

Development and Quality Evaluation of Ready to Drink Fruit Flavoured Whey Beverage

K.H.I. Gimhani and A.L.C.J. Liyanage

Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka.

DOI: 10.29322/IJSRP.9.08.2019.p92107

<http://dx.doi.org/10.29322/IJSRP.9.08.2019.p92107>

Abstract- Dairy industry is one of the main sectors in the food industry of Sri Lanka which produces large amount of cheese per year. The major by-product of cheese manufacturing is cheese whey which retains many milk nutrients with good functional properties and high nutritional value. But in Sri Lanka, the cheese whey is not used in effective manner. Therefore this study was carried out to develop a ready-to-drink fruit flavoured whey beverage as a value addition to cheese whey for human consumption. Three whey beverages were developed using passion fruit, water melon and nelli (*Phyllanthus emblica*). They were evaluated for colour, sedimentation, odour, taste and overall acceptability using nine point hedonic scale. Then crude protein, titrable acidity, moisture percentage, pH and the total soluble solids (TSS) of the most accepted sample were analyzed. The results of sensory evaluation revealed that there was a significant difference among three tested samples with respect to colour, sedimentation, odour, taste and overall acceptability. The whey beverage flavoured with passion fruit had the highest acceptance. It contained 0.47% of crude protein, 0.73% of titrable acidity, 82.03% of moisture and 17.97% of TSS and the pH was 3.82 at 25^oC. In conclusion, development of a beverage is a good approach for the utilization of cheese whey for human consumption and adding of passion fruit enhanced its nutritional and sensory properties.

Index Terms- Cheese whey, Beverage, Fruit flavoured, Value addition

I. INTRODUCTION

Whey is the basic by-product of cheese manufacturing. Although there are variety types of cheese, all cheeses have to undergo the same basic processes. Finally, the cheese curd is braked up, separating a rich cloudy liquid from the solid curd and this liquid cloudy water is known as whey (Senarathna *et al.*, 2009). Whey constitutes 45-50% of total milk solids, 70% of milk sugar, 20% of milk proteins and 70-90% of milk minerals and almost all the water soluble vitamins originally present in milk (Yadav *et al.*, 2010). In Sri Lanka, it is estimated that large amount of cheese whey is annually derived as a by-product of cheese manufacturing and it is directly discarded to the environment in many cases which leads to the loss of nutritious whey solids and also it causes many environmental problems due to its high BOD value of approximately 35,000 to 40,000 mgL⁻¹ (Yadav *et al.*, 2010).

Discarding cheese whey into the environment or use it as animal feed or as fertilizer is in vain because its nutrients have indispensable value as human food. Considerable work has been done throughout the world to utilize cheese whey for the production of various whey products. But the conversion of whey into beverage is one of the most attractive attempts for utilization of whey for human consumption because it is a thirst quencher, light and refreshing, less acidic than fruit juices, has good health and nutritional qualities and also it provides a good profit margin (Singh *et al.*, 2014).

Ready to drink beverage industry has made significant progress during last several years due to the busy life style of the people and also beverages based on fruits and milk products are currently receiving considerable attention as their market potential is growing. In addition to that, fruits are very much relished for their delicious taste and therefore flavouring the whey beverage with a fruit will further enhance the nutritional value of the beverage and consumer's appetite towards the whey beverage.

Many attempts have been taken to incorporate different fruit types into the whey beverages. But this study was conducted to develop a ready drink fruit flavoured beverage with under-utilized fruits and the fruits which have been not much used in previous studies. Therefore three fruits; passion fruit, water melon and nelli (*Phyllanthus emblica*) were selected considering their nutritional and functional properties to flavour the whey beverage.

II. MATERIALS AND METHODS

Materials: Cheese whey was collected from Digana Milco plant and selected fruits were found from Pabahinna area, Belihuloya. Other required food additives were purchased from Pettah essence at Colombo.

Analysis of cheese whey: Total soluble solid content and pH of the filtered cheese whey through a muslin cloth were measured using refractometer and digital pH meter respectively (AOAC, 2003).

Preparation of fruit juice: Fresh well ripen fruits were selected. Water melon was peeled out and seeds were removed. The flesh was cut into small pieces. Then they were blended to make the pulp and the pulp was strained through a strainer to obtain the juice. Passion fruit was washed well and cut into halves. Then the flesh was scooped out and it was squeezed through a strainer to obtain the juice. In case of nelli (*Phyllanthus emblica*), the fruits were cut into small pieces and they were mixed with water in 1:1 ratio. After that it was blended and the blended mixture was strained through a muslin cloth to get the juice

Analysis of fruit juice: Total soluble solid content and pH of the prepared fruit juices were measured using refractometer and digital pH meter respectively (AOAC, 2003).

