Original Research

Development and Quality of Pomegranate Incorporated Whey Beverage Prepared From Camel and Buffalo Milk

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Abstract

Naturally flavoured ready-to-serve whey beverages were developed with combination of whey and pomegranate juice in different proportion (Pomegranate, 0%, 5%, 15%, 20%) and (Whey, 94.5%, 89.5%, 79.5%, 69.5%) in T_0,T_1, T_2, and T_3 using constant amount of sugar (4.5%) and black salt (1%).To determine the sensory characteristics such as appearance/colour, flavour, taste and overall acceptability of the formulations, the developed beverages were evaluated by a panel of sensory experts using a 8 point hedonic rating scale. The treatment having 69.5% whey and 25% pomegranate juice (T_3) had highest overall acceptability. On the basis of sensory evaluation further storage study of T_3 beverage at refrigeration temperature (5±1ºC) was done on 0, 3,6,9 and 12 day for different parameters like pH, TA, DPPH, ABTS, TBA. The results of storage study revealed a decrease in pH and antioxidant activity (DPPH and ABTS) and increase in titratable acidity and rancidity (TBA). Thus, from the study it may be concluded that the whey beverage have its highest functional properties and accessibility when consume in fresh state.

Key words: Antioxidant, Ready-to-Serve, Pomegranate, Rancidity, Whey

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Introduction

Whey is a valuable by-product obtained during coagulation of milk by using acid and/or rennet or physico-chemical process for the preparation of cheese, paneer, chhana, chakka and casein. Whey contains about 80-90% of the volume of milk that is used for production of these products. It contains about half of the milk solids in which nutritional components such as lactose, protein and minerals are present in large amount. In terms of functionality, whey protein enhances protein content of beverage while improving its

quality. Thus, a nutritionally rich and valuable product goes as a waste with serious biological consequences if not handled properly by the dairy industry (Hofer, 1995). Considerable work has been done throughout the world to utilize whey for production of whey protein concentrate (WPC), whey powder, lactose, lactic acid, whey paste etc. The conversion of whey into beverages through fermentation or without fermentation is one of the most attractive avenues for the utilization of whey for human consumption. Beverages based on fruit and milk products are currently receiving considerable attention as their market potential is growing. Besides being delicious, these beverages are highly nutritious. Beverage manufacturers are taking a serious look at, how to add valuable nutrition to their product and 'whey' is an ideal option. Hence, development of such a value-added product can provide a new outlet for the use of whey in a more nutritious product (Seethalakshmi *et al*. 2009).The manufacture of whey based beverage requires the mixing of appropriate fruit juices and minimally processed whey with selection of suitable stabilizers and acidulants to develop acceptable whey based fruit beverages (Singh *et al.,* 2002). By adding some simple ingredients in the whey, like sugar, colour and flavor to it, results in improvement of its nutritive value, taste and acceptability. So utilization of such whey for the conversion into best beverage would be one of the important ways to utilize it. There is a lot of scope to explore the possibility of its utilization in beverage industries (Sakhale *et al*., 2012). Beverages are very popular all across the country and people from all age groups drink either hot or cold beverages regularly.

Pomegranate (*Punicagranatum*) juice can be blended with whey to prepare a health drink. As pomegranate is a great source of ellagic acid, as antioxidant and omega-5 polyunsaturated fatty acid which is highly beneficial for cell regeneration and proliferation (Rahimi *et al.,* 2012). The health benefits of pomegranate juice are that it is an excellent anti-aging agent, maintains blood pressure, reduces risk of cancer, helps in treating diarrhoea and dysentery, boosts immunity, prevents anaemia and helps in cartilage regeneration. It is known to have considerable health-promoting properties such as antimicrobial, antiviral, antioxidant and anti-mutagenic effects (Negi *et al.,* 2003).

Looking towards all of its health benefits an attempt was made to utilize whey in combination with different proportions of pomegranate juice to develop pomegranate based whey beverage which are nutritious as well as palatable. Also, the inclusion of pomegranate juice makes better the sensory quality and enhances the acceptability of beverage. The aim of this research was to standardize fruit flavoured whey beverage, evaluate the physicochemical characteristics and also to estimate the shelf life of the product.

