

Development of functional *Gulabjamun* from soya fortified milk

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Five different ratios of buffalo milk and soya milk *i.e.* 1 : 0, 1 : 1, 1 : 2, 1 : 3 and 1 : 4 indicated as T₀, T₁, T₂, T₃ and T₄, respectively and three different levels of maida *i.e.* 30 per cent, 33 per cent and 35 per cent indicated as M₁, M₂ and M₃, respectively were used in the present study. Fifteen treatment combinations used in the study *i.e.* T₀M, T₁M₁, T₁M₂, T₁M₃, T₂M₁, T₂M₂, T₂M₃, T₃M₁, T₃M₂, T₃M₃, T₄M₁, T₄M₂ and T₄M₃ were replicated six times. Sensory evaluation of the 179 prepared functional *Gulabjamun* was carried out by using nine point hedonic scales. The data obtained during investigation were statistically analyzed by using factorial design and critical difference between treatment combinations. Highest overall acceptability of functional *Gulabjamun* was found in T₀M (8.35) and T₁M₁ (8.49). Amongst the different treatment combinations the highest flavour and taste score of 8.25 was found in T₀M followed by T₁M₁ (8.37). The treatment combination T₁M₁ was most acceptable in terms of body and texture as it has the highest score of 8.47.

Key Words : Buffalo milk, Soya milk, Khoa, Fortified milk, Sugar, Temperature

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INTRODUCTION

Foods which promote health beyond providing basic nutrition are termed as functional foods. It refers to a food that has been modified or value-added. Significant strategy in the development of functional foods evolves increasing the levels of specific nutraceuticals that are known as health benefits. This can be through enhancement of levels of the desired component with proper and economic process technology (Prabhakar *et al.*, 2015). The functional property is inherent in the food by fortification of food products with functional ingredients, such as dietary fibres, antioxidants, natural

isoflavones, plant sterols/stanols, other phytochemicals or phytonutrients, bioactive peptides, w-3, -6 PUFA, probiotics, prebiotics, minerals and vitamins etc. (Kant and Broadway, 2015).

METHODOLOGY

The samples of functional *Gulabjamun* were

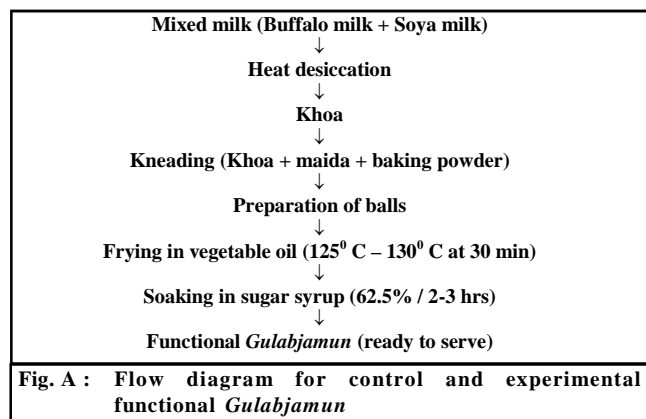


Fig. A : Flow diagram for control and experimental functional *Gulabjamun*

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evaluated for flavour, body and texture, colour and appearance, sweetness and overall acceptability on a 9-point Hedonic scale by a sensory panel consisting of 8 judges on the basis of Srilakshmi (2002).

OBSERVATIONS AND ASSESSMENT

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Flavour and taste score of functional Gulabjamun :

The average flavour and taste score of functional Gulabjamun samples were shown in Table 1. It can be observed that the average flavour and taste score of functional Gulabjamun sample T₁M₁ [Buffalo milk: Soya milk as 50:50 (6 % fat and 9 % SNF) and Maida: 30 % on the basis of Khoa obtained from mixed milk] was higher than other samples.

Data for average flavour and taste score of functional Gulabjamun were statistically analysed to find out significant difference between treatments with regard to the flavour and taste score of functional Gulabjamun samples.

The ANOVA Table 2 showed that the calculated F values were less than their respective F values at 5 per cent probability levels for sources of variations M, T and M x T. Therefore, it can be concluded from the

experimental data that there were no significant difference between levels of maida, between treatments as well as interaction between them.

Body and texture score of functional Gulabjamun :

The average body and texture score of functional Gulabjamun samples were presented in Table 3. It can be observed that the average body and texture score of functional Gulabjamun sample T₁M₁ was higher than other samples. Data for average body and texture score of functional Gulabjamun were statistically analysed to find out significant difference between treatments with regard to the body and texture score of functional Gulabjamun samples.

The ANOVA showed that the calculated values of F were greater than their tabulated F values at 5 per cent as well as at 1 per cent probability levels for level of Maida as well as treatment. However, the interaction between level of maida (M) and treatments (T) i.e. M x T were not significant at P < 0.05 as well as P < 0.01. Therefore, it can be concluded from the experimental data that there are high significant difference between levels of maida and between treatments over body and texture score.