Preparation of fruit flavoured whey beverage: 15 g of each fruit juice was measured and 9 g of sugar was added to each sample. All three samples were heated to 65°C and they were cooled below 25°C using crush ice. 75 g of filtered cheese whey was added to each sample separately and they were stirred well. Then 0.3 g of citric acid was added to each sample and all three samples were heated at 75°C for one minute. While heating 0.7 g of pectin dissolved in small amount of hot water was added to every sample. The heated samples were filtered through a muslin cloth and they were allowed to cool below 25°C by dipping them in a crush ice vessel. Finally three prepared whey beverage samples were filled into three pre-sterilized glass bottles and they were sealed well. Then they were kept in the refrigerator until further analysis.

Sensory evaluation of ready to drink fruit flavoured whey beverages: Sensory evaluation was conducted to evaluate their sensory characteristics namely colour, sedimentation, odour, taste and overall acceptability by using semi-trained sensory panel comprising 35 panelists drawn from Department of Food Science and Technology, Faculty of Applied Sciences, Sabaragamuwa University of Sri Lanka. The panelists were asked to record their observations on the given ballot sheet based on a nine point hedonic scale (9 and 1 points showing like extremely and dislike extremely). All the samples were served in transparent disposable cups labeled with three digit numbers while they were cold (Syed and Babar, 2018). Data from sensory evaluation were analyzed using Friedman non-parametric test in MINITAB software package version 17.1.0 (Minitab, 2010) with 95% confidence interval.

Chemical analysis of ready to drink fruit flavoured whey beverage: Chemical analysis was only done for the most accepted whey beverage sample. Crude protein content and moisture content were analyzed according to the AOAC procedures (AOAC, 2003). Also pH was measured by using digital pH meter (Eutech700, USA) and total soluble solid content was measured using refractometer (AOAC, 2003). Titratable acidity was analyzed by titrating the samples with 0.1N NaOH solution (Fssai, 2015). Sedimentation was observed visually. pH and sedimentation were measured daily for one week at refrigerated condition.

III. RESULTS AND DISCUSSION

Physico-chemical parameters of cheese whey and fruit juices: Table 1 shows the physiochemical parameters of raw cheese whey and the extracted fruit juices which were used for the preparation of ready to drink fruit flavoured whey beverage. The stability of a fruit flavoured whey beverage mainly depends on its pH value, total soluble solids (TSS) and dry matter content (Jelicic *et al.*, 2008). Therefore controlling of those parameters in appropriate range has significant importance to maintain the quality of fruit flavoured whey beverage. Brix value and pH of the cheese whey and the fruit juices used in the preparation of ready to drink fruit flavoured whey beverage are very much important to obtain the desired pH level and brix value of the final product.

Table 1: Physico-chemical parameters of cheese whey and fruit juices

Sample	pH	Brix value
Cheese whey	6.17	7.0
Water melon juice	5.66	6.0
Passion fruit juice	3.23	15.0
Nelli juice	3.10	8.0

Sensory evaluation ready to drink fruit flavoured whey beverage: The whey beverage flavoured with passion fruit juice scored best for all the tested sensory attributes and it had the highest acceptance among the treatments (Figure 1). Moreover, there was a significant difference ($P < 0.05$) among three treatments with respect to all the tested sensory attributes. Also passion fruit was able to mask the cooked flavour and the odour of cheese whey completely compared to other two fruits used. That may be the reason to be selected it as the best scored sample.