Materials and Methods

Fresh camel milk (collected from camel dairy maintained at ICAR-NRC on Camel, Bikaner.) and buffalo milk (buffaloes maintained under the project "Establishment of live demonstration models of diversified

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livestock production systems for motivating adaption to enhancing agricultural income (RKVY-15)" C.V.A.S., RAJUVAS, Bikaner) in a ratio of 70:30 was collected for preparation of good quality whey beverage. The fresh and good quality of pomegranate, sugar and black salt were obtained from the local market.

Both camel and buffalo milk was mixed well the reason behind mixing of camel and buffalo milk is due to that camel milk alone cannot coagulate due to vitamin C deficiency so buffalo milk is added and heated at 80°C and milk was coagulated using 2% citric acid solution followed by continuous stirring resulted in complete coagulation of milk protein (casein). The liquid (whey) was filtered using muslin cloth and stored for further use. Pomegranate juice was extracted from the edible part (arils + seeds). The edible part of pomegranate was grinded in a juicer and the prepared juice was then filtered through a double layered muslin cloth to get a clear pomegranate juice and stored.

Preparation of Pomegranate Based Whey Beverages

The blended beverages were prepared using different ratios of whey and pomegranate juice with constant level of 4.5% sugar and 1% black salt (Table 1). All the ingredients are mixed with a shaker, filtered (muslin cloth), bottled and finally corked. Before storing the beverages, bottles were pasteurized at a temperature of 65-70°C for 15 minutes and then cooled to room temperature. The storage stability of the optimized beverage sample is determined at refrigeration temperature (5 ±1°C) without addition of preservative.

Table 1: Formulation for preparation of 100ml of pomegranate based whey beverages

Treatments/Ingredients	T_0 (Control)	T_1	T_2	T_3
Pomegranate Juice	0%	5%	15%	25%
Whey	94.50%	89.50%	79.50%	69.50%
Sugar	4.50%	4.50%	4.50%	4.50%
Black Salt	1%	1%	1%	1%

Sensory Evaluation

Prepared beverages of various combinations were chilled before evaluation. The samples were subjected to sensory evaluation on 8 point hedonic scale by a panel of eight semi-trained members from academic staff and students of the department for various sensory attributes viz., appearance, flavour, texture and overall acceptability using 8 point descriptive scale, where '8' denotes 'Excellent' and '1'denotes 'extremely poor'. All the treatment beverages were presented in transparent plastic cups under fluorescent light. All samples were marked with digital code, and the order of presentation of samples was randomized for each panellist.

Analytical Tests

The determination of pH was carried out using a digital pH meter (HANNA instrument USA). Titratable acidity expressed as percentage of lactic acid, was determined by using 10 ml of sample titrating with 0.1

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N NaOH solution using phenolphthalein as an indicator to an end-point of faint pink color. The ability to scavenge 2, 2′-diphenyl-1-picrylhydrazyl (DPPH) radical by added antioxidants in samples was estimated following the method of Brand-Williams *et al.* (1995). The spectrophotometric analysis of ABTS radical-scavenging activity was determined according to method described by Salami *et al.* (2009). The TBA values were determined according to the extraction method described by Witte *et al.* (1970).

Statistical Analysis

All the experiments of study were repeated three times and samples were drawn in duplicate. Data collected during the present investigation were subjected to statistical analysis by adopting appropriate methods of analysis of variance as described by Snedecor and Chochran (1994).

Results and Discussion

Formulation of Beverage

The different formulations as indicated in Table 1 were analyzed for sensory properties by a panel of experts. All formulations were prepared in triplicate and these triplicate scores were averaged for each panelist. The treatments (beverages) in Table 2 indicate that the panelists, on average, T_3 is preferred on average for, appearance/ colour, flavour, taste and overall acceptability. The panelists also appreciate T_2 for the appearance/colour and taste, but less for the flavor. Hence this formula is used to evaluate its nutritional profile and storage stability of the beverage at refrigeration temperature.

