STUDY OF FORMULATION, SENSORY EVALUATION, PROXIMATE ANALYSIS AND COST OF WHEY BEVERAGES PREPARED FROM CAMEL AND BUFFALO MILK[#]

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ABSTRACT

The present study was carried out with objectives to estimate the proximate analysis and cost evaluation of naturally flavoured whey beverages. The formulation of whey beverages blended in various combinations of whey, pomegranate and watermelon juice was done under study. On the basis of sensory evaluation such as appearance, color, flavour, taste and overall acceptability the preparation of 69.5% whey and 25% pomegranate juice (T_1) and 74.5% whey and 20% watermelon juice (T_2) were further selected as naturally flavoured whey beverages for storage study whereas plain whey was considered as control (T_0). The proximate analysis for dry matter, crude protein, ether extract, crude fibre and total ash showed a significant difference among all the three beverages under study. The cost of production was found to be Rs 8.41, 70.79, 18.31/liter for control whey beverage, pomegranate based whey beverage and watermelon based whey beverage, respectively.

***Key words*:** Proximate analysis, whey beverages, pomegranate, watermelon

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. 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. In terms of functionality, whey protein enhances protein content of beverage while improving its quality. 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 and Sankar, 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).There is a lot of scope to explore the possibility of its utilization in beverage industries (Sakhale *et al*., 2012).

Pomegranate (*Punica granatum*) 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. The juice of this fruit is an exceptional source of vitamin A, C and E and minerals such as calcium, phosphorous, potassium, iron, folic acid, niacin, thiamin, folates and riboflavin. It is known to have considerable health-promoting properties such as antimicrobial, antiviral, antioxidant and anti-mutagenic effects (Negi *et al.,* 2003). Level of antioxidants in pomegranate juice was shown to be higher as compared to green tea and red wine (Gil *et al*., 2000) and these antioxidants are more potent than many other antioxidants such as vitamin C and E (Aviram *et al*., 2002).

Watermelon (*Citrullus lanatus*) is one of the most abundant and cheap fruits that is available in India. Watermelon production contributes to 6-7% of overall fruit production in the world (Reddy *et al.,* 2008). This fruit is a rich natural source of lycopene, a compound responsible for its red colour (Perkins-Veazie *et al*., 2001). Intake of lycopene containing-products has been associated with a reduced incidence of coronary heart disease and some types of cancer (Giovannucci, 2002). Whey based fruits beverages are more suitable for health as compared to other drinks.

Looking towards all of the health benefits of pomegranate and watermelon juice an attempt was made to utilize whey in combination with different proportions of pomegranate and watermelon juice to develop naturally flavoured whey beverages which are nutritious as well as palatable.

Materials and Methods

Material collection and sample preparation

Fresh buffalo milk was obtained from buffaloes maintained under the project "Establishment of live demonstration models of diversified livestock production systems for motivating adaption to enhancing agricultural income (RKVY-15)" CVAS, RAJUVAS, Bikaner and was kept at refrigeration temperature till further use. Fresh camel milk was collected from camel dairy maintained at ICAR-NRC on Camel, Bikaner.

In a different study on coagulation properties of camel

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milk for channa production, 70% of camel milk and 30% of buffalo milk was standardized for production of channa with good yield and binding properties. The by-products of that study were used for the preparation of good quality whey beverage. Briefly, admixed milk was 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. Fresh pomegranate, watermelon, sugar and black salt were procured from the local market to prepare juice for incorporation in whey to form naturally flavoured whey beverages from camel and buffalo milk. 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 for a clear pomegranate juice and stored. Fresh and best quality watermelon was procured from the local market. For the extraction of juice watermelon was peeled and cut into small pieces. After separating the seeds the fruit pieces were grinded in a mixture and the pulp was then filtered through a double layered muslin cloth for a clear watermelon juice and stored.

Product development

The different formulations (treatments) of pomegranate based whey beverage were prepared by using constant level of sugar 4.5% and black salt 1% in different combinations of whey and pomegranate juice *viz*. T_0 (94.5% whey: 0% pomegranate juice), T_1P_1 (89.5% whey: 5% pomegranate juice), T_1P_2 (79.5% whey: 15% pomegranate juice) and T_1P_3 (69.5% whey: 25% pomegranate juice). The different formulations (treatments) of watermelon based whey beverage were prepared by using constant level of sugar 4.5% and black salt 1% in different combinations of whey and watermelon juice *viz.* T_0 (94.5% whey: 0% watermelon juice), T_2W_1 (89.5% whey: 5% watermelon juice), T_2W_2 (84.5% whey: 10% watermelon juice), T_2W_3 (79.5% whey: 15% watermelon juice) and T_2W_4 (74.5% whey: 20% watermelon juice). The treatments were heated to dissolve the added ingredients followed by filling into sterilized glass bottles then sealed.

Sensory evaluation

Formulated 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.

