

Studies on the Process Optimization and Quality Characteristics of Turmeric Fortified Milkshakes with Honey as Sugar Replacer

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ABSTRACT: The present study was undertaken to develop Fortified milk shake. Optimization of the fortified milk shake was done by incorporating various ingredients along with other modifications in view of current study. This study aimed at characterizing sensory and physico-chemical profile of the fortified milk shake stored at refrigeration temperature. Scope and plan of work has been explained to include; 1. To optimize the process of fortified milk shake. 2. To standardize the level of honey as the sugar replacer in the fortified milk shake 3-To standardize the level of turmeric in the fortified milk shake. 4-To study the sensory characteristics of the fortified milk shake under refrigeration temperature 5- To study the physico-chemical characteristics of the fortified milk shake under refrigeration temperature. The fortified milk shake was prepared as per the previous protocol, with the suitable modifications keeping in view for the current study. The four different levels of honey in the fortified milk shake were tried that is, i.e. 5%, 10%, 15% and 20%. Similarly, four different levels of turmeric in the fortified milk shake were tried that is i.e. 0.1%, 0.3%, 0.5%, 0.7% making of different combination. The sensory evaluation of the product was been carried out by the panelists using seven-point hedonic scale. The level of 10% Honey along with turmeric @0.3% was found superior over other combinations. The best combination of honey @ 10% and turmeric @ 0.3% was taken further for the study of sensory characteristics and physicochemical parameters. Study on sensory characteristics of fortified milk shake during refrigeration temperature was conducted. The study included the sensory evaluation of the products at 0 day, 3th day, and 5th days.

The results indicated that the scores for appearance and colour, flavour of the product were significantly different with rating “Good” by the panelists on 5th day of storage. The result indicated that the scores for consistency, texture, sedimentation, mouth feel and overall acceptability on 5th day of storage were found to be non significant scores with rating good to very good by the panelist. The physico-chemical parameter showed a significant decrease in the pH value, i.e. 6.72 on 0 day to 6.69 on 7th day of storage. Acidity value showed a linear increase from 0.13 on 0 day to 0.23 on 7th day of refrigeration storage. Specific gravity, total solid and SNF value of fortified milk shakes was found a non significant change on the 7th day of storage. The COB test of the FMS was found negative on 0 day, 3rd day and 5th day of storage. The test found positive on 7th day of refrigeration storage.

Keywords: Sensory, Physico- chemical, fortified, storage.

INTRODUCTION

Milk has been an important source of food for man since the dawn of civilization and regarded as an ideal food

from nutritional point of view milk is nature's the most nearly perfect food. It provides all the nutrient elements, essential for the human nourishment, it contains high

quality proteins, lactose, and flavor enriching fat, essential fatty acids, vitally essential amino acids, mineral, and vitamins in well balanced form in an easily digestible and assailable form. Milk components not only provide nutritional security but also are capable of providing potential health benefits in their various forms (Burrington, 1999). Transforming the milk into milk products have been developed from prehistoric times and practiced even today. The Indian milk production system is getting elevated in recent times according to the demands of the market which ultimately symbolizes the consumer taste. Milk shake is a western dairy product similar to soft serve ice cream mix obtained by freezing a mix with speedy mixing the frozen product in a mixer to make it pourable and generate foam in it, with lower fat and sugar contents and higher milk solids not fat (MSNF) than ice cream (Sharma and Gupta 1978). Recently, herbal products either in the form of food popularizes in the world market. Studies suggested as well the epidemiological data shows that the food containing phyto-chemical with anti-oxidation potential has strong protective effect against major disease risks including cancer, arthritis and cardiovascular disease (Kaur and Kapoor 2002). Dairy industry comes with the recent concept of fortifying the milk with different herbs and spices. Various value added milk products fortified with herbs and spices is been designed and commercialized in today's market globally. Spices are considered good source of minerals and medicinal property.

The scientific name of turmeric comes from Latin name "Curcuma Longa", which comes from the Arabic name for the plant, "Kurkum." and in Sanskrit is called "Haridra" (The Yellow One). It has been shown to counteract the inflammatory conditions, degenerative eye conditions, metabolic syndrome pain and to help in the management of other metabolic diseases.

