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Enhancement of functional properties of Gulabjamun by soya fortified milk

Rajni Kant and Arif A Broadwayb

Abstract
Five different ratios of buffalo milk and soya milk i.e. 1:0 (T_0), 1:1 (T_1), 1:2 (T_2), 1:3 (T_3) and 1:4 (T_4) and three different levels of maida i.e. 30% (M_1), 33% (M_2) and 35% (M_3) respectively were used in the present study was undertaken with the objectives “Development of Functional Gulabjamun Using Khoa from Soya Fortified Milk” to improve the functional qualities of gulabjamun. These treatment combination (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) used in the study were replicated six times. Products were tested for moisture, fat, protein, carbohydrate, ash, total solids, Coli form, yeast and mould, hardness, adhesiveness, cohesiveness, gumminess, springiness and Chewiness. The data obtained during investigation were statistically analyzed by using factorial design and critical difference between treatment combinations. Treatment combinations T_3M_3 contained the highest percentage of total carbohydrate (45.15), ash (1.99), total solids (69.82) and yield (54.16). The treatment combination T_2M_1 contained highest percentage of fat (13.99). The treatment combination T_4M_2 contained highest percentage of protein (9.14).

Keywords: Buffalo milk, soya milk, Khoa, fortified milk, isoflavones, genistein

Introduction

Food which promotes health beyond providing basic nutrition is termed as functional food (Head *et al*. 1996) [9]. 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 neutraceuticals that are known as health benefits. This can be through enhancement of levels of the desired component that 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 phytonutrientvs, bioactive peptides, w-3, -6 PUFA, probiotics, prebiotics, minerals and vitamins etc (Heasman *et al*. 2001) [11].

Gulabjamun is a popular khoa based sweet and originally it was made with khoa and maida. It got the name of Gulabjamun As it looks like monsoon fruit “Jamun” and is flavoured with “rose water” (Chetana *et al*. 2004) [17]. Dhap Khoa having 40 -45 per cent moisture is normally used for its preparation (Badami *et al*. 2006) [12]. Gulabjamun is largely produce by manual operation which adopts small scale batch method. Though there is large variation in the sensory quality of gulabjamun, the most liked product should have brown colour, smooth and spherical shape, soft and slightly spongy body free from both lumps and hard central core, uniform granular texture, mildly cooked and oily flavour, free from doughy feel and fully succulent with sugar syrup. It should have optimum sweetness. The gross chemical composition of gulabjamun varies widely depending on numerous factors, such as composition and quality of Khoa, proportion of ingredients and sugar syrup concentration, etc. The composition of gulabjamun, on the drained weight basis, varies in the following range: 25 – 35% (moisture), 8.5 – 10.5% (fat), 6 – 7.6% (protein), 0.9 – 1.0% (ash) and 43 – 48% (total carbohydrates) (Minhas *et al*. 1985) [13]. In gulabjamun manufacture, dipping in sugar syrup is a key unit operation. This gives not only its characteristic sweetness but also its typical texture. The characteristic sweetness is only due to the diffusion of sugar syrup into fried gulabjamun balls. Hence the diffusion is one of the key processes taking place in gulabjamun manufacture (Naikwadi *et al*. 2010) [14].

High intake of fat increase risk of heart attack because of high proportions of saturated fats in the diet (Hu *et al.* 2005) [15]. Many nutritionists believe that if fat intake is reduced to provide less than 30 per cent of the calories through fats and oil dietary fat would not be risk factor at all in heart disease. Soya bean is a leguminous crop and is rich in proteins (Clarke *et al.* 2000) [3]. Many value-added products are made from it like milk, sauce, paneer etc.

Soya products are increasingly becoming popular especially amongst health conscious people. Cow's milk does not contain isoflavones. Isoflavones have many health benefits including reduction of cholesterol, easing of menopause symptoms, prevention of osteoporosis and reduction of risk for certain cancers (prostate cancer and breast cancer). Incidents of these cancers are very low in countries with high intake of soya products, including soya milk. Isoflavones are also antioxidants which protect our cells and DNA against oxidation.