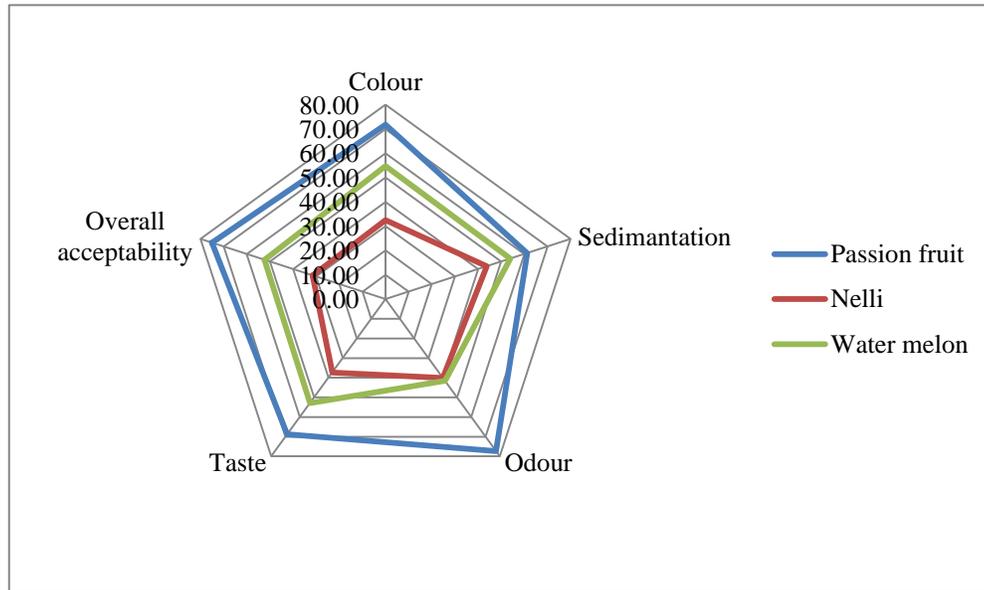


Figure 1: Sensory properties of ready to drink whey beverages flavoured with different fruit juices

Nutritional properties and physico-chemical parameters of ready to drink passion fruit flavoured whey beverage: Table 2 shows the nutritional properties and physico-chemical parameters of passion fruit flavoured whey beverage. The average protein percentage in passion fruit flavoured whey beverage was $0.47 \pm 0.08\%$. But the whey protein percentage in cheese whey is about 0.8% (Yang, 1989). Therefore it can be assumed that whey proteins present in the cheese may have been denatured during the heat treatment.

According to the results obtained, the most abundant constituent in passion fruit flavoured whey beverage was moisture. The moisture percentage of a whey guava beverage was 80% in the study conducted by Singh *et al.* (2014). Also Gad *et al.* (2013) has recorded the moisture percentage of a whey mango beverage as 79% .

Total soluble content of the passion fruit flavoured whey beverage was in agreement with the findings of Chavan *et al.*, (2015). Usually TSS content of a fruit flavoured whey beverage is maintained around 18-20 (Whey processing, 2014). The high amount TSS in the beverage causes for the sedimentation during storage while low amount of TSS in the beverage will lead to the poor sensory qualities.

The average TA percentage in passion fruit flavoured whey beverage was almost same as the value reported by Chavan *et al.*, (2015). Passion fruit juice contains acetic, ascorbic, citric, malic, lactic, malonic and succinic acids. But citric acid is the predominant acid present in both yellow and purple color passion fruits (Hui, 2010). Also citric acid was added in the preparation of this whey beverage as an acidulant. Therefore TA percentage in the beverage was calculated as citric acid.

Table 2: Nutritional properties and physico-chemical parameters of passion fruit flavoured whey beverage

Parameter	%
Protein	0.47 ± 0.08
Moisture	82.03 ± 2.00
Total soluble solids	17.97 ± 2.00
Titrateable acidity	0.73 ± 0.01

Data are presented as means ± SD

Figure 2 shows that pH of the passion fruit flavoured whey beverage dropped down upon storage as an indication of the acidification of the whey beverage. But there was no observable sedimentation in passion fruit flavoured whey beverage during one week storage. The pH value of the whey beverage at the point of heating or thermal treatment is a critical factor to prevent the whey protein denaturation. Whey proteins are heat liable and normally they will tend to coagulate at the temperature above 60⁰C (Whey processing, 2014). But acidification of whey below the pH of 3.9 causes whey proteins to become thermo-resistant and then they do not precipitate even during UHT treatment (Paquin, 2009). The acidification or lowering the pH is done with an acidulant like citric acid. The pH adjustment should always be compatible with the typical flavour profile of used fruit to flavour the beverage. The issue of whey protein denaturation during heat treatment can be avoided by using deproteinised cheese whey.

