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### Physico-chemical quality of drumstick (*Moringa oleifera* L.) whey beverage

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#### Abstract

Initially Pre-experimental trials were conducted to decide the levels of addition of *Moringa* pod powder in the whey beverage. On the basis of results of preliminary trials the most acceptable three levels of *Moringa* pod powder were chosen for experimental trials. The experimental treatments prepared without drumstick pod powder as control (T<sub>0</sub>), incorporation of 0.5 per cent drumstick pod powder (T<sub>1</sub>), 1 per cent drumstick pod powder (T<sub>2</sub>) and 1.5 per cent drumstick pod powder in the whey beverage (T<sub>3</sub>), and 8 per cent sugar was kept constant for all treatments. The mean fat, protein, total sugar, reducing sugar, total solids, total fibre, ash, titratable acidity (% lactic acid) and pH, values ranged from 0.54 to 0.82 per cent, 0.73 to 1.01 per cent, 12.42 to 13.49 per cent, 4.39 to 4.40 per cent, 14.28 to 16.15 per cent, 0.00 to 0.15 per cent, 0.59 to 0.83 per cent, 0.29 to 0.32% LA and 5.25 to 5.16, respectively.

**Keywords:** Beverage, Drumstick pod powder, Whey, RTS, Physico-chemical quality

#### Introduction

Whey is a nutritious by-product obtained from cheese, *chhana* and *paneer* industry containing valuable nutrients like lactose, proteins ( $\alpha$ -lactalbumin,  $\beta$ -lactoglobulin serum albumin, immunoglobulin's), minerals and vitamins etc. which have indispensable value as human food. Whey constitutes 45-50 per cent of total milk solids, 70 per cent of milk sugar (lactose), 20 per cent of milk proteins and 70-90 per cent of milk minerals and most importantly, almost all the water soluble vitamins originally present in milk (Horton, 1995) [10].

Whey contains approximately half of the total solids of the original milk (Gupta, 2000) [2]. The total solids content of whey ranges between 6.5 – 7.0 per cent of which lactose comprises 75 per cent in addition to water soluble vitamins, minerals and proteins. Presence of all these ingredients makes whey a highly nutritious base for the preparation of beverage like products. *Cheese* whey contains about 20 per cent of total milk protein (Khamrui and Rajorhia, 1998) [14]. The whey is an excellent source of high quality proteins, minerals and easily digestible carbohydrates.

*Moringa oleifera* (Moringaceae) is one of the most useful tropical trees. The relative ease with which it propagates through both sexual and asexual means and its low demand for soil nutrients and water after being planted makes its production and management easy. Introduction of this plant into a farm which has a biodiverse environment can be beneficial for both the owner of the farm and the surrounding eco-system (Fuglie, 1999) [7]. *Moringa oleifera* (Moringaceae) have more than a dozen species belonging to the *Moringa* family and found in India, Arabia, Africa (e.g. Togo, Benin, Senegal, Kenya, Tanzania, Malawi, Niger), America (e.g. Nicaragua, Mexico), as well as Sri Lanka, Malaysia and the Philippines. The tree is often referred to as a "wonder-tree" for its multipurpose usability and also known as "Drumstick-tree", "Horseradish-tree" and "Ben-oil tree".

#### Materials and Methods

The samples of Whey beverage under preliminary and experimental trials were subjected to the sensory evaluation by adopting 9 point hedonic scale as per IS: 6273 part I and part II (1971). A panel of 5 semi trained judges was carried out the sensory evaluation. The samples were coded every time to conceal their identity and were offered to the judges for evaluation of the quality attributes.

