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Development of ginger (*Zingiber officinalis* L.) Flavoured *Chhana* whey beverage

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Abstract
The present investigation was planned to develop the ginger *Chhana* whey beverage (CWB). Initially, the pre experimental trials were conducted with addition of different levels of ginger powder in *chhana* whey to optimize and finalize the experimental treatments. The experiments were laid out in completely randomized design with four replications for pre experimental and experimental trials. Initially, *Chhana* whey beverage (CWB) samples were prepared with the addition of 0.1, 0.2, 0.3, 0.4, 0.5, and 0.6% ginger powder and 10% sugar. The experimental treatments were; without ginger powder (T_0), addition of 0.1% (T_1), 0.2% (T_2), 0.3% (T_3), 0.4% (T_4) ginger powder.
All the experimental samples were analyzed on day 0 (fresh), for mean sensory scores for colour and appearance, consistency, flavour and overall acceptability ranged from 7.5 (T_0) to 7.9 (T_2 and T3), 7.4 (T_4) to 8.0 (T_0), 7.4 (T_0) to 8.1 (T_3) and 7.5 (T_0) to 8.2 (T_3) for fresh CWB samples, respectively. samples showed significant (P<0.05) differences due to addition of ginger powder in the *chhana* whey, and chemical qualities under different treatments showed significant differences (P<0.05) in respect fat, protein, lactose, total sugar, total solids, titratable acidity (%L.A.) and pH ranged from 0.48 (T_0) to 0.64 (T_4), 0.70 (T_0) to 0.78 (T_4), 4.60(T_3) to 4.90 (T_1), 14.91 (T_0) to 15.17(T_4), 16.39 (T_0) to 16.77 (T_4), 0.20(T_0 and T_1) to 0.23(T_4) and 5.11(T_4) to 5.19(T_0) respectively.
Better quality *Chhana* Whey Beverage (CWB) could be prepared by blending of 0.3% ginger powder and 10% sugar.

Keywords: *Chhana*, whey, ginger, sensory evaluation

Introduction
Whey is the highly nutritious important by-product of the dairy industry. It is obtained during the manufacture of casein, cheese, paneer, shrikhand and *chhana*. lactose is the major constituent and whey proteins, water soluble vitamins and minerals are secondary components. The whey contains nutritious proteins like α-lactalbumin, β -lactoglobulin serum albumin, immunoglobulin's plus lactose, milk salts etc. (Puranika and Rao,1996) [14]. Whey is a nutritious by- product from cheese, *chhana* and paneer industry containing valuable nutrients like lactose, proteins, minerals and vitamins etc. which have indispensable value as human food. Whey constitutes 45-50% of total milk solids, 70% of milk sugar (lactose), 20% of milk proteins and 70-90% of milk minerals and almost all the water soluble vitamins present in milk.
Whey is source of calcium, phosphorus and essential amino acids. hence highly nutritious product (Saravana *et al*., 2005) [18].
Currently, total world production of whey is approximately 85 million tones in which India contributes approximately 8 million tones of the total global production. About 40% of the total global production of whey is disposed as raw whey (Reddy *et al*., 1987) [16] causing serious problems of environmental pollution due to high organic matter content (6-7%) comprising of fat, protein, sugar, minerals and water soluble vitamins. At the same time pre-disposal treatment of whey is very costly affair as it influences the economics of dairy plant operation (Kumar and Tiwari, 2005) [10]. Now day"s Product diversification is quite feasible using whey as water replaces without much change in the composition (Patel *et al*., 2007) [13].
Conversion of whey into a beverage on a commercial scale also has an economic advantage, as the whole quantity is being used and there are no problems of leftover residues (Shendurse *et al.* 2009) [21]. Beverages in general provide energy and water to digest food, regulate body temperature, prevent dehydration, quench thirst and remove psychological tensions (Shaikh *et al.* 2001) [19].
Ginger, being a major spice, has many uses in food as a flavoring and Medicinal product.

