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Chemical quality of whey based kiwi (*Actinidia deliciosa*) fruit beverage

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Abstract
Investigation was planned to prepare the kiwi fruit blended with *Chhana* Whey Beverage (CWB).The preliminary trials were conducted with 0, 5, 6, 7, 8, 9, 10, 11 and 12% levels of kiwi fruit pulp and 8% sugar in *chhana* whey to optimize the experimental treatments. On the basis of sensory evaluation, the treatments *viz*; no kiwi fruit pulp (T_0), 8% kiwi fruit pulp (T_1), 9% kiwi fruit pulp (T_2) and 10% (T_3) kiwi fruit pulp with 8% sugar level were chosen for experimental trials. The experimental samples were analysed for chemical composition using standard procedures.The increase in the fat, protein, total sugar, total solids, titratable acidity (%L.A.), pH, ash and total fiber was observed in kiwi pulp blended samples of whey beverage. All chemical constituents were significantly (P<0.05) influenced as fresh and during storage of *Channa* whey beverage at a temperature of 5- 6 ^{0}C.

Keywords: Kiwi fruit pulp, whey beverage, chemical composition

Introduction
Whey is highly nutritious by-product obtained during coagulation of milk by using acid and / or physico-chemical processes for the preparation of *cheese, panner, chhana, chakka, casein* and co-precipitates.
Whey contains approximately half of the total solids of the original milk (Gupta, 2000) [5]. 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 food to human beings. It serves as the most potent pollutant of all the dairy wastes, it content high amount of organic matter (6-7%) comprising of fat, protein, sugar, minerals and water soluble vitamins.
Whey posses preventive and curative elements and is especially used to treat a wide variety of ailments such as arthritis, anemia and liver complaints (Jelen, 1992) [8]. Whey drinks can stabilize the osmolar system in the body and have a thirst quenching effect. Whey proteins also have special reference to biological activities such as appetite suppression, antioxidant actions, anticarcinogenic effects, against HIV infection, immune system, stimulation and therapeutic value (Bajaj and Sangwan, 2002) [1]. Utilization of whey proteins for the preparation of geriatric foods represents a promising avenue for new product development (Purnik, 1999) [11].
In recent years there has been a significant increase in different varieties of soft drinks and beverages available in the market and this could probably be directly connected to the changed life-style of the people. The fast growth of soft-drinks and beverage industry has also provided good profit margin to the producers. However, with the growing awareness of balanced diet and nutrition among the health conscious consumer, whey based beverages would find its due place as refreshing and nourishing drink.
Recently the value addition of whey is being done by using various fruit pulp (juice) such as mango (Zhang *et al.*, 1994) [17], guava (Singh, 1999) [14] and preparation of soup using whey along with fruits and vegetables such as beet root and kokum (Kamat *et al.*, 1999) [9]
Kiwi fruit (*Actinidia deliciosa*) is a very good source of dietary fiber. It contain plenty of fiber which reduces high cholesterol level. Fiber also good for binding and removing toxins from colon and preving colon cancer. Kiwi fruit helps for keeping the blood sugar level under control. Kiwi fruit also posses a good source of the minerals like potassium, magnesium, copper and phosphorous. Vitamin C kiwi fruit also have significant protective effect against respiratory symptoms associated with asthma such as wheezing. It was therefore, decided to explore the possibility of utilizing kiwi fruit in the preparation of whey beverage.

Materials and Methods

Milk

The fresh cow milk was procured from Research-Cum-Development project (RCDP) on cattle, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra) for preparation of *Channa* whey.

Ingredients

Sugar was purchased from the local market. The kiwi fruit pulp was procured from M/S Malvis Food Products, Mahabaleshwar, Dist.Satara. MS (India).

Methods

Preparation of *chhana whey*:

The *chhana* whey samples were prepared as per the procedure given by Bhavsagar (2010) [2].