Proximate analysis

Proximate analysis including estimation of moisture content, dry matter (DM), crude protein (CP), crude fiber (CF), ether extract (EE) and total ash of control and treatment (pomegranate and watermelon based whey beverages) beverages was done according to method described by AOAC (2000) (Official methods of analysis).

Cost evaluation of the developed naturally flavoured whey beverages

The cost evaluation of the developed naturally flavoured whey beverages have been worked from prevalent market prices of all the ingredients (whey, pomegranate juice, watermelon juice, sugar and black salt) required for preparation of treatment beverages (pomegranate based whey beverage and watermelon based whey beverage).

Results and Discussion

Sensory evaluation of naturally flavoured whey beverages

On the basis of data presented in Table 1, whey beverages with a composition of 69.5% whey and 25% pomegranate juice (T_1P_3) had obtained maximum overall acceptability (7.47 ± 0.03) whereas for watermelon based whey beverage the composition of 74.5% whey and 20% watermel on juice (T_2W_4) had obtained maximum overall acceptability (7.45 ± 0.06). Thus on the basis of sensory evaluation or overall acceptability the preparation of 69.5% whey and 25% pomegranate juice (T_1P_3) and 74.5% whey and 20% watermelon juice (T_2W_4) were further selected as naturally flavoured whey beverages for storage study whereas plain whey was considered as control (T_0), T_1P_3 as Treatment 1st (T_1- Pomegranate based whey beverage) and T_2W_4 as Treatment 2nd (T_2 - Watermelon based whey beverage).

Proximate analysis of naturally flavoured whey based beverages

Proximate analysis of whey based beverages was done according to method described by AOAC (2000) (Official methods of analysis). The data of proximate analysis of whey based beverages has been presented in Table 2. The mean moisture content percentage in plain whey beverage (control or T_0) was observed to be 93.4 ± 0.02 whereas in pomegranate based whey beverage (T_1) and watermelon based whey beverage (T_2) were found to be 90.55 ± 0.04 and 91.45 ± 0.05, respectively. Moisture content in sample T_0 was found to be higher than sample T_1 and sample T_2 due to less dry matter content in sample T_0.

The mean dry matter percentage of sample T_0, T_1 and T_2 were observed 6.05 ± 0.05%, 8.55 ± 0.05% and 7.85 ± 0.02%, respectively. The mean crude protein percentage of sample T_0, T_1 and T_2 were observed 0.85 ± 0.005 %, 1.22 ± 0.01 % and 1.04 ± 0.005 %, respectively whereas the value of 0.15 ± 0.05 %, 1.11 ± 0.01% and 0.65 ± 0.05% were observed for the mean crude fibre percentage of sample T_0, T_1 and T_2, respectively. The mean ether extract percentage of sample T_0, T_1 and T_2 were found 0.19 ± 0.005%, 0.22 ± 0.005 % and 0.21 ± 0.005%, respectively. The mean total ash percentage of sample T_0, T_1 and T_2 were found 0.85 ± 0.005 %, 0.96 ± 0.005 % and 0.93 ± 0.005%, respectively. Almost similar results were also observed by Bhavsager *et al*. (2010) who studied the proximate analysis of pineapple flavoured chhana whey beverage.

Cost evaluation of the developed naturally flavoured whey beverages

The cost production of whey beverages has been shown in Table 3. The cost of production per litre of plain whey beverage (control or T_0) was worked out as Rs 8.41 whereas pomegranate based whey beverage (treatment or T_1) was worked out as Rs 70.79 and watermelon based whey

Table 1: Sensory evaluation of naturally flavoured whey beverages

Treatment	Appearance / colour	Flavour	Taste	Overall acceptability
T_0	6.11± 0.01	6.11± 0.02	6.01 ± 0.01	6.07 ± 0.03
T_1P_1	6.70 ±0.04	7.05 ± 0.05	7.20 ± 0.06	6.95 ± 0.12
T_1P_2	7.40 ± 0.02	7.21 ± 0.03	7.51 ± 0.04	7.37 ± 0.09
T_1P_3	7.40 ± 0.01	7.51 ± 0.01	7.52 ± 0.02	7.47 ± 0.03
T_2W_1	6.65 ± 0.03	6.50 ± 0.04	6.80 ± 0.04	6.65 ± 0.08
T_2W_2	6.70 ± 0.05	6.75 ± 0.06	6.70 ± 0.07	6.88 ± 0.15
T_2W_3	7.13 ± 0.02	7.21 ± 0.03	7.33± 0.02	7.22 ± 0.05
T_2W_4	7.53 ± 0.02	7.32 ± 0.02	7.49 ± 0.03	7.45 ± 0.06

Table 2: Proximate analysis (Mean ± SE) of whey based beverages

Constituent (%)	T_0	T_1	T_2
Moisture	93.4 ± 0.02	90.55 ± 0.04	91.45 ±0.05
Dry matter	6.05± 0.05	8.55 ± 0.05	7.85 ± 0.02
Crude protein	0.85 ± 0.005	1.22 ± 0.01	1.04 ± 0.005
Crude fibre	0.15 ± 0.05	1.11 ± 0.01	0.65 ± 0.05
Ether extract	0.19± 0.005	0.22 ± 0.005	0.21 ±0.005
Total ash	0.85 ± 0.005	0.96 ± 0.005	0.93 ± 0.005