Soya milk is rich in isoflavones. The presence of isoflavones is the most important and unique benefit of soya milk, (Alekel *et al*. (2000) [1]. The Soyabean is often called the "golden miracle bean and is the world's foremost provider of protein and used for health food, feed sources and industrial products. It contains about 20% oil and 40% high quality protein (as against 7.0% in rice, 12% in wheat, 10% in maize and 20-25% in other pulses) (Deshpande *et al*. 2006) [6]. Soybean products also have protective properties against breast, prostate, colon and lung cancers because of the isoflavones content. Other than the whole seed, many processed soy products are available in the market. They include soya milk, soya flour, soya curd and tofu (soya paneer). Soya protein is a complete protein, meaning it contains all of the indispensable amino acids required by the body in the correct proportions and amounts to meet human needs for growth, maintenance and repair of living tissues (Davies *et al.* 1990) [4]. Soya protein is the only complete plant based protein which is available to those maintaining a vegetarian lifestyle and is equal in protein quality to milk, meat and egg proteins. Muscles need protein to repair, rebuild and grow. In accordance with the guidelines given by WHO/FAO/UNU, used of soy protein as a whole source of protein in the daily diet will support normal muscle formation and maintain nitrogen balance in both children and adults. The gulabjamun prepared with soya fortified milk namely functional gulabjamun is planned to impart functional characteristics for healthy benefits (Faghih *et al.* 2011) [8]. Keeping these unique properties of soya milk, an attempt was made to enhance the functionality of gulabjamun by fortification of soya milk.

Materials and Methods

The experiment "Development of Functional Gulabjamun Using Khoa from Soya Fortified Milk" was carried out in the Student's Training Dairy and research Lab, Warner School of Food and Dairy Technology, Sam Higginbottom Institute of Agriculture, Technology and Sciences (Formerly Allahabad Agricultural Institute) (Deemed -to-be- University) Allahabad -211007, U.P. (India) during Ph.D. Research work of first author.

Treatment combination

Four different ratio Buffalo milk and Soya milk i.e. 100:0 50:50, 60:40, 70:30 & 80:20 were used for making Khoa and three different levels of maida were used in the present experimental work. The different treatment combinations used in the experiment were represented as follows:

Table 1: Details treatment combination

Treatments	Buffalo milk (%)	Soymilk (%)	Maida (%)	Standardized value	
				Fat (%)	SNF (%)
T_0	100	-	35	6	9
$T_1 M_1$	50	50	30	6	9
$T_1 M_2$	50	50	33	6	9
$T_1 M_3$	50	50	35	6	9
$T_2 M_1$	60	40	30	6	9
$T_2 M_2$	60	40	33	6	9
$T_2 M_3$	60	40	35	6	9
$T_3 M_1$	70	30	30	6	9
$T_3 M_2$	70	30	33	6	9
$T_3 M_3$	70	30	35	6	9
$T_4 M_1$	80	20	30	6	9
$T_4 M_2$	80	20	33	6	9
$T_4 M_3$	80	20	35	6	9

Process flow chart for soya fortified milk

Functional gulabjamun was prepared adding with 30 per cent, 33 per cent and 35 per cent maida which was indicated as M_1, M_2 and M_3 respectively.

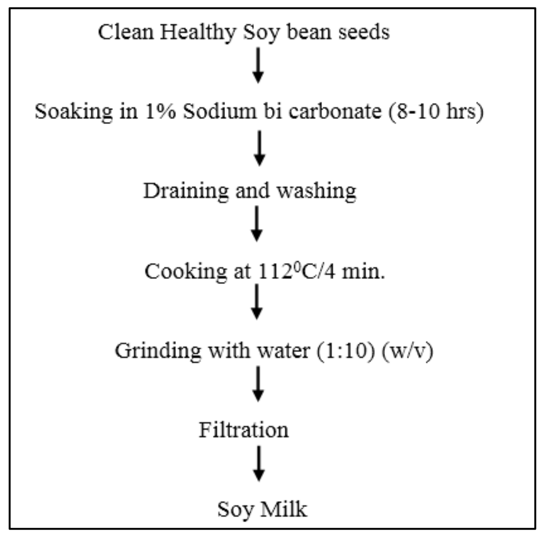

Fig 1: Flow diagram for preparation of soya fortified milk.