Honey is a natural, sweet, viscous food produce that is formed from the nectar of flowers by honeybees (Apismellifera; Family: Apidae). Honey contains the most abundant amino acids proline, alongs with other eighteen free amino acids comprises trace amounts of the B vitamins riboflavin, niacin, folic acid, pantothenic acid, and vitamin B6, ascorbic acid (vitamin C), and the minerals calcium, iron, selenium, chromium, zinc, potassium, phosphorous, magnesium, and manganese. It also contain a number of enzymes like glucose oxidase, which converts glucose to gluconolactone, and yields gluconic acid and hydrogen peroxide; invertase, amylase, oxidase, catalase, selenium, and the flavonoids like pinocembrin (www.chm.bris.ac.uk), is unique to honey and bee propolis. The benefits of turmeric and honey are plenty including anti-inflammatory, antioxidant, and antibacterial properties. In the recent times, we came across the pandemic phase of COVID - 19, which embarks the universal consumption of herbs and spices in the diet. So, this study will focus to optimize the formulation with additional ingredients

which should be stable at refrigeration temperature. The Milkshake was prepared by following the procedure as described by Kuchekar *et al.* (2017) with suitable modification keeping in view of the present study. The sensory evaluation of product was carried out by the P.G. students and faculty members of the college of veterinary science, A.N.D.U.A.T., Kumarganj- Ayodhya by using seven-point hedonic scale based on the different characteristics and judged by them on the provided proforma.

MATERIAL AND METHODS

The Milk was obtained from the local market Kumarganj-Ayodhya. The honey of the reputed brand was purchase from the market of Kumarganj-Ayodhya. The turmeric variety "Narendra Haldi-1" was received from Vegetable Research Center, A.N.D.U.A.T., Kumarganj -Ayodhya. It is to mention here that "Narendra *Haldi -1" is the developed variety of this university and is among the highly appreciable one in terms of composition.

Processing of Turmeric: Turmeric (Narendra Haldi-1) was processed in order to obtain the readable powder form, by adopting the following procedure:

1. Fresh 'Narendra haldi-1' was obtain from vegetable research center, A.N.D.U.A.T., Kumarganj-Ayodhya.
2. **Washing:** 'Narendra haldi-1 was washed with potable water and white vinegar (3-4 times) to minimize dust contamination.
3. **Boiling:** The turmeric was pressure cooked in a pressure cooker at a temperature of 121 degree Celsius (3-4whistle).
4. **Cutting:** Boiled turmeric was cut with the knife into small and equal size.
5. **Drying:** Sun drying (7-8 days).
6. **Grinding:** Dried turmeric was grinded with the help of mixer grinder.
7. **Sieving:** Grinded turmeric powder was sieved with the help of muslin cloth.
8. **Storage:** Turmeric powder was stored in air tight container for further experiments under dried conditions. Analytical grade chemical was used for chemical analysis of for tified milk shake. The storage study of the fortified milk shake was carried out in the closed lid Glass bottles of 100 ml capacity.

The fortified milk shake was prepared as per the protocol given by Kuchekar *et al.* (2017), with the suitable modifications keeping in view for the current study. Standardization of the level of honey as sugar replacer and turmeric in the fortified milk shake. The four different levels of Honey (5%, 10%, 15%, and 20%) and Turmeric (0.1%, 0.3%, 0.5%, and 0.7%) were tried, of different combination as per the Table 1.

Sensory Evaluation: The sensory evaluation of product was been carried out by the panelists using seven-point hedonic scale based on the different characteristics and marks were given by the panelist on the provided

Performa as per Table 2. The sensory quality of samples was evaluated using 7 point descriptive scale, where, 7 to 1 denotes Excellent, very good, Good, Average, Poor, Very poor, Unacceptable respectively. Evaluation of the product for different quality attributes viz., appearance and colour, flavour, Consistency, texture, Sedimentation, Mouth feel and overall acceptability was carried out by the panelists. On the basis of sensory evaluation by the

panelists, the best combination was selected. To study the sensory and physicochemical characteristics of the fortified milk shake under refrigeration temperature. The best combination on the basis of sensory characteristics was taken and carried further for the study of the sensory and physico-chemical characteristics under refrigeration temperature (5±1 °C).

Table 1: Different Combinations of Honey and Turmeric Level.

