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Chemical Parameters Of Antioxidant-Enriched And Iron-Based Prebiotic Milk Cake

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Abstract

In this research study, control milk cake was developed without prebiotics and experimental milk cake was prepared by varying the percentage of prebiotics; kiwi fruit powder was used as a prebiotic. The nutritional value of bakery goods and their potential for use in feeding programmes and emergencies captured the attention of customers. The main goal of this research study was to develop antioxidant enriched and iron based prebiotic milk cake and to evaluate chemical parameters of newly prepared milk cake.

Keywords: antioxidant, dates powder, iron, prebiotics, kiwi fruits, chemical analysis.

Introduction:

Traditional dairy products are essential to the dairy sector in India since they are made from more than half of all milk produced. One of the traditional dairy products (sweets) that is consumed extensively in northern and central India is milk cake. These milk-based Indian sweets have developed home markets and are well-liked by Indian ethnic groups residing abroad (**Das et al., 2023**).

Traditional dairy food: milk cake

Originating from the Indian subcontinent. It's made primarily from milk, sugar, and often flavored with cardamom and sometimes garnished with nuts like almonds or pistachios. The process of making milk cake involves simmering milk until it reduces to a thick consistency, then adding sugar and other flavorings before allowing it to set. It's then typically cut into squares or diamond shapes for serving. Milk cake holds a significant place in Indian cuisine and is often prepared for festivals, celebrations, and special occasions. Its creamy texture and rich taste make it a beloved treat for many. It's also a popular sweet in other South Asian countries like Pakistan and Bangladesh **(Chandan, 2011)**.

While traditionally made on stovetops, there are modern adaptations that utilize condensed milk or even microwave methods for quicker preparation. However, the essence of the dessert remains rooted in the slow-cooking process that allows the flavors to meld and develop fully. **(Landge et al., 2009)**.

Aims and Objectives:

1. To evaluate the chemical properties of newly prepared prebiotic milk cake.

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 evaluated chemical parameters.

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

Chemical analysis:
- Carbohydrate (gm)
- Protein (gm)
- Fat (gm)
- Moisture (%)
- Ash (%)

Carbohydrate estimation:
The Anthrone method is a commonly used colorimetric method for the estimation of carbohydrates, particularly reducing sugars like glucose, in food samples. It involves the reaction of carbohydrates with anthrone reagent under acidic conditions, resulting in the formation of a blue-green complex whose intensity is directly proportional to the concentration of reducing sugars present **(Yemm and Willis, 1954)**.

Protein estimation:
Estimating protein content in milk cake can be done using various methods, with the most common being the Kjeldahl method **(Racusen and Johnstone, 1961)**.

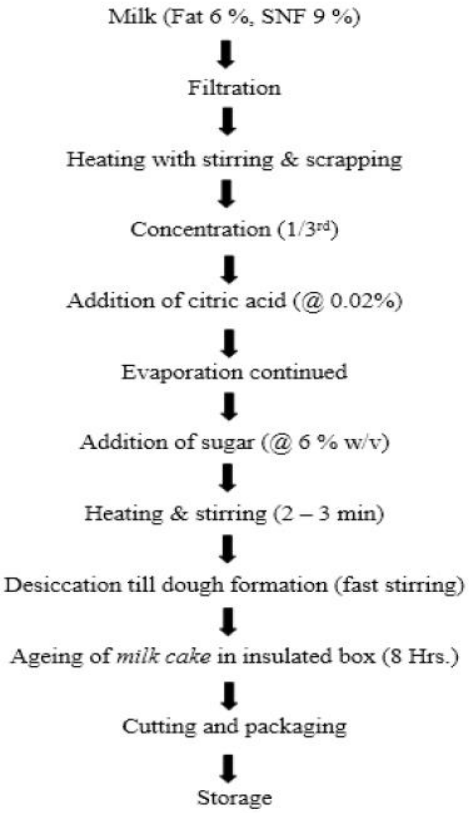
Fat estimation:

Estimating the fat content in milk cake can be accomplished through various methods, with one common approach being the Soxhlet method **(Leinhard et al., 2008)**.

Moisture content:
Estimating the moisture content in milk cake can be done through various methods, with the most common being the oven-drying method **(Sharma et al., 2018)**.

Ash content:
Estimating the ash content in milk cake involves determining the residue left behind after complete combustion of organic matter, which typically consists of minerals, salts, and other inorganic materials **(Maki et al., 2012)**.

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



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.

