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A Comparative Study on the Quality of Rasogolla Made in Laboratory and Collected from Local Markets of Mymensingh, Bangladesh

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Abstract: Rasogolla is one of the most important pleasant and charming foods to most of the people of Bangladesh. In most of the markets of Bangladesh rasogolla are more or less available, but the quality of rasogolla varies from place to place. Sometimes manufacturers add some ingredients that decrease the quality of rasogolla. That is why, this research work was carried out to study the quality of rasogolla available in markets and to compare them with rasogolla prepared in the laboratory and also to investigate both the physical and chemical characteristics. Four rasogolla samples were collected from local markets of Mymensingh district and another sample was prepared in the laboratory to conduct the experiment with the above theme. Then the rasogolla were judged by a panel of expert judges for organoleptic test and also analyzed for chemical qualities. Considering the physical and chemical properties of both the samples of rasogolla, the results indicated that the laboratory made rasogolla was significantly better in quality than market rasogolla. As the laboratory made rasogolla was prepared with special care whereas market rasogolla might have the adulterated during preparation. It may be suggested that to obtain the better quality rasogolla proper method, proper composition of the ingredients, and also the strict hygienic and sanitation measures should be followed that will also gives the consumers satisfaction.

Key words: Rasogolla, physical quality and chemical quality

Introduction

Bangalies consume various daintily foods, among them rasogolla is the very important one. That is why, the rasogolla is acceptable to Bangali and also to others. Not only Bangali but also Indian people are fond of this product. Kuila *et al.* (2000) in their review paper discussed the manufacture and characteristics of milk sweets in eastern India. These include sandesh, rasogolla, cham-cham, pantooa, rasmalai, khir mohan, kalojam, chhanar jilipi, babri, sitabhog, sharpuria, sharbhaja, chhana poda, burfi, peda, kalakand, kheer kadamba and misti doi (dahi). It is concluded that the industry offers employment to approximately 200,000 people per year and has tremendous export potential. Bhattacharya and Raj (1980) also defined rasogolla as famed chhana based sweet-meats of Bengal, being made from milk curd which is kneaded into small balls that are boiled in clarified sugar syrup. Chhana is the residue obtained after the liquid portion is drained off from fermented boil milk and rasogolla is prepared by boiling chhana (rolled in to small ball) in 40-60% sugar syrup.

Actually when the rasogolla first prepared was not investigated but it is more or less obvious that the product was first introduced in the Indian subcontinent. It is reported that about 10% of the total milk produced in Bangladesh are used for the preparation of chhana and finally for sweet making (Forth plan study, No. 3, 1968).

In Bangladesh, more commonly rasogolla is made from cow milk. But adequate quantity of milk is not available round the year. The average milk production of local cow is very low. Moreover, the production and supply of cow milk is not satisfactory, specially in the months from July to November due to the seasonal effect the production goes to a minimal level. The scarcity of milk hampers the production of sweetmeat, which contributes in the rise of price. The daily requirement of milk and its deficits in Bangladesh are given in Table 1.

Rasogollas are obtained most of all markets of Bangladesh because from birth to death in each sphere of life rasogolla have occupied a significant place in our society. On each and every occasion like Eid, Puja, Birthday, Marriage, funeral ceremonies, religious festivals and even in guest entertainment, rasogolla inevitable. In shortly it may said that, there is no such ceremony and festival which goes out of rasogolla. Rasogolla is one of the most important pleasant and charming foods to most of the people of Bangladesh. Rasogolla are extensively used, chiefly alone with other foods due to their flavour and high food value. They are also easily digested. However, rasogolla is chhana based food product, it is very vital to health because of its fairly high protein and fat content, minerals, specially calcium and phosphorus content and also fat soluble vitamins, particularly, vitamin A and D content. The food value of rasogolla largely depends upon the chhana which is prepared from milk. The average chemical composition of