International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 2331-2338

Received: 15-07-2019
Accepted: 19-08-2019

Dravesh Kumar
M. Tech. (Dairy Technology) WCDT, SHUATS, Prayagraj, Uttar Pradesh, India

Rekha Rani
Assistant Professor (Dairy Technology), WCDT, SHUATS, Prayagraj, Uttar Pradesh, India

Prachi Wasnik
Ph.D. Dairy Technology, WCDT, SHUATS, Prayagraj, Uttar Pradesh, India

John David
Dean, Faculty of Dairy Technology, WCDT, SHUATS, Prayagraj, Uttar Pradesh, India

Sandeep Kumar
M. Tech. Dairy Technology, WCDT, SHUATS, Prayagraj, Uttar Pradesh, India

Correspondence
Rekha Rani
Assistant Professor (Dairy Technology), WCDT, SHUATS, Prayagraj, Uttar Pradesh, India

Development of evaporated milk *Shrikhand* and vitamin C enrichment by using *Malta* orange juice

Dravesh Kumar, Rekha Rani, Prachi Wasnik, John David and Sandeep Kumar

Abstract
Shrikhand is one of the most popular fermented milk product known for its taste and therapeutic value. *Shrikhand* was prepared using evaporated milk and evaporation was done as 1:2.5 folds. Orange is rich source of vitamin C sufficient amount of folacin, calcium, potassium, thiamine, niacin and magnesium. Initial trials were conducted to find the most acceptable levels of *Malta* orange juice (15%, 20%, and 25%) and the best level was selected on the basis of sensory evaluation.The optimized product contained 20% *Malta* orange juice, and it was highly acceptable without adversely affecting the sensory attributes of *shrikhand*. Physicochemical analysis for optimized product contained fat (8.71%), protein (6.18%), total solids (47.35%), ash (0.61%), carbohydrate (31.63%), Ascorbic acid (0.033%), crude fiber (0.89%), titratable acidity (1.06% L.A.). Sensory characteristics (flavour and taste, colour and appearance, consistency, sweetness, overall acceptability) were judged by panel on 9 point hedonic scale. Overall acceptability score for treatments T_0, T_1, T_2 and T_3 were 7.4, 8.1, 8.5 and 7.6 respectively. The cost of production of final product for treatments T_0, T_1, T_2 and T_3 were 231.2, 238.75, 229.33, 217.44 (Rs/Kg) respectively. Textural properties of treatment T_2 evaluated firmness (g), consistency (g sec), cohesiveness (g) and index of viscosity were 407.145, 9869.794,-277.571 and -17.368 respectively. Treatment T_2 with 20 % *Malta* orange was found to be the best among all. Adition of *Malta* orange juice in evaporated milk *shrikhand* increased vitamin C content as well as enriched natural flavour. Chakka prepared using evaporated milk saved drainage time of whey which was 4 hr, as well as have the potential to solve the problem of availability of milk in lean season to industries. Thus, product acceptability judged by sensory evaluation, the best treatment can be rated as $T_2>T_1>T_3>T_0$.

Keywords: Evaporated, juice, *Malta*, milk, orange, sensory, *shrikhand*.

1. Introduction
Milk, and milk products like curd, buttermilk lassi and *shrikhand* is inseparable dish in a regular diet of Indians. Fermented milk products constitute a vital component of the human diet in many regions of the world. One such product is *shrikhand* which plays a prominent role in people's diet (Srinivas *et al.,* 2017) [35]. It is used as a delicacy in western part of the country like Maharashtra and Gujarat. The name *shrikhand* is derived from Sanskrit word "*Shikharani*" (Shambharkar *et al.,* 2011). It is one of the most popular fermented milk product obtained by lactic acid fermentation through the action of *Lactobacillus bulgaricus, Lactobacillus lactis* and *Streptococcus thermophilus.* It is known for its taste and therapeutic value along with containing appreciable amount of milk protein and phospholipids (Mehta, 2013) [26]. Recently there has been an increasing trend to fortify *shrikhand* with different types of ingredients like herbs, fruits, minerals etc. According to FSSAI (2017) [17], *shrikhand*-means the product obtained from chakka or skimmed milk chakka to which milk fat is added. It may contain fruits, nuts, sugar, cardamom, saffron and other spices. It shall not contain any added colouring and artificial flavouring substances.

Fruits are considered good source of mineral and vitamins. Oranges are one of the fruits globally known for their nutritional and medicinal properties. The fruit is fleshy, indehiscent, berry ranging from 4 cm to 12 cm and belongs to *Rutaceae* family (FAO, 2006) [15]. Common *Malta* fruits are orange-yellow, surface smooth; shape medium to large in size; spherical; thickness of the rind medium, segments 10, well-defined; pulp orange, abundant juice, good flavour. Blood Red *Malta* fruits skin is yellow with scarlet blush. Rind is relatively thin, tight and glossy. Pulp corn coloured and red streaked, early ripening; pulp sweet, abundant juice, red coloured, pleasant flavor (Milind and Dev, 2012) [27]. It is grown almost all over the world as a source of food because of its high nutritional values (especially vitamin C), sufficient amount of folacin, calcium, potassium, thiamine, niacin and magnesium (Angew, 2007) [2].

Nutrient composition of sweet orange includes sugar 9.35 g, dietary fiber 2.4 g, fat 0.12 g, protein 0.94 g, water 86.75 g, vitamin A equiv. 11µg (1%), vitamin C 53.2 mg (64%), iron 0.1 mg (1%) and energy197 kJ (47 kcal) (Parle and Chaturvedi, 2012) [30]. It posses anti-bacterial, anti-fungal, anti-diabetic, cardio-protective, anti-cancer, anti-arthritic, anti-inflammatory, anti-oxidant properties, that's why have a centre of attraction for various scientists (Milind and Dev, 2012) [27]. The main flavonoids found in citrus species are hesperdine, narirutin, naringin and eriocitrin. Vitamin C is the primary water soluble antioxidant, which prevents free redicals generation in the body and damage to tissue in the aqueous environment both inside and outside the cells (Etebu *et al*., 2014) [14].