Table 3: Cost structure of whey based beverages

S. No.	Particulars	Cost (Rs.)		
		T_0	T_1	T_2
1.	Qty. of whey used (litre)	94.5 (ml)	69.5 (ml)	74.5 (ml)
2.	Cost of whey (Rs./ litre)	5.50	5.50	5.50
3.	Cost of whey used (Rs.)	0.519	0.382	0.409
4.	Qty. of fruit juices (Pomegranate and watermelon) used (lit.)	-	25 (ml)	20 (ml)
5.	Cost of fruit juices (Pomegranate and watermelon) (Rs./litre)	-	255	55
6.	Cost of fruit juices (Pomegranate and watermelon) used (Rs.)	-	6.375	1.1
7.	Qty. of Sugar used (kg)	0.0045	0.0045	0.0045
8.	Cost of Sugar (Rs. /kg.)	36	36	36
9	Cost of Sugar used(Rs.)	0.162	0.162	0.162
10.	Qty. of black salt used (kg)	0.001	0.001	0.001
11.	Cost of black salt (Rs./kg.)	160	160	160
12.	Cost of black salt used (Rs.)	0.16	0.16	0.16
13	Total Cost (Rs.) (3+6+9+12)	0.841	7.079	1.831
14.	Cost of whey beverage (Rs./litre)	8.41	70.79	18.31

beverage (treatment or T_2) was worked out as Rs. 18.31. The cost of production per litre of whey based beverages (whey based pomegranate beverage and whey based watermelon beverage) was found less in control (T_0) and highest cost per litre whey based beverages was observed in treatment T_1.

Conclusion

Now a days dairy industries are looking for new product ideas and technologies to meet the ever increasing consumer requirement for healthy foods and to increase the profitability. Especially for poorly developed and developing countries, product development using whey as a water replacement with added nutrition can be used as an excellent source of good quality protein. In this study, whey is successfully utilized to develop pomegranate-based fruit beverage and watermelon-based fruit beverage with optimum sensory and nutritional properties as well as good storage stability. The beverage possesses high color, flavor and stability properties. A nutritious beverage with better storage life is developed with the addition of whey, pomegranate, watermelon juice and sugar in appropriate proportion. In view of the functional properties arising from bioactive constituents present in fruit and whey, it is proposed that pomegranate and watermelon based whey beverages with excellent nutritional, sensory and storage properties could be an interesting 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.

References

AOAC (2000) Official methods of analysis, 17th edn, Association of Official Analytical Chemists, Washington, D.C.

Aviram M, Dornfeld L, Kaplan M, Coleman R, Gaitini D, Nitecki S and Attias J (2002) Pommegranate juice flavonoids inhibit low-density lipoprotein oxidation and cardiovascular diseases: studies in atherosclerotic mice and in humans. *J. Drugs under Experi. Clinic. Res.* **28**(2-3): 49-62.

Bhavsagar MS, Awaz HB and Patange UL (2010) Manufacture of pineapple flavoured beverage from chhana whey. *J. Dairying, Foods Home Sci.* **29**(2): 110-113.

Gil MI, Tomás-Barberán FA, Hess-Pierce B, Holcroft DM and Kader AA (2000) Antioxidant activity of pommegranate juice and its relationship with phenolic composition and processing. *J. Agri. Food Chem*. **48**(10): 4581-4589.

Giovannucci E (2002) A review of epidemiologic studies of tomatoes, lycopene, and prostate cancer. *Experi. Bio. Med.* **227**(10): 852-859.

Negi PS, Jayaprakasha GK and Jena BS (2003) Antioxidant and antimutagenic activities of pomegranate peel extracts. *Food Chem.* **80**(3): 393-397.

Perkins Veazie P, Collins JK, Pair SD and Roberts W (2001) Lycopene content differs among red fleshed watermelon cultivars. *J. Sci. Food Agri.* **81**(10): 983-987.

Reddy LV, Reddy YHK, Reddy LPA and Reddy OVS (2008) Wine production by novel yeast biocatalyst prepared by immobilization on watermelon (*Citrullus vulgaris*) rind pieces and characterization of volatile compounds. *Process Biochem.* **43**(7): 748-752.

Sakhale BK, Pawar VN and Ranveer RC (2012) Studies on the development and storage of whey based RTS beverage from mango cv. Kesar. *J. Food Proc. Technol.* **3**(3).

Seethalakshmi M and Sankar M (2009) Production and analysis of low cost acido-whey beverage. *Ind. J. Nutri. Diet.* **46**(6): 241-245.

Singh S, Singh AK and Patil GR (2002) Whey utilization for health beverages. *Ind. Food Indus*. **21**(4): 38-41.