



P-ISSN: 2349-8528
E-ISSN: 2321-4902
IJCS 2018; 6(2): 3725-3727
© 2018 IJCS
Received: 11-01-2018
Accepted: 12-02-2018

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Studies on preparation and sensory evaluation of whey beverages developed from camel and buffalo milk using pomegranate and watermelon fruit extract

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Abstract

Utilization of whey for the conversion into best beverage would be one of the important ways to utilize it. Nutritive value and acceptability of whey may be increased by the addition of some naturally flavoured fruit extracts. In present study the whey obtained as a by-product from admixture of camel and buffalo milk (70:30) acid coagulation was used for ready to serve (RTS) fruit based whey beverages by incorporating fruit extracts (pomegranate: T₁P₁- 5%, T₁P₂-15%, T₁P₃- 25% and watermelon: T₂W₁- 5%, T₂W₂- 10%, T₂W₃- 15%, T₂W₄- 20%) with constant amount of sugar (4.5%) and black salt (1%) in all samples. Control treatment (T₀) was the whey added with sugar and salt as that of treatments. The beverages further evaluated by a group of panellists for sensory evaluation using 8 point Hedonic scale. The result showed that the pomegranate based whey beverages with a composition of 69.5% whey and 25% pomegranate juice (T₁P₃) had highest overall acceptability (7.47 ± 0.03) whereas for watermelon based whey beverage, the composition of 74.5% whey and 20% watermelon juice (T₂W₄) had highest overall acceptability (7.45 ± 0.06). From the study it was concluded that fruit extracts incorporated whey beverage of good quality could be products as of developed products (T₁P₃ and T₂W₄) and the same could be used for its shelf life study during refrigerated storage.

Keywords: Ready to serve (RTS), whey, beverages, pomegranate, watermelon.

Introduction

Whey is one of the major by-product of dairy industry. It is containing almost all water soluble nutrients present in milk, particularly lactose, whey proteins, vitamins and minerals (Goyal and Gandhi, 2009) [1]. By adding some simple ingredients in the whey like sugar, colour, flavor it improves the nutritive value, taste and acceptability. Dairy waste is major issue in the dairy industry. So utilization of such whey for the conversion into best beverage would be one of the important ways to utilize it. Nutritive value of whey may be increased by the addition of some simple ingredients.

Camel milk proteins are well known for its biological activities (Salami *et al.*, 2009) [2], (Kumar *et al.*, 2016) [3], (Jrad *et al.*, 2014) [4] and whey proteins contribute to about 20-25% of total proteins, and of the two major whey proteins, α -lactalbumin is the main component in camel milk, while β -lactoglobulin is deficient (Laleye *et al.*, 2008) [5]. Other whey proteins present in camel milk are serum albumin, lactoferrin, immunoglobulins and peptidoglycan recognition protein (Kappeler *et al.*, 2004) [6]. The major functionalities of milk proteins are contributed by whey proteins viz. antimicrobial, antioxidant, immunomodulatory etc. Recently, many authors have reviewed the benefits of whey consumption on human health (Umaraw *et al.*, 2016) [7], (Birsan and Nihat, 2012) [8], (Sousa *et al.*, 2012) [9], (Madureira *et al.*, 2007) [10].

Milk from buffalo is preferred for preparing milk and dairy products of western and traditional (indigenous) type and is nutritionally superior. Due to more calcium, better calcium: phosphorous ratio and less sodium and potassium than in cow milk make it a better nutritional supplement for infants. The main buffalo milk proteins show high homology to their cow counterparts, therefore, buffalo milk proteins are potential precursors for diversified functionalities. (D'Ambrosio *et al.*, 2008) [11]. So, looking towards the health benefits of camel and buffalo milk many dairy products viz. paneer, milk slices, value added milk nuggets etc.

have been developed and the whey procured during their preparations can be tried to make RTS whey beverage.

Fruit extract of Pomegranate (*Punica Granatum*) can be blended with whey to prepare a health drink. Pomegranate fruit juice 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. 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 also the inclusion of pomegranate juice makes better the sensory quality and enhances the acceptability of beverage (Negi *et al.* 2003) [12].

Watermelon (*Citrullus lanatus*) is one of the most abundant and cheap fruits that is available in India. It is available throughout the year, but production is highest in the summer. This fruit is a rich natural source of lycopene, a compound responsible for its red colour (Perkins-Veazie *et al.* 2001) [13]. Intake of lycopene containing-products has been associated with a reduced incidence of coronary heart disease and some types of cancer (Giovannucci, 2002) [14].

Looking towards all of the health benefits of pomegranate and watermelon juice an attempt was made to utilize whey procured from camel and buffalo milk 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

Fresh camel milk and buffalo milk in a ratio of 70:30 was collected for manufacturing the milk nuggets production. The by-products of nuggets production was 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 and 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.

- **T₀** (Control) - Whey beverage contains 94.5% plain whey, 4.5% sugar and 1% black salt.
- **T₁P₁**-Pomegranate based whey beverage contains 89.5% whey, 5% pomegranate juice, 4.5% sugar and 1% black salt.

- **T₁P₂**- Pomegranate based whey beverage contains 79.5% whey, 15% pomegranate juice, 4.5% sugar and 1% black salt.
- **T₁P₃**- Pomegranate based whey beverage contains 69.5% whey, 25% pomegranate juice, 4.5% sugar and 1% black salt.
- **T₂W₁**- Watermelon based whey beverage contains 89.5% whey, 5% watermelon juice, 4.5% sugar and 1% black salt.
- **T₂W₂**- Watermelon based whey beverage contains 84.5% whey, 10% watermelon juice, 4.5% sugar and 1% black salt.
- **T₂W₃**- Watermelon based whey beverage contains 79.5% whey, 15% watermelon juice, 4.5% sugar and 1% black salt.
- **T₂W₄**- Watermelon based whey beverage contains 74.5% whey, 20% watermelon juice, 4.5% sugar and 1% black salt.