Para *et al*., (2014) [29] evaluated the effect of orange pulp and chiku pulp in combination (1:1) on the quality attributes of *Shrikhand*. The pulp combination was incorporated at 0%, 7%, 14% and 21% level (replacing chakka) into the formulation of *shrikhand*. Bhoyar *et al*. (2018) made efforts to incorporate the nutritional value of banana in *shrikhand* and prepared the value added fermented dairy product. Dhotre and Bhadania (2016) [13] studied thermised *shrikhand* at 8 ± 2 °C. Kumar *et al*. (2017) [23] developed *shrikhand* by partial addition of different level of sapota pulp and cocoa powder and to evaluate its effect on nutritional and microbial quality. Deshmukh *et al*., (2017) [11] studied that preparation and standardization of probiotic *shrikhand* by utilizing mango and banana pulp. Chaudhari *et al*. (2018) [9] prepared the probiotic *shrikhand* blending with sapota pulp in different concentration by using whole milk. Sameem *et al*. (2018) [32] studied dragon fruit pulp *shrikhand*. Devi *et al*. (2018) [12] conducted experiments to evaluate the shelf life of soy-milk (20%) incorporated mango pulp (25%) based *shrikhand*. Chorage *et al*. (2018) [10] prepared *shrikhand* from buffalo milk by using yoghurt culture. Ginger juice was used as flavouring agent at different levels viz. 5 % (T_1), 10 % (T_2) 15 % (T_3) and 20 % (T_4) of the chakka.

No studies have been carried out on incorporation of *Malta* orange juice in evaporated milk for preparation of *Shrikhand*. *Malta* orange juice with evaporated milk *shrikhand* could be much more beneficial to health than the traditional *shrikhand*. Hence the present study was carried out to find their effect on physico-chemical, sensory and microbial characteristics of the final product.

2. Materials and Method

The experiments were carried out in the Laboratory of Dairy Technology, Warner College of Dairy Technology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.). The control and evaporated milk and *Malta* orange juice supplemented *Shrikhand* samples were tested and statistically analyzed by Analysis of Variance (ANOVA).

2.1 Procurement of ingredients

Buffalo milk, *Malta* Orange, Ground sugar, Muslin cloth and Polystyrene Cups were collected from local market. Evaporated milk was prepared in laboratory of Dairy Technology. Starter culture was collected from NCDC-167, NDRI, Karnal. (*Lactococcus lactis ssp. lactis, Lactococcus lactis ssp. cremoris, Lactococcus lactis ssp. biovar. diactetylactis* in 1:1:1 ratio). Amount of ingredients used for various ingredients are given in Table 1. Preparation of control sample and experimental samples are illustrated in Figure 1.

Table 1: Treatments combination for preparation of evaporated milk *shrikhand*

Treatment	Chakka (g)	Ground Sugar (g)	*Malta* Orange Juice (g)
T_0	77	23	0
T_1	69	21	10
T_2	67	20	13
T_3	65	19	16

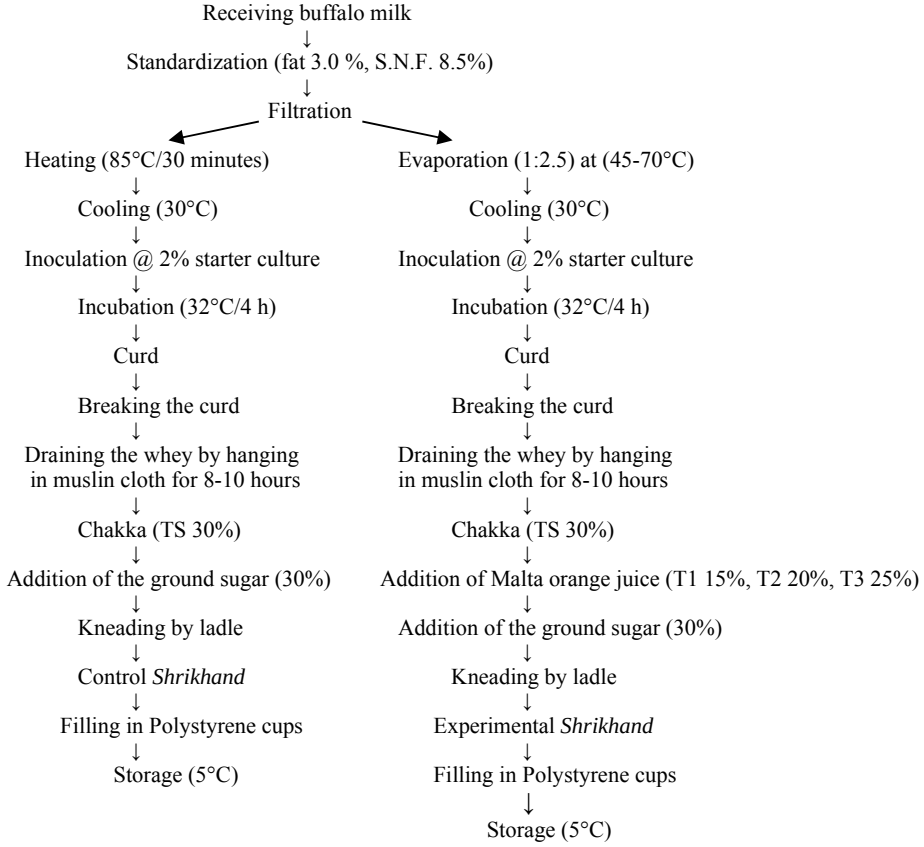

Fig 1: Flow diagram for preparation of control and experimental *shrikhand*

2.2 Sensory evaluation of control and experimental *shrikhand*

Standardization of *shrikhand* supplemented with evaporated milk and *Malta* orange juice was done by sensory evaluation using 9 point Hedonic scale.

