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Sensory Evaluation of Antioxidant Enriched and Iron Based Prebiotic Milk Cake

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Article History	Abstract
	The main objective of this research study was to develop antioxidant enriched and iron based prebiotic milk cake and to evaluate sensory analysis of newly prepared milk cake. In this research study, control milk cake was developed without prebiotics and experimental milk cake was prepared by different percentage of prebiotics. As a prebiotics kiwi fruits powder was used. The nutritional value of bakery goods and their potential for use in feeding programmes and emergencies captured the attention of customers. After sensory analysis, it was found that T_3 treatment combination was showed higher overall acceptability.

Introduction:

More than half of all milk produced is used to produce traditional dairy products, which makes them crucial to the dairy industry in India. Milk cake is one of the traditional dairy foods (sweets) that is eaten widely in northern and central India. These milk-based Indian confections are popular among Indian ethnic groups living overseas and have developed domestic markets (**Das et al., 2023**).

Milk cake as a traditional Dairy food

Milk cake is one of the most beloved traditional dairy foods (sweets) in northern and central India, and its popularity is spreading to other parts of the country. The distinguishing characteristic of milk cake is its well-defined grains, which have a more intense caramelised flavour than Kalakand. The traditional milk cake recipe calls for the manufacture of Danedar form of khoa, which is similar to Kalakand; however, a portion of the mass is caramelised more intensely and placed between the less caramelised portions **(Landge et al., 2009)**.

Chawla *et al*. (2021) reported that in India, milk cake is a well-known khoa-based dairy product that is either made with buffalo milk or using a particular danedar khoa variation. Milk cake typically has a shelf life of 3 to 4 days at room temperature, but it can last up to 12 to 14 days when refrigerated. Therefore, the current study's objective is to assess how modified atmosphere packaging (MAP) might prolong the shelf life of milk cake while maintaining its freshness at 4 °C or lower. According to **Aneja *et al.* (2002)**, once the condensed mass has reached a dough-like consistency, the hot dough should be moved to a greased tray and cooled slowly in an enclosed box for five to six hours. Alternatively, to increase color contrast in the top and bottom layers, the bottom of the tray may be cooled in chilled water. **Rao *et al.* (2000)** found substantial differences in sensory consistency between Milk cake obtained from the market and Milk cake produced in the laboratory. According to them, variations in the production of sensory qualities of Milk cake may be due to the amount and stage of

addition of citric acid and sugar. The unregulated heat treatment during preparation was blamed for the discrepancies. Variations in colour and appearance can be caused by changes in sugar levels and manufacturing methods.

Aims and Objectives:

To optimize/standardize the ratio of kiwi fruits and dates powder in prebiotic milk cake. To evaluate the sensory properties of newly prepared prebiotic milk cake.

2. Materials and methods

The experiments related to "**Development of antioxidant enriched and iron based prebiotic milk cake**" carried out in the research laboratory of Nutrition, Mahishadal Raj College, W.B., India.

Procurement of raw material:

For preparation of milk cake, the raw ingredients like buffalo milk, kiwi fruits powder, sugar, ghee, citric acid were purchased from local market of Mahishadal.

A local market supplied buffalo milk was homogenised to five to six percent fat and nine percent SNF. The market survey's findings were used to determine the fat and SNF levels (Kumar, 2005; Patel, 2010) and available literature. Three cane sugar (4, 6, and 8%) and fat (5 and 6%) concentrations were tested. The milk cake production technique suggested by Mathur (1991). Standardised milk was heated in a kettle and filtered through muslin cloth to make milkcakes. To cause partial coagulation and grain formation in the final product, the milk was heated to a boil and then acidified with 0.02 percent citric acid. After completing the patting stage of the decoction, sugar was added and thoroughly mixed. Corn syrup was added and the mass was worked for a few more minutes, or until the mass began to come away from the kettle's surface. The hot mass was then placed inside laminated pouches, sealed, and placed inside a tin container. A hot air oven was used to thermize the mass at various time-temperature combinations. The product was removed from the thermization process, allowed to cool to room temperature, and then presented to the panel of judges for sensory assessment. A 9-point hedonic scale was used to assess the sensory qualities of the samples (Lawless and Hayman, 1998).