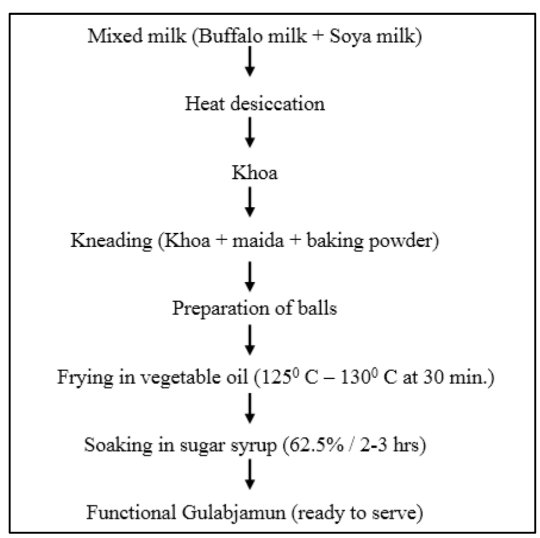

Fig 2: Flow diagram for control and experimental Functional Gulabjamun.

Results and Discussions

Chemical composition

It can be observed from table 2. The average per cent moisture in functional gulabjamun samples 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 were 30.48, 30.73, 31.12, 30.39, 30.73, 31.13, 30.20, 30.77, 30.96, 30.16, 30.81, 30.82 and 30.17 respectively. It can be observed that the per cent moisture in functional gulabjamun sample T_2M_2 was higher than other samples. Data for average per cent moisture in functional gulabjamun were statistically analysed to find out significant difference between treatments with regard to the moisture in functional gulabjamun samples. The data were further analysed using critical difference and the results are presented in the table appended below:

Table 2: Nutritional profile of soya fortified functional Gulabjamun

Treatments	Moisture Content (%)	Carbohydrate (%)	Protein (%)	Fat (%)	Ash (%)	TSS (%)
T_0	30.48 ± 0.031^{b}	44.92 ± 0.454^{c}	8.62 ± 0.016^{a}	13.83 ± 0.015^{ab}	1.94 ± 0.012^{g}	69.47 ± 0.018^{f}
$T_1 M_1$	30.73 ± 0.023^{c}	44.40 ± 0.016^{b}	8.96 ± 0.016^{f}	13.87 ± 0.016^{c}	1.94 ± 0.008^{g}	69.22 ± 0.016^{e}
$T_1 M_2$	31.12 ± 0.016^{e}	44.14 ± 0.199^{a}	8.91 ± 0.016^{e}	13.83 ± 0.015^{ab}	1.67 ± 0.012^{c}	68.86 ± 0.008^{b}
$T_1 M_3$	30.39 ± 0.350^{b}	45.02 ± 0.012^{cd}	8.86 ± 0.026^{c}	13.81 ± 0.014^{a}	1.97 ± 0.013^{h}	69.72 ± 0.013^{g}
$T_2 M_1$	30.73 ± 0.016^{c}	44.40 ± 0.016^{b}	8.81 ± 0.014^{b}	13.97 ± 0.016^{e}	1.90 ± 0.005^{f}	69.23 ± 0.019^{e}
$T_2 M_2$	31.13 ± 0.021^{e}	44.40 ± 0.012^{b}	8.90 ± 0.012^{e}	13.81 ± 0.016^{ab}	1.66 ± 0.009^{b}	68.82 ± 0.019^{a}
$T_2 M_3$	30.20 ± 0.015^{a}	45.06 ± 0.016^{cd}	8.90 ± 0.012^{e}	13.81 ± 0.012^{a}	1.95 ± 0.016^{g}	69.77 ± 0.016^{h}
$T_3 M_1$	30.77 ± 0.018^{d}	44.43 ± 0.019^{b}	8.91 ± 0.035^{e}	13.92 ± 0.016^{d}	1.90 ± 0.005^{f}	69.19 ± 0.015^{d}
$T_3 M_2$	30.96 ± 0.400^{de}	44.36 ± 0.014^{b}	8.87 ± 0.021^{c}	13.83 ± 0.021^{b}	1.61 ± 0.009^{a}	68.86 ± 0.008^{b}
$T_3 M_3$	30.16 ± 0.017^{a}	45.12 ± 0.019^{d}	8.83 ± 0.021^{c}	13.81 ± 0.012^{a}	1.98 ± 0.008^{i}	69.80 ± 0.010^{i}
$T_4 M_1$	30.81 ± 0.009^{cd}	44.37 ± 0.016^{b}	8.92 ± 0.019^{e}	13.93 ± 0.021^{d}	1.87 ± 0.0016^{e}	69.16 ± 0.012^{c}
$T_4 M_2$	30.82 ± 0.014^{cd}	44.42 ± 0.019^{b}	9.12 ± 0.016^{g}	13.83 ± 0.021^{b}	1.71 ± 0.009^{d}	69.16 ± 0.008^{c}
$T_4 M_3$	30.17 ± 0.018^{a}	45.33 ± 0.220^{e}	8.90 ± 0.012^{e}	13.81 ± 0.014^{a}	1.95 ± 0.008^{g}	69.80 ± 0.009^{i}