2.3 Chemical analysis of control and experimental *shrikhand*

Total solids of *Shrikhand* supplemented with evaporated milk and *Malta* orange juice was determined gravimetrically as per the procedure for milk laid down in IS 2802,1964. The fat percentage was determined as per AOAC Method 934.01. Determination of protein was done as per the procedure method IS: 1479, Part-II, 1961. Estimation of carbohydrate was done as per the Difference method. Total carbohydrate was determined by using formula Carbohydrate (%) = [Total solids % - (% Fat + % Ash + % Protein + % Crude Fiber)]. Total ash was determined according to A.O.A.C. (1975) [4]. Determination of acidity content was done as per the procedure laid down in IS: 1479-Part-I-1960. Determination of crude fiber contents was done as per AOAC (1995) [5]. Moisture Analysis was done as per IS: (SP: 18, 1981) [21]. Vitamin C content was obtained as per AOAC (2016) [3] method using titration with DCPIP (dichlorophenol-indophenol). The pH of *Shrikhand* samples was determined by potentiometric method using a digital pH meter.

2.4 Textural properties of control and experimental *shrikhand*

The textural properties were evaluated using the TA.HD. Plus Texture analyzer of Stable Micro System equipped with 50 kg load cell with Pre-test Speed (1mm/sec), Test speed (1 mm/sec), Post-test speed (5 mm/sec), Target mode (Distance), Distance (5 mm), Count (2 Count). The analyzer is linked to a computer that recorded the data via a software programme for Firmness/Hardness, Cohesiveness, Consistency and Index of Viscosity (Figure 2-5).

2.5 Microbiological Analysis of control and experimental *shrikhand*

Lactic Acid Bacteria, Coliform count, Yeast and mould count was carried out as per the procedure given by (APHA) standard method for the examination of Dairy products (1992) [6].

2.6 Statistical Analysis

Data was analyzed using Analysis of Variance (ANOVA) and Critical difference (C.D) in WASP software.

2.7 Cost analysis

Cost of production was calculated by considering cost of all raw materials (food cost), cost of process like heating (15% of food cost), labour cost (20% of food cost), overhead cost (20% of food cost) like packaging, space, equipment etc., profits (15% of food cost).

3. Results and Discussion

The present study was carried out on "Development of *shrikhand* using evaporated milk and vitamin C enrichment by using *Malta* orange juice". The data collected on different aspects were tabulated and analyzed statistically using the method of analysis of variance and critical difference. The significant and non-significant differences observed have been analyzed critically within and between the treatment combinations of chemical, microbiological and Sensory characteristics of *shrikhand*.

3.1 Effect of evaporated milk chakka on drainage time

Chakka was prepared using evaporated and drainage time was studied and given in Table 2. From Table 2, it was found that draining was completed in 4 h when chakka prepared using evaporated milk and yield was also 28%. Whereas, in traditional process when the *shrikhand* was prepared using milk, the drainage time is generally 6-8 h and yield was also in between 21-25%. Rani *et al.* (2012) [31] prepared chakka using cow milk and given heat treatment (pasteurization) and found drainage time 8 h and yield was 21%.

Table 2: Yield of experimented chakka from evaporated milk

Quantity of toned milk (l)	Heating temperature/ time	Quantity of evaporated milk (ml)	Quantity of curd (kg)	Quantity of chakka (g)	Quantity of whey (ml)	Drainage time (h)	Yield (%)
2.5	45-70°C/3 h	1.0	1.0	702	300	4 h	28

3.2 Sensory attributes of control and experimental *shrikhand*

The best optimized level of malta orange juice was judged by sensory parameters and are depicted in Table 3.

3.2.1 Effect on color and appearance of control and experimental *shrikhand*

The sensory score for colour and appearance of the samples from T0 to T3 were found in the range of 7.6 to 8.30, which increased substantially throughout the sample T1 to T3. Highest mean was recorded in treatment of T3 (8.3±0.44). The difference between the mean value of T0-T1 (0.10), T0-T2 (0.60), T1-T2 (0.50), T1-T3 (0.70), T2-T3 (0.20) was less than the C.D. value (0.72). Therefore, the difference was non-significant but higher for T0-T3 (0.80) hence was significant (Table 3).

3.2.2 Effect on consistency of control and experimental *shrikhand*

The panelist scores for consistency for all the samples of *shrikhand* from T0 to T3 were found in the range of 7.6 to 8.5. The highest mean score recorded in the sample of T0 (8.5±0.70) followed by T1 (7.9±0.54), T2 (7.8±0.57), T3 (7.6±0.54). The non-significant difference was further analyzed statistically to find out the C.D. between and within the different treatment combinations. The difference between the mean values of T0-T1 (0.60), T0-T2 (0.70), T1-T2 (0.10), T1-T3 (0.30), T2-T3 (0.20) was less than the C.D value (0.78). Therefore, the difference was non-significant. Whereas it was greater in case of T0-T3 (0.90). Therefore, the difference was significant (Table 3).

Table 3: Average data for different parameters of control and experimental samples

Parameters	T_0	T_1	T_2	T_3	C.D. at 0.5%
Sensory parameters (Headonic scale Score)					
Flavor	7.15±0.03	7.44±0.04	8.52±0.04	7.58±0.08	0.047
CA	7.7±0.35	7.6±0.82	8.1±0.22	8.3±0.44	0.725
Consistency	8.5±0.70	7.9±0.54	7.8±0.57	7.6±0.54	0.783
Sweetness	7.8±0.75	8.0±0.35	7.7±0.44	7.5±0.35	0.641
OA	7.4±0.82	8.1±0.22	8.5±0.35	7.6±0.65	0.680

Mean±SE; N=7, CA=Colour and appearance, OA=Overall acceptability

3.2.3 Effect on flavor of control and experimental *shrikhand*

The sensory score for flavour in control and experimental samples were in range of 7.15 to 8.52, which gradually obtained a higher score from treatment T0 to T2. The highest mean score was recorded in the sample of T0 (8.52±0.04) followed by T3 (7.58±0.08), T1 (7.44±0.04) and T0 (7.15±0.03). The difference between the mean values of T0-T1 (0.29), T0-T2 (1.38), T0-T3 (0.43), T1-T2 (1.08), T1-T3 (0.14), T2-T3 (0.94) was greater than the C.D value (0.047).Therefore, the difference was significant (Table 3).