Treatment combinations
T_0= Buffalo Milk (95%) + Sugar (5%) + Citric acid (0.2 %)
T_1= Buffalo Milk (90%) + Kiwi fruit powder (3%) + Dates Powder (3%) + Sugar (4%) + Citric acid (0.2 %).
T_2= Buffalo Milk (90%) + Kiwi fruit powder (2%) + Dates Powder (2%) + Sugar (6%) + Citric acid (0.2 %).
T_3= Buffalo Milk (90%) + Kiwi fruit powder (1%) + Dates Powder (1%) + Sugar (8%) + Citric acid (0.2 %).
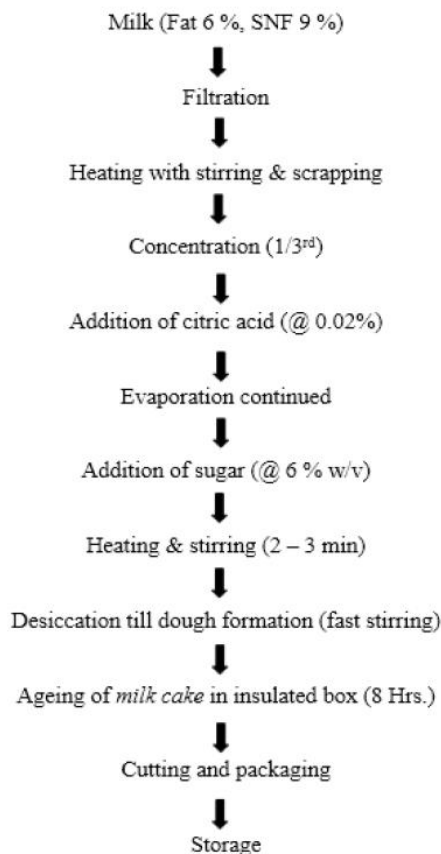No. of Treatment: 3 +1 =4
No of replication: 03
Total no of trials: 12

Sensory Evaluation
A semi-trained panel of 10 judges assessed the cookies' sensory qualities using a 9-point hedonic scale.
• Texture
• Colour
• Taste
• Flavour
• Overall acceptability

Flow chart for the preparation of milk cake (control milk cake) (Meshram et al., 2018)

Milk (Fat 6 %, SNF 9 %)
↓
Filtration
↓
Heating with stirring & scrapping
↓
Concentration (1/3rd)
↓
Addition of citric acid (@ 0.02%)
↓
Evaporation continued
↓
Addition of sugar (@ 6 % w/v)
↓
Heating & stirring (2 – 3 min)
↓
Desiccation till dough formation (fast stirring)
↓
Ageing of *milk cake* in insulated box (8 Hrs.)
↓
Cutting and packaging
↓
Storage

Statistical analysis:
To determine the statistical significance of the research data, Factorial Analysis and Critical difference (C.D) used for physico-chemical and antioxidant parameters for developed cookies and Two-Way Analysis of Variance (ANOVA) technique and Critical difference (C.D) was used for developed dough. Means & SD's were calculated for all analysis. All values are expressed as mean and standard deviation of five parallel measurements.

3. Results and discussions

Table 4.1 Sensory Evaluation of newly prepared prebiotic milk cake

Treatments	Sensory parameters				
	Texture	Colour	Taste	Flavour	Overall acceptability
T0	6.2 ± 0.11	6.6 ± 0.17	6.3 ± 0.28	6.8 ± 0.28	6.4 ±0.23
T1	7.1 ± 0.11	7.6 ± 0.34	7.4 ± 0.23	7.2 ± 0.40	7.3 ± 0.23
T2	7.2 ± 0.11	7.7 ± 0.28	7.9 ± 0.17	7.7 ± 0.28	7.6 ±0.17
T3	7.9 ± 0.11	7.8 ± 0.28	8.2 ± 0.23	7.9 ± 0.17	7.9 ± 0.23

Table 4.1.1 Descriptive statistics of texture of control (T_0) and experimental (T_1, T_2, T_3) newly developed products

