

## RESEARCH ARTICLE

# Optimisation of the *Shrikhand* incorporated with lemongrass (*Cymbopogon citratus*) distillate

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**Abstract:** *Shrikhand* is a fermented milk product prepared from Chakka, a finely ground sugar and flavouring ingredient. Fermentation is a process of adding value to raw materials by converting them with microorganisms and enzymes into a variety of products with different nutritional and sensory qualities. The purpose of this study was to standardize the optimum level of lemongrass distillate in the manufacturing of *Shrikhand*, with the major goal of evaluating the product organoleptically, physico-chemically, and microbiologically. *Shrikhand* was prepared with lemongrass distillate replacing sugar with jaggery powder (28%) used as a sweetener in *Shrikhand*. Different levels of lemongrass distillate viz. 0.5%, 1% and 1.5% were tried and 28% jaggery powder was used as a sweetener. *Shrikhand* with 0.5% lemongrass distillate ( $T_1$ ) showed better sensory attributes as compared to others. The optimized product contained 38.24% carbohydrate, 8.34% protein, 11.90% fat, 0.99% ash, 59.37% total solids, 40.63% moisture, 0.99% titratable acidity, 94.48% antioxidant activity, 0.04% crude fiber, 2.28mg vitamin C and 282.07 kcal Energy. Thus, product acceptability as judged by sensory evaluation, was rated as  $T_2 > T_1 > T_0 > T_3$ .

**Keywords:** Chakka, lemongrass distillate, *Shrikhand*, Antioxidant activity, Jaggery

## Introduction

Presently, Dairy is the single largest agricultural commodity contributing 5 per cent of the national economy and employing more than 8 crore farmers directly. India is ranked 1st in milk production contributing 23 per cent of global milk production. Milk production in the country has grown at a compound annual

growth rate of about 6.2 per cent to reach 209.96 million tons in 2020-21 from 146.31 million tonnes in 2014-15 (Economic Survey 2022). This increase in milk production represents sustained growth in TIDPs (Traditional Indian Dairy Products) to meet the requirement of the growing population. The market for TIDPs is the second-highest after fluid milk, and accounts for 95 % of all the milk-based products consumed (Rasane et al. 2015). The milk and milk products are so valued that the National Institute of Nutrition of India (NIN, 2011), and US Department of Agriculture (USDA 2022), and the Food and Agriculture Organization (FAO 1990), have recommended it in their dietary guidelines. TIDPs are highly valued in society due to their social, economic, religious, medicinal, and cultural significance (Rasane et al. 2015). Currently, there is a lack of reliable data about the exact quantity of milk used for the production of TIDPs (Sanyal 2020).

*Shrikhand* is a semi-solid, sweetish-sour fermented milk product made from Dahi. Whey is drained from Dahi to give Chakka, which is then mixed with sugar, flavour, color, and spices to form a soft homogeneous mass. *Shrikhand* is a popular dessert that is served as part of a festive meal. *Shrikhand* is known for its high nutritive, characteristic flavour, taste, palatable nature and possible therapeutic value. It is very refreshing particularly during summer months. It can be recommended as health food for specific patients suffering from obesity and cardiovascular disease (Swapna and Chavannavar 2013).

Fermented milk products have a long history of use in human nutrition. Protein, vitamins, and minerals are abundant in fermented milk products. Constipation, diarrhea, acidity, gastroenteritis, gingivitis, tumor genesis, hypercholesterolemia,

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and other disorders have been claimed to be mitigated successfully by consumption of fermented milks (Hadjimbei et al. 2022). Different colorants and flavouring agents are commonly used to improve the colour, flavour, and overall acceptability of milk products. Charoli, nutmeg, cardamom, and saffron were once used to enhance the flavour and acceptance of *Shrikhand*. However, multiple attempts have been made to mix various additives into *Shrikhand* in order to accommodate the growing desire in diversifying food products in order to appeal to a wider spectrum of consumers.