3.2.4 Effect on sweetness of control and experimental *shrikhand*

The sensory score for sweetness in control and experimental samples were in range of 7.5 to 8.0, which gradually obtained a higher score from treatment T0 to T1. The highest mean score was recorded in the sample of T□ (8.0±0.35) followed by T1(7.8±0.75),T3(7.7±0.44) and T3(7.5±0.35). The difference between the mean values of T0-T1 (0.20), T0-T2 (0.10), T0-T3 (0.30), T1-T2 (0.30), T1-T3 (0.50), T2-T3 (0.20) was lesser than the C.D value (0.64). Therefore, the difference was not significant (Table 3).

3.2.5 Effect on overall acceptability of control and experimental shrikhand

Overall acceptability score in samples of different treatments and control were analyzed. The highest mean overall acceptability score was recorded in treatment of T□(8.5±0.35) followed by T1(8.1±0.22), T3(7.6±0.65) and T1 (7.4±0.82). The difference between the mean values of T0-T1 (0.70), T0-T2 (1.10) and T2-T3 (0.90) was greater than the C.D value (0.68) and that of T0-T3 (0.20), T1-T2 (0.40) and T1-T3 (0.50) was less than the C.D value. Therefore, the difference was non-significant (Table 3).

3.3 Chemical characteristics of control and experimental *shrikhand*

The chemical composition (Carbohydrate content, Fat, protein, ash, total solids, moisture) of different treatment samples are given in Table 4.

3.3.1 Effect on carbohydrate content of control and experimental *shrikhand*

The highest mean carbohydrate percentage in treatments samples was recorded in sample T0 (33.45±0.02) followed by T1 (32.47±0.02), T2 (31.63±0.02) and T3 (30.47±0.02) (Table 4). It slowly decreased from T_0 to T_3, because of the decreasing levels of chakka and increasing amount of *Malta* orange juice. The difference between the mean values of T0-T1 (0.98) T0-T2 (1.82), T0-T3 (3.16), T1-T2 (0.84), T1-T3 (2.18), T2-T3 (1.34) was greater than the C.D value (**0.033**). Therefore, the difference was significant. This may be because of the composition of the ingredients utilized.

3.3.2 Fat percentage of control and experimental *shrikhand*

From the different treatments (Table 4) noted the highest mean fat percentage in T0 (8.82±0.01), T1(8.71±0.02), T2 (8.66±0.01) and T3 (8.15±0.02).The fat percentage of the control was found to be more than that of other treatment samples because of characteristic fat % in evaporated milk obtained and used in the preparation of *shrikhand*., it slowly decreased from T_1 to T_3, because of the replacement of chakka with the *Malta* orange juice. The difference between the mean values of T0-T1 (0.66), T0-T2 (0.56), T0-T3 (0.50), T1-T2 (0.11), T1-T3 (0.16) and T2-T3 (0.05) was more than the C.D value (0.023). Therefore, the difference was significant.

3.3.3 Protein content of control and experimental *shrikhand*

Among the different treatment samples, treatment T0 (Control) noted the highest mean protein percentage (6.94±0.00) which reduced significantly from T0 to T3(6.27±0.01 for T1, 6.18±0.01 for T2 and 5.96±0.01 for T3). The protein percentage of the control was found to be more than that of other treatment samples on account of characteristic protein % in evaporated milk used in the preparation of *shrikhand*, it slowly decreased from T1 to T3, because of the replacement of chakka with the *Malta* orange juice. The difference between the mean values of T0-T1 (0.67), T0-T2 (0.76), T0-T3 (0.98), T1-T2 (0.09), T1-T3 (0.31) and T2-T3 (0.22) was greater than the C.D value (0.015). Therefore, the difference was significant (Table 4).

3.3.3 Ash content of control and experimental *shrikhand*

Ash percentage of different treatments and control, the highest mean ash percentage was recorded in the samples of T_0 (0.75±0.00) followed by T1 (0.62±0.01), T2 (0.52±0.00) and T3 (0.43±0.00). An addition of *Malta* orange juice (15, 20 and 25 per cent) by replacing chakka significantly reduced ash in finished product as compare to control. It indicates significant difference between the treatment (P>0.05). The significant difference was further analyzed statistically to find out the C.D. between and within the different treatment combinations. The difference between the mean value of T□-T□ (0.14), T□-T□ (0.23), T□-T□ (0.32), T□-T□ (0.09) and T□-T□ (0.18) was greater than the C.D. value (0.011). Therefore, the difference was significant (Table 4).

3.3.4 Total solids percentage of control and experimental *shrikhand*

The highest average value of total solid percentage (49.72±0.03) was obtained in the treatment T0 followed by T1 (48.33±0.02), T2 (47.35±0.02) and T3 (45.24±0.01). It slowly decreased from T0 to T3, because of the decreasing levels of chakka and increasing amount of *Malta* orange juice which resulted in dilution. The difference between the mean values of T0-T1 (1.34), T0-T2 (2.37), T0-T3 (4.48), T1-T2 (1.04), T1-T3 (3.14) and T2-T3 (2.11) was greater than the C.D value (0.027). Therefore, the difference was significant (Table 4).