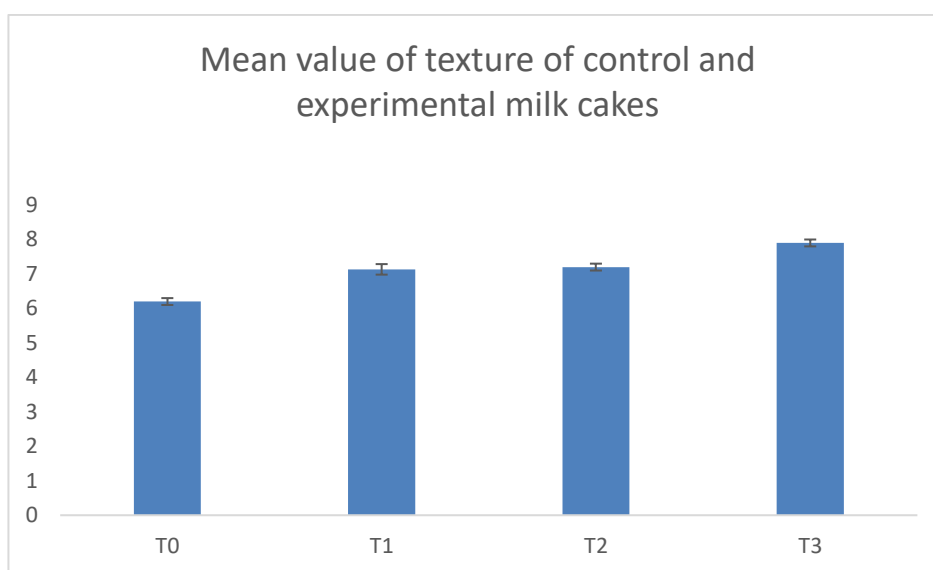| Treatments	T_0	T_1	T_2	T_3
Observations N	3	3	3	3
Mean	6.2000	7.1333	7.2000	7.9000
Sample std. dev.	0.1000	0.1528	0.1000	0.1000
Std. dev. of mean SE	0.0577	0.0882	0.0577	0.0577

After descriptive statistical analysis of texture, it was found that the mean value of texture of control (T_0) milk cake was 6.2 and mean value of texture of experimental milk cake were 7.1, 7.2 and 7.9 respectively.

Table 4.1.2 One-way ANOVA of texture of control (T_0) and experimental (T_1, T_2, T_3) newly developed products

Source	Sum of squares SS	Degrees of freedom	Mean square MS	F statistic	p-value
treatment	4.3825	3	1.4608	109.5625	7.7693e-07
error	0.1067	8	0.0133		
total	4.4892	11			

Table 4.1.3 significance and insignificance results of treatments

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs B	14.0000	0.0010053	** p<0.01
A vs C	15.0000	0.0010053	** p<0.01
A vs D	25.5000	0.0010053	** p<0.01
B vs C	1.0000	0.8859972	insignificant
B vs D	11.5000	0.0010053	** p<0.01
C vs D	10.5000	0.0010053	** p<0.01

Figure: 1 graphical representation of texture of newly prepared milk cake

Table 4.2.1 Descriptive statistics of colour of control (T_0) and experimental (T_1, T_2, T_3) newly developed products

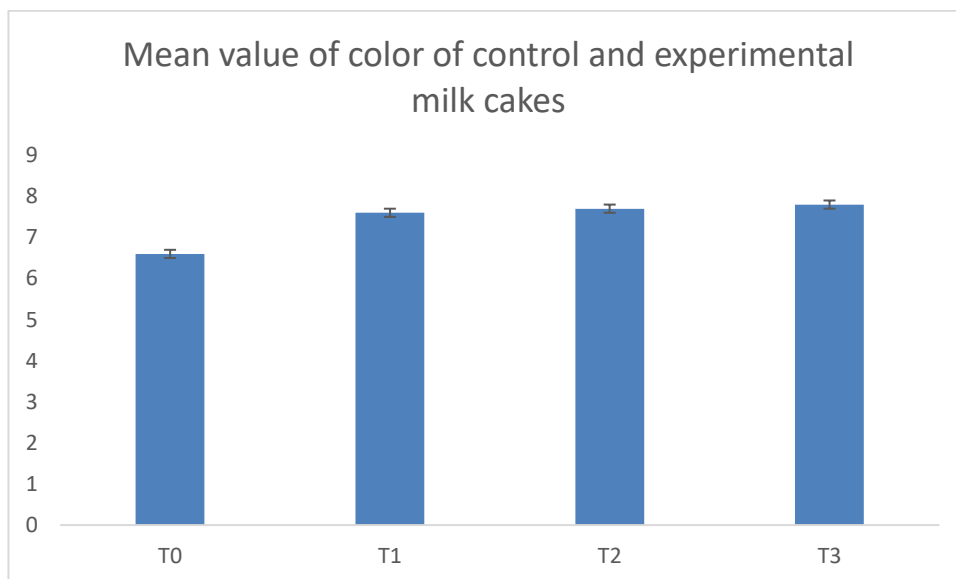| Treatments	T_0	T_1	T_2	T_3
Observations N	3	3	3	3
Mean	6.6000	7.6000	7.7000	7.8000
Sample std. dev.	0.1000	0.1000	0.1000	0.1000
Std. dev. of mean SE	0.0577	0.0882	0.0577	0.0577