Turmeric Level		0.1 %	0.3%	0.5%	0.7%
Honey Level	5%	5%+0.1% Sample-A	5%+0.3% Sample-B	5%+0.5% Sample-C	5%+0.7% Sample-D
	10%	10%+0.1% Sample-E	10%+0.3% Sample-F	10%+0.5% Sample-G	10%+0.7% Sample-H
	15%	15%+0.1% Sample-I	15%+0.3% Sample-J	15%+0.5% Sample-K	15%+0.7% Sample-L
	20%	20%+0.1% Sample-M	20%+0.3% Sample-N	20%+0.5% Sample-O	20%+0.7% Sample-P

Table 2: Performa for the Sensory Evaluation of Fortified Milk Shake.

Sensory Attributes	7	6	5	4	3	2	1
Appearance and Colour	Excellent	Very Good	Good	Average	Poor	Very Poor	Unacceptable
Flavor	Excellent	Very Good	Good	Average	Poor	Very Poor	Unacceptable
Consistency	Excellent	Very Good	Good	Average	Poor	Very Poor	Unacceptable
Texture	Excellent	Very Good	Good	Average	Poor	Very Poor	Unacceptable
Sedimentation	Excellent	Very Good	Good	Average	Poor	Very Poor	Unacceptable
Mouth Feel	Excellent	Very Good	Good	Average	Poor	Very Poor	Unacceptable
Overall Acceptability	Excellent	Very Good	Good	Average	Poor	Very Poor	Unacceptable

Physico-chemical analysis:

pH- The pH of fortified milk shake were measured with digital pH meter.

Acidity- Titratable acidity of the fortified milk shake was estimated by using procedure of the % acidity were calculated by the formula:

Titratable acidity of the sample was calculated Formula as per FAO (1999)

$$\% \text{ Acidity} = \frac{\text{No. of ml of N/10 NAOH used} \times 0.009}{\text{wt. of milk}} \times 100$$

Specific Gravity. Lactometer reading of the fortified milk shake was taken by using the standard Lactometer reading procedure and the specific gravity was calculated by the formula:

$$\text{Specific gravity} = \frac{\text{Correct Lactometer reading (C. L. R.)}}{100} + 1$$

Total solids and solids not fat. The total solid and solids not fat was be calculated by the Richmond's Formula, viz.,

$$\% \text{ TS} = \frac{G}{4} + 1.2F + 0.14$$

Where, G is the correct lactometer reading F is fat content of milk

$$\% \text{ S.N.F.} = \frac{G}{4} + 0.2F + 0.14$$

Where, G is the correct lactometer reading
F is fat content of milk

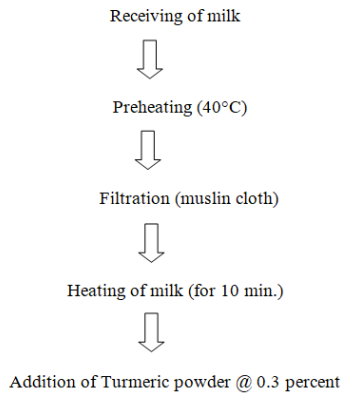
Clot on Boiling (COB)- 5 ml of milk sample was taken in a clean test tube and the sample was heated over the flame for 2 minutes. The observation was done for the coagulation / curdling of the respective milk sample stored under refrigeration temperature for different days.

Statistical analysis: Trails of each experiment were carried out and the Parameter was analyzed by one way ANOVA using graphpad prism software (version 8.02) for comparison test.

RESULT AND DISCUSSION

To optimize the process of fortified milk shake. The milkshake was prepared as per the protocol given by Kuchekar *et al.* (2017) with the suitable modification in view of the current study.

Preparation of turmeric fortified milk shake Flow Diagram



Standardization of the Level of Honey and Turmeric in Fortified milkshake: The four different levels of honey and turmeric were tried in different combinations as per the Table 1, the sensory scores given by the different panelist for each sample was evaluated. The Mean and Standard error of the sensory scores of Fortified milk shake with varying levels of Honey and Turmeric are presented in Table 3.

Table 3: The Mean and Standard error of the sensory scores of Fortified milk shake with varying levels of Honey and Turmeric standardized.