Results and discussions

Table 4.1 *Chemical parameters of newly prepared prebiotic milk cake*

	Chemical parameters				
Treatments	**Carbohydrate (gm)**	**Protein (gm)**	**Fat (gm)**	**Moisture (%)**	**Ash (%)**
T0	55 ± 0.11	8.37 ± 0.17	17.37 ± 0.28	17.27± 0.28	2.45
T1	57.38 ± 0.11	9.96 ± 0.34	14.47 ± 0.23	18.55 ± 0.40	2.69
T2	58.35 ± 0.11	10.35 ± 0.28	15.86 ± 0.17	19.25 ± 0.28	2.75
T3	59.96 ± 0.11	10.96 ± 0.28	16.37 ± 0.23	19.94 ± 0.17	2.87

Table 4.1.1 *Descriptive statistics of carbohydrate 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	55	57.38	58.35	59.96
Sample std. dev.	0.1050	0.1528	0.5300	0.1500
Std. dev. of mean SE	0.0527	0.0982	0.0597	0.0567

After descriptive statistical analysis of carbohydrate, it was found that the mean value of carbohydrate of control (T_0) milk cake was 55 and mean value of texture of experimental milk cake were 57.38, 58.35 and 59.96 respectively.

Table 4.1.2 *One-way ANOVA of carbohydrate 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	5.3225	3	2.7924	109.5625	7.7693e-07
error	0.1857	8	0.0163		
total	4.4272	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

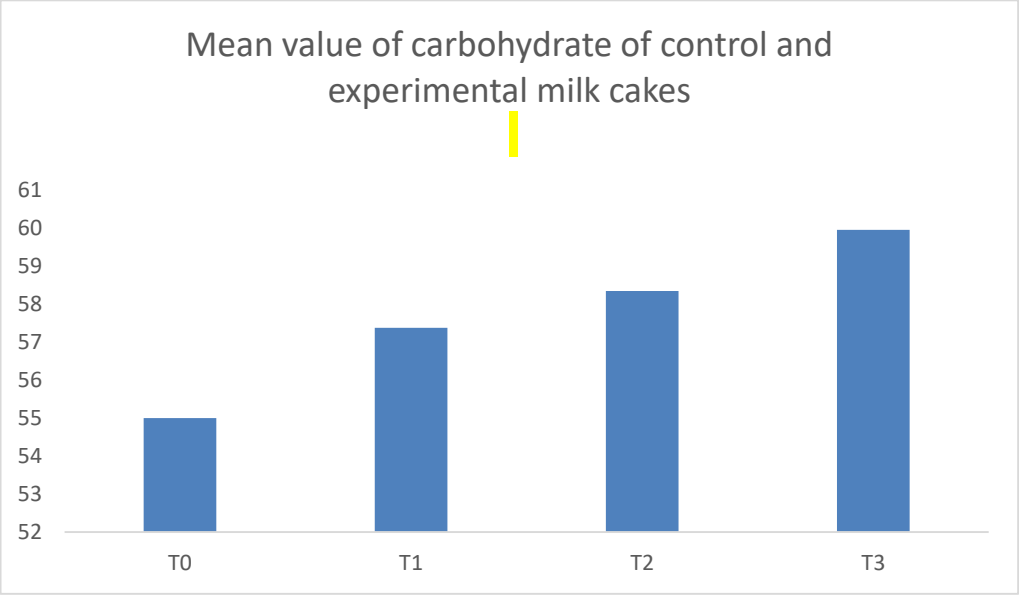


Figure: 1 *graphical representation of carbohydrate of newly prepared milk cake*

Table 4.2.1 *Descriptive statistics of protein 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	8.37	9.96	10.35	10.96
Sample std. dev.	0.1026	0.1890	0.1800	0.1026
Std. dev. of mean SE	0.0547	0.4982	0.1477	0.0378

After descriptive statistical analysis of protein, it was found that the mean value of protein 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 protein 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	1.7825	3	0.9226	92.7500	1.4845e-06
error	0.0680	8	0.0186		
total	2.8955	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