Lemongrass (*Cymbopogon citratus*) is an aromatic perennial tall grass with rhizomes and densely tufted fibrous root. It has short underground stems with ringed segments, coarse, green slightly leathery leaves in dense clusters (Figueirinha et al. 2008).

Lemongrass is used to flavour tea and in dishes like kadha, a traditional herbal soup used to treat coughs, colds, and other ailments. It's also high in -ione, which is used to make synthetic vitamin A, and - ionone, which is the key flavouring ingredient. Citral, an aromatic molecule also known as lemonal, is the major chemical component found in lemongrass. It's an antibacterial, which means it may kill or prevent microbes from growing. Citral also contains anti-fungal properties. It also has a positive effect on the body's ability to use Vitamin A.

Lemongrass has high antioxidant capacity and free radical scavenging effect of hydro-alcoholic extract of *Cymbopogon citratus* was established (Rao et al. 2009). Mirghani et al (2012) collected lemongrass leaves from Kuala Lumpur state of Malaysia for evaluating the antioxidant potential of its oil. The results showed that the phenolic concentration in lemongrass oil was 2100.769 mg/l GAE, DPPH scavenging activity for lemongrass stalk was 89.5% and highest degree of inhibitory activity in anti-diabetic tests was found as 89.63%.

Jaggery contains considerable amount of ferrous salts (iron), which are good for health, particularly for those who are anemic or lack iron. Jaggery is very good as cleansing agent. It cleans lungs, stomach, intestines, oesophagus and respiratory tracts. Jaggery helps to prevent asthma, cough, cold, congestion in chest etc. Jaggery is supplied to the workers to prevent them from dust allergies (Shrivastav et al. 2016). Jaggery is far complex than sugar, as it is made up of longer chains of sucrose. Hence, it is digested slower than sugar and releases energy slowly and not spontaneously. Jaggery is generally called as "medicinal sugar" because of its use in Ayurveda as well as its comparison with honey (APEDA 2016). The objective of this research is to standardize the process of production of *Shrikhand* with different concentrations of lemongrass distillate and keeping jaggery concentration constant, along with evaluation of the physico-chemical, microbiological, and sensory properties of the final product. The final product's cost and shelf life were also evaluated.

## Materials and Methods

### Raw materials

#### Milk and other items

The whole fresh and clean standardized fresh milk was procured from Ajmer Saras Dairy plant having 6.0 percent fat and 9 percent SNF. Lemongrass and jaggery powder were procured from local market

#### Preparation of lemongrass distillate

Lemongrass leaves were freshly collected and rinsed using water to wash away any debris and dust. The leaves were broken up into little pieces and put through a grinder. 100 g of the ground leaves added with 1000 ml of distilled water were transferred to 2000 ml round bottom flask and mixed. After the mixture was boiled, the vapours were condensed in a 100 ml conical flask after being collected over an ice bath. Using aluminum foil, the flask was quickly sealed tightly before being placed in the refrigerator. To determine the amount of leaves to be used, the amount of water to be utilized, the amount of distillate to be collected, etc., preliminary trials were conducted. From 100 g of lemongrass leaves, it was found that roughly 35 ml of distillate collection was sufficient to extract the majority of the aromatic components (Sutariya and Rao 2015).

#### Preparation of control sample

The control sample was prepared according to De (2013) with a slight modification. The milk procured (4-7°C) was heat treated at 85°C for 30 min and used for dahi (yoghurt) preparation.

#### Preparation of experimental lemongrass *Shrikhand*

The experimental *shrikhand* from dahi (yoghurt) was prepared by the process as shown in Figure 1. The *shrikhand* samples thus prepared were packaged in polystyrene cups and stored at 4-5°C.

#### Sensory analysis

Optimized *Shrikhand* with lemongrass distillate was evaluated for organoleptic properties by using 9-point Hedonic scale designed and described by Munoz and King (2007).