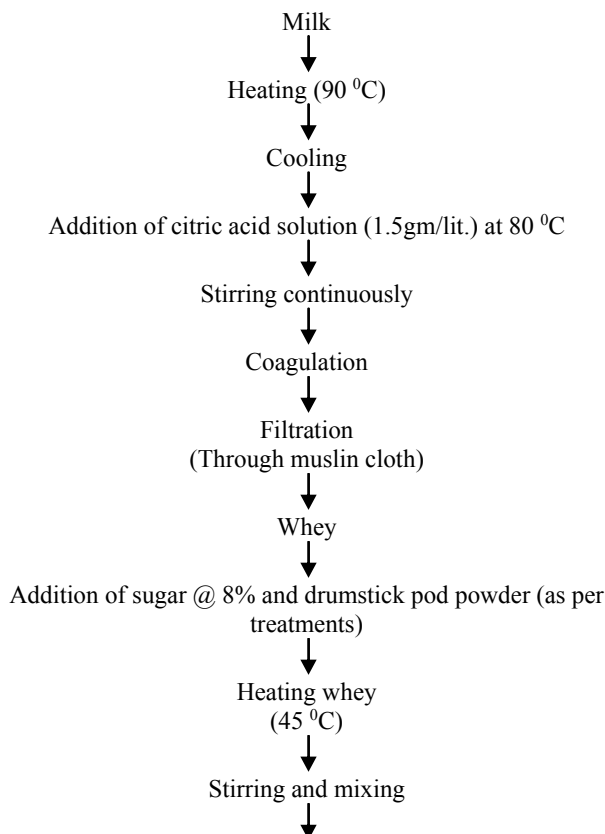
#### Experimental Treatment details

T<sub>0</sub> : Control (without drumstick pod powder) + 8% sugar

T<sub>1</sub> : 0.5% Drumstick pod powder (w/v) of whey + 8% sugar

T<sub>2</sub> : 1.0% Drumstick pod powder (w/v) of whey + 8% sugar

T<sub>3</sub> : 1.5% Drumstick pod powder (w/v) of whey + 8% sugar



Cooling at room temperature

(30±2 °C)

Filling of glass bottles

Sealing

Pasteurization  
(63 °C, 30 min)

Cooling at  
(30±2 °C)

Storage  
(5±2 °C)

Flow chart for preparation of whey beverage

### Physico-chemical properties

Fat, Protein, Reducing sugar, Total sugar, Total solids, Total fibre, Ash, pH and Acidity were analyzed as per using standard procedures.

### Statistical Analysis

Experiment was laid out in Completely Randomized Design (CRD) with 3 replications for preliminary trials and 5 replications for experimental trials. The data was tabulated and analyzed according to Snedecor and Cochran (1994) [22].

### Result and Discussion

**Table 1:** Chemical composition of Drumstick whey beverage (%)

Treatments	Fat (%)	Protein (%)	Total Sugar (%)	Reducing sugar (%)	Total Solids (%)	Total Fibre (%)	Ash (%)	Lactic acidity (% L.A)	pH
T <sub>0</sub> (0.0%)	0.54 <sup>d</sup>	0.73 <sup>d</sup>	12.42 <sup>d</sup>	4.39	14.28 <sup>d</sup>	ND	0.59 <sup>d</sup>	0.29 <sup>c</sup>	5.25 <sup>a</sup>
T <sub>1</sub> (0.5%)	0.58 <sup>c</sup>	0.83 <sup>c</sup>	12.74 <sup>c</sup>	4.38	14.88 <sup>c</sup>	0.05 <sup>c</sup>	0.73 <sup>c</sup>	0.31 <sup>b</sup>	5.23 <sup>b</sup>
T <sub>2</sub> (1.0%)	0.72 <sup>b</sup>	0.94 <sup>b</sup>	13.08 <sup>b</sup>	4.39	15.53 <sup>b</sup>	0.10 <sup>b</sup>	0.79 <sup>b</sup>	0.31 <sup>b</sup>	5.18 <sup>c</sup>
T <sub>3</sub> (1.5%)	0.82 <sup>a</sup>	1.01 <sup>a</sup>	13.49 <sup>a</sup>	4.40	16.15 <sup>a</sup>	0.15 <sup>a</sup>	0.83 <sup>a</sup>	0.32 <sup>a</sup>	5.16 <sup>d</sup>
S.E. ±	0.019	0.006	0.05	0.020	0.07	0.001	0.004	0.004	0.018
CD at 5%	0.058	0.020	0.15	NS	0.22	0.004	0.012	0.012	0.057

NS= Non Significant ND = Not Detected

### Fat

The fat content of drumstick whey beverage is presented in the Table 1. The mean fat content of drumstick whey beverage for T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> was 0.54, 0.58, 0.72 and 0.82 per cent, respectively. All the experimental treatments differed significantly ( $P < 0.05$ ) among themselves. The fat content in the whey beverage increased with increased in the level of drumstick pod powder in the whey beverage samples. The treatment T<sub>3</sub> had highest fat content (0.82%). Suzan *et al.* (1994) [23] manufactured *chhana* whey based fruit drinks and reported the fat content as 0.02 to 0.96 per cent. Sharma *et al.* (1995) [24] reported 0.5% fat content in the whey based carrot juice prepared using buffalo milk *paneer* whey.