Values in the same columns followed by different letters (a–i) are significant ($P < 0.05$).

Table 3: Comparison of average percent Moisture content of functional gulabjamun against critical difference. (For maida):

Level of maida	Average value of moisture	M_3	M_2	M_1
M_3	30.17	0.792^{**}		0.288^{**}
M_2	31.11	0.504^{**}		
M_1	30.71			

CD at 5% = 0.123 ** Significant

On comparing the average moisture content for different levels of maida against the critical difference, the significant difference was observed between the mean values of (M2, M3), (M2, M1) and (M1, M3). The difference in moisture content in gulabjamun is attributed to the initial composition of khoa. Moisture retention in gulabjamun is largely affected by the addition of additives. In this regard 30 per cent and 33 per cent level of maida found to be equally good.

It can be observed from table 2. The average per cent fat in functional gulabjamun samples 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 were13.83, 13.87, 13.83, 13.81, 13.97, 13.83, 13.81, 13.92, 13.83, 13.81, 13.93, 13.83 and 13.81 respectively. It can be observed that the per cent fat in functional gulabjamun sample T_2M_1 was higher than other samples. Data for average fat in functional gulabjamun were statistically analysed to find out significant difference between treatments with regard to the fat in functional gulabjamun samples.

It can be observed from table 2. The average per cent protein in functional gulabjamun samples 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 were 8.62, 8.96, 8.91, 8.86, 8.81, 8.90, 8.90, 8.91, 8.87, 8.83, 8.92, 9.12 and 8.90 respectively. It can be observed that the per cent protein in functional gulabjamun sample T_4M_2 was higher than other samples. Data for average per cent protein in functional gulabjamun were statistically analysed to find out significant difference between treatments with regard to the protein in functional gulabjamun samples. The data were further analysed using critical difference and the results are presented in the table appended below:

Table 4: Comparison of average Protein content of functional gulabjamun against critical difference. (For maida)

Level of maida	Average value of protein	M_3	M_2	M_1
M_3	8.90	0.15*		0.03
M_2	8.83	0.12*		
M_1	8.86			

CD at 5% = 0.03 * Significant

On comparing the average protein content for different levels of maida against the critical difference, the significant difference was observed between the mean values of (M_2, M_3) and (M_1, M_3). Whereas, non-significant difference was observed between the mean values of (M_2, M_1).