The aroma of ginger is pleasant with flavor, slightly biting due to antiseptic or pungent compounds present in it, which make it indispensible in the manufacture of number of food products. (Abdullah Al-Nahain, *et al.* 2014) [1] According to the Ayurvedic medical system, ginger is carminative, stimulant and gives stimulating remedies. Ginger extracts also have antibacterial, anti spasmoctic, antiulcer, antiallergenic and antioxidant qualities as well**.** (Prasanna, *et al* 2014.) [12]
Ginger is a popular home remedy in India today. in preventing cough and cold are well documented. (Buchman, 1980) [5] There are tendency of some people to refrain from consuming chilled/ cold drinks for fear of catching cold. Ginger milk shake, however, may be acceptable to them. (Chan *et al*. 2013) [6]. Ginger contains all the nutrients required for good nutrition. It also contains calcium, dietary fibre, iron, vit-C, E and B_6. Ginger is free from cholesterol. Ginger act as useful food preservative. (Anonymous, 2010) [2]. However, available literature indicates that the scantly work has been so far carried out on utilization of ginger powder admixed with whey. It was therefore, decided to explore the possibility of utilizing ginger powder in the preparation of whey beverage. Hence the present investigation has been planned with following objectives.

1. To optimize the ginger levels in the whey beverage
2. To study the sensory qualities of fresh (0 day) whey beverage
3. To study the chemical qualities of fresh (0 day) whey beverage

Material and Methods

The Present investigation entitled, "Development of ginger (*Zingiber officinale* L.) Flavored *chhana* whey bevarage was undertaken in laboratories of Animal husbandry, Dairy Science and Biochemistry, Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra).

Materials:-

Milk

The fresh, clean, composite milk samples of crossbred cows were be procured from Research cum-Development Project on cattle (RCDP), Dept. of Animal husbandry and dairy science, Mahatma phule krishi vidyapeeth Rahuri, Dist.Ahmednagar (Maharashtra).

Citric Acid

LR grade citric acid was used for coagulation of milk purpose.

Sugar

Good quality, clean, crystalline, white cane sugar was purchased from local market.

Muslin cloth

Clean, suitable size muslin cloth piece was used for straining of whey.

Ginger powder

Good quality of fresh ginger (*Zingiber officinale* L.) powder was procured from the Local market (Geo fresh organic powder).

Glass Bottles

Glass bottles (250 ml capacity) was made available from the department of Post harvest technology of Horticulture for filling of whey beverage.

Glassware

The corning/Borosil brand glasswares were used for analytical work.

Electronic balance

An Electronic precision balance (BT 2245, Sartorius ISO 9001) was used for weighing purpose.

pH meter

A digital pH meter manufactured by Lab Techno, Mumbai (India) was used for determination of pH.

Chemicals

All the chemicals used for analysis were of the A.R and G.R grades manufactured by Merk, India Ltd and Glaxo India Ltd.

Methods

Preparation of *chhana* whey beverage:

The *chhana* whey beverage samples were prepared as per the procedure given by Bhavsagar (2010) [3].