Table 4: Average data for different parameters of control and experimental samples

Parameters	T_0	T_1	T_2	T_3	C.D. at 0.5%
Chemical parameters:					
Carbohydrate %	33.45±0.02	32.47±0.02	31.63±0.02	30.47±0.02	0.033
Fat %	8.82±0.01	8.71±0.02	8.66±0.01	8.15±0.02	0.023
Protein %	6.94±0.00	6.27±0.01	6.18±0.01	5.96±0.01	0.015
Ash %	0.75±0.00	0.62±0.01	0.52±0.00	0.43±0.00	0.011
Total solid %	49.72±0.03	48.33±0.02	47.35±0.02	45.24±0.01	0.027
Moisture %	50.29±0.02	51.17±0.01	52.65±0.02	54.76±0.02	0.031
Acidity (% LA)	0.86±0.02	0.92±0.02	1.06±0.01	1.19±0.15	0.112
pH	4.68±0.00	4.65±0.01	4.58±0.03	4.52±0.01	0.027
Nutritional parameters					
Crude fiber %	0.0±0.00	0.69±0.01	0.89±0.02	0.97±0.02	0.021
Ascorbic acid %	0.025±0.00	0.030±0.01	0.033±0.01	0.042±0.01	0.014
Textural properties					
Firmness (g)	696.75±178.75	490.73±196.17	407.15±209.41	364.33±199.33	82.224
Consistency (g sec)	16695.68±57634.48	12023.70±4300.31	9869.79±4759.07	8866.15±4612.57	41082
Cohesiveness (g)	-313.35± 34.27	-313.16±51.03	-277.57± 45.15	-263.96± 47.89	55.104
Index of Viscosity (g sec)	-6.96±2.67	-18.88±16.21	-17.36±7.10	-21.89±12.40	12.190
Microbiological Parameters					
SPC (cfu/g)×10^3	7.05±0.01	7.12±0.01	7.14±0.01	7.18±0.01	0.012
Yeast and mold (cfu /g)×10^1	5.75±0.03	6.21±0.03	6.32±0.02	6.37±0.01	0.038
Coliform (cfu/ml)	3.63±0.02	4.20±0.03	4.61±0.02	4.86±0.01	0.033

Mean±SE, Average of three replications

3.3.5 Moisture percentage of control and experimental *shrikhand*

The moisture percentage in *shrikhand* samples of different treatments and control, the highest mean moisture percentage was recorded in sample of T3 (54.76±0.02) followed by T2 (52.65±0.02), T1 (51.17±0.01) and T0 (50.29±0.02). The moisture content of the control was found to be lower than that of other treatment samples, it slowly increased from T1 to T3, because of the higher moisture content in the *Malta* orange juice. The difference between the mean values of T0-T1 (0.88), T0-T2 (2.36), T0-T3 (4.47), T1-T2 (1.48), T1-T3 (3.59) and T2-T3 (2.11) was greater than the C.D value (0.031). Therefore, the difference was significant (Table 4).

3.3.6 Acidity percentage of control and experimental *shrikhand*

Acidity percentage in *shrikhand* samples was recorded highest in treatment T3 (1.19±0.15) followed by T2 (1.06±0.01), T1 (0.92±0.02) and T0 (0.86±0.02). The acidity percentage of the control was found to be lesser than that of the prepared *Malta* orange juice *shrikhand* samples and it slowly increased from T0 to T3. The difference between the mean values of T0-T1 (0.06) was less than the C.D value (0.112). Therefore, the difference was non-significant. The difference between the mean values of T0-T2 (0.20), T0-T3 (0.36), T1-T2 (0.14), T1-T3 (0.30) and T2-T3 (0.16) was greater than the C.D value (0.112). Therefore, the difference was significant (Table 4).

3.3.7 pH of control and experimental *shrikhand*

The observed pH values in different treatment samples of *shrikhand* noted was highest for T0 (4.68±0.00) followed by T1 (4.65±0.01), T2 (4.58±0.03) and T3 (4.52±0.01). The pH of the *shrikhand* sample is very important because it helps in the formation of optimum consistency. The difference between the mean values of T0-T1 (0.03), T0-T2 (0.10), T0-T3 (0.15), T1-T2 (0.07), T1-T3 (0.13) and T2-T3 (0.06) was greater than the C.D value (0.027). Therefore, the difference was significant (Table 4).

3.4 Nutritional properties of optimized product

3.4.1 Crude fiber content in control and evaporated milk *shrikhand*

The average of crude fiber percentage in evaporated and *Malta* orange juice supplemented *shrikhand* was T_0 (0.0±0.00), T_1 (0.69±0.01), T_2 (0.89±0.02) and T_3 (0.97±0.02). The highest average value of crude fiber percentage was obtained in the treatment T_3 because of higher fiber content in *Malta* orange juice and its increasing level from T1 to T3. The difference between the mean values of T0-T1 (0.70), T0-T2 (0.90), T0-T3 (1.19), T1-T2 (0.20), T1-T3 (0.50) and T2-T3 (0.30) was greater than the C.D value (0.021). Therefore, the difference was significant (Table 4).

3.4.2 Ascorbic acid content of control and evaporated milk *shrikhand*

The highest average value of ascorbic acid percentage (0.042±0.01) was obtained in the treatment T_3. This may be due to the inherited acid present in *Malta* orange juice incorporated in *shrikhand* samples which goes on increasing from T1 to T3. The difference between the mean values of T0-T1 (0.10), T0-T2 (0.32), T0-T3 (0.38), T1-T2 (0.20), T1-T3 (0.28) and T2-T3 (0.07) was greater than the C.D value (0.014). Therefore, the difference was significant (Table 4).

3.5 Textural parameters of evaporated milk *shrikhand*

The textural parameters such as firmess/ hardness, constistency, Cohesiveness and index of viscosity are given in Table 4 and illustrated in Figure 2, 3, 4 and 5.