Table 5: Comparison of average protein content of functional gulabjamun against critical difference. (For treatment)

Treatment	Average value of protein	T_0	T_3	T_2	T_1
T_4	8.90	0.09*	0.08*	0.08*	0.07*
T_1	8.96	0.02	0.01	0.01	
T_2	8.81	0.01	0		
T_3	8.91	0.01			
T_0	8.62				

CD at 5% = 0.04 * Significant

On comparing the average protein content for different treatments against the critical difference, the significant difference was observed between the mean values of (T_4, T_0), (T_4, T_3), (T_4, T_2) and (T_4, T_1).Whereas, non-significant difference was observed between the mean values of (T_1, T_0), (T_1, T_3), (T_1, T_2), (T_2, T_0), (T_2, T_3) and (T_3, T_0).

It can be observed from table 2. The average per cent carbohydrate in gulabjamun samples 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 were 44.92, 44.40, 44.14, 45.02, 44.40, 44.40, 45.06, 44.43, 44.36, 45.12, 44.37, 44.42 and 45.33 respectively. It can be observed that the per cent carbohydrate in gulabjamun sample T_3M_3 was higher than other samples. Data for average per cent carbohydrate in gulabjamun were statistically analysed to

find out significant difference between treatments with regard to the carbohydrate in gulabjamun samples. De (1982) stated that carbohydrate or total sugar percentage was influenced by total solid content in a product. As the moisture content decreases the total solid increases and because of the increase in total solid content, the total sugar content increases.
The data were further analysed using critical difference and the results are presented in the table appended below:

Table 6: Comparison of average Carbohydrate content of functional gulabjamun against critical difference. (For maida)

Level of maida	Average value of carbohydrate	M_3	M_2	M_1
M_3	45.33	0.672*		0.652*
M_2	44.39	0.02		
M_1	44.40			

CD at 5% = 0.037 * Significant

On comparing the average carbohydrate content for different levels of maida against the critical difference, the significant difference was observed between the mean values of (M_3, M_2), (M_3, M_1). Whereas, non-significant difference was observed between the mean values of (M_1, M_2). The significant difference in carbohydrate content in the product was mainly because of the differences in total solids content of the product. This may be because of the addition of different levels of additives in the final product.
It can be observed from table 2. The average per cent ash in functional gulabjamun samples 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 were 1.94, 1.94, 1.67, 1.97, 1.90, 1.66, 1.95, 1.90, 1.61, 1.98, 1.81, 1.71 and 1.95 respectively. It can be observed that the per cent ash in functional gulabjamun sample T3M3 was higher than other samples. Data for average per cent ash in functional gulabjamun were statistically analysed to find out significant difference between treatments with regard to the ash in functional gulabjamun samples.

Table 7: Average of data obtained on percent Ash in functional gulabjamun samples
The data were further analysed using critical difference and the results are presented in the table appended below:

Table 7, 8: Comparison of average Ash content of functional gulabjamun against critical difference. (For maida)

Level of maida	Average value of ash	M_3	M_2	M_1
M_3	1.98	0.29*		0.08*
M_2	1.66	0.21*		
M_1	1.94			

CD at 5% = 0.039 * Significant

On comparing the average ash content for different levels of maida against the critical difference, the significant difference was observed between the mean values of (M_3, M_2), (M_3, M_1) and (M_1, M_2). The significant difference in ash content in the product was mainly because of the differences in total solids content of the product. This may be because of the addition of different levels of additives in the final product.
It can be observed from table 2. The average per cent total solids in functional gulabjamun samples 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 were 69.47, 69.22, 68.86, 69.72, 69.23, 68.82, 69.77, 69.19, 68.86, 69.80, 69.16, 69.16 and 69.78 respectively. It can be observed that the per cent total solids in functional gulabjamun sample T3M3 was higher than other samples. Data for average per cent total solids in functional gulabjamun were statistically analysed to find out significant difference between treatments with regard to the total solids in functional gulabjamun. The data were further analysed using critical difference and the results are presented in the table appended below:

Table 9: Comparison of average Total solids content of functional gulabjamun against critical difference. (For maida)