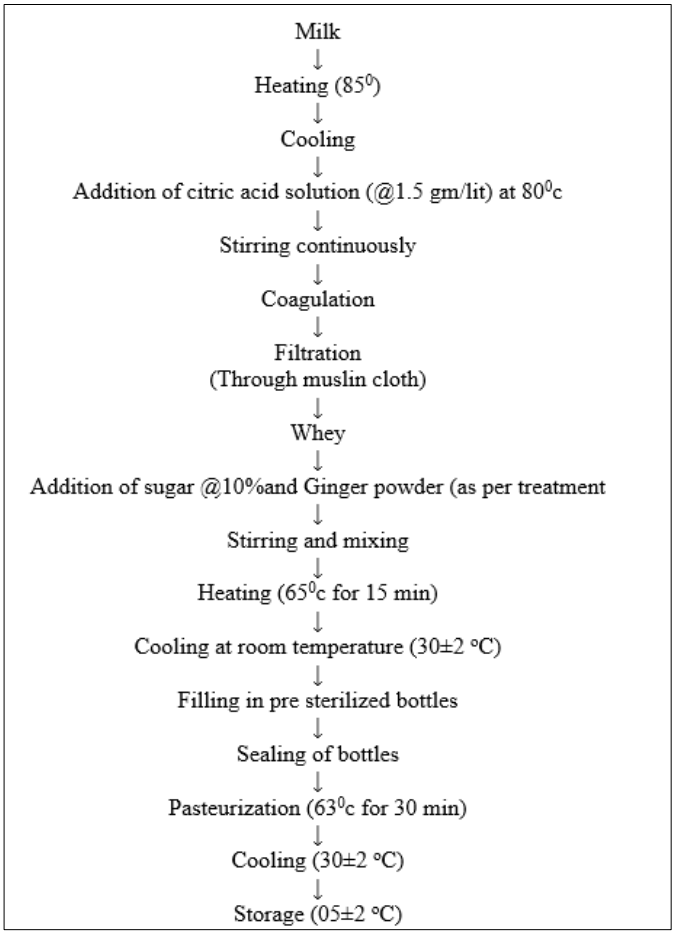

Fig 1: Flow chart for preparation of *chhana whey* beverage using ginger powder

Pre-experimental trials

Pre-experimental trials were conducted to decide the levels of addition of ginger powder in the whey using G_0 (0%), G_1(0.1%), G_2(0.2%), G_3(0.3%), G_4(0.4%), and G_5(0.5%), percent ginger powder and 10% sugar for all treatments. The prepared samples of whey beverage were subjected to sensory evaluation by panel of five trained judges.

Experimental trials
On the basis of the results of sensory evaluation of pre-experimental trials 0, 0.1, 0.2,0.3 and 0.4 per cent ginger powder levels were chosen for experimental trials.

Experimental Treatments
Levels of Ginger powder (w/v)
T_0 - Control (Without addition of ginger powder)
T_1 - 0.1 per cent ginger powder of *chhana* whey.
T_2 - 0.2 per cent ginger powder of *chhana* whey.
T_3 - 0.3 per cent ginger powder of *chhana* whey.
T_4 - 0.4 per cent ginger powder of *chhana* whey.
Sugar @ 10 per cent of whey was used for all treatments.

Sensory evaluation
Samples of whey beverage prepared under different pre-experimental and experimental trials were subjected to sensory evaluation using the method described in the IS:6273, Part-I and Part- II (1971) adopting 9 point Hedonic scale. A panal of five semi trained judges was formulated for this purpose. The samples were coded every time to conceal their identity and were offered to the judges for evaluation of the quality attributes.

Chemical analysis of *Chhana* whey and *Chhana* Whey Beverage
Fat
The fat content was determined by Gerber method as per procedure described in BIS (1981) [4].

Protein
The protein content was determined by Micro-Kjeldahl method as described in BIS (1981) [4].

Lactose
The lactose content was determined by Lane -Eynon volumetric method described in BIS (1981) [4].

Total Sugar
The total sugar content was determined as per the method described by Ranganna (1986) [15].

Total Solids (TS)
The total solids content was determined by gravimetric method as per BIS (1981) [4].

Titratable Acidity (%L.A)
The titratable acidity content was determined as per the procedure described in BIS (1981) [4].

pH
The pH was determined as per procedure described in BIS (1981) [4].

Statistical analysis
Experiment was laid out in completely randomized design (CRD) with four replications for pre-experimental and experimental trials. The data was tabulated and analyzed according to Snedecor and Cochran (1994) [23].

Result and Discussion
The present investigation entitled "Development of ginger (*Zingiber officinale*) flavoured *chhana* whey beverage" prepared by using ginger powder was undertaken to optimize the levels of ginger powder in the preparation of *chhana* whey beverage. The prepared *chhana whey* beverage was evaluated for sensory and chemical qualities. The results was obtained are.

Chemical composition of *Chhana* whey
The composite samples of the crossbred cows milk were used for preparation of *chhana* whey.

