as compared to 90°C for 1min. Temperature influences the nature of degradation mechanism of vitamin C (Kimball, 2012). Loss of vitamin C activity during heat treatment of milk at 75°C/15s was 5 to 20 per cent (Walstra *et al*., 1999).

Table 4. Effect of various heat treatments on vitamin C stability of amla whey drink

Treatments	Vitamin C (mg/100 ml)
Control (no heat) (whey + amla juice)	12.5
63°C/30 min (T1)	7.19
72°C/1 min (T2)	10.93
80°C/5 min (T3)	9.88
CD	0.63

All the values are average of three trials

The sensory score and vitamin C stability results confirmed that the best heat treatment was 72°C /1min for amla whey drink. The flowchart for preparation of amla whey drink is given in Figure1.

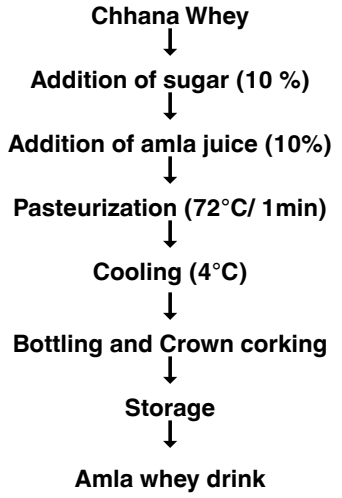

Fig. 1. Flow diagram for preparation of Amla whey drink

Conclusion

From the results, it can be concluded that amla whey drink can be prepared by addition of amla juice (10%) and sugar (10%) into chhana whey followed by pasteurisation at 72°C for one minute. The pH, acidity, ascorbic acid, total soluble solids, total solids and viscosity of 10 per cent blend was found to be 4.89, 0.37

per cent lactic acid, 11.6 mg/100 ml, 10°Brix, 14.53 per cent and 1.77 cp, respectively. There was five times increase in vitamin C content of whey when amla juice was added at 10 per cent. The study on effect of heat treatment on amla whey drink revealed that among different pasteurisation time-temperature combinations tried (63°C/30 min, 72°C/1 min and 80°C/5 min) 72°C /1 min was the best as there was less loss of ascorbic acid in amla whey drink and overall acceptability scores was higher compared to other treatments. Thus, the product can prove a nutritionally as well as organoleptically desirable beverage.

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Conflict of interest

The authors declare that they have no conflict of interest.

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