Level of maida	Average value of total solids	M_3	M_2	M_1
M_3	69.80	0.79*		0.50*
M_2	68.82	0.29*		
M_1	69.22			

CD at 5% = 0.204 * Significant

On comparing the average total solids content for different levels of maida against the critical difference, the significant difference was observed between the mean values of (M_3, M_2), (M_3, M_1) and (M_1, M_2). The differences in the total solids content in the product were due to the variation in moisture retention and addition of different levels of binder in the product. With the increase in the retention of moisture, the total solid was decreased whereas, with the increase in the percentage of binder, the total solid was increased.

Rheological quality of Functional Gulabjamun

The sensory quality of functional gulabjamun was greatly influenced by the moisture content of khoa. The present studies were conducted to investigate the effect of moisture content in khoa on the rheological quality of functional gulabjamun as examined by INSTRON UNIVERSAL TESTING machine. The hardness of functional gulabjamun greatly decreased with increased moisture content in khoa (Fig. 3). Functional gulabjamun samples prepared from khoa with 40 percent moisture were softest (4.773 mN) and those from 44 percent moisture having the highest hardness (12.27 mN).

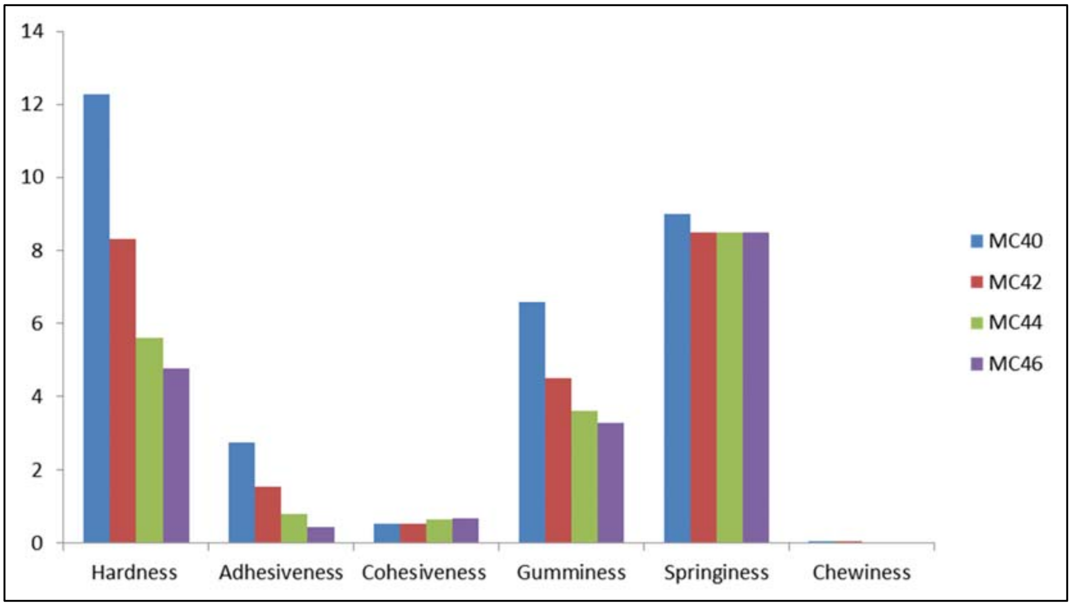

Fig 3: The Hardness of functional gulabjamun greatly decreased with increased moisture content in khoa

The gumminess, chewiness and adhesiveness of functional gulabjamun decreased and cohesiveness increased with increased moisture content in khoa. Not much decrease in springiness due to moisture content in khoa was noticed.

Good quality functional gulabjamun formed buffalo milk can be described with the following rheological attributes; Hardness 6.255 × 10^{-3} ± 0.43 N, Adhesiveness 3.771 × 10^{-3} ± 0.43 N, Cohesiveness 0.649 ± 0.04, Springiness 8.7 ± 0.19 mm, Gumminess 4.059 × 10^{-3} ± 0.322 N and Cheesiness 0.035 ± 0.002 N mm.

