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Effect of ginger (*Zingiber officinalis* L.) on quality and shelf life of *Chhana* whey beverage

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Abstract

The present investigation was planned to evaluate the effect of ginger on *chhana* whey beverage (CWB). The pre optimized and finalized different levels of ginger powder in *chhana* whey were used to the experimental treatments. The experiments were laid out in completely randomized design with four replications for pre experimental and experimental trials. The experimental treatments were; without ginger powder (T0), addition of 0.1% (T1), 0.2% (T2), 0.3% (T3), 0.4% (T4) ginger powder.

All the experimental samples were analyzed for sensory, chemical and microbiological qualities on day 0 (fresh), 5th day, 10th and 15th day of storage at refrigerated temperature of (5- 6 °C). The standard methods of analysis were followed and the data were statistically analyzed. The fresh samples of CWB were analyzed for chemical, sensory and microbiological qualities.

On increasing level of ginger over 0.3% and 10% sugar, the sensory scores for colour and appearance, consistency, flavour and overall acceptability was going decreasing. the chemical parameters like lactose protein, total sugar, total solids, titrable acidity increased significantly ($p < 0.05$) whereas fat was irrespective and pH show close similarity. The SPC counts increased, The YMC and Coliforms were detected during storage period.

On storage time increased the sensory scores for colour and appearance, consistency, flavour and overall acceptability was going decreasing. The chemical parameters like fat, protein, total sugar, total solids, titrable acidity increased significantly ($p < 0.05$) whereas lactose and pH decreased significantly. The SPC mean counts increased from 11.0 (T4) to 15.0 (T0) cfu/ml x 103 on 15th day of storage period. The YMC Increased from 0 to 38.0 cfu/ml x103. No coliforms were detected during storage period.

Better quality *Chhana* Whey Beverage (CWB) could be prepared by blending of 0.3% ginger powder and 10% sugar. The prepared ginger CWB remained acceptable upto 10 days at refrigerated temperature (5-6 ± 2 °C).

Keywords: Whey, *Channa*, ginger, evaluation, storage, shelf life

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*. In whey, lactose is the major constituent and whey proteins, water soluble vitamins and minerals are secondary components. 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. The production of a beverage from whey butter, cheese and acerola juice has been shown to have good commercialization potential, uniting the benefits provided by the former with that of the latter, including the ingestion of essential amino acids and increasing vitamin C content, resulting in a product of differentiated nutritive value (Cruz *et al.*, 2009) [6].

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 indispensable in the manufacture of number of food products. (Abdullah Al-Nahain, *et al.* 2014) [1] It is common ingredient in Asian cooking. Ginger has a several medicinal properties. According to the Ayurvedic medical system, ginger is carminative, stimulant and gives stimulating remedies. Ginger is diaphoretic, spasmolytic and intestinal stimulant.

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Fresh ginger has been used for cold induced diseases, asthma, nausea, cough, heart palpitation, swelling and rheumatism. Ginger extracts also have antibacterial, anti spasmotic, antiulcer, antiallergenic and antioxidant qualities as well. (Prasanna, *et al.* 2014) [15].

Ginger (*Zingiber officinale* L.) belonging to family *Zingiberaceae*. It is a major spice and has many uses in food as flavoring and having medicinal properties. The aroma of ginger is pleasant with flavor, slightly biting due to antiseptic or pungent compounds present in it, which make it indispensable in the manufacture of number of food products. Though it was revealed that blending of milk shake with ginger extract yield was novel dairy Nutraceutical. Those improve the acceptability of milk shake and also result into its value addition.

However, available literature indicates that the scanty work has been so far carried out on analysis of ginger powder admixed with whey. Therefore, thought essential to evaluate the suitability of ginger juice as a flavoring agent in developing ginger whey beverage. Hence the present investigation has been planned with following objectives.

1. To study sensory quality of whey beverage
2. To study chemical quality of whey beverage
3. To study microbiological quality of whey beverage
4. To study the shelf life of the product

Material and Methods

The Present investigation entitled, "Development of ginger (*Zingiber officinale* L.) Flavored *chhana* whey beverage 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 procured from Research cum-Development Project on cattle (RCDP), Dept. of Animal husbandry and dairy science, Mahatma Phule krishi vidyapeeth Rahuri, Dist. Ahmednagar (Maharashtra).