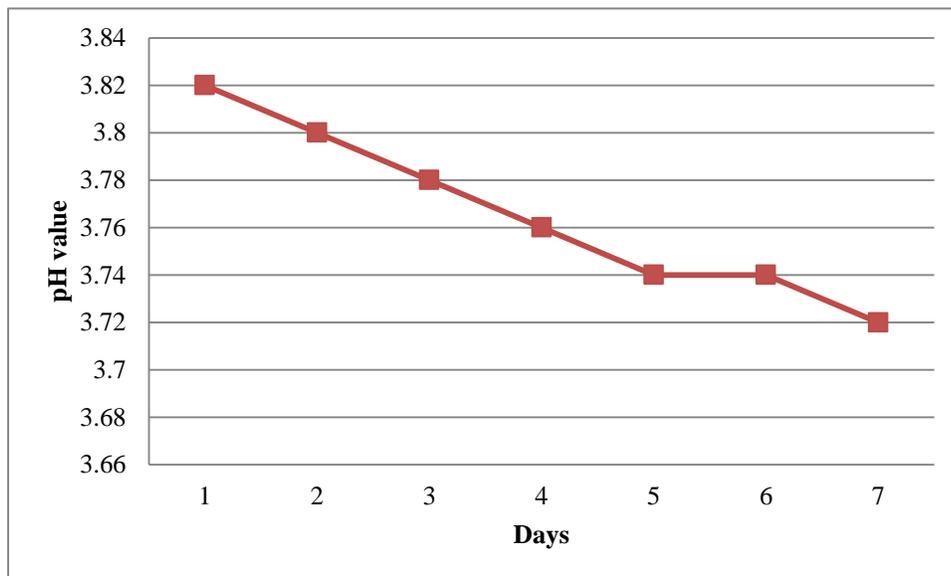


Figure 2: pH variation in the passion fruit flavoured whey beverage upon storage

IV. CONCLUSION

Physicochemical and sensory properties of whey beverage can be significantly improved by flavouring it with fruit juices. The whey beverage flavoured with passion fruit is the most consumer accepted product. Passion fruit could totally mask the undesirable flavour and the odour of raw cheese whey. Development of a ready to drink fruit flavoured whey beverage is a good approach to utilize the cheese whey for human consumption.

REFERENCES

- [1] AOAC, (2003). Official Methods of Analysis. Association of Official Analytical Chemists (18th ed.), Washington D.C., U.S.A.
- [2] Chavan, R.S., Shraddha, R.C., Kumar, A. and Nalawade, T. (2015) Whey based beverage: Its functionality, formulations, health benefits and applications. *Journal of food processing and technology*. 6 (10): 1-8.
- [3] Fssai, (2015). Food Safety and Standards in India, Manual of Methods of Analysis of Foods Milk and Milk Products, New Delhi.
- [4] Gad, A.S., Emam, W.H., Mohamad, G.F. and Sayd, A.F. (2013) Utilization whey in production of functional healthy beverage “Whey-mango beverages”. *American journal of food technology*. 8 (3): 133-148.
- [5] Hui, Y.H. (ed.) (2010) *Handbook of fruit and vegetable flavors*. [Online] Hoboken: John wiley and sons Inc. Available from: <http://books.google.lk/>. [Accessed: 31 June 2019]
- [6] Jelacic, R., Bozanic, R. and Tratnik, L. (2008) Whey-based beverages - a new generation of dairy products. *Mljekarstvo*. 58 (3): 257-274.
- [7] Minitab, (2010). Minitab, version 16.1.0. In. Minitab Inc., State College, Pennsylvania, USA.
- [8] Paquin, P. (ed.) (2009) *Functional and speciality beverage technology*. [Online] United Kingdom: Woodhead publishing limited. Available from: <http://www.amazon.com/>. [Accessed: 30 June 2019]
- [9] Senarathna, I.W.P., Bandara, R.M.A.S., Wickramanayaka, D., Udayathilaka, E.U. and Wijerathne, A.W. (2009) Development of a cultured milk beverage using cheddar cheese whey. *Journal of agricultural sciences*. 4 (1): 29-45.
- [10] Singh, D., Singh, R. and Bhatt, F. (2014) Development, quality evaluation and shelf-life studies of whey-guava beverage. *International journal of current engineering and technology*. 4 (3): 2171-2174.
- [11] Syed, K. and Babar, K. P. (2018). Formulation and evaluation of traditional dairy product, Sheerqurma, *Asian Journal Of Dairy And Food Research*, 37: 100–104. DOI: <http://dx.doi.org/10.18805/ajdfdr-1335>.
- [12] Whey processing. (2014) *Different whey processes*. [Online] Available from: <http://openlibrary.org/>. [Accessed: 24 July 2019]
- [13] Yadav, R.B., Yadav, B.S. and Kalia, N. (2010) Development and storage studies on whey-based banana herbal (*Mentha arvensis*) beverage. *American journal of food technology*. 5 (2): 121-129.
- [14] Yang, S.T. (1989) *Pollution prevention and waste minimization in the dairy industry through novel uses of whey permeate*. [Online] Available from: <http://infohouse.p2ric.org/>. [Accessed: 28 July 2019]

AUTHORS

First Author – K.H.I. Gimhani, Assistant Lecturer, khigimhani@gmail.com

Second Author – A.C.J.C. Liyanage, Senior Lecturer, janitha@appsc.sab.ac.lk

Correspondence Author – K.H.I. Gimhani, khigimhani@gmail.com, +94716890708