Rheological characteristics of functional gulabjamun prepared from buffalo milk and soya milk using the technology developed in this project were compared with the help of Instron Universal Testing Instrument. The results are presented in Table 16. Functional gulabjamun samples prepared from buffalo milk adopting the soya milk technology in the preliminary investigations were hard. Hardness of functional gulabjamun samples from buffalo milk (5.691 × 10^{-3} N), was lesser than that of soya milk (7.839 × 10^{-3} N). Such an improvement in softness of functional gulabjamun from buffalo milk was the result of the modified process developed in this investigation.

Table 11: Rheological quality of functional gulabjamun obtained from buffalo milk and soya milk best sample (70:30) respectively

Rheological attribute	Soya milk	Buffalo
Hardness (N) × 10^{-3}	7.839 ± 0.583	5.691 ± 0.714
Adhesiveness (N) × 10^{-3}	4.626 ± 0.601	6.00 ± 0.211
Cohesiveness	0.662 ± 0.020	0.661 ± 0.04
Gumminess (N) × 10^{-3}	5.189 ± 0.987	3.763 ± 0.63
Springiness (mn)	11.500 ± 0.710	9.00 ± 0.623
Chewiness (N mm^2)	0.059 ± 0.014	0.034 ± 0.003

Data is presented as average of three replicates in terms of Mean ± SE. Functional gulabjamun samples from buffalo milk were observed to be less cohesive (0.661 Vs 0.662), less gummy (3.763 × 10^{-3} N Vs 5.189 × 10^{-3} N), less springy (9.0 Vs 11.5 mm) and less chewy (0.034 Vs 0.059 N mm^2) in comparison with those from soya milk. Adhesiveness of buffalo milk functional gulabjamun (16.00 ×10^{-3} N), was found to be higher than that of soya milk functional gulabjamun characteristics of two types of functional gulabjamun were not significant as revealed from the sensory acceptability of the two products. The standard method of production of functional gulabjamun form buffalo milk developed in the present investigation can be recommended for industrial production.

Microbiological Studies

Yeast and mould content in functional gulabjamun

It can be seen from Table 10. That the average yeast and mould count for functional gulabjamun samples respectively.

Table 10: Average Y/M count for functional gulabjamun

Day	Y/M	Coliform content
	Range	+/-
1	10-12	-
5	12-14	-
10	14-16	-
15	16-17	-

Coliform content in functional gulabjamun

It can be seen from Table 10. The average Coliform count for functional gulabjamun samples respectively.

Rheological quality of Functional Gulabjamun

The sensory quality of functional gulabjamun was greatly influenced by the moisture content of khoa. The present studies were conducted to investigate the effect of moisture content in khoa on the rheological quality of functional gulabjamun as examined by INSTRON UNIVERSAL TESTING machine. The hardness of functional gulabjamun greatly decreased with increased moisture content in khoa (Fig. 3). Functional gulabjamun samples prepared from khoa with 40 percent moisture were softest (4.773 mN) and those from 44 percent moisture having the highest hardness (12.27 mN).