Ingredients

All ingredients like Sugar, Ginger powder (Geo fresh organic powder) was purchased from local market, LR grade citric acid was used for coagulation of milk purpose.

Glasswares

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

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.

Laboratory instruments Packaging material

Glass bottles (250 ml capacity) were made available from the department of Post-harvest technology of Horticulture for filling of whey beverage and Sterilized aluminium foil was used for packaging the filled bottles.

Microbiological media

Dehydrated media *viz.*, tryptone glucose yeast extract agar (M-014) and potato dextrose agar (M-016) from M/S Hi-media Laboratory Pvt. Ltd, Mumbai (India) were used.

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)

T0 - Control (Without addition of ginger powder)

T1 - 0.1 per cent ginger powder of *chhana* whey. T2 - 0.2 per cent ginger powder of *chhana* whey. T3 - 0.3 per cent ginger powder of *chhana* whey. T4 - 0.4 per cent ginger powder of *chhana* whey.

Sugar @ 10 per cent of whey was used for all treatments.

Methods

Sensory evaluation

Experimental trials were subjected to sensory evaluation using the method described in the IS:6273, Part-I and Part- II (1971) [10] adopting 9 point Hedonic scale. A panel of five semi trained judges was formulated for this purpose. The samples were coded every time

Chemical analysis of *Chhana* whey and *Chhana* Whey Beverage

The fat content was determined by Gerber method, The protein content was determined by Micro-Kjeldahl method, The lactose content was determined by Lane -Eynon volumetric method, The total solids content was determined by gravimetric method, The titratable acidity and pH content was determined as per procedure described in BIS (1981) [4]. The total sugar content was determined as per the method described by Ranganna (1986) [16].

Storage studies

The *chhana* whey beverage samples were stored at refrigerator temperature 5-60 C. The samples were analysed for sensory, chemical and microbiological qualities on day 0,5,10 and 15th day of storage.

Microbiological analysis enumeration of microorganisms

The pour plate method was adopted for enumeration of Standard Plate Counts (SPC) was determined by adopting standard procedure using Standard Plate Count Agar (SPCA) media as mentioned by Amin, (1997) [2], Yeast and Mould Counts (YMC) was determined as per the procedure described in IS: 5403 (1999) [8] using Potato Dextrose Agar (PDA), Coliform Counts of whey beverage samples was determined as per the procedure described in IS: 5550 (1970) [9].

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) [19].

Result and Discussion

The present investigation entitled "Effect of ginger (*Zingiber officinale*) on *chhana* whey beverage" was undertaken to evaluate the effect of ginger on quality and shelf life of *chhana* whey beverage. The prepared *chhana* whey beverage was evaluated for sensory, chemical and microbiological qualities.

Chemical composition of *Chhana* whey

The composite samples of the crossbred cow's milk were used for preparation of *chhana* whey. The average chemical

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

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

Table 2: Sensory quality of fresh *chhana* whey beverage (Sensory score out of 9)

Treatment	Colour and appearance	Consistency	Flavor	Overall acceptability
T0	7.5c	8.0a	7.4d	7.5c
T1	7.8b	7.8b	7.8c	7.9b
T2	7.9a	7.7c	8.0b	8.0a
T3	7.9a	7.7c	8.1a	8.2a
T4	7.8b	7.4d	7.8c	7.7b
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 Treatment T3 with score 7.9 was superior among all other treatments under study. It might be due to intense colour of ginger powder. whey guava beverage get sensory score for colour as 6.02 to 7.82 in the different blends studied Singh *et al.* (2014) [18].

Consistency

The mean score ranged from 7.4 (T4) to 8.0 (T0). The treatment T3 had more acceptable consistency. The consistency became thicker as level of ginger powder increased.

On an average *chhana* whey contains: 0.50, 0.70, 4.86, 6.37, 0.19 and 5.50, per cent fat, protein, lactose, Total solids, lactic acidity (% L.A.) respectively. The pH of *channa* whey beverage was 5.50.

Experimental trials

On the basis of results of sensory evaluation 0 (T0), 0.1(T1), 0.2(T2), 0.3(T3) and 0.4(T4) per cent ginger powder levels were chosen for experimental trials.

Sensory quality of fresh *chhana* whey beverage

Flavour: The flavour score increased from T1 to T3 significantly. It might be due to oleoresin and gingerol levels of ginger powder.