3.5.1 Firmness/hardness (g) of control and experimental *shrikhand*

Average firmness/hardness (g) in evaporated and *Malta* orange juice supplemented *shrikhand* was recorded as T_0 (696.753±178.75), T_1 (490.731±196.17), T_2 (407.145±209.) and T_3 (364.330±199.33). The highest average value of firmness/hardness (g) (696.69) was obtained in the treatment T_0. This may be because of addition of increasing order of *Malta* orange juice from T1 to T3. The difference between the mean values of T0-T1 (205.96), T0-T2 (289.54), T0-T3 (332.36), T1-T2 (83.59), T1-T3 (126.40) was greater than the

C.D value (82.22). Therefore, the difference was significant but that for T2-T3 (42.81) was less than the C.D value. Hence, the difference was non- significant (Table 4) and figure 2 also explains the same.

3.5.2 Consistency (g sec) of control and experimental *shrikhand*

Average consistency (g sec) in evaporated and *Malta* orange juice supplemented *shrikhand* was found to be T_0 (16695.68±57634.48), T_1 (12023.704±4300.31), T_2 (9869.794±4759.07) and T_3 (8866.157±4612.57). The highest value was noted for the treatment T_0 which may be due to the addition of increasing order of *Malta* orange juice from T1 to T3 resulting in the loose consistency (Figure 3). The difference between the mean values of T0-T1 (30671.96), T0-T2 (32825.87), T0-T3 (33829.50), T1-T2 (21532.91), T1-T3 (3157.55), T2-T3 (1003.64) was less than the C.D value (41082.413). Therefore, the difference was non-significant (Table 4).

3.5.3 Cohesiveness (g) of control and experimental *shrikhand*

Average cohesiveness (g) in evaporated and *Malta* orange juice supplemented *shrikhand* was found to be T_0 (-313.355±34.27), T_1 (-313.162±51.03), T_2 (-277.571±45.15) and T_3 (-263.965±47.89). The difference between the mean values of T0-T1 (18.19), T0-T2 (35.78), T0-T3 (49.39), T1-T2 (17.59), T1-T3 (31.20), T2-T3 (13.61) was less than the C.D value (55.104). Therefore, the difference was non-significant (Table 4). Figure 4 also describes the cohesivenss pattern of samples.

3.5.4 Index of viscosity in (g sec) of control and experimental *shrikhand*

Average index of viscosity in (g sec) in evaporated and *Malta* orange juice supplemented *shrikhand* was depicted in figure 5 and from Table 4 thse were found to be T_0 (-6.963±2.67), T_1 (-18.889±16.21), T_2 (-17.368±7.10) and T_3 (-21.891±12.40). The difference between the mean value of T0-T1 (-11.93), T0-T2 (-10.40), T1-T2 (-1.52), T1-T3 (-3.00), T2-T3 (-4.52) was less than the C.D value (**12.190)**. Therefore, the difference was non-significant whereas that of T0-T3 (-14.93) was greater than the C.D value. Therefore, the difference was significant.

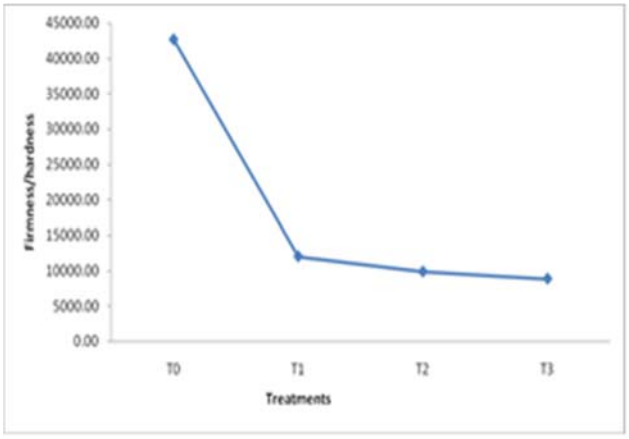

Fig 2: Firmness/hardness (g) of control and experimental *shrikhand*

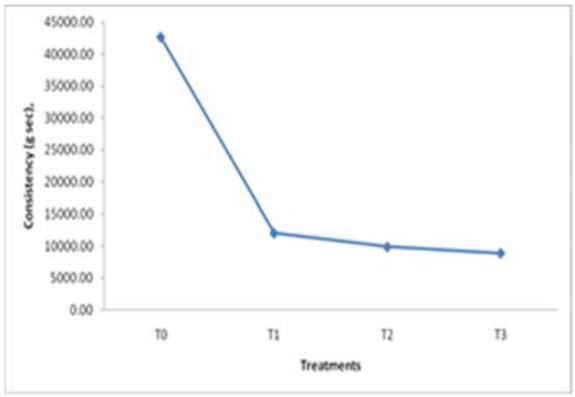

Fig 3: Consistency (g sec) of control and experimental *shrikhand*

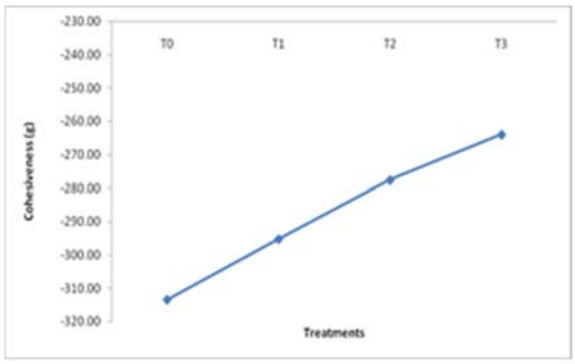

Fig 4: Cohesiveness (g) of control and *shrikhand*

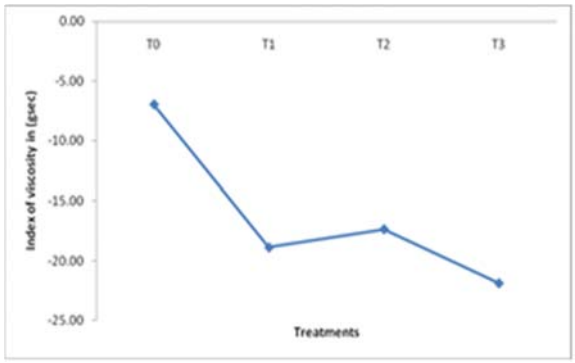

Fig 5: Index of viscosity in (g sec) of control experimental and experimental *shrikhand*