The data were further analysed using critical difference and the results are presented in the Table 4.

On comparing the average body and texture scores

Table 1 : Average of data obtained on different parameters in functional Gulabjamun samples

Sr. No.	Parameters	T ₀	T ₁ M ₁	T ₁ M ₂	T ₁ M ₃	T ₂ M ₁	T ₂ M ₂	T ₂ M ₃	T ₃ M ₁	T ₃ M ₂	T ₃ M ₃	T ₄ M ₁	T ₄ M ₂	T ₄ M ₃
1.	Flavour and taste score of functional gulabjamun	8.25	8.36	8.26	8.19	8.25	8.06	8.17	8.17	8.17	8.06	7.96	7.96	7.86
2.	Body and texture score of functional gulabjamun	8.28	8.46	8.25	8.20	8.17	8.11	8.15	8.23	8.06	7.59	6.62	6.50	6.17
3.	Colour and appearance score of functional gulabjamun	8.47	8.62	8.55	8.41	8.46	8.42	8.41	8.50	8.42	8.47	8.55	8.47	8.47
4.	Overall acceptability score of functional gulabjamun	8.34	8.48	8.36	8.27	8.22	8.20	8.15	8.20	8.17	8.02	7.71	7.65	7.50

Table 2 : ANOVA for flavour and taste score of functional Gulabjamun

Sources of variation	d. f.	S. S	M.S.S.	F(cal)	F. tab (5%)	Result
Replication	5	1.984	0.3968	7.39		
Level of maida (M)	2	0.14	0.07	1.29	3.13	NS
Treatment (T)	4	0.53	0.1325	2.45	2.5	NS
Interaction (M x T)	8	0.073	0.00912	0.17	2.07	NS
Error	70	3.764	0.054			
Total	89	6.491				

NS = Non-significant

for different levels of maida against the critical difference, the significant difference was observed between the mean values of (M_1, M_3), (M_1, M_2) and (M_2, M_3).

On comparing the average body and texture scores for different treatments against the critical difference, the significant difference was observed between the mean values of $T_0, T_1M_1, T_1M_2, T_1M_3, T_2M_1, T_2M_2, T_2M_3, T_3M_1, T_3M_2, T_3M_3, T_4M_1, T_4M_2$ and T_4M_3 . Whereas, non-significant difference was observed between the mean values of T_0 and T_1 .

The differences in body and texture scores in the product were probably attributed to differences in physical properties of milk fat and different levels of binder *i.e.* maida used in the experiment. It was also due to the variation in the moisture retention in the product. With the increase in the retention of moisture, the body and texture of the product was improved (Table 5).

Colour and appearance score of functional Gulabjamun :

Colour and score can be observed from Table 6. It can be observed that the average colour and appearance score of functional *Gulabjamun* sample T_1M_1 was higher than other samples. Data for average colour and appearance score of functional *Gulabjamun* were statistically analysed to find out significant difference between treatments with regard to the colour and appearance score of functional *Gulabjamun* samples.

The ANOVA showed that the calculated values of F were less than their tabulated F values at 5 per cent probability levels for M, T and M X T. Therefore, it can be concluded from the experimental data that there were

no significant difference between levels of maida, between treatments as well as interaction between them over colour and appearance of functional *Gulabjamun*.

Overall acceptability score of functional Gulabjamun :

It can be observed from Table 7. It was observed that the average overall acceptability score of functional *Gulabjamun* samples T_0 and T_1M_1 were higher than other samples. Data for average overall acceptability score of *Gulabjamun* were statistically analysed to find out significant difference between treatments with regard to the overall acceptability score of functional *Gulabjamun* samples.

The ANOVA showed that the calculated values of F due to levels of maida and due to treatments are greater than their respective F values at 5 per cent as well as at 1 per cent probability levels. Therefore, it can be concluded from the experimental data that there are high significant difference between levels of maida and between treatments.

Whereas, the calculated value of F due to interaction between maida and treatment is less than its tabulated value F values at 1 per cent and at 5 per cent probability levels, the calculated value is slightly higher than tabulated value. Therefore, it can be concluded from the experimental data that there is non-significant difference due to interaction between maida and treatment at $P < 0.05$ but slightly significant at $P < 0.01$.

The data were further analysed using critical difference and the results are presented in the Table 8.