Overall acceptability

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(T0) to 8.2(T3).

Chemical composition of fresh *Chhana* whey beverage

Table 3: Chemical composition of fresh *Chhana* whey beverage (day 0)

Treatments	Fat (%)	Protein (%)	Lactose (%)	Total Sugar (%)	Total Solids (%)	Titrateable Acidity (%)	pH
T0	0.48e	0.70e	4.90a	14.91e	16.39e	0.20d	5.19a
T1	0.53d	0.72d	4.81b	14.97d	16.47d	0.20d	5.18b
T2	0.57c	0.73c	4.69c	15.07c	16.56c	0.21c	5.16c
T3	0.61b	0.76b	4.65d	15.14b	16.68b	0.22b	5.14d
T4	0.64a	0.78a	4.60e	15.17a	16.77a	0.23a	5.11e
SE(+)	0.003	0.002	0.002	0.009	0.006	0.001	0.001
CD at 5%	0.009	0.006	0.006	0.028	0.020	0.003	0.005

Fat

The mean fat content in the samples under experimental treatments ranged from 0.48 (T0) to 0.64 (T4) per cent fat content irrespective of the addition of the ginger powder in the CWB samples.

Protein

The mean values for protein content under various experimental samples ranged from 0.70 (T0) to 0.78 (T4). The highest value for protein content was 0.78 in the treatment T4 (0.4% ginger powder). It may be cause of higher protein content of ginger powder.

Lactose

The mean values for Lactose content under various experimental samples ranged from 4.60 (T4) to 4.90 (T0). It is obviously due to sugar content in the ginger powder.

Total sugar

The mean values of total sugar in the experimental samples ranged from 14.91 (T0) to 15.17 (T4) 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.

Total solids

From Table (3) it is seen that mean total solids content in the various experimental samples were range from 16.39 to 16.77 per cent. The control sample had lower total solids content (16.39%). Mohamed *et al.*, (2014) [14] studied physico-chemical properties of papaya functional whey beverage and noted the TS content 18%.

Titrateable acidity

The titrateable acidity were ranged from 0.20% LA (T0) to

0.23% LA (T4) in the experimental samples. The results indicated that as the level of addition of ginger powder increases, the acidity content of CWB samples were also increased proportionately.

Sakhale *et al.*, (2012) [17] developed whey based RTS beverage from mango kesar and reported the acidity content from 0.32 to 0.36%.

pH

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. Bhavsagar *et al.*, (2010) [3] reported the pH values of pineapple flavoured beverage from *chhana* whey as 3.91 to 3.89.

Microbiological quality of fresh *Chhana* Whey Beverage (day 0)

In the present investigation, were made to evaluate The microbiological quality has of prime importance as quality of the product is considered. Hence after preparation of CWB, microbiological qualities of fresh CWB samples were evaluated.

Table 4: Microbiological quality of fresh (day 0) *Chhana* whey beverage

Storage period/ Treatment	SPC 0 day (cfu/ml x 102)	YMC 0 day (cfu/ml x 10)	Coliform count 0 day cfu/ml x 10
T0	9.2a	ND	ND
T1	8.5ab	ND	ND
T2	8.2ab	ND	ND
T3	7.5b	ND	ND
T4	7.5b	ND	ND
SE (+)	0.376	-	-
CD at 5%	1.134	-	-

ND: Not detected

Standard Plate Count (SPC)

The CWB samples under various treatments showed a variation in microbiological quality (Table 6). The SPC content of the different sample treatments ranged from 7.5x102cfu/ml (T4) to 9.2x102cfu/ml (T0). Damane *et al.*, (2015) [7] reported total plate count less than 20 in formulation of milk whey blended sugarcane juice.

Yeast and Mould Count (YMC)

No YMC was detected in the CWB samples.

Coliform Counts

No Coliforms was detected in the CWB samples.

Quality of *chhana* Whey Beverage During Storage

On the basis of chemical, sensory and microbiological analysis of fresh *Chhana* Whey Beverage the best treatment T3 (0.3% Ginger powder) was selected for storage study. T0 treatment was taken as control treatment.