Table 1: Chemical composition of *Chhana* whey

Sr. No.	Constituent	Content
1.	Fat (%)	0.50
2.	Protein (%)	0.70
3.	Lactose (%)	4.86
4.	Total solids (%)	6.3
5.	Lactic Acidity (% LA)	0.19
6.	pH	5.50

The average chemical composition of *chhana* whey used during the study is presented in Table 1.

Chemical composition of ginger powder

Table 2: Chemical composition of ginger powder

Sr. No.	Constituent	Conten(g/100gm)
1.	Protein	5.08(mg/100g)
2.	Carbohydrate	38.35(mg/100g)
3.	Total solids	11.37 (%)
4.	Ascorbic acid	7.0(mg/100g)
5.	pH	6.22

Chemical composition of ginger powder depicted in Table 2.

Pre-experimental trials
Finalizing the levels of ginger powder in the *chhana* whey beverage

Table 3: Sensory evaluation of CWB (Pre-experimental trials) (Mean of 4 trials)

Sensory quality		Colour and appearance	Consistency	Flavour	Overall acceptability
Treatment	Ginger powder (%)	(Sensory score out of 9)			
G_0	0.0	7.5^d	8.1^a	7.4^d	7.4^d
G_1	0.1	7.8^c	8.0^b	7.7^c	7.8^c
G_2	0.2	8.0^b	7.9^c	8.2^a	8.2^b
G_3	0.3	8.0^b	7.9^c	8.3^a	8.4^a
G_4	0.4	8.4^a	7.3^d	7.9^b	7.5^d
G_5	0.5	7.5^d	7.0^e	7.3^e	7.0^e
SE (±)		0.444	0.025	0.028	0.036
CD at 5%		0.1321	0.076	0.076	0.107

All different superscripts are statistically different.

Colour and appearance
The colour and appearance of *chhana* whey beverage significantly differed ($P< 0.05$) due to addition of ginger powder in the *chhana* whey (Table 3). As the level of addition of ginger powder in the CWB increased the colour and appearance increased upto 4% level. Then colour and appearance started decline. The colour of whey beverage gradually become darker (creamish yellow) as level increased. The treatment G_2 and G_3 were at par. The treatment G_4 secured highest colour and appearance score. Whereas treatment G_5 and G_0 obtained lower score.

Consistency
The consistency of CWB significantly influenced (P<0.05) due to addition of different level of ginger powder in *chhana* whey (Table. 3). All the treatments differed significantly among themselves. The treatment G_2 and G_3 were at par. The highest consistency score received to G_0. Whereas the lowest score received to G_5 i.e. 7.0. As the level of addition of ginger powder increases the consistency significantly decreased. The consistency became thicker as the level of ginger powder increased.

Flavour
The flavour of the *chhana* whey beverage significantly differed (P< 0.05) due to addition of ginger powder in the *chhana* whey (Table. 3). The treatment G_2 and G_3 were at par. All the treatments differed significantly among themselves. The treatment G_3 had highest flavour score among all treatments. The treatment G_5 had lowest sensory score it might be due to higher level of gingerol content in it.

Overall acceptability
The overall acceptability score of *chhana* whey beverage significantly (P< 0.05) differed due to addition of ginger powder in the *chhana* whey (Table. 3). The overall acceptability is depends on sensory attributes namely colour and appearance, consistency and flavour of the product. The highest overall acceptability score received to the treatment G_3 i.e. 8.4. The treatment G_5 had lowest overall acceptability i.e.7.0.
The sensory score for colour and appearance, consistency, flavour and overall acceptability for the treatment G_1,G_2.G_3 and G_4 remain in between „like moderately to like very much‟ considering the sensory scores received these treatments. Were chosen for the experiment trials.

Experimental trials
On the basis of results of sensory evaluation 0 (T_0), 0.1(T_1), 0.2(T_2), 0.3(T_3) and 0.4(T_4) per cent ginger powder levels were chosen for experimental trials.