On comparing the average overall acceptability

Table 3 : ANOVA for body and texture score of functional Gulabjamun

Sources of variation	d. f.	S. S	M.S.S.	F(cal)	F. tab (5%)	F. tab (1%)	Result
Replication	5	0.355	0.071	1.61			
Level of maida (M)	2	1.01	0.505	11.48**	3.13	4.92	HS
Treatment (T)	4	42.41	10.60	240.91**	2.5	3.6	HS
Interaction (M x T)	8	0.528	0.07	1.6 ^{NS}	2.07	2.77	NS
Error	70	3.057	0.044				
Total	89	47.36					

**HS = Highly significant at $P < 0.01$ and $P < 0.05$ NS = Non-significant

Table 4 : Comparison of average body and texture score of functional Gulabjamun against critical difference (For maida)

Level of maida	Average value of body and texture	M_3	M_2	M_1
M_1	8.46	0.26**	0.12**	
M_2	8.11	0.14**		
M_3	6.17			

** Significant for CD at 5% = 0.11

scores for different levels of maida against the critical difference, the significant difference was observed between the mean values of (M₁, M₃) and (M₂, M₃). Whereas, non-significant difference was observed between the mean values of (M₁, M₂).

On comparing the average overall acceptability scores for different treatments against the critical

difference, the significant difference was observed between the mean values of (T₀, T₄), (T₀, T₃), (T₀, T₂), (T₁, T₄), (T₁, T₃), (T₁, T₂), (T₂, T₄), (T₂, T₃) and (T₃, T₄). Whereas, non significant difference was observed between the mean values of (T₀, T₁). The differences in overall acceptability scores of the product were attributed due to the sensory and physical characteristics (Table

Table 5 : Comparison of average body and texture score of functional Gulabjamun against critical difference (For treatment)

Treatments	Average value of body and texture	T ₄	T ₃	T ₂	T ₁	T ₀
T ₀	8.28	1.85*	0.42*	0.23*	0.04NS	
T ₁	8.46	1.81*	0.38*	0.19*		
T ₂	8.11	1.62*	0.19*			
T ₃	8.15	1.43*				
T ₄	6.62					

CD at 5% = 0.139 * Significant NS=Non-significant

Table 6 : ANOVA for colour and appearance score of functional Gulabjamun

Sources of variation	d. f.	S. S	M.S.S.	F(cal)	F. tab (5%)	Result
Replication	5	0.12	0.024	0.24		
Level of maida (M)	2	0.172	0.086	0.87	3.13	NS
Treatment (T)	4	0.28	0.07	0.71	2.5	NS
Interaction (M x T)	8	0.19	0.024	0.24	2.07	NS
Error	70	6.92	0.099			
Total	89	7.68				

NS = Non-significant at P < 0.05

Table 7: ANOVA for overall acceptability score of functional Gulabjamun

Sources of variation	d. f.	S. S	M.S.S.	F(cal)	F. tab (5%)	F. tab (1%)	Result
Replication	5	0.066	0.0132	0.825			
Level of maida (M)	2	0.706	0.0353	22.06**	3.13	4.92	HS
Treatment (T)	4	7.34	1.835	111.687**	2.5	3.6	HS
Interaction (M x T)	8	0.274	0.034	2.125	2.07 ^{NS}	2.77*	NS
Error	70	1.124	0.016				
Total	89	9.51					

** HS at P < 0.01 and P < 0.05, NS=Non-significant at P < 0.05, * significant at P < 0.01

Table 8 : Comparison of average overall acceptability score of functional milk Gulabjamun against critical difference (For maida)

Level of maida	Average value of body and texture	M ₃	M ₂	M ₁
M ₁	8.48	0.21*	0.06	
M ₂	8.20	0.15*		
M ₃	8.02			

CD at 5% = 0.066, * Significant

Table 9 : Comparison of average overall acceptability score of functional gulabjamun against critical difference (For treatment)

Treatments	Average value of body and texture	T ₄	T ₃	T ₂	T ₁	T ₀
T ₀	8.40	0.77*	0.34*	0.2*	0.02NS	
T ₁	8.38	0.75*	0.32*	0.18*		
T ₂	8.20	0.57*	0.14*			
T ₃	8.06	0.43*				
T ₄	7.63					

CD at 5% = 0.084 * Significant, NS=Non-significant

9).

Conclusion :

The effects of treatments (T) and Maida (M) on overall acceptability and sensory attributes reflected to have T₁M₁ combination. The scores of overall acceptability, flavour and taste, body and texture and colour and appearance were 8.48, 8.36, 8.46 and 8.47, respectively, which were closer to control sample. Therefore, the mixed milk of 6 per cent fat and 9 per cent SNF prepared by mixing buffalo milk with soya milk in the ratio of 50 : 50 is found to be best for preparation of khoa to be used in functional *Gulabjamun*. The maida variation was found to be best as 30 per cent of Khoa on weight basis to be used as binder in preparation of *Gulabjamun*. The standard method of De (1980) was followed to prepare the functional *Gulabjamun*.

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