Chhana whey

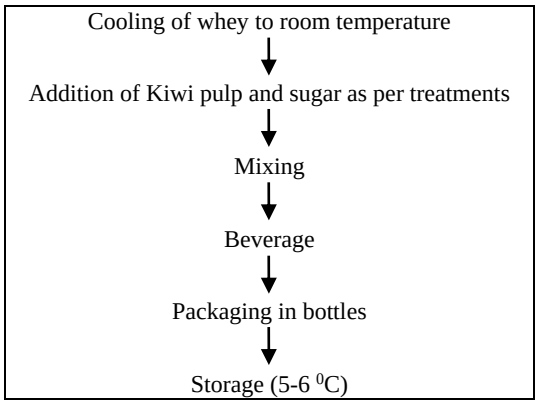

Fig 1: Flow chart for preparation of *Chhana* whey beverage using Kiwi pulp

Preliminary trials were conducted to decide the levels of addition of kiwi fruit pulp in the whey using 0, 5, 6, 7, 8, 9, 10, 11 and 12 percent kiwi fruit pulp and 8 % sugar level.

On the basis of the results of sensory evaluation of pre-experimental trials 0, 8, 9 and 10 % kiwi fruit pulp levels were selected for experimental trials.

T_0 - Control (Without addition of kiwi fruit pulp).

T_1 - 8 per cent kiwi fruit pulp of *chhana* whey.

T_2 - 9 per cent kiwi fruit pulp of *chhana* whey.

T_3 - 10 per cent kiwi fruit pulp of *chhana* whey.

Constant sugar @ 8 per cent of whey was used for all treatments.

Chemical analysis of *Chhana* whey, Kiwi fruit pulp and *Chhana* Whey Beverage

Fat, protein, lactose, total solids, titratable acidity (% LA), pH, ash and Total Fiber content in the whey beverage was determined as per BIS (1981) [3]. The total sugar content was determined as per the method described by Ranganna (1986) [12].

Mineral contents

Calcium (Ca), P, Na, K and Fe analyzed by using Atomic Absorption Photospectrometer procedure described by Veena Mani (2011) [16].

Sensory evaluation

Samples of whey beverage prepared were subjected to sensory evaluation using the method described in the IS: 6273, Part-I and Part- II (1971) [6] adopting 9 point Hedonic scale.

Statistical analysis

Experiment was laid out in completely randomized design (CRD) with five replications. The data was tabulated and analyzed according to Snedecor and Cochran (1994) [15].

Results and Discussion

Chemical composition of *chhana* whey

An average cow milk *chhana* whey used for preparation of beverage had 0.52, 0.48, 0.70, 4.1, 0.59, 6.63 per cent Fat, Acidity (%L.A.), Protein, Lactose, Ash, total solids, respectively. The pH content of *chhana* whey was 5.6. The Ca, P, Na and K were 98.40, 80.75, 49.30 and 119.85mg/100ml, respectively. The iron (Fe) content of *chhana* whey was 382.50 microgram/lit.

Chemical composition of kiwi fruit pulp

Table 1: Chemical composition of kiwi fruit pulp

Constituent	Quantity
Protein	1.05 %
Total sugar	14.86 %
Total solids (TS)	26.06 %
Ash	0.58 %
Total fibre	2.3gm/100 gm
Acidity	1.07 %

The mean kiwi (Table1) pulp contains 1.05, 14.86, 26.06, and 0.58 per cent protein, total sugar, total solids (TS) and ash, respectively. The total fibre content and acidity content of kiwi pulp was 2.3gm/100gm and 1.07%, respectively.

Table 2: Mineral content of kiwi fruit pulp

Mineral	Quantity
Ca mg/100ml	22.48
P mg/100ml	22.24
Na mg/100ml	2.19
K mg/100ml	213.27
Fe microgram/lit	24

The mean value (Table 2) for Ca, P, Na and K were 22.48, 22.24, 2.19 and 213.27mg/100ml, respectively. The iron (Fe) content of kiwi pulp was 24 microgram/lit.

Table 3: Influence of addition of kiwi pulp on fat content of CWB during storage

Storage period / Treatment	0 day	5th day	10th day
T_0	0.52^a	0.52^a	0.42^a
T_1	0.54^a	0.52^a	0.50^b
T_2	0.56^a	0.56^a	0.56^c
T_3	0.66^b	0.66^b	0.63^d
SE(+)	0.02	0.02	0.02
CD at 5%	0.07	0.07	0.05

The data presented in Table 3 revealed that, experimental treatments significantly (P<0.05) influenced irrespective of the addition of kiwi fruit pulp in the *chhana* whey during all the days of storage. The mean fat content in the sample under experimental treatments far day 0, day 5, and day 10th were 0.52 (T_0) to 0.66 (T_3) and 0.42 (T_0) to 0.63 (T_3), respectively. All the treatments on all the days of storage differed significantly among themselves. Treatment T_0, T_1 and T_2 were on par on day 0 and 5th day of storage treatment T_3 were significantly differed among T_0, T_1 and T_2 on day 0, 5th day and 10th day of storage period.