#### Microbiological analysis

Yeast and mold count and coli form counts were determined as per procedure laid down in BIS (1981).

**Physico-chemical analysis of control and experimental *Shrikhand***

Total solids and moisture was measured using the procedure outlined in AOAC (2005).

The technique, as defined in AOAC (2005) for cheese, was used to determine fat. *Shrikhand's* total nitrogen/protein was evaluated using the Semi Micro Kjeldahl technique (IS: 1479 Part II 1961). The ash content of all the samples was evaluated using the IS: 1479 Part II technique (1961) mentioned for milk. *Shrikhand's* acidity was determined using a method published in IS: 1166 (1986) for condensed milk. The carbohydrate content was determined using the differential technique (AOAC 2005).

The pH was measured using a digital pH meter in accordance with the AOAC guidelines (2005).

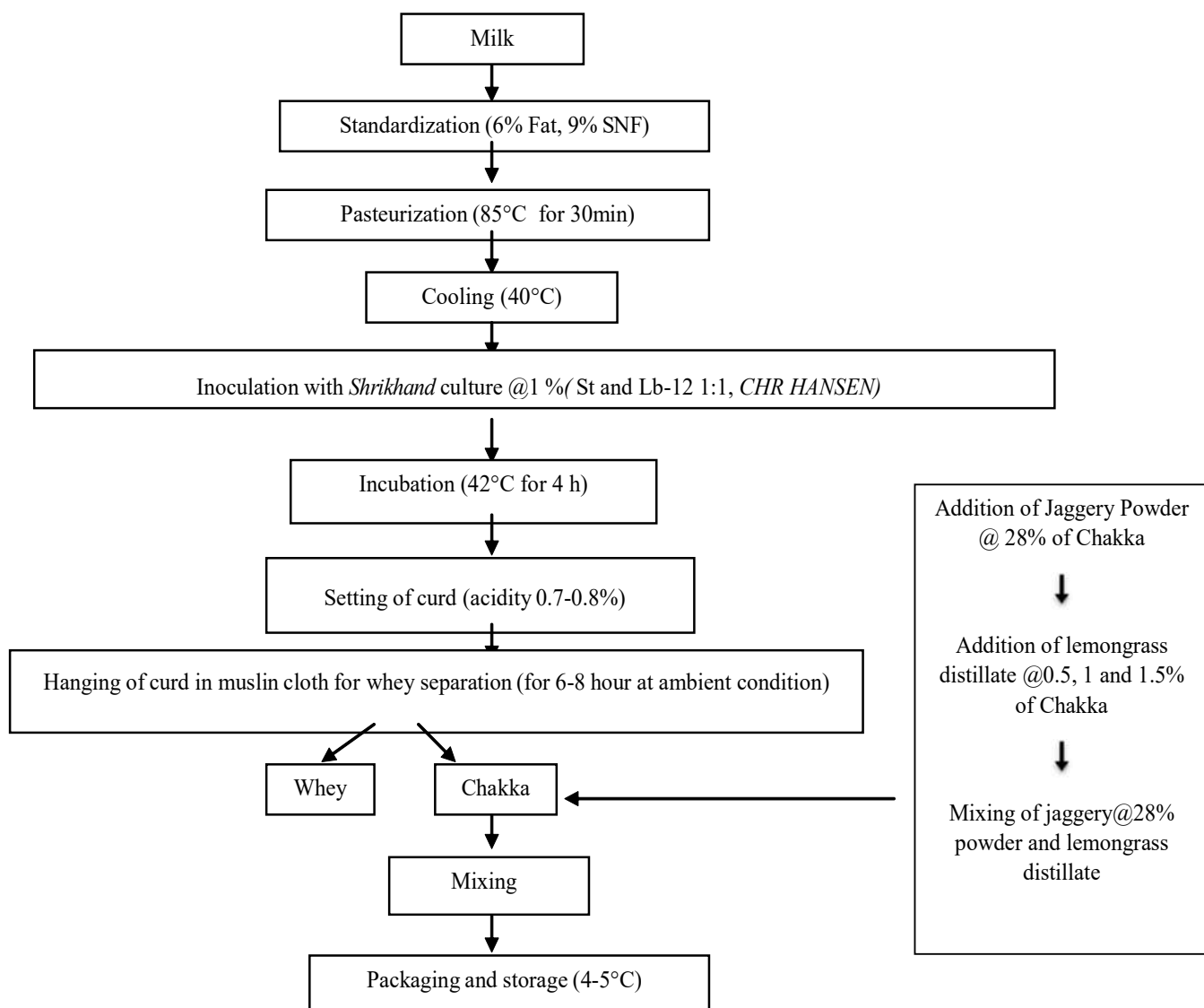
**Antioxidant activity**

The antioxidant activity of control and experimental *Shrikhand* was done using DPPH (2, 2-diphenyl-1-picrylhydrazyl) method reported by Chanda and Dave (2009) using stable DPPH. The results were expressed as percent inhibition using the formula.

$$\text{DPPH inhibition percentage (\%I)} = \frac{A_0 - AS}{A_0} \times 100$$

Where, A0 is the absorbance of the control, AS is the absorbance in the presence of the sample.

Crude fiber, vitamin C, Ca, P and energy contents were determined as per AOAC (2005).



**Fig. 1** Process flow chart for the manufacturing of experimental *Shrikhand* (Source: De 2013 with slight modification)

## Statistical analysis

WASP software and Excel software were used to analyze the data using Analysis of Variance (ANOVA) at a 5% level of significance and critical difference (C.D).

## Cost estimation

The cost estimation of the formulated product was done to compare it with the options available in the market.