3.6 Microbiological parameters of control and experimental *shrikhand*

3.6.1 Standard Plate (cfu/g) count

Standard Plate (cfu/g) count at 10^3 dilution was observed for all the treatment samples. The highest mean standard plate count was noted in treatment T3 (7.18±0.01) and lowest for T0 (7.05±0.01). The difference between the mean values of T0-T1 (0.06), T0-T2 (0.09), T0-T3 (0.12), T1-T2 (0.02), T1-T3 (0.06) and T2-T3 (0.04) was greater than the C.D value (0.012). Therefore, the difference was significant.

3.6.2 Yeast and Mould (cfu/g) count

The Yeast & Mould count (cfu/g) in *shrikhand* samples of different treatments and control noted the highest mean for T3 (6.37±0.01) followed by T2 (6.32±0.02),T1 (6.21±0.03) and T0 (5.75±0.03). The difference between the mean values of T0-T1 (0.45), T0-T2 (0.57), T0-T3 (0.61), T1-T2 (0.61), T1-T3 (0.11) and T2-T3 (0.16) was greater than the C.D value

(0.038). Therefore, the difference was significant among the treatment samples.

3.6.3 Coliform count

The result of coliform test count of control and experimental samples of *shrikhand* is 3.63±0.02 for T0, 4.20±0.03 for T1, 4.61±0.02 for T2 and 4.86±0.01 for T3. The difference between the mean values of T0-T1 (0.57), T0-T2 (0.99), T0-T3 (1.23), T1-T2 (0.42), T1-T3 (0.66), T2-T3 (0.24) was greater than the C.D value (0.033). Therefore, the difference was significant.

3.7 Cost analysis

As seen from Table 4, Cost (Rs.) per Kg of Treatment samples is highest for T1 (238.75) and lowest for T3 (217.44). Experimental samples of treatment T0 and T2 was 231.2 and 217.44 Rs per Kg respectively. Optimised product T2 cost lesser than the control product. Hence it can be inferred that the utilization of Malta orange juice in evaporated milk *shrikhand* was cost effective. The selling cost for 100 g *shrikhand* is Rs. 23.87.

Table 5: Cost analysis of control and experimental samples

Ingredients	Amount required for 1000 gm. Mix (in gm.) from evaporated milk.				Rate in Rs/Kg	Cost in Rs/kg			
	T_0	T_1	T_2	T_3		T_0	T_1	T_2	T_3
Chakka	770	690	670	650	147	126	106.45	96.77	85.80
Malta orange juice(ml)	0	100	130	160	50	-	25	30.14	34.80
Sugar	230	210	200	190	40	10	9	8	7
Total raw material cost	1000	1000	1000	1000	237	136	140.45	134.9	127.6
Cost of process like heating	15% of food cost					20.4	21.06	20.235	19.4
Labour cost (self, etc.)	20% of food cost					27.2	28.09	26.98	25.52
Overhead cost (packaging, space, equipment)	20% of food cost					27.2	28.09	26.98	25.52
Profits	15% of food cost					20.4	21.06	20.235	19.4
Total Cost (Rs. Per Kg) for different Treatment						231.2	238.75	229.33	217.44
Cost of *Shrikhand* (100 g) in Rs.						23.12	23.87	22.93	21.74

4. Conclusion

The optimized product contained 20% *Malta* orange juice, and it was highly acceptable without adversely affecting the sensory attributes of *shrikhand*. Physicochemical analysis for optimized product contained fat (8.71%), protein (6.18%), total solids (47.35%), ash (0.61%), carbohydrate (31.63%), Ascorbic acid (0.033%), crude fiber (0.89%), titratable acidity (1.06% L.A.). Overall acceptability score for treatments T_0, T_1, T_2 and T_3 were 7.4, 8.1, 8.5 and 7.6 respectively. The cost of production of final product for treatments T_0, T_1, T_2 and T_3 were 231.2, 238.75, 229.33, 217.44 (Rs/Kg) respectively. Rheological properties analysis of treatment T_2 noted firmness (g), consistency (g sec), cohesiveness (g) and index of viscosity were 407.145, 9869.794,-277.571 and -17.368 respectively. Addition of *Malta* orange juice increased vitamin C content in *shrikhand* as well as enriched natural flavour. Chakka prepared using evaporated milk saved drainage time of whey which was 4 hr in evaporated milk *shrikhand*, as well as have the potential to solve the problem of availability of milk in lean season to industries. Thus, product acceptability judged by organoleptic evaluation, the best treatment can be rated as $T_2>T_1>T_3>T_0$.