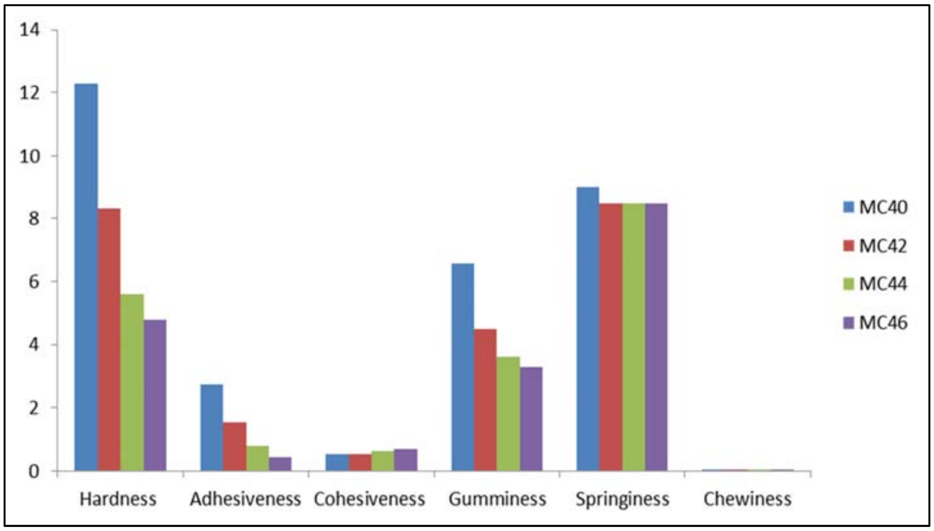

Fig 4: The Hardness of functional gulabjamun greatly decreased with increased moisture content in khoa

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Good quality functional gulabjamun formed form buffalo milk can be described with the following rheological attributes; Hardness 6.255 × 10^{-3} ± 0.43 N, Adhesiveness 3.771 × 10^{-3} ± 0.43 N, Cohesiveness 0.649 ± 0.04, Springiness 8.7 ± 0.19 mm, Gumminess 4.059 × 10^{-3} ± 0.322 N and Cheesiness 0.035 ± 0.002 N mm.

Rheological characteristics of functional gulabjamun prepared from buffalo milk and soya milk using the technology developed in this project were compared with the help of Instron Universal Testing Instrument. The results are presented in Table 16. Functional gulabjamun samples prepared from buffalo milk adopting the soya milk technology in the preliminary investigations were hard. Hardness of functional gulabjamun samples from buffalo milk (5.691 × 10^{-3} N), was lesser than that of soya milk (7.839 × 10^{-3} N). Such an improvement in softness of functional gulabjamun from buffalo milk was the result of the modified process developed in this investigation.

Table 11: Rheological quality of functional gulabjamun obtained from buffalo milk and soya milk best sample (70:30) respectively

Rheological attribute	Soya milk	Buffalo
Hardness (N) × 10^{-3}	7.839 ± 0.583	5.691 ± 0.714
Adhesiveness (N) × 10^{-3}	4.626 ± 0.601	6.00 ± 0.211
Cohesiveness	0.662 ± 0.020	0.661 ± 0.04
Gumminess (N) × 10^{-3}	5.189 ± 0.987	3.763 ± 0.63
Springiness (mn)	11.500 ± 0.710	9.00 ± 0.623
Chewiness (N mm^2)	0.059 ± 0.014	0.034 ± 0.003

Data is presented as average of three replicates in terms of Mean ± SE. Functional gulabjamun samples from buffalo milk were observed to be less cohesive (0.661 Vs 0.662), less gummy (3.763 × 10^{-3} N Vs 5.189 × 10^{-3} N), less springy (9.0 Vs 11.5 mm) and less chewy (0.034 Vs 0.059 N mm^2) in comparison with those from soya milk. Adhesiveness of buffalo milk functional gulabjamun (16.00 ×10^{-3} N), was found to be higher than that of soya milk functional gulabjamun characteristics of two types of functional gulabjamun were not significant as revealed from the sensory acceptability of the two products. The standard method of production of functional gulabjamun form buffalo milk developed in the present investigation can be recommended for industrial production.

Conclusion

These findings will be helpful from therapeutic point of view for people suffering from cardiovascular disease, cancer, postmenopausal symptoms and consequences, although other diseases and conditions have been examined. Soya milk is rich in isoflavones. The presence of isoflavones is the most important and unique benefit of soya milk. Isoflavones have many health benefits including reduction of cholesterol, easing of menopause symptoms, prevention of osteoporosis and reduction of risk for certain cancers (prostate cancer and breast cancer). Isoflavones are also antioxidants which protect our cells and DNA against oxidation. Soybean products also have protective properties against breast, prostate, colon and lung cancers because of the isoflavones content. It will be helpful for people suffering from protein energy malnutrition also because this product is rich in protein and energy.

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