## Result and Discussion

### Optimization of lemongrass distillate

Optimization of experimental *Shrikhand* was based on sensory assessments. Table 1 shows the data of sensory analysis of control and experimental *Shrikhand* with different level of lemongrass distillate. It was noticed that the increasing concentration of lemongrass distillate first increased the acceptability of sensory parameters such as flavor, body and texture and overall acceptability and then decreased them. Therefore, *Shrikhand* with low level of lemongrass distillate i.e., 0.5% was most preferred. At 1% and 1.5%, level of lemongrass distillate, the scores though in acceptable range, were less because of acrid smell and astringent flavor of lemongrass distillate. Hence, *Shrikhand* with 0.5% lemongrass distillate and 28% of jaggery powder was acceptable in sensory parameters without causing adverse effect and considered as optimized lemongrass *Shrikhand*. (Sameem et al. 2018) also reported similar trend in dragon fruit pulp *Shrikhand*, where with increased concentration of dragon fruit pulp (0-9%), decreased sensory score are given by the panelists.

### Proximate composition of control and experimental samples of *Shrikhand*:

The proximate analysis result of control and experimental *Shrikhand* is shown in Table 1. There were significant differences observed in the carbohydrate content of control and experimental *Shrikhand*. Its value ranged from 39.74% to 37.26% for different treatments. After adding lemongrass distillate in Chakka and keeping the jaggery powder constant, the carbohydrate content from the final product was reduced. Protein of *Shrikhand* samples ranged between 8.15%- 8.80% for different treatments. The fat content ranged between 12.22% - 11.31%. Ash content of the control and experimental *Shrikhand* treatments ranged between 0.95%- 1.10%; ash content represents minerals present in food. Jaggery contains significant amounts of minerals (Jabeen Begum 2023). Total solid percentage ranged between 61.06%-58.27%, the declining trend in control and experimental *Shrikhand* can be attributed to the fact that addition of lemongrass distillate and jaggery powder significantly decreases the total solid percentage as it contains more moisture. There were significant differences observed in the moisture content of control and experimental *Shrikhand* treatments. Its value ranged from 38.97%- 41.73%.