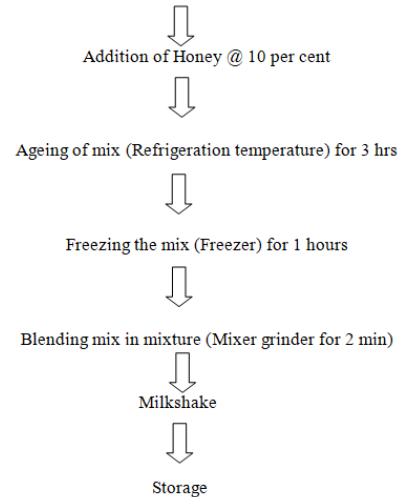
Sample	Appearance & colour	Flavour	Consistency	Texture	Sedimentation	Mouth feel	Overall acceptability
Control	5.66±0.18	6.33±0.18	5.33±0.18	5.66±0.18	5.66±0.18	5±0.32	5.33±0.37 ^a
A	2.66±0.18	3.33±0.18	3±0.32	3.33±0.18	3.33±0.18	3±0.32	3±0.32 ^c
B	3.33±0.18	4±0.32	3.66±0.37	3.33±0.18	4.33±0.18	3.66±0.37	3.33±0.18 ^c
C	4±0.32	4±0.32	4±0.32	4.33±0.18	4.33±0.18	3.66±0.37	4±0.32 ^c
D	5±0.32	4.66±0.18	4.66±0.18	4.66±0.18	4.33±0.18	4.66±0.18	4.66±0.18 ^{a,c}
E	4.33±0.18	5.33±0.18	5.33±0.18	5.33±0.18	5.66±0.18	5±0.32	5.33±0.37 ^c
F	6.66±0.18	6.66±0.18	6.33±0.18	6.33±0.18	6.33±0.18	6.33±0.18	6.66±0.18 ^b
G	5.66±0.18	6.33±0.18	5.33±0.18	5.66±0.18	5.66±0.18	5±0.32	5.33±0.37 ^a
H	5.33±0.18	6±0.32	5.33±0.18	5.66±0.18	5.33±0.18	5.33±0.18	5.33±0.18 ^a
I	5.33±0.18	5.33±0.18	5.33±0.18	5.33±0.18	5.33±0.18	4.66±0.18	4.66±0.18 ^{a,c}
J	4.66±0.18	4.66±0.18	4.66±0.18	4.33±0.18	4.33±0.18	4.33±0.18	4.66±0.18 ^{a,c}
K	4.33±0.18	3.66±0.18	3.66±0.18	4.33±0.18	3.66±0.18	3.66±0.18	3.66±0.18 ^c
L	3.66±0.18	3.66±0.18	3.66±0.18	3.33±0.18	3.66±0.18	3.66±0.18	3.33±0.18 ^{d,c}
M	2.66±0.18	3±0.32	3±0.32	3±0.32	3.33±0.37	3±0.32	3.33±0.18 ^{d,c}
N	2.66±0.18	2.66±0.18	2.66±0.18	3.33±0.18	3±0.32	3±0.32	2.33±0.18 ^c
O	2.33±0.18	2.66±0.18	2.66±0.18	2.66±0.18	2.33±0.18	2.66±0.18	2.33±0.18 ^c
P	2.33±0.18	2.33±0.18	2.33±0.18	2.33±0.18	2.33±0.18	2.33±0.18	2.33±0.18 ^c

NS-non significant (P>0.05), *significant (P<0.05), **highly significant

The sensory score was rated “good” to “very good” by panelist on 5th day of storage which might be due to use of honey at respective level, since it prevents lipid oxidation of the milk fat and reduces the off flavour developed during storage. Our finding suggests the use of glass container with air tight lid for the storage of the fortified milkshake in order to prevent the lipid oxidation and off flavour during the storage.

Study on the physico-chemical characteristic of the Fortified milk shake under refrigeration temperature. The Mean and Standard error of the pH scores of fortified milk shake at refrigeration temperature was found 6.69±0.003 on 7th day of storage is presented in Table 5.

Study of the Sensory characteristics of the Fortified milk shake under refrigeration temperature. The mean and standard error of the sensory scores of fortified milk shake with varying levels of Honey and Turmeric standardized are presented in Table 4.