Table 2: Sensory evaluation of naturally flavoured whey beverages

Treatment	Appearance / Colour	Flavour	Taste	Overall Acceptability
T_0	6.11^{a}± 0.01	6.11^{a}± 0.02	6.01^{a} ± 0.01	6.07^{a} ± 0.03
T_1	6.70^{b} ±0.04	7.05^{b}± 0.05	7.20^{b} ± 0.06	6.95^{b} ± 0.12
T_2	7.40^{c} ± 0.02	7.21^{c}± 0.03	7.51^{c}± 0.04	7.37^{c}± 0.09
T_3	7.40^{c}± 0.01	7.51^{d}± 0.01	7.52^{c}± 0.02	7.47^{c}± 0.03

Storage Stability of Formulated Beverage

On the basis of sensory evaluation beverage T_3 was stored at refrigeration temperature (5 ±1°C) to determine its storage stability without addition of preservative. During storage the changes in pH, titratable acidity, DPPH activity, ABTS activity and TBA value were measured and analyzed at 0, 3, 6, 9 and 12 days of storage at refrigeration temperature were indicated in Table 3. The initial pH of 4.65± 0.004 decreases to 4.29± 0.009 after 12 days of storage. Production of organic acids and amino acids lead to an increase in acidity thereby a decrease in pH, as also reported for mango based beverages (Kalra *et al.*, 1991; Sikder *et al.*, 2001). The pomegranate based whey beverage has an initial titratable acidity of 1.78± 0.009 % in terms of citric acid and increases to 2.99± 0.016 % citric acid after 12 day of storage. Similar results of significantly increase in titratable acidity were also observed in the study conducted for utilization of

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pomegranate juice for the preparation of chakka whey beverage by Babar *et al*. (2008). Naik *et al*. (2009) also reported a significant increase in titratable acidity in whey based watermelon beverage. The changes in DPPH (2, 2′-diphenyl-1-picrylhydrazyl) radical-scavenging antioxidant activity, ABTS Activity (% inhibition) (2, 2′-azinobis (3-ethylbenzthiazoline-6-sulphonic acid) radical-scavenging antioxidant activity of beverage during storage at refrigeration temperature are indicated in Table 3.

Table3: Physico-chemical and antioxidant properties of developed whey beverage during refrigerated storage study (Mean ± SE) of formulated beverage

Parameter/Storage Period	Day 0	Day 3	Day 6	Day 9	Day 12
pH**	4.65^{e} ± 0.004	4.62^{d} ± 0.009	4.50^{c} ± .008	4.42^{b} ± 0.004	4.29^{a} ± 0.009
TA**	1.78^{a} ± 0.009	2.06^{b} ± 0.008	2.36^{c} ±0.011	2.84^{d} ± 0.006	2.99^{e} ± 0.016
DPPH**	20.02^{e} ±0.231	18.00^{d} ± 0.337	16.11^{c}±0.224	14.00^{b} ±0 .283	12.02^{a}± 0.339
ABTS**	35^{e}± 0.477	31.19^{d}± 0.293	27.05^{c}±0.349	23.23^{b}± 0.239	19.01^{a}±0.299
TBA**	0.07^{a}±0.0029	0.10^{b}± 0.0028	0.15^{c}±0.0007	0.21^{d}± .0031	0.36^{e}±0.0039

***Significant at 1% (P<0.01) (N=5)*

The similar results were obtained for DPPH activity by Ujjala (2012) who had also reported that antioxidant properties of polyphenols (fruit) extract fortified whey beverages with storage significantly decreased. Tak (2017) and Singh (2017) also reported that the DPPH activity of fermented camel and buffalo milk yoghurt was significantly decreased with respect to increase in the storage period. For ABTS activity similar results of significant decrease of the antioxidant activity with respect to the storage period were reported by Tak (2017) and Singh (2017). TBARS (2-Thio Barbituric Acid) values of the beverage during storage at refrigeration temperature are indicated in Table 3. The initial TBA (2-Thio Barbituric Acid) value of pomegranate based whey beverage 0.07± 0.0029 increases to 0.36±0.0039 after 12 days of storage. However elevation of TBA value during storage was due to change in its physico- chemical as well as microbial properties of whey beverages. Tak (2017) and Singh (2017) also observed similar results of highly significant increased TBA value with increase of storage period of fermented camel and buffalo milk yoghurt.

Conclusion

In this study, whey is successfully utilized to develop a pomegranate-based fruit beverage with optimum sensory and nutritional properties as well as good storage stability. The beverage possesses high colour, flavour and stability properties. A nutritious beverage with better storage life is developed with the addition of whey, pomegranate juice, sugar and black salt in appropriate proportion. In view of the functional properties arising from bioactive constituents present in fruit and whey, it is proposed that pomegranate based whey beverages with excellent nutritional, sensory and storage properties could be an interesting

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product in the constantly growing market for functional foods. This could potentially increase the commercial and economical value of whey as a functional food which is still considered as a by-product.

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