Sensory Quality of *chhana* Whey Beverage during Storage

Table 5: Sensory quality of *Chhana* whey beverage during storage

Storage Time / parameters	Treatments	0 Days	5 Days	10 Days	15 Days
Colour and appearance	T0	7.5	7.5	7.3	7.0
	T3	7.9	7.9	7.5	6.9
Consistency	T0	8.0	7.9	7.5	6.9
	T3	7.7	7.7	7.6	6.7
Flavour	T0	7.5	7.5	7.4	6.9
	T3	8.1	8.2	7.7	6.6
Overall acceptability	T0	7.5	7.5	7.4	6.8
	T3	8.2	8.0	8.0	6.7

Colour and appearance

The addition of ginger powder in the *chhana* whey significantly ($P < 0.05$) influenced the colour and appearance (Table 5) of the product during storage period. The mean score for colour and appearance varied from 7.9 to 6.7 (T3) and 7.5 to 7.0 (T0) during storage. The colour and appearance score remain, liked moderately up to 10 day of storage at 5-60 C. The original colour creamish white declined to darker in all treatments from 10 days onwards. All the treatments became dull in appearance at 15 days storage. Yadav *et al.*, (2010) [20] noted colour score 7.60 on day 0 and 6.80 on 10th day of storage while studying the development and storage studies on whey based banana herbal (*Mentha arvensis*) beverage.

Consistency

The consistency becomes thicker in the treatment samples as storage period. The consistency score decreased from 7.7 to 6.7 (T3) and 8.0 to 6.9 (T0) as storage period increased from day 0 to day 15 in all the treatments. Kumar *et al.*, (2005) [12]

reported the sensory score for consistency on day 0 was 4.50 and 4.40 on 10th day in formulation of whey sweet orange based RTS fruit beverage.

Flavour

The flavour is one of the important component of sensory quality, from the (Table 5). It is revealed that, influence of addition of ginger powder on flavour during all the days of storage. The mean sensory score of the samples under different experimental treatments were ranged from 8.1 to 6.6 (T3) and 7.5 to 6.9 (T0) on 0th, 5th, 10th and 15th days respectively during storage period. The flavour score of CWB significantly decreased as the storage period increased. It might be due to physico-chemical changes takes place in the product during storage. Particularly increased in lactic acidity of the product. Which results in decrease of flavour attribute. Chavan *et al.*, (2015) [5] reported that sensory score for flavor was 8.5 on day 0 and also 8.5 on 10th day of storage in development of whey based mango beverage.

Overall acceptability

From the (Table.5) it is revealed that, the influence of addition of different level of ginger powder in the *chhana* whey samples significantly ($P < 0.05$) influenced the overall acceptability of the product during all the days of storage. The mean overall acceptability scores of the CWB samples under two treatments ranged from 8.2 to 6.7 (T3) and 7.5 to 6.8 (T0) on day 0th, 5th, 10th and 15th of storage.

Chavan *et al.*, (2015) ^[5] reported that sensory score for overall acceptability was 8.5 on day 0 and also 8.4 on 10th day of storage in development of whey based mango beverage.

Chemical Composition of *Chhana* whey beverage during storage

Table 6: Chemical Composition of *Chhana* Whey Beverage During Storage

Stoage period / parameter	Treatments	0 Days	5 Days	10 Days	15 Days
Fat	T0	0.48	0.44	0.42	0.36
	T3	0.61	0.60	0.51	0.43
Protein	T0	0.70	0.68d	0.65	0.62
	T3	0.76	0.73	0.70	0.64
Lactose	T0	4.90	4.82	4.55	4.26
	T3	4.65	4.55	4.29	4.10
Total Sugar	T0	14.91	14.89	13.88	12.88
	T3	15.14	15.10	14.09	13.09
Total Solids	T0	16.39	16.42	16.48	16.59
	T3	16.68	16.72	16.75	16.85
Titrable acidity (L.A.)	T0	0.20	0.26	0.30	0.39
	T3	0.22	0.29	0.34	0.46
pH	T0	5.19	5.17	5.13	4.8
	T3	5.14	5.13	5.00	4.6

FAT

The data presented in Table (6) revealed that, blends of ginger powder affected fat content significantly ($P < 0.05$) The mean fat content in the samples under experimental treatment 0.61 per cent. On a 15th day of storage all the treatment differed significantly among themselves.

Kumar and Peter (2015) ^[13] prepared whey based aonla beverage and reported fat content in the range of 0.05 to 0.07 per cent.