On a 10th day of storage all the treatment T_0, T_1, T_2, and T_3 differed significantly among themselves.

Chavan *et al.,* (2015) [4] reported slight reduction in fat content during storage i.e. on day 0 fat was 0.14 and on 10th day it reduces slightly up to 0.11 per cent, while studying the development of whey based mango beverage.

Table 4: Influence of addition of kiwi pulp on protein content of CWB during storage

Treatment \ Storage period	0 day	5th day	10th day
T_0	0.71^a	0.70^a	0.65^a
T_1	0.75^b	0.74^b	0.72^b
T_2	0.84^c	0.84^c	0.83^c
T_3	0.89^d	0.89^d	0.88^d
SE(+)	0.01	0.01	0.01
CD at 5%	0.03	0.03	0.03

The addition of different levels of kiwi fruit pulp in *chhana* whey significantly ($P<0.05$) influenced the protein content of the product during all the days of storage period (Table 4). The mean protein content was ranged from 0.65 (T_0) to 0.89 (T_3) per cent, respectively. All the sample treatments also significantly differed among each other during day 0, 5th day and 10th day of storage.

Chavan *et al.,* (2015) [4] reported slight reduction in protein content during storage i.e. on day 0 fat was 0.75 percent and on 10th day it reduces slightly up to 0.72 per cent, while studying the development of whey based mango beverage.

Singh *et al.,* (2014) [13] 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.

Table 5: Influence of addition of kiwi pulp on total sugar content of CWB during storage

Treatment \ Storage period	0 day	5th day	10th day
T_0	18.44^a	18.43^a	18.01^a
T_1	19.03^b	19.03^b	18.99^b
T_2	20.56^c	20.55^c	20.52^c
T_3	22.54^d	22.53^d	22.48^d
SE (+)	0.12	0.12	0.11
CD at5%	0.36	0.36	0.32

The influence of addition of different levels of kiwi fruit pulp in the *chhana* whey (Table 5) significantly ($P<0.05$) differed on all the days of storage period. The mean total sugar content ranged from 18.01 (T_0) to 22.56 (T_2) per cent. The values for total sugar were increased as the level of kiwi fruit pulp increased. It is due to the sugar content in the kiwi fruit pulp. All the samole treatments differed significantly among themselves on 0, 5th and 10th day of storage period. It is also observed that as storage period increased the total sugar content slightly decreased. It may be due to microbial degradation of sugar content in the sample treatments. Ismail *et al.,* (2011) [7] 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 studieng microbial and chemical evaluation of whey based mango beverage.

Table 6: Influence of addition of kiwi pulp on total solids content of CWB during storage

Treatment \ Storage period	0 day	5th day	10th day
T_0	20.24^a	20.23^a	20.02^a
T_1	20.82^b	20.77^b	20.63^b
T_2	22.07^c	22.06^c	22.02^c
T_3	24.28^d	24.27^d	24.24^d
SE(+)	0.13	0.14	0.15
CD at 5%	0.40	0.41	0.44

The addition of different levels of kiwi fruit pulp in the chhana whey, the total solid content (Table 6) of CWB significantly ($P<0.05$) influenced on day 0, 5th day and 10th day of storage period. All the sample treatments significantly differed among each other on all the days of storage. On a day 0 total solid content was ranged from 20.24 (T_0) to 24.28 (T_3). The corresponding values were 20.23 (T_0) to 24.27 (T_3) and 20.02 (T_0) to 24.24 (T_3) per cent, respectively. It is also seen that as the level of kiwi fruit pulp increased the total solids content also increased. It is due to Total solids content of kiwi fruit pulp.

Mohamed *et al.,* (2014) [10] studied physic-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.