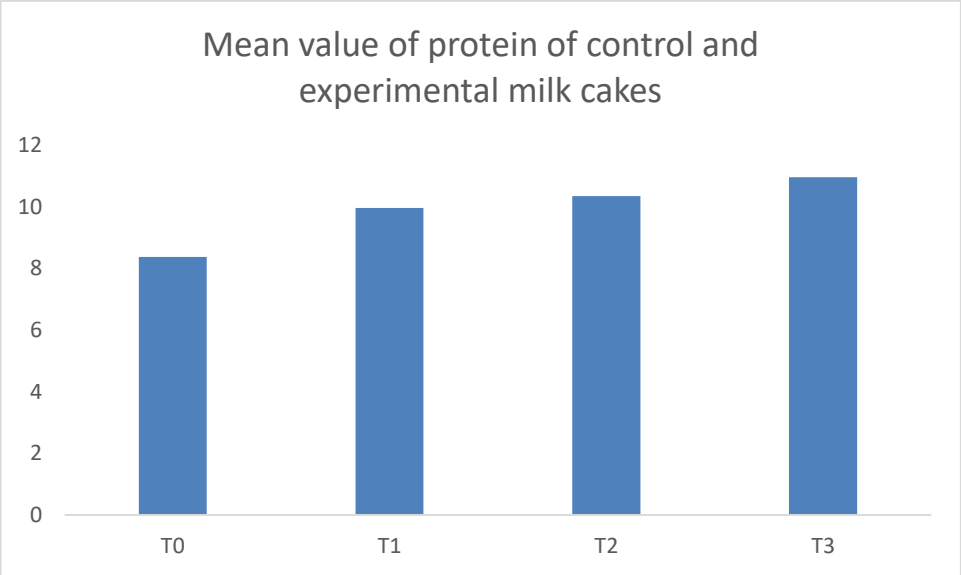


Figure: 2 *graphical representation of protein of newly prepared milk cake*

Table 4.3.1 *Descriptive statistics of fat 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	17.37	14.47	15.86	16.37
Sample std. dev.	0.3970	0.3900	0.1600	0.2600
Std. dev. of mean SE	0.1262	0.1922	0.0527	0.1255

After descriptive statistical analysis of fat, it was found that the mean value of fat of control (T_0) milk cake was 17.37 and mean value of texture of experimental milk cake were 14.47, 15.86 and 16.37 respectively.

Table 4.3.2 *One-way ANOVA of fat 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	8.2700	3	2.0650	36.3478	5.2222e-05
error	0.7500	8	0.0365		
total	6.7540	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

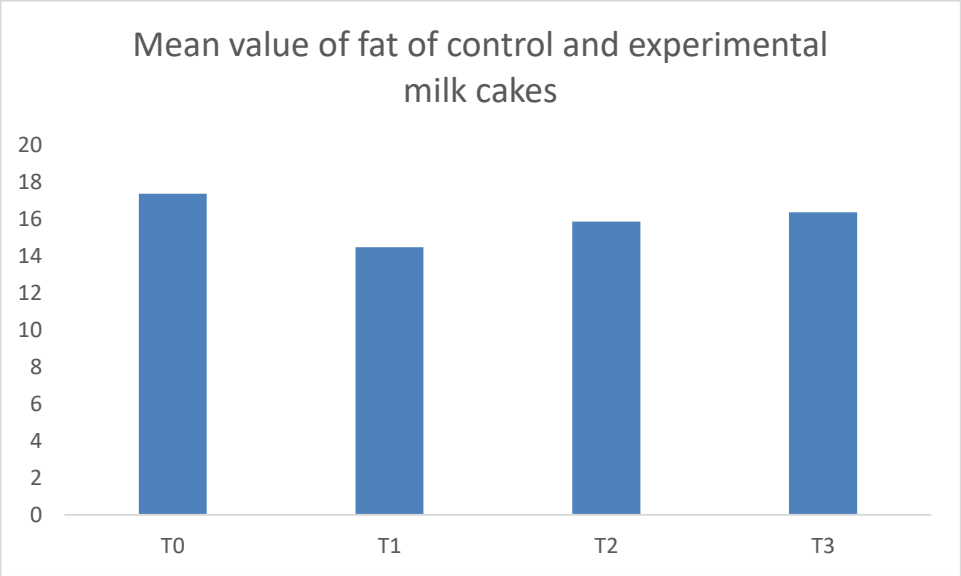


Figure: 3 *graphical representation of fat of newly prepared milk cake*

Table 4.4.1 *Descriptive statistics of moisture 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	17.27	18.55	19.25	19.94
Sample std. dev.	0.4320	0.5400	0.1530	0.1650
Std. dev. of mean SE	0.1165	0.1125	0.0547	0.3477

After descriptive statistical analysis of *moisture*, it was found that the mean value of *moisture* of control (T_0) milk cake was 17.27 and mean value of texture of experimental milk cake were 18.55, 19.25 and 19.94 respectively.