Protein

The influence of storage life (Table 6) on protein content in CWB samples was significant ($P < 0.05$). The mean values for protein content ranged from 0.70 (T0) to 0.76(T3).

Protein content was decreased on increasing storage time. Singh *et al.*, (2014) ^[18] observed 0.33% protein content on day 0 and 0.32% on 10th day of storage period, while

studying development, quality evaluation and shelf life studies of whey guava beverage.

Lactose

The mean values for lactose content under various experimental samples ranged from 4.65 to 4.10 (T3) and 4.90 to 4.26 (T0). The lactose content was decreased with increasing storage study.

Total sugar

All the experimental treatment samples differed significantly among themselves. The mean values of total sugar in the experimental samples decreased from 15.14 to 13.09 per cent (T3) and 14.91 to 12.88 (T0). Ismail *et al.*, (2011) ^[11] reported the total sugar content 16.28% on day 0 and 16.17% on 30th day of storage period in the cheese whey based mango beverage while studying microbial and chemical evaluation of whey based mango beverage.

Total solids

The total solid content (Table 6) of CWB significantly ($P < 0.05$) influenced on day 0, 5th, 10th and 15th day of storage period. All the sample treatments significantly differed on storage. Total solid content was ranged from 16.68 to 16.85 (T3). It is due to total solid content of ginger powder. Mohamed *et al.*, (2014) ^[14] studied physico-chemical and microbiological properties of papaya functional whey beverage and noted the TS content 18% on day 0 and reduces upto 17.70% on 30th day of storage.

Titrable acidity (%L.A.)

The values for acidity content varied from 0.22 to 0.46(T3) during storage period. It is seen that the acidity content increased with increase in the storage period progressed. Chavan *et al.*, (2015) ^[5] reported increase in acidity content during storage i.e. on day 0 acidity was 0.40 per cent and on 10th day it increases upto 0.41 per cent, while studying the development of whey based mango beverage.

pH

The mean pH values of CWB samples were varied from 4.8 (T3) to 5.19(T0). The pattern of pH in the sample of CWB show close similarity, The pH and acidity levels in the various experimental samples of CWB seemed to be having a close relationship. Mohamed *et al.*, (2014) ^[14] observed the pH values of fresh functional papaya whey beverage as 4.90 to 5.30.

Microbiological quality of *Chhana* whey beverage during storage

Table 7: Microbiological quality of *Chhana* whey beverage during storage

Storage Time / parameters	Treatments	0 Days	5 Days	10 Days	15 Days
SPC	T0	9.2	8.0	13.5	15.0
	T3	7.5	5.0	11.0	11.0
Yeast and mould count	T0	ND	ND	7.0	38.0
	T3	ND	ND	8.2	36.2
Coliform count	T0	ND	ND	ND	ND
	T3	ND	ND	ND	ND

Standard plate count (SPC): The mean standard plate count of *chhana* whey beverage during storage is depicted in the (Table7). The mean SPC varied from 7.5 cfu/ml x 10² to 11

cfu/ml (T3) during storage at 5-60 C. Ismail *et al.*, (2011) ^[11] observed total viable count on day 0 were 2.60 x 10⁴ and 2.67 x 10⁴ on 10th day of storage.

Yeast and Moulds counts (YMC)

It was seen that YMC was not detected on a day 0 and day 5 of storage. The YMC ranged from 7.0 to 8.2 x10² on day 10 of storage and which were increased to 36.2 cfu/ml x10³ to 38.00 cfu/ml x 10³ on day 15 of storage.

This might be due to contamination during post handling of the product. Mohamed *et al.*, (2014)^[14] reported YMC on day 0 was 6.33 x 10²/gm, it becomes 0.50 x 10²/gm on 30th day of storage in papaya functional beverage based on sweet cheese whey.

Coliform Counts of Channa whey beverage during storage

ND: Not detected

No Coliforms were detected during storage of the product.

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 prepared ginger based *chhana* whey beverage remains acceptable up to 10days at refrigerated temperature of 5-60C.

The sensory score of the T3(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 (T3) remain more or less similar during storage at 5-60C.

The SPC of T3 (0.3% ginger powder) was in the range of 7.5x10²cfu/ml to 11.0 x10³cfu/ml during 15 days storage at 5 - 60C.

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