Sensory quality of fresh *chhana* whey beverage

Table 4: Sensory quality of fresh *chhana* whey beverage (Sensory score out of 9)

Sensory quality Treatment	Colour and appearance	Consistency	Flavor	Overall acceptability
T_0	7.5^c	8.0^a	7.4^d	7.5^c
T_1	7.8^b	7.8^b	7.8^c	7.9^b
T_2	7.9^a	7.7^c	8.0^b	8.0^a
T_3	7.9^a	7.7^c	8.1^a	8.2^a
T_4	7.8^b	7.4^d	7.8^c	7.7^b
SE(+)	0.005	0.031	0.015	0.021
CD at 5%	0.016	0.095	0.047	0.064

-Nine point hedonic scale score card

Colour and Appearance
From Table 4 it is revealed that the sensory score for colour and appearance of the *chhana* whey beverage under different treatments was significant (P<0.05%).Treatment T_3 with score 7.9 was superior among all other treatments under study.
Whereas treatment T_0 scored lowest but sensorilly acceptable. As far as the levels of ginger powder increased upto 0.3% the sensory score increased. But the level goes on increasing above 0.3% the sensory score of colour and appearance started decreasing. It might be due to intense colour of ginger powder.
Fruit beverage from *chhana* whey by adding 5, 10 and 15% pineapple juice and recorded the average colour and appearance score as 7.64, Bhavsagar *et al.* (2010) [3]. whey guava beverage get sensory score for colour as 6.02 to 7.82 in the different blends studied Singh *et al.* (2014) [22].

Consistency
The treatment differences in the mean scores of consistency were found to be significant (P<0.05) (Table 4).
The mean score ranged from 7.4 (T_4) to 8.0 (T_0). All the treatments also differed significantly (P<0.05%) among themselves. The treatment T_3 had more acceptable consistency as compared to other Treatment T_0, T_1, $T_2$and T_4. The consistency of *chhana* whey beverage samples significantly influenced due to addition of ginger powder in *chhana* whey.
As the level of addition of ginger powder increased the consistency score decreased significantly. It might be due to the increase in the ginger powder level in the product. The consistency became thicker as level of ginger powder increased.

Flavour
The flavor is the most important component of sensory attributes. The mean score for flavor was 7.4, 7.8, 8.0, 8.1 and 7.8, for the treatment Samples T_0, T_1, T_2, T_3 and T_4, respectively (Table 4).
Which differed significantly (P<0.05). The highest sensory score received to the CWB sample (T_3) prepared by addition of 0.3% ginger powder in the *chhana* whey followed by T_4 (0.4%), T_2 (0.2%) T_1 (0.1%) and T_0 (Control) samples. However there were significant differences among the treatments T_1 and T_4were at par. The flavor score increased from T_1 to T_3 significantly.
It might be due to oleoresin and gingerol levels of ginger powder.The treatments T_3 has optimum flavour which was reflected by sensory panel of judges.
Bhavasagar *et al.* (2010) [3] manufactured pineapple flavoured beverage from *chhana* whey and reported the flavour score in the range of 7.3 (T_3) to 8.0 (T_2) treatment combinations. These results are in agreement with results reported in this investigation.

Overall acceptability
From Table 4.and Fig.1, it is seen that the addition of different levels of ginger powder in the *chhana* whey samples significantly (P<0.05) influenced the overall acceptability of the product. The mean sensory scores of experimental CWB samples under different treatments were ranged from 7.5 (T_0) to 8.2 (T_3).
The highest sensory score 8.2 was observed in treatment T_3 over the rest of sample treatments. The overall acceptability *chhana* whey beverage sample significantly influenced due to addition of ginger powder in *chhana* whey.
The sensory score for overall acceptability ranged from 7.5(T_0) to 8.2(T_3).The treatment T_3 had highest overall acceptability scores i.e. 8.2. The treatment T_2 and T_3 were at par. The treatment T_4 had lowest overall acceptability scores.
Bhavsagar *et al.* (2010) [3] reported the overall acceptability score for different blends of pineapple flavoured *chhana* whey beverage as 7.7 to 7.9.