The moisture content from the control product increased due to addition of lemongrass distillate. Titratable acidity of control and experimental *Shrikhand* treatments was observed in increasing manner ranging from 0.97%-1.02%. Titratable acidity is inversely proportional to pH. Its values ranged from 4.71-4.58. The difference was significant, indicating significant effect of treatments on pH. The crude fiber percentage of the control was found to be nil, whereas crude fiber content in the different treatments of experimental lemongrass *Shrikhand* was found to be 0.04, 0.05 and 0.08. However, the jaggery could be source of fibre in the experimental samples. The energy value for the experimental and control treatments was 280.92±0.53 to 282.40±0.03kcal/100g. The results regarding the increase and decrease in proximate composition of experimental lemongrass *Shrikhand* and control are similar to the findings of Sameem et al (2018) and Masih et al (2020).

### Antioxidant activity

The value represented in Table 1 of antioxidant activity in term of DPPH (% Radical scavenging activity) was found to be 92.95% for the control and 94.48%, 95.44% and 97.24% for experimental treatments respectively. When the result of control *Shrikhand* and experimental *Shrikhand* treatments were compared, increased antioxidant activity percentage of experimental *Shrikhand* treatments was found because of lemongrass distillate and jaggery powder, as they have good free radical scavenging property. Methanol, MeOH/water extracts, infusion and decoction of *Cymbopogon citratus* were shown to have free radical scavenging effects by measuring the bleaching of the 1, 1-diphenyl-2-picryl-hydrazyl (DPPH) radical, scavenging of the superoxide anion and inhibition of the enzyme xanthine oxidase and lipid peroxidation in human erythrocytes (Cheel et al. 2005).

### Vitamin C

Table 1 shows the Vitamin C content of control and experimental *Shrikhand* treatments. Vitamin C content in experimental *Shrikhand* treatments was 2.28 mg/100g, 2.46 mg/100g and 2.65 mg/100g which was higher than that of the control sample (1.90 mg/100g). Jaggery added could be the source for vitamin C content. Plant-based foods include a significant amount of polyphenols and flavonoids, which have antioxidant and nutritional benefits. Increase in Vitamin C content relates to the presence of lemongrass distillate.

### Calcium

The results shown in Table 1, revealed that the average of calcium value were 107.90mg/100g for control and 108.09, 108.39 and 108.61 for experimental samples (T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>), respectively. The calcium contents of experimental samples could be traced to the added jaggery which contains significant amounts of calcium (Jabeen Begum 2023).

**Phosphorus**

The phosphorus content in control sample and experimental treatments was 60.88(mg/100g) and 61.24, 61.63 and, 61.90(mg/100g) for T<sub>1</sub>, T<sub>2</sub> and T<sub>3</sub>, respectively. The nutritional importance

of the *Shrikhand* is increased by its higher mineral content. The quality of milk used for the preparation of Chakka may be attributed to the higher content of the mineral. According to Boghra, the Chakka's mineral composition could significantly change as a