Table 1: Formulation for preparation of 100ml of Pomegranate Based Whey Beverage (PBWB)

Treatment	Whey (%)	Pomegranate Juice (%)	Sugar (%)	Black salt (%)
T ₀ (Control)	94.5	00	4.5	1
T ₁ P ₁	89.5	5	4.5	1
T ₁ P ₂	79.5	15	4.5	1
T ₁ P ₃	69.5	25	4.5	1

Table 2: Formulation for preparation of 100ml of Watermelon based whey beverage (WBWB)

Treatment	Whey (%)	Watermelon juice (%)	Sugar (%)	Black salt (%)
T ₀ (Control)	94.5	00	4.5	1
T ₂ W ₁	89.5	5	4.5	1
T ₂ W ₂	84.5	10	4.5	1
T ₂ W ₃	79.5	15	4.5	1
T ₂ W ₄	74.5	20	4.5	1

Results and discussions

Sensory evaluation of naturally flavoured whey beverages

The sensory evaluations of prepared beverages were performed by a panel of 5 judges using 8-point hedonic scale to know the sensory characteristics such as appearance/color, flavour, taste and overall acceptability. Eight semi-trained panellists consisting of academic staff and students were included in sensory evaluation. Control whey, all the preparations of pomegranate based whey beverages and watermelon based whey 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. The result of Sensory evaluation of naturally flavoured whey beverages has been presented in table 3

Table 3: 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 ₁ P ₁	6.70 ±0.04	7.05 ± 0.05	7.20 ± 0.06	6.95 ± 0.12
T ₁ P ₂	7.40 ±0.02	7.21 ± 0.03	7.51± 0.04	7.37 ± 0.09
T ₁ P ₃	7.40 ±0.01	7.51 ± 0.01	7.52 ± 0.02	7.47 ± 0.03
T ₂ W ₁	6.65 ± 0.03	6.50 ± 0.04	6.80 ± 0.04	6.65 ± 0.08
T ₂ W ₂	6.70 ± 0.05	6.75 ± 0.06	6.70± 0.07	6.88 ± 0.15
T ₂ W ₃	7.13 ±0.02	7.21 ± 0.03	7.33±0.02	7.22 ± 0.05
T ₂ W ₄	7.53 ± 0.02	7.32 ± 0.02	7.49 ±0.03	7.45 ± 0.06

The average point for appearance / colour, taste and flavour for different whey beverages varies from 6.01 to 7.53. The average point for appearance / colour of control or plain whey beverage (T_0) was found to be 6.11 ± 0.01 and for pomegranate based whey beverage i.e. for T_1P_1 , T_1P_2 and T_1P_3 it was found to be 6.70 ± 0.04 , 7.40 ± 0.02 and 7.40 ± 0.01 respectively and for Watermelon based whey beverage i.e. T_2W_1 , T_2W_2 , T_2W_3 and T_2W_4 the average point for appearance/colour were observed 6.65 ± 0.03 , 6.70 ± 0.05 , 7.13 ± 0.02 and 7.53 ± 0.02 respectively. Thus it may be concluded that T_2W_4 scored maximum point (7.53 ± 0.02) for appearance / colour by the panellists whereas control or plain whey beverage obtained minimum point (6.11 ± 0.01) for appearance / colour.

The average point for flavour of T_0 was observed 6.11 ± 0.01 , whereas for T_1P_1 , T_1P_2 and T_1P_3 were observed 7.05 ± 0.05 , 7.21 ± 0.03 and 7.51 ± 0.01 respectively and for watermelon based whey beverages i.e. T_2W_1 , T_2W_2 , T_2W_3 and T_2W_4 were observed 6.50 ± 0.04 , 6.75 ± 0.06 , 7.21 ± 0.03 and 7.32 ± 0.02 respectively. Thus from the results obtained for flavour of different treatment beverages it may be concluded that T_1P_3 obtained maximum (7.51 ± 0.01) for flavour by the panellists whereas control or plain whey beverage scored minimum point (6.11 ± 0.02).

The average point for taste of T_0 (control) or plain whey beverage without addition of pomegranate or watermelon juice was observed to be 6.01 ± 0.01 whereas for T_1P_1 , T_1P_2 and T_1P_3 were found 7.20 ± 0.06 , 7.51 ± 0.04 and 7.52 ± 0.02 respectively and for T_2W_1 , T_2W_2 , T_2W_3 and T_2W_4 were observed 6.80 ± 0.04 , 6.70 ± 0.07 , 7.33 ± 0.02 and 7.49 ± 0.03 respectively. From the results obtained for taste of different treatment beverages it may be concluded that T_1P_3 scored maximum point (7.52 ± 0.02) for taste by the panellists whereas control or plain whey beverage obtained minimum point (6.01 ± 0.01).

On the basis of data presented in table 3 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% watermelon 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) and T_2W_4 as Treatment 2nd (T_2). Similar results for sensory analysis were also observed by Bhavsagar *et al.*, (2010)^[15] and Dande *et al.*, (2017)^[16].

Conclusion

Based on the above results, it may be concluded that the whey obtained as by-products of nuggets production from fresh camel milk and buffalo milk can very well be utilized for preparation of fruit based whey beverage. Pomegranate based 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% watermelon juice (T_2W_4) had obtained maximum overall acceptability (7.45 ± 0.06).

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