Chemical composition of fresh *Chhana* whey beverage

Table 5: Chemical composition of fresh *Chhana* whey beverage (day 0)

Treatments	Fat (%)	Protein (%)	Lactose (%)	Total sugar (%)	Total solids (%)	Titratable acidity (%)	pH
T_0	0.48^e	0.70^e	4.90^a	14.91^e	16.39^e	0.20^d	5.19^a
T_1	0.53^d	0.72^d	4.81^b	14.97^d	16.47^d	0.20^d	5.18^b
T_2	0.57^c	0.73^c	4.69^c	15.07^c	16.56^c	0.21^c	5.16^c
T_3	0.61^b	0.76^b	4.65^d	15.14^b	16.68^b	0.22^b	5.14^d
T_4	0.64^a	0.78^a	4.60^e	15.17^a	16.77^a	0.23^a	5.11^e
SE(+)	0.0030	0.0020	0.002	0.009	0.0068	0.0011	0.0018
CD at5%	0.0091	0.0061	0.006	0.028	0.020	0.0033	0.0055

Fat

The data presented in Table 5 and Fig.1 revealed that, all blends of experimental treatments affected fat content significantly ($P<0.05$) irrespective of the addition of the ginger powder in the CWB samples. The mean fat content in the samples under experimental treatments ranged from 0.48 (T_0) to 0.64 (T_4) per cent. All the experimental Treatments differed significantly ($P<0.05$) among themselves.

Hande (2016) [7] studied that, all blends of experimental treatments affected fat content significantly ($P<0.05$) irrespective of the addition of the kiwi fruit pulp in the CWB samples.

Sharma *et al.* (1995) [20] reported 0.5% fat content in the whey based carrot juice prepared using buffalo milk paneer whey.Kumar and Peter (2015) [9] prepared whey based aonla beverage and reported fat content in the range of 0.05 to 0.07 per cent. Suzan *et al.* (1994) [24] manufactured *chhana* whey based fruit drinks and reported the fat content as 0.02 to 0.96 per cent.

Protein

The influence of experimental treatments (Table 5) on protein content in CWB samples was significant ($P<0.05$). The mean values for protein content under various experimental samples ranged from 0.70 (T_0) to 0.78 (T_4). The highest value for protein content was 0.78 in the treatment T_4 (0.4% ginger powder). Treatment sample T_4 significantly differed among all other treatments. It may be cause of higher protein content of ginger powder.

Hande (2016) [7] Studied The influence of experimental treatments on protein content in CWB. The mean values for protein content under various experimental samples ranged from 0.71 (T_0) to 0.89 (T_3). It may be cause of higher protein content of pulp.

Bhavsagar *et al.* (2010) [3] reported the values for protein content from 0.57 to 0.76% in the pineapple flavoured beverage.

Lactose

The influence of experimental treatments (Table 5) on Lactose content in CWB samples was significant ($P<0.05$). The mean values for Lactose content under various experimental samples ranged from 4.60 (T_4) to 4.90 (T_0). The highest value for Lactose content was 4.90 in the treatment T_0. Treatment sample T_0 significantly differed among all other treatments.

Total sugar

The influence of addition of various levels (Tables 5) of ginger powder on total sugar in the CWB were found significant ($P<0.05$). All the experimental treatment samples differed significantly among themselves. The mean values of total sugar in the experimental samples ranged from 14.91 (T_0) to 15.17 (T_4) per cent. It was noticed that as the level of addition of ginger powder increased the total sugar content in the experimental CWB samples increased significantly. It is obviously due to sugar content in the ginger powder. The treatment T_4 had the highest (15.17%) mean total sugar content followed by T_3 (15.14%), T_2 (15.07%) and T_1 (14.97%), T_0 (14.91%), respectively.