**Table 1:** Physico-chemical, microbial and sensory analysis of control and experimental lemongrass *Shrikhand*

Parameters	Treatments				C.D	F VALUE
	T <sub>0</sub>	T <sub>1</sub>	T <sub>2</sub>	T <sub>3</sub>		
Physico-chemical analysis						
Carbohydrate (%)	39.74±0.10	38.24±0.02	37.51±0.05	37.26±0.02	0.09	1337.84
Protein (%)	8.15±0.03	8.34±0.06	8.64±0.06	8.80±0.04	0.09	111.46
Fat (%)	12.22±0.05	11.90±0.10	11.54±0.03	11.31±0.06	0.10	144.28
Ash (%)	0.95±0.01	0.99±0.02	1.06±0.02	1.10±0.02	0.02	67.57
Total Solid (%)	61.06±0.07	59.37±0.02	58.55±0.04	58.27±0.03	0.08	2346.91
Moisture (%)	38.97±0.03	40.63±0.15	41.45±0.08	41.73±0.07	0.15	388.44
Titratable acidity (%) LA#	0.97±0.01	0.99±0.00	1.00±0.01	1.02±0.00	0.02	11.52
pH	4.71±0.01	4.66±0.01	4.64±0.03	4.58±0.03	0.04	22.84
Anti-oxidant activity(%Radical scavenging activity)	92.95±0.33	94.48±0.20	95.44±0.43	97.24±0.45	0.44	157.96
Crude fiber (%)	0.00±0.00	0.04±0.01	0.05±0.01	0.08±0.01	0.02	37.84
Vitamin C(mg/100g)	1.90±0.02	2.28±0.01	2.46±0.01	2.65±0.02	0.05	1433.04
Energy(kcal/100g)	280.92±0.53	282.07±0.02	282.22±0.03	282.40±0.03	0.40	26.40
Calcium(mg/100g)	107.90±0.02	108.09±0.04	108.39±0.03	108.61±0.03	0.04	657.74
Phosphorus(mg/100g)	60.88±0.03	61.24±0.03	61.63±0.03	61.90±0.02	0.06	979.31
Microbial analysis						
Yeast and mould count (cfu/g)	19.00±0.48	20.60±0.74	21.20±0.80	22.00±0.40	1.17	3.82
Coliform count (cfu/g)	NIL	NIL	NIL	NIL	NIL	
Sensory analysis						
Colour and appearance	7.20±0.40	8.20±0.40	8.60±0.48	8.40±0.48	0.59	10.5455
Flavour	7.60±0.48	8.40±0.48	7.80±0.40	7.00±0.63	0.74	5.71429
Body and texture	8.60±0.17	9.32±0.11	8.70±0.12	8.64±0.10	0.21	25.8502
Overall acceptability	8.42±0.33	8.70±0.21	8.08±0.24	7.70±0.22	0.38	11.9463

- Results are mean of five determinations ± SD (standard deviation)
- #as Lactic Acid. T<sub>0</sub> – Control; , T<sub>1</sub>- Shrikhand with 0.5% lemongrass distillate; , T<sub>2</sub>- Shrikhand with 1.0% lemongrass distillate; and T<sub>3</sub> - Shrikhand with 1.5% lemongrass distillate

**Table 2:** Storage related changes in overall acceptability and yeast and mould count of control and experimental lemongrass *Shrikhand*

Treatment	Storage period (Days)					
	Overall acceptability					
	0	3	6	9	12	15
T <sub>0</sub>	8.50	8.40	8.40	8.00	7.50	7.00
T <sub>1</sub>	8.70	8.50	8.20	8.20	8.00	7.50
T <sub>2</sub>	8.08	8.00	8.00	8.00	7.50	7.00
T <sub>3</sub>	7.70	7.50	7.50	7.00	7.00	6.00
YMC						
T <sub>0</sub>	19.00	20.00	22.00	25.00	28.00	31.00
T <sub>1</sub>	20.60	22.00	24.00	26.00	28.00	30.00
T <sub>2</sub>	21.20	22.00	24.00	27.00	29.00	30.00
T <sub>3</sub>	22.00	22.00	23.00	25.00	27.00	30.00