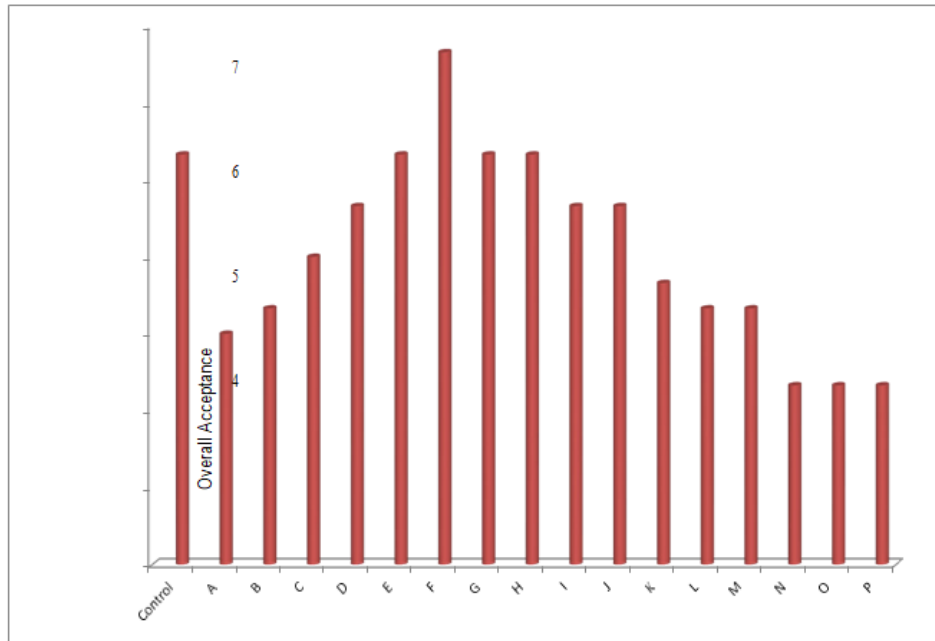


Fig. 1. The Mean and Standard error of the sensory scores of Fortified milk shake with varying levels of Honey and Turmeric standardized.

Table 4: Study on the sensory characteristics of F.M.S. storage at refrigeration temperature.

Parameters	0 Day	3 Day	5 Day	P value
Appearance & Colour	6.66±0.18 ^a	6.33±0.18 ^{ab}	5.66±0.18 ^b	0.0203 *
Flavour	6.66±0.18 ^a	5.66±0.18 ^b	5.66±0.18 ^b	0.0115*
Consistency	6.33±0.18	6±0.18	6±0.18	0.3860^{NS}
Texture	6.33±0.18	6.33±0.18	5.66±0.18	0.0611^{NS}
Sedimentation	6.33±0.18	6.33±0.18	6±0.32	0.5546^{NS}
Mouth feel	6.33±0.18	6±0.32	5.66±0.18	0.2142^{NS}
Overall acceptability	6.66±0.18	6.33±0.37	6±0.00	0.2254^{NS}

NS-non significant (P>0.05), *significant (P<0.05), **highly significant (P<0.01)