5. References

1. Abu FJ, Jeniffer O, Alakali JS. Effect of packaging and storage condition on the quality of sweet orange. Journal of Agricultural Technology. 2011; 7(3):797-804.
2. Angew ON. Functional foods, Trends in Food Science and Technology. 2007; 30:19-21.
3. AOAC. International Guidelines for Standard Method Performance Requirements. AOAC Official Methods of Analysis (2016). Appendix F, p. 2 policy, 2016.
4. AOAC. Official Methods of Analysis. 12th Edition, Association of Official Analytical Chemists, Washington DC, 1975.
5. AOAC. Official Methods of Analysis Official Method for Protein. Method No. 920.87. Association of Official Analytical Chemists, Washington DC, 1995.
6. APHA. Standard Methods for the Examination of Water and Wastewater. 18th Edition, American Public Health Association (APHA), 1992.
7. Bahuguna A, Vijayalaxmi KG. Formulation and evaluation of dehydrated red Hawaiian hibiscus (*Hibiscus rosa-sinensis*) incorporated valued added products. International Journal of Food Science and Nutrition. 2018; 3(4):194-199.
8. Bhoyar DR, Kahate PA, Shelke RR, Wadatakar HV. Standardization of process line for preparation of unripe banana *Shrikhand*. Research Journal of Animal Husbandry and Dairy Science. 2014; 5(2):136-139.
9. Chaudhari AS, Gawai AS, Palishikar LS, Manohar AB, Kedare VS, Shinde DV. Phisico-chemical analysis of probiotic *Shrikhand* blending with sapota pulp. International Journal of Chemical Studies. 2018; 6(3):146-147.
10. Chorage N, Surve S, Mule S, Kadam S, Dandekar VS. Probiotic *shrikhand* prepared by using yoghurt culture and incorporation of ginger (*Zingiberofficinale* L) Juice. International Journal of Chemical Studies. 2018; 6(5):1943-1946.
11. Deshmukh NM, Sawate AR, Sontakke MD, Desai GB. Preparation and sensory evaluation of probiotic *Shrikhand* added with Mango and Banana Pulp. Trends in Biosciences. 2017; 10(4):1165-1168.
12. Devi R, Khanna N, Vaquil D, Kumar S, Ahlawat SS. Studies on shelf life of developed mango pulp based *shrikhand* incorporated with soy milk at refrigeration (4±1ºC) temperature. Chemical Science Review and Letters. 2018; 7(26):546-549.
13. Dhotre AV, Bhadania AG. Acceptability of thermized *shrikhand* during storage at refrigeration temperature (8 ±

2°C). Indian Journal Dairy Sciences. 2016; 69(4):407-414.
14. Etebu. A Review on sweet orange (*citrus sinesis* L Osbeck): Health, Disease and management. American Journal of Research Communication. 2014; 2(2):33-70.
15. Food and Agriculture Organization of the United Nations Rome Agriculture series number, 2006, 37 ISBN 978-92-5-105600-4.
16. FSSAI. Food Safety and Standard Athority of India manual, 2015.
17. FSSAI. Food Safety and Standard Authority of India manual, 2017.
18. Hadeil MA, Ulfat MO. A Comparative Study to Evaluate the Polyphenol Content and Antioxidant Activity of Coffee with Fresh Whole Milk and Evaporated Milk. Food and Public Health. 2017; 7(4):75-80.
19. Hassan SM, Khaskheli M, Shah AH, Shah MG, Umer M, Nisha AR *et al*. Physico-chemical evaluation of skimmed and condensed milk of Buffalo. Journal of Chemical and Pharmaceutical Research. 2015; 7(2):698-707.
20. Hertog MGL, Fesens EJM, Hollman PCH, Katan MB, Kromhout D. Dietary antioxidant flavonoids and the risk of coronary heart disease: The Zutphen elderly study. Lancet. 1993; 342:1007-1011.
21. IS: (SP: 18) ISI Handbook of Food Analysis, Part XI: Dairy Products, Indian Standards Institution, New Delhi, 1981.
22. IS: 2802 Indian Standards Institute, Manak Bhavan Bahadur Shah Zafar Marg. New Delhi, 1964.
23. Kumar S, Peter S, Sharma A, Kumar A, Rai VP. Effect of incorporation of sapota pulp and cocoa powder on the physico-chemical and microbiological characteristics of *shrikhand*. Asian Journal Dairy and Food Research. 2017; 36(1):34-36.
24. Longoria-García S, Cruz-Hernández MA, Flores-Verástegui MIM, Contreras-Esquivel JC, Montañez-Sáenz JC, Belmares-Cerda RE. Potential functional bakery products as delivery systems for prebiotics and probiotics health enhancers. Journal of Food Science and Technology. 2018; 55(3):833-845.
25. Maneffee SS, Overman OR. A semi Kjeldahl method for determination of total nitrogen in samples. Journal of Dairy Science. 1940; 23(A):143.
26. Mehta M. Proximate Analysis of Branded Srikhand. Journal of Food and Dairy Technology. 2013; 1(2):9-12.
27. Milind P, Dev C. Orange range of benefits. International Research Journal of pharmacy. 2012; 3(7):59-63.
28. Okonkwo OI. Microbiological analyses and safety evaluation of Nono: A fermented milk product consumed in most parts of Northern Nigeria. International Journal of Dairy Science. 2011; 6:181-189.
29. Para AP, Razvi R, Ahmad N. Effect of Orange Pulp and Chiku Pulp in Combination (1:1) on the Quality Characteristics of *Shrikhand*. World Journal of Dairy and Food Sciences. 2014; 9(2):135-137.
30. Parle M, Chaturvedi D. Orange: Range of Benefits. International Research Journal of Pharmacy. 2012; 3(7):59-63.
31. Rani R, Dharaiya CN, Unnikrishnan V, Singh B. Factors Affecting Syneresis from Yoghurt for Preparation of Chakka. Indian Journal of Dairy Sci. 2012; 65(2):135-140.
32. Sameem M, Singh A, Hossain SK, Shaeeduddin K. Studies on preparation of *Shrikhand* by using dragon fruit pulp. The Pharma Innovation Journal. 2018; 7(8):455-458.
33. Samuel N, Osei D, Priscilla OA, Ruth B, Victoria A, Boakye K *et al*. Preparation of Ghanaian Dish 'Fufu' With Evaporated Milk. American Journal of Food Science and Technology. 2016; 2(2):48-51.
34. Sharma S, Rai DC, Singh P, Singh DV. Development of Soy Milk in Litchi Pulp Based *Shrikhand* for Development of a Novel Fermented Milk Product. International Journal of Current Microbiology and Applied Sciences. 2018; 7(6):2319-7706.
35. Srinivas J, Jessie SW, Uma MK, Anila K, Devi SNK. Nutritional analysis of value added *Shrikhand*. Journal of Pharmacognosy and Phytochemistry. 2017; 6(5):1438-1441.