**Table 3:** Cost estimation of control and experimental lemongrass *Shrikhand*

S. No.	Particulars	Cost(Rs/kg)	Qty	T <sub>0</sub>		T <sub>1</sub>		T <sub>2</sub>		T <sub>3</sub>	
				Amt. (Rs)	Qty	Amt. (Rs)	Qty	Amt. (Rs)	Qty	Amt. (Rs)	Qty
1.	Milk (g)	56	1000	56	1000	56	1000	56	1000	56	1000
2.	Chakka obtained(g)	-	350	-	350	-	350	-	350	-	350
3.	Jaggery powder (g)	140	100	14	100	14	100	14	100	14	100
4.	Lemongrass (1000 g)	200	-	-	2.26	0.45	4.54	0.91	6.75	1.35	-
5.	<i>Shrikhand</i> culture	-	--	1.8	-	1.8	-	1.8	-	1.8	-
6.	Total product obtained (g)	-	450	-	152.26	-	454.54	-	456.75	-	-
7.	Miscellaneous	-	-	10	-	10	-	10	-	10	-
8.	Labour charges	-	-	10	-	10	-	10	-	10	-
9.	Total cost of product obtained (Rs)	-	-	91.8	-	92.25	-	92.71	-	93.15	-
10.	Total cost, Rs per kg	-	-	204	-	205	-	206.02	-	207	-
11.	Total cost Rs per 100g	-	-	20.4	-	20.5	-	20.60	-	20.7	-

result of the fermenting process. The calcium contents of experimental samples could be traced to the added jaggery which contains significant amounts of phosphorus (Jabeen Begum 2023).

### Microbial analysis

Yeast and mold count and coliform counts are the basic tests for food safety from a microbiological standpoint. The result of yeast and mold count and coliform counts of control and experimental *Shrikhand* treatments are shown in Table 1. The coliform count was nil because of the properly maintained hygienic conditions during the preparation of the treatments, whereas yeast and mold growth was observed.

### Storage study

The overall acceptability scores including sensory parameters of the control and experimental lemongrass *Shrikhand* during the storage at 4-5°C are shown in Table 2. The mean scores of overall acceptability also showed a significantly decreasing trend with increasing storage days for both control as well as treatment samples. Devi et al (2018) added mango pulp (25% on chakka basis) in *Shrikhand* and observed that a significant effect of storage was observed on the entire sensory parameters.

### Microbial analysis of control and developed *Shrikhand* during storage

On days 3, 6, 9, 12, and 15 of storage, the amount of yeast and mould increased. The rise in titratable acidity of different treatments may be responsible for the increase in the number of

yeast and mould. Increased yeast and mould counts are signs that dairy products are deteriorated as shown in Table 2.

### Cost estimation

The calculation for cost estimation was done for 1000g of control and experimental *Shrikhand*. Cost analysis calculation are shown in Table 3. The cost for control and experimental *Shrikhand* treatments (developed product) were 204 (T<sub>0</sub>), 205(T<sub>1</sub>), 206.02(T<sub>2</sub>) and 207(T<sub>3</sub>) per 1000g. The cost of developed lemongrass *Shrikhand* was lower as compared to market *Shrikhand* as these costs did not include state taxes, sale commission, etc. The findings of the present cost investigation are similar to Waghmare et al (2019) in ginger powder *Shrikhand*, where cost of most acceptable quality ginger *Shrikhand* (T<sub>2</sub>) was Rs.153.1 per kg.

### Conclusion

It can be concluded from the results obtained that the *Shrikhand* can be successfully prepared by using milk, jaggery (added @28% of Chakka) and lemongrass distillate. The product prepared was found to have high anti-oxidant activity, energy value and vitamin C content, owing to the jaggery and lemongrass distillate. The developed product can be stored up to 15 days at 5°C. As a result, we can assert that our product not only offers significant health advantages but also is affordable and suitable for consumption by people from all socio-economic groups.

### References

APEDA (2016) The Agriculture and Processed Food product Export Development Authority. Govt. of India. <http://agriexchange.apeda.gov.in/Market%20Profile/one/TOMATO.aspx>