After descriptive statistical analysis of colour, it was found that the mean value of colour of control (T_0) milk cake was 6.6 and mean value of texture of experimental milk cake were 7.6, 7.7 and 7.8 respectively.

Table 4.2.2 One-way ANOVA of colour of control (T_0) and experimental (T_1, T_2, T_3) newly developed products

Source	Sum of squares SS	Degrees of freedom	Mean square MS	F statistic	p-value
treatment	2.7825	3	0.9275	92.7500	1.4845e-06
error	0.0800	8	0.0100		
total	2.8625	11			

Table 4.2.3 significance and insignificance results of treatments

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs B	17.3205	0.0010053	** $p<0.01$
A vs C	19.0526	0.0010053	** $p<0.01$
A vs D	20.7846	0.0010053	** $p<0.01$
B vs C	1.7321	0.6211878	insignificant
B vs D	3.4641	0.1442067	insignificant
C vs D	1.7321	0.6211878	insignificant

Figure: 2 graphical representation of colour of newly prepared milk cake

Table 4.3.1 Descriptive statistics of taste of control (T_0) and experimental (T_1, T_2, T_3) newly developed products

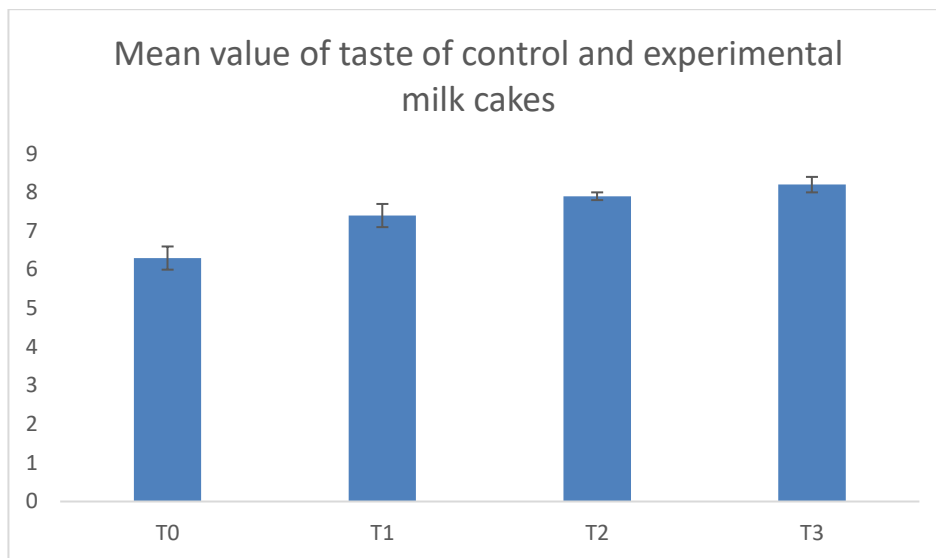| Treatments	T_0	T_1	T_2	T_3
Observations N	3	3	3	3
Mean	6.3000	7.4000	7.9000	8.2000
Sample std. dev.	0.3000	0.3000	0.1000	0.2000
Std. dev. of mean SE	0.1732	0.1732	0.0577	0.1155

After descriptive statistical analysis of taste, it was found that the mean value of taste of control (T_0) milk cake was 6.3 and mean value of texture of experimental milk cake were 7.4, 7.9 and 8.2 respectively.