Table 7: Influence of addition of kiwi pulp on acidity (% LA) content of CWB during storage

Treatment \ Storage period	0 day	5th day	10th day
T_0	0.49^a	0.66^a	0.78^a
T_1	0.52^b	0.71^b	0.80^a
T_2	0.64^c	0.72^b	0.84^b
T_3	0.66^d	0.79^c	0.94^c
SE(+)	0.00	0.01	0.01
CD at 5%	0.01	0.02	0.02

The influence of addition of kiwi fruit pulp on acidity content (Table 7) of CWB was significant ($P<0.05$) on all the days of storage period. The values for acidity content varied from 0.49(T_0) to 0.94(T_3) during storage period. All the sample treatments significantly differed among themselves due to addition of kiwi fruit pulp in the *chhana* whey during da0, 5th and 10th day of storage. It is seen that the acidity content increased with increase in the levels of kiwi fruit pulp in the *chhana* whey and storage period progressed.

On 5th day of storage the treatments T_1 and T_2 and Treatment T_0 and T_1 on a 10th day were on a par. Treatment T_2 and T_3 were significantly differed among other treatment samples on 10th day of storage period. Chavan *et al.*, (2015) [4] 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 studieng the development of whey based mango beverage. Ismail *et al.*, (2011) [7] reported the acidity content was 0.15 % on day 0 and 0.15% on 10th day of storage period in the cheese whey based mango beverage while studying microbial and chemical evaluation of whey based mango beverage.

Table 8: Influence of addition of kiwi pulp on pH content of CWB during storage

Treatment \ Storage period	0 day	5th day	10th day
T_0	5.64^c	4.46^b	4.36^b
T_1	5.12^b	4.30^b	4.20^b
T_2	4.62^a	4.18^{ab}	4.02^b
T_3	4.40^a	3.95^a	3.71^a
SE(+)	0.11	0.10	0.09
CD at 5%	0.34	0.31	0.27

The pH values were also significantly differed on all the days of storage but in the reverse direction (Table 8) as compare to acidity of beverage. The mean pH values ranged from 3.71(T_3) to 5.64(T_0) during all the stages of storage period. Ismail *et al.*, (2011) [7] reported the acidity content was 4.86 on day 0 and 4.85 on 10th day of storage period in the cheese whey based mango beverage while studying microbial and chemical evaluation of whey based mango beverage. Mohamed *et al.*, (2014) [10] studied physic-chemical and microbiological properties of papaya functional whey beverage and noted the pH value 5.30 on day 0 and reduced up to 4.90 on 10th day of storage.

Table 9: Influence of addition of kiwi pulp on total fiber content of CWB during storage

Treatment \ Storage period	0 day (mg/ 100 ml)	5th day (mg/ 100 ml)	10th day (mg/ 100 ml)
T_0	0.00^a	0.00^a	0.00^a
T_1	0.18^b	0.17^b	0.17^a
T_2	0.20^c	0.19^c	0.19^b
T_3	0.20^c	0.20^c	0.20^b
SE(+)	0.00	0.00	0.00
CD at 5%	0.01	0.01	0.01

The influence of addition of kiwi fruit pulp in the chhana whey significantly influenced the total fibre content (Table 9) of CWB during all the days of storage period. The values were ranged from 0.00 (T_0) to 0.20 (T_3) mg/100ml during storage period. From it is also seen that the total fiber content increased significantly due to addition of kiwi fruit pulp in the sample treatments.

Mineral content of CWB

Table 10: Influence of addition of kiwi pulp on mineral content of CWB (Day 0)

Days \ Minerals	Ca (mg/100ml)	P (mg/100 ml)	Na (mg/100 ml)	K (mg/100ml)	Fe (microgram/lit.)
	0	0	0	0	0
T_0	98.5	80.75	49.3	119.86	382.70
T_1	92.30	76.09	46.97	127.32	353.82
T_2	91.56	75.48	45.05	128.29	350.24
T_3	90.81	74.87	44.09	129.15	346.64
SE(±)	0.03	0.01	0.02	0.01	0.01
CD at 5%	0.10	0.02	0.06	0.03	0.04

From Table 10 it is seen that, all the mineral content (Ca, P, Na, K, and Fe) increased significantly as the addition of levels of kiwi fruit pulp increased in the sample treatment as compare to individual kiwi fruit pulp and *chhana* whey mineral contents.

Conclusion

The nutritionally better quality CWB can be prepared by blending of 9 per cent kiwi fruit pulp and 8 % sugar in the *chhana* whey.

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