### Protein

It was revealed that, the protein content in whey beverage sample were 0.73, 0.83, 0.94 and 1.01 per cent for T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> (Table 1). The protein content in whey beverage sample significantly ( $P < 0.05$ ) differed due the addition of

drumstick pod powder in the whey beverage samples. The highest value for protein content was observed 1.01 per cent in treatment T<sub>3</sub>. All the treatments significantly differed among themselves. The protein content in the whey beverage sample increased with increase in the level of drumstick pod powder in the whey.

Babar *et al.* (2008) [2] studied the utilization of pomegranate juice for the preparation of *chakka* whey beverage observed that the average protein content was 0.394, 0.468, 0.504 and 0.544 per cent in treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>, respectively. Bhavsagar *et al.* (2010) [4] reported the values for protein content from 0.57 to 0.76% in the pineapple flavoured beverage. Gaikwad *et al.* (2010) [8] studied preparation of *chhana* whey beverages using sapota pulp. The beverage was prepared by using 0, 5, 10 and 15 per cent of sapota pulp. They observed an average protein 0.38, 0.40, 0.41 and 0.42 per cent for treatment T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively. Chaudasama and John (2014) [1] studied the development and evaluation of whey based mango mint beverage. Per cent

protein of prepared WBMM beverage samples was 0.672, 0.706, 0.764 and 0.796 respectively.

### Total sugar

The mean total sugar content of drumstick whey beverage samples is presented in Table 1. The total sugar content in whey beverage samples significantly ( $P<0.05$ ) differed due to the addition of drumstick pod powder in the whey beverage. The mean total sugar content of drumstick whey beverage was 12.42, 12.74, 13.08 and 13.49 per cent in the treatment T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively. It was noticed that as the level of addition of drumstick pod powder increased in the whey beverage the total sugar content in the whey beverage samples increased significantly. It might be due to carbohydrate content present in the drumstick pod powder.

Ismail *et al.* (2011) [12] reported the total sugar content 16.28% in the cheese whey based mango beverage while studying microbial and chemical evaluation of whey based mango beverage. Baljeet *et al.* (2013) [3] studied on development and storage of whey based pineapple (*Ananas comosus*) and bottle gourd mixed herbal beverage (WPBH) and observed the total sugar of H<sub>0</sub>, H<sub>1</sub>, H<sub>2</sub>, H<sub>3</sub> and H<sub>4</sub> were 13.12, 13.44, 13.35, 13.48 and 13.15, respectively.

### Reducing sugar

Reducing sugar is a major reducing sugar in *channa* whey. Non significant variation was observed in the values of reducing sugar of drumstick whey beverage (Table 1) due to the addition of drumstick pod powder in the whey beverage. The mean reducing sugar content of drumstick whey beverage was 4.39, 4.38, 4.39 and 4.40 per cent in the treatment T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively.

### Total solids

The mean total solids content of drumstick whey beverage was 14.28, 14.88, 15.53 and 16.15 per cent in the treatments of T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively (Table 1). The total solids content of experimental samples increased due to addition of drumstick pod powder. There was significant ( $P<0.05$ ) differences in the total solids content of drumstick whey beverage due to addition of various level of drumstick pod powder in the product. The control sample had significantly lower total solids content (14.28%) over the rest of the treatments. While the sample under treatment T<sub>3</sub> (16.15%) had significantly higher total solids content over rest of treatments. All the treatments significantly differed among themselves. It was seen that, with increase in addition of drumstick pod powder in the whey beverage, there was increase in total solids content in drumstick whey beverage samples. Mohamed *et al.* (2014) [15] studied physico-chemical and microbiological properties of papaya functional whey beverage and noted the TS content 18 per cent. Panghal *et al.* (2017) [16] utilization of dairy industry waste-whey in formulation of papaya RTS beverage and reported the total solids was found to increase from 15.20 ± 0.35 to 18.15 ± 0.18. This is due to water replacement with whey as whey contains water, milk solids, lactose, proteins and minerals. Shukla and Singh (2014) [21] development of probiotic beverage from whey and orange juice and reported the total soluble solids ranged from 14.4 to 12 of treatments with *Bifidobacterium bifidum* and from 14.37 to 11.9 fermented with lactobacillus acidophilus.