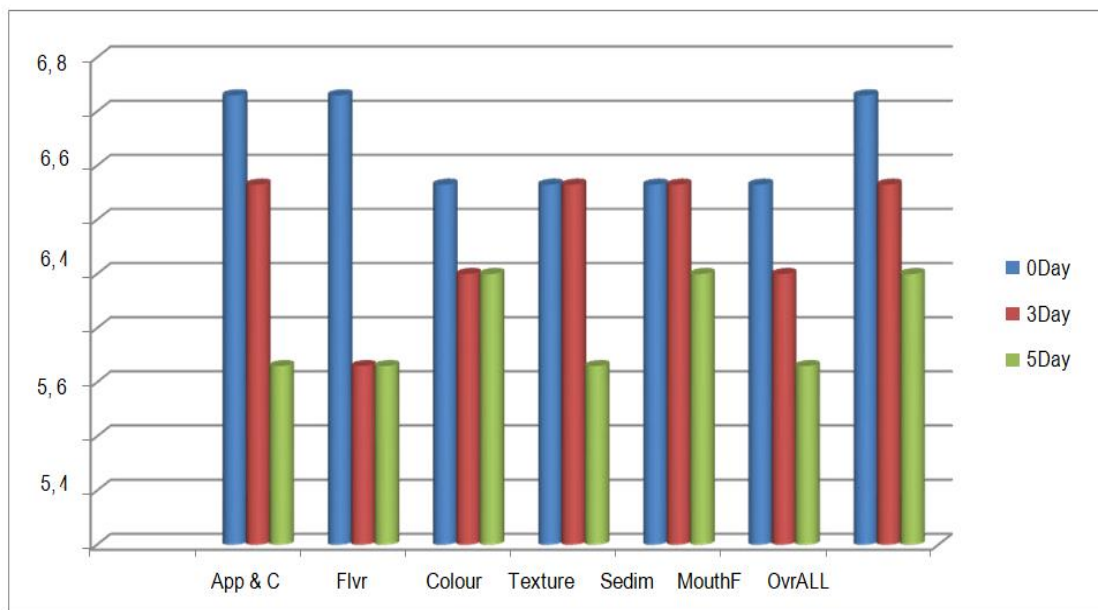


Fig. 2. Study on the sensory characteristics of F.M.S. storage at refrigeration temperature.

This findings is in agreement with Gaur *et al.* (2019) in which addition of turmeric powder at the level of 0.1% had significant effect on the specific gravity of herbal milk. The value of mean had the non-significant change in the Total Solid (T.S.) of fortified milk shake at refrigeration temperature and was found 12.95±0.02 on 7th day of storage. Johri and Chauhan (2014) determined total solid content of 14.96% in misthidoi

prepared with Tulsi extract which was in accordance findings. The value of mean and error clearly defined the non-significant change in the Solids Not Fat (S.N.F.) of different between the days of storage and found 7.93±0.21. On 5th day of storage, COB test was found negative on the 7th day storage of the fortified milk shake, the clot on boiling test was found positive since the curdling of milk occurs.

Table 5.

Parameter	0 Day	3 Day	5 Day	7 Day	P Value
pH	6.72±0.004 ^a	6.70±0.003 ^b	6.7±0.003 ^b	6.69±0.003 ^b	0.0013 ^{**}
Acidity	0.13±0.003 ^a	0.15±0.003 ^b	0.18±0.001 ^c	0.23±0.003 ^d	<0.0001 ^{**}
S.G.	1.028±0.01 ^{NS}	1.030±0.01 ^{NS}	1.030±0.002 ^{NS}	1.031±0.001 ^{NS}	0.9921
T.S.	12.88±0.004 ^{NS}	12.90±0.004 ^{NS}	12.91±0.003 ^{NS}	12.95±0.02 ^{NS}	> 0.999
S.N.F.	7.90±0.19 ^{NS}	7.90±0.19 ^{NS}	7.93±0.21 ^{NS}	7.93±0.21 ^{NS}	0.999
pH	6.72±0.004 ^a	6.70±0.003 ^b	6.7±0.003 ^b	6.69±0.003 ^b	0.0013 ^{**}
C.O.B.	Negative	Negative	Negative	Positive	

NS-non significant (P>0.05); *significant (P<0.05); **highly significant (P<0.01)

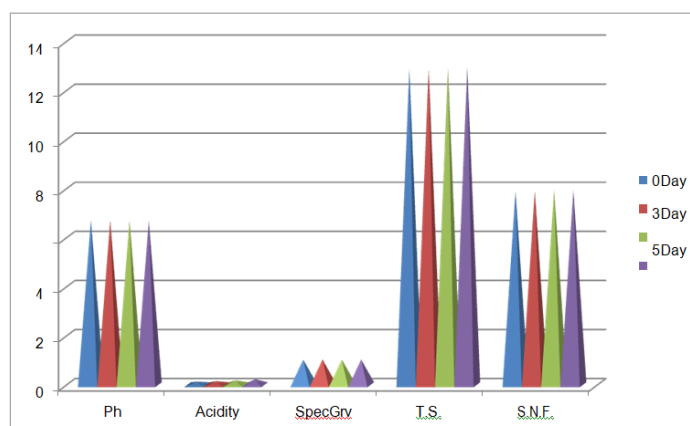


Fig. 3. The different parameter of mean and error of different the day of storage fortified milk shake at refrigeration temperature.

CONCLUSIONS

1. The processing protocol for preparation of fortified milk shake was optimized.
2. Different ingredient and their level were optimized and formulation for fortified milk shake was developed keeping in view the requirement of the products.
3. Study on the sensory and physico-chemical parameter of fortified milk shake at refrigeration temperature (5±1°C) work conducted.
4. The fortified milk shake was rated very good on the basis of sensory and physico-chemical attributes and was observed safe for consumption.

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