Table 4.3.2 One-way ANOVA of taste of control (T_0) and experimental (T_1, T_2, T_3) newly developed products

Source	Sum of squares SS	Degrees of freedom	Mean square MS	F statistic	p-value
treatment	6.2700	3	2.0900	36.3478	5.2222e-05
error	0.4600	8	0.0575		
total	6.7300	11			

Table 4.3.3 significance and insignificance results of treatments

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs B	7.9455	0.0022301	** $p<0.01$
A vs C	11.5570	0.0010053	** $p<0.01$
A vs D	13.7240	0.0010053	** $p<0.01$
B vs C	3.6116	0.1248364	insignificant
B vs D	5.7785	0.0148493	* $p<0.05$
C vs D	2.1669	0.4645894	insignificant

Figure: 3 graphical representations of taste of newly prepared milk cake

Table 4.4.1 Descriptive statistics of flavour of control (T_0) and experimental (T_1, T_2, T_3) newly developed products

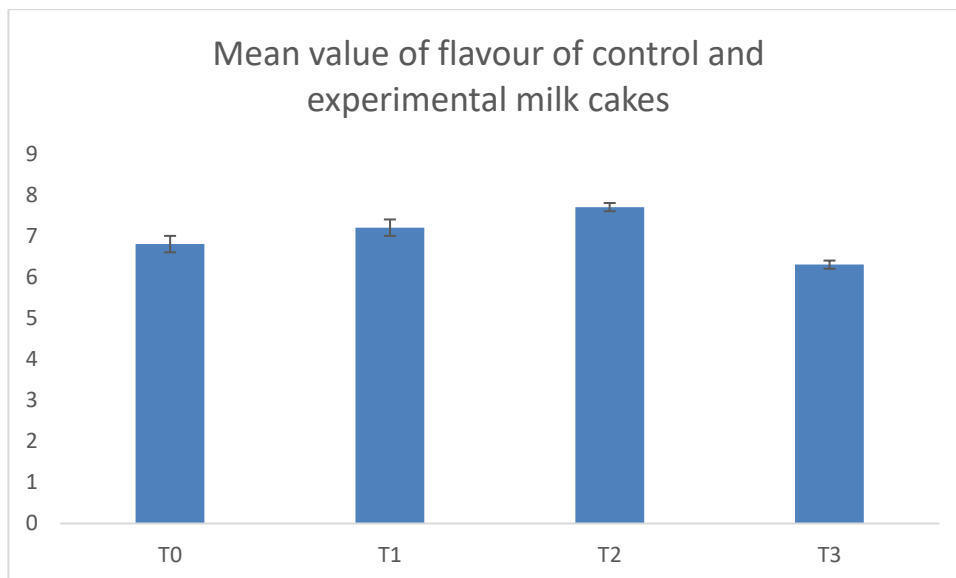| Treatments	T_0	T_1	T_2	T_3
Observations N	3	3	3	3
Mean	6.8000	7.2000	7.7000	6.3000
Sample std. dev.	0.2000	0.2000	0.1000	0.1000
Std. dev. of mean SE	0.1155	0.1155	0.0577	0.0577

After descriptive statistical analysis of flavour, it was found that the mean value of flavour of control (T_0) milk cake was 6.8 and mean value of texture of experimental milk cake were 7.2, 7.7 and 6.3 respectively.

Table 4.4.2 One-way ANOVA of flavour of control (T_0) and experimental (T_1, T_2, T_3) newly developed products

Source	Sum of squares SS	Degrees of freedom	Mean square MS	F statistic	p-value
treatment	2.2200	3	0.7400	29.6000	0.0001
error	0.2000	8	0.0250		
total	2.4200	11			

Table 4.4.3 significance and insignificance results of treatments

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs B	4.3818	0.0579184	insignificant
A vs C	9.8590	0.0010053	** $p<0.01$
A vs D	12.0499	0.0010053	** $p<0.01$
B vs C	5.4772	0.0197680	* $p<0.05$
B vs D	7.6681	0.0027994	** $p<0.01$
C vs D	2.1909	0.4561734	insignificant

Figure: 4 graphical representation of flavour of newly prepared milk cake

Table 4.5.1 Descriptive statistics of overall acceptability of control (T_0) and experimental (T_1, T_2, T_3) newly developed products

| Treatments	T_0	T_1	T_2	T_3
Observations N	3	3	3	3
Mean	6.4000	7.3000	7.6000	7.9000
Sample std. dev.	0.1000	0.2000	0.2000	0.3000
Std. dev. of mean SE	0.0577	0.1155	0.1155	0.1732

After descriptive statistical analysis of overall acceptability, it was found that the mean value of overall acceptability of control (T_0) milk cake was 6.4 and mean value of texture of experimental milk cake were 7.3, 7.6 and 7.9 respectively.