### Total fibre

The mean total fibre content in the drumstick whey beverage samples of T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> were 0.0, 0.05, 0.10 and 0.15 per

cent, respectively (Table 1). These treatments significantly ( $P<0.05$ ) differed among themselves due to the addition of drumstick pod powder in the whey beverage. Treatment T<sub>3</sub> had highest total fibre content i.e. 0.15 per cent. All the treatments significantly differed among themselves. It was noticed that, as the level of drumstick pod powder increased the total fibre content in the whey beverage sample treatments also increased. It may be due to the fibre content in the drumstick pod powder.

### Ash

The mean ash values of drumstick whey beverage samples were varied from 0.59, 0.73, 0.79 and 0.83 per cent for T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively. The Ash of whey beverage sample significantly ( $P<0.05$ ) differed in different treatments.

The treatment T<sub>3</sub> (0.83%) had significantly higher ash content over rest of treatments. All the treatments significantly differed among themselves. As the level of drumstick pod powder increased the ash content also increased. It may be due to mineral content in the drumstick pod powder. Mohamed *et al.* (2014) [15] noticed the ash content in the functional papaya whey beverage lies in the range of 0.61 to 0.65 per cent.

Kumar and Peter (2015) [13] observed that the ash content from 0.51 to 0.52 per cent while studied manufacturing of whey based aonla beverage. Devi *et al.* (2017) [6] development, chemical analysis and sensory evaluation of whey based pineapple juice beverages and reported the highest average value of ash content was obtained in the treatment T<sub>1</sub>P<sub>3</sub> (0.32%) and the lowest average value of ash content was obtained in the treatment T<sub>5</sub>P<sub>1</sub> (0.22%) and T<sub>5</sub>P<sub>2</sub> (0.22%). The ash content increased with increased in whey and water ration and also with increased in fruit juice per cent.

### Lactic acidity (%LA)

Lactic acidity content of drumstick whey beverage sample is presented in Table 1. The mean Lactic acidity content of drumstick whey beverage samples were 0.29, 0.31, 0.31 and 0.32% Lactic acidity for T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively. The Titratable acidity of whey beverage sample significantly ( $P<0.05$ ) influenced due to the addition of different levels of drumstick pod powder in the whey beverage. The control sample had significantly lower acidity (0.29% LA) over the rest of treatments. While the treatment T<sub>3</sub> had significantly higher Titratable acidity (0.32% LA) over all other experimental treatment samples. Treatment T<sub>1</sub> and T<sub>2</sub> were at par to each other. There was increasing in the Titratable acidity content in the treatment samples with increasing in the level of drumstick pod powder in whey beverage. It might be due to ascorbic acid content of drumstick pod powder.

Bhavsagar *et al.* (2010) [4] reported the titratable acidity in the different treatments 0.59 to 0.62% LA, while manufacturing pineapple flavoured beverage from chhana whey. Sakhale *et al.* (2012) [19] developed whey based RTS beverage from mango cv. Kesar and reported the acidity content from 0.32 to 0.36 per cent. Prashant *et al.*, (2018) [17] development of fruit enriched whey beverage and reported the acidity of control was 0.22% LA whereas pineapple juice blended whey was 0.32, 0.34, 0.35, and 0.36% LA at 15, 20, 25, and 30 per cent blending of pineapple juice to whey beverage respectively and for orange juice blended whey beverage it was 0.25, 0.26, 0.27 and 0.28% LA at 15, 20, 25 and 30 per cent blended respectively. Satpute *et al.* (2018) [20] studied on preparation of herbal whey based beverage using menthol and reported

the average acidity was 0.37, 0.36, 0.35 and 0.34 per cent for treatment T<sub>1</sub>, T<sub>2</sub>, T<sub>3</sub> and T<sub>4</sub>, respectively.