Table 4.4.2 *One-way ANOVA of moisture 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	3.7400	3	0.7460	29.6000	0.0001
error	0.6400	8	0.0280		
total	2.4890	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

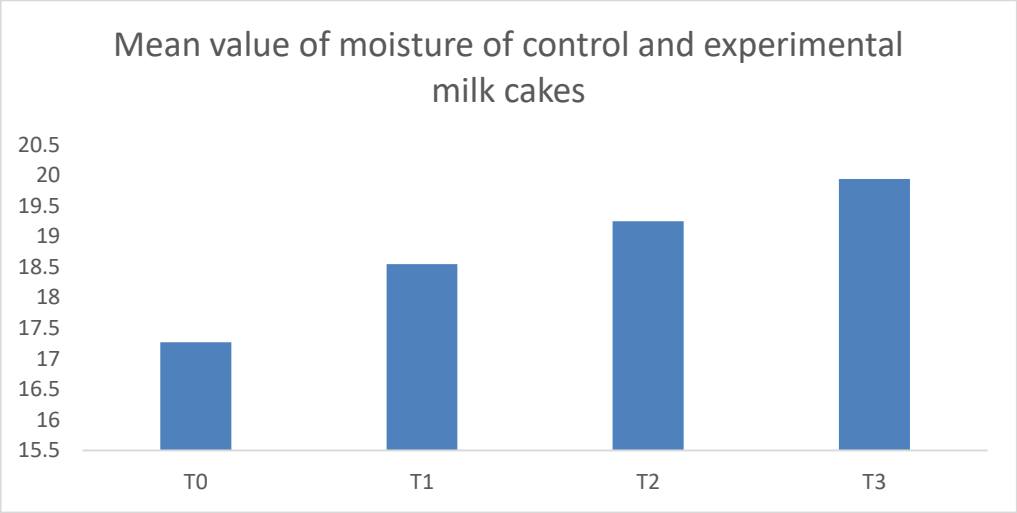


Figure: 4 *graphical representation of moisture of newly prepared milk cake*

Table 4.4.1 *Descriptive statistics of ash 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	2.45	2.69	2.75	2.87
Sample std. dev.	0.5400	0.2035	0.1000	0.1800
Std. dev. of mean SE	0.1965	0.1165	0.0577	0.0277

After descriptive statistical analysis of *ash*, it was found that the mean value of *ash* of control (T_0) milk cake was 2.45 and mean value of texture of experimental milk cake were 2.68, 2.75 and 2.87 respectively.

Table 4.4.2 *One-way ANOVA of ash 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	2.2960	3	0.7420	29.6000	0.0001
error	0.2360	8	0.0280		
total	2.4080	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

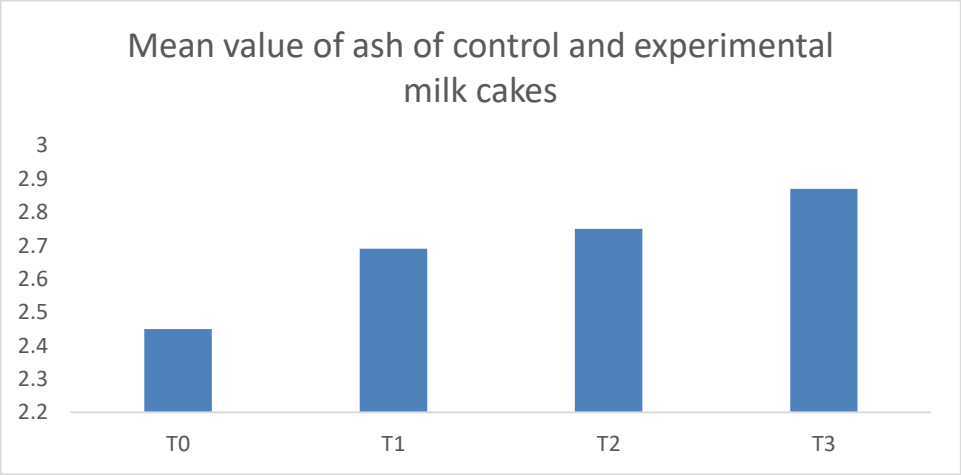


Figure: 4 *graphical representation of ash of newly prepared milk cake*

Conclusion:

Following a descriptive statistical examination of the carbohydrate content, it was discovered that the experimental milk cake's mean texture value was 59.96, while the control milk cake's mean texture value was 55. Following a descriptive statistical study of protein, it was discovered that the experimental milk cake's mean texture value was 7.6, 7.7, and 7.8, whereas the control milk cake's mean protein value was 6.6. It was discovered that the mean protein value of the control (T0) milk cake was 6.6 and the mean texture value of the experimental milk cake was 7.6, 7.7, and 7.8, respectively, following a descriptive statistical analysis of protein. Following a descriptive statistical study of moisture, it was discovered that the experimental milk cake's mean texture value was 19.94, while the control milk cake's mean moisture value was 17.27 (T0). Following a descriptive statistical analysis of the ash, it was discovered that the experimental milk cake's mean texture value was 2.68, 2.75, and 2.87, whereas the control milk cake's mean ash value was 2.45 (T0).

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