Table 4.5.2 One-way ANOVA of overall acceptability of control (T_0) and experimental (T_1, T_2, T_3) newly developed products

Source	Sum of squares SS	Degrees of freedom	Mean square MS	F statistic	p-value
treatment	3.7800	3	1.2600	28.0000	0.0001
error	0.3600	8	0.0450		
total	4.1400	11			

Table 4.5.3 significance and insignificance results of treatments

Treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs B	7.3485	0.0036520	** $p<0.01$
A vs C	9.7980	0.0010053	** $p<0.01$
A vs D	12.2474	0.0010053	** $p<0.01$
B vs C	2.4495	0.3694296	insignificant
B vs D	4.8990	0.0346710	* $p<0.05$
C vs D	2.4495	0.3694296	insignificant
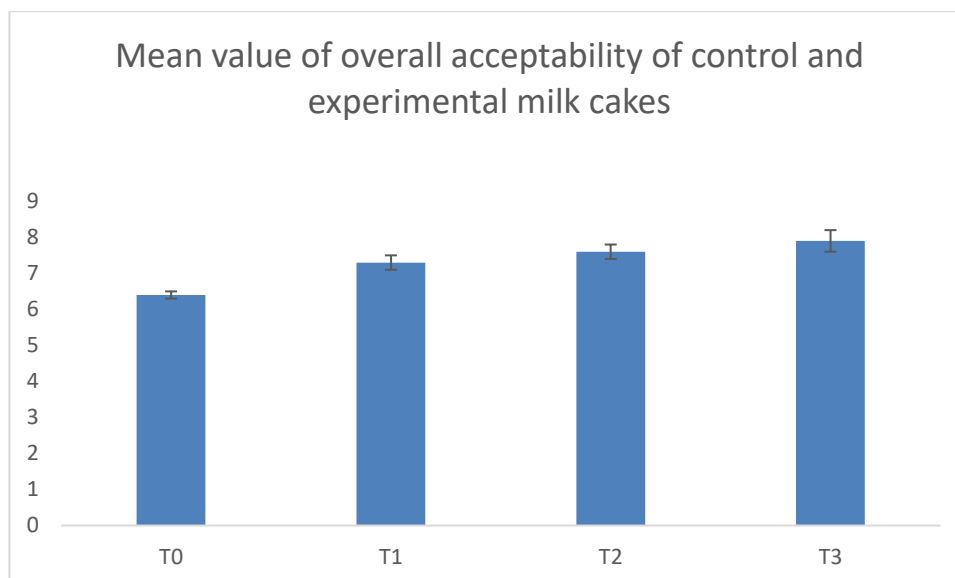
Figure: 5 graphical representations of overall acceptability of newly prepared milk cake

Conclusion:

Following a descriptive statistical study of texture, it was discovered that the experimental milk cake's mean texture value was 7.9, whereas the control milk cake's mean texture value was 6.2. Following a descriptive statistical examination of colour, it was discovered that the experimental milk cake's mean texture value was 7.6, 7.7, and 7.8, while the control milk cake's mean colour value was 6.6. After descriptive statistical analysis of taste, it was found that the mean value of taste of control (T_0) milk cake was 6.3 and mean value of texture of experimental milk cake were 7.4, 7.9 and 8.2 respectively. Following a descriptive statistical study of flavour, it was discovered that the experimental milk cake's mean texture value was 6.3, whereas the control milk cake's mean flavour value was 6.8. After descriptive statistical analysis of overall acceptability, it was found that the mean value of overall acceptability of control (T_0) milk cake was 6.4 and mean value of texture of experimental milk cake were 7.3, 7.6 and 7.9 respectively.

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