Hande (2016) [7] Studied The influence of addition of various levels of kiwi pulp on total sugar in the CWB. All the experimental treatment samples differed significantly among themselves.It was noticed that as the level of addition of kiwi fruit pulp increased the total sugar content in the experimental CWB samples increased significantly.

Ismail *et al* (2011) [8] 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.

Total solids

From the results presented in the (Table 5.) it is seen that mean total solids content in the various experimental samples were range from 16.39 to 16.77 per cent. The total solids content of experimental samples due to addition of ginger powder *viz.*, 0%, 0.1%, 0.2%, 0.3% and 0.4% were 16.39, 16.47, 16.56, 16.68, 16.77 per cent, respectively. There was significant ($P< 0.05$) differences in the total solids content of CWB due to addition of various level of ginger powder in the product. The control sample had significantly lower total solids content (16.39%) over the rest of the treatments. While the sample under treatment T_4 (16.77%) had significantly higher total solids content over rest of experimental treatments. It was seen that, with increase in addition of ginger powder in the CWB, there was increase in total solids content in CWB samples. It is due to solids present in the ginger powder. Hande (2016) [7] Studied that mean total solids content in the various experimental samples were range from 20.24 to 24.28 per cent. The total solids content of experimental samples due to addition of kiwi fruit pulp in various level of kiwi fruit pulp in the product.Mohamed *et al.*, (2014) [11] studied physico-chemical and microbiological properties of papaya functional whey beverage and noted the TS content 18%.

Titratable acidity

It is one of the important parameter which is directly related with the sensory quality of product. The influence of addition of various levels of ginger powder on titratable acidity (Table 5) in the CWB found to be significant ($P<0.05$). All the sample treatments differed significantly among themselves. The titratable acidity were ranged from 0.20% LA (T_0) to 0.23% LA (T_4) in the experimental samples. The control sample had significantly lower acidity (0.20% LA) over the rest of treatments. While the sample under treatment T_4 had significantly higher titratable acidity (0.23% L.A.) over all other experimental treatment samples. All treatment shows significant ($P<0.05$) difference amongst each other. The titratable acidity level in the various samples might be related to acidity content in the ginger powder. It was seen from Table 5. That the results indicated that as the level of addition of ginger powder increases, the acidity content of CWB samples were also increased proportionately. Hande (2016) [7]

Studied the influence of addition of various levels of kiwi fruit pulp on titrable acidity in the CWB found to be significant ($P<0.05$). All the sample treatments differed significantly among themselves. The titratable acidity were ranged from 0.49% L.A (T_0) to 0.66% LA (T_3) in the experimental samples. Bhavsagar *et al.,* (2010) [3] reported the titratable acidity in the different treatments 0.59 to 0.62% L.A, while manufacturing pineapple flavoured beverage from *chhana* whey. Sakhale *et al.,* (2012) [17] developed whey based RTS beverage from mango kesar and reported the acidity content from 0.32 to 036%.

pH

In this case the difference due to experimental treatments (Table 5) were found significant ($P<0.05$). The mean pH values of CWB samples were varied from 5.11 to 5.19. The pattern of pH in the various sample of CWB show close similarity, but in the reverse direction as seen in case of titratable acidity. The pH and acidity levels in the various experimental samples of CWB seemed to be having a close relationship.

Bhavsagar *et al.,* (2010) [3] reported the pH values of pineapple flavoured beverage from *chhana* whey as 3.91 to 3.89. Mohamed *et al.,* (2014) [11] observed the pH values of fresh functional papaya whey beverage as 4.90 to 5.30. Ismail *et al.,* (2011) [8] reported pH values as 4.86 for whey based mango beverage.

Conclusions

Better quality *chhana* whey beverage can be prepared by addition of 0.3 per cent ginger powder and 10% sugar in the *chhana* whey.

The sensory score of the T_3(0.3%) for colour and appearance, consistency, flavor and over all acceptability ranged from 6.9 to 7.9, 6.7 to 7.7, 6.6 to 8.1 and 6.7 to 8.2, respectively.

The physico- chemical composition of sample (T_3) remain more or less similar to sample (T_0).

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