### pH

The mean pH of the drumstick whey beverage samples of T<sub>0</sub>, T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub> were 5.25, 5.23, 5.18 and 5.16, respectively. The pH of whey beverage samples significantly ( $P < 0.05$ ) differed due to the addition of drumstick pod powder in the whey beverage. Treatment T<sub>1</sub> had highest pH (5.25). Increasing in the acidity content decreasing the pH.

Bhavsagar *et al.* (2010)<sup>[4]</sup> reported the pH values of pineapple flavoured beverage from *chhana* whey as 3.91 to 3.89. Mohamed *et al.* (2014)<sup>[15]</sup> observed the pH values of fresh

functional papaya whey beverage as 4.90 to 5.30. Ismail *et al.*, (2011)<sup>[12]</sup> reported pH values as 4.86 for whey based mango beverage.

### Conclusion

The most acceptable whey beverage can be prepared by using 1.0 per cent drumstick pod powder and 8.0 per cent sugar. The drumstick whey beverage containing 1.0 per cent drumstick pod powder had the 0.72 per cent fat, 0.94 per cent protein, 13.08 per cent total sugar, 4.39 per cent reducing sugar, 15.53 per cent total solids, 0.10 per cent total fibre, 0.79 per cent ash, 0.31 titratable acidity (% lactic acid) and 5.18 pH.

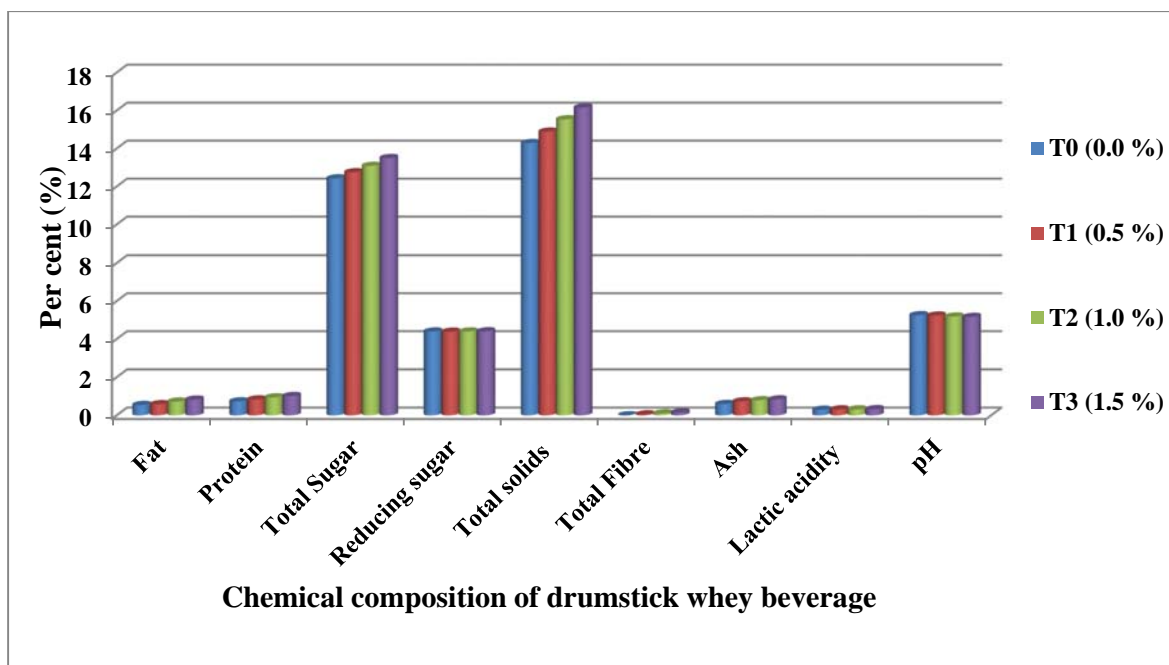


Fig 1: Chemical composition of drumstick whey beverage

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