- AOAC (2005) Official methods of analysis. Association of Official Analytical Chemists, Washington DC, USA. 18th edition
- BIS (1981) Hand Book of Food Analysis. SP: 18 (Part XI - 1981) Dairy products. Bureau of Indian Standards, New Delhi
- Chanda S, Dave R (2009) *In vitro* models for antioxidant activity evaluation and some medicinal plants possessing antioxidant properties: an overview. African J Microbiol Res 3: 981-996.
- Cheel J, Theoduloz C, Rodríguez J, Schmeda-Hirschmann G (2005) Free radical scavengers and antioxidants from lemongrass (*Cymbopogon citratus* DC. Stapf.). J Agri Food Chem 53(7): 2511-2517
- De S (2013) Outline of Dairy Technology. Oxford University Press. New Delhi, India
- Devi R, Khanna N, Vaquil, Kumar S, Ahlawat SS (2018) Studies on shelf life of developed mango pulp based shrikhand incorporated with soy milk at refrigeration (4±1°C) temperature. Chem Sci Rev Lett 7(26): 546-549
- Economic Survey (2022) Economic Survey 2012-22. Ministry of Finance, Dept of Economic Affairs, New Delhi. P. 277
- FAO (1990) The technology of traditional milk products in developing countries. Food and Agriculture Organization, Rome, Italy
- Figueirinha A, Paranhos A, Perez-Alonso JJ, Santos-Buelga C, Batista MT (2008) *Cymbopogon citratus* leaves: characterization of flavonoids by HPLC–PDA–ESI/MS/MS and an approach to their potential as a source of bioactive polyphenols. Food Chem 110(3):718–728
- Hadjimbei E, Botsaris G, Chrysostomou S (2022) Beneficial effects of yoghurts and probiotic fermented milks and their functional food potential. Foods 11: 1-15
- IS: 1479 (1961) IS: 1479 Methods of test for dairy industry part ii chemical analysis of milk. Bureau of Indian Standards, New Delhi
- IS: 1166 (1986) Specification for condensed milk, partly skimmed and skimmed condensed milk, Bureau of Indian Standards, New Delhi
- Jabeen Begum (2023) Jaggery: is it good for you? <https://www.webmd.com>
- Masih A, Broadway AA, Rani R, Wasnik P, Bharti BK (2020) Studies on the utilization of maize milk for the preparation of *Shrikhand*. Int Res J Engg Technol 7: 793-799
- Mirghani MES, Liyana Y, Parveen J (2012) Bioactivity analysis of lemongrass (*Cymbopogon citratus*) essential oil. Int Food Res J 19(2): 569-575
- Munoz AM, King SC (2007) International consumer product testing across cultures and countries: ASTM International MNL 55
- NIN (2011) Dietary guidelines for Indians - a manual. ICMR- National Institute of Nutrition, Hyderabad
- Rao S, Shanbhoge R, Rao B, Adiga S, Dinesh U, Aithal K, Kumar M (2009) Preventive efficacy of hydroalcoholic extract of *Cymbopogon citratus* against radiation-induced DNA damage on V79 cells and free radical scavenging ability against radicals generated *in vitro*. Human Exp Toxicol 28: 195-202
- Rasane P, Tanwar B, Dey A (2015) Khoa: A heat desiccated indigenous Indian dairy product. Res J Pharm Biol Chem Sci 6: 39–48
- Sameem M, Singh A, Hossain SA (2018) Studies on preparation of *Shrikhand* by using dragon fruit pulp. Pharma Inn J 7(8): 455-458
- Sanyal MK (2020) Technological innovations in processing of traditional Indian Dairy Products. National seminar on traditional Indian dairy products—prospects of commercialization (pp. 20), West Bengal University of Animal & Fishery Sciences
- Shrivastav P, Verma AK, Walia R, Parveen R, Singh AK (2016) Jaggery- A revolution in the field of natural sweeteners. European J. of Pharmaceutical and Medical Res 3(3): 198-202
- Swapna G, Chavannavar S (2013) *Shrikhand*-value added traditional dairy product. Int J Food and Nutr Sci 2: 45-51
- USDA (2022) How much food from the Dairy Group should I consume daily? How much milk should I drink?. United States Department of Agriculture, Washington, USA.
- Waghmare SS, Andhare BC, Supekar SJ (2019) Cost of production of *Shrikhand* blended with ginger powder. Int J Chem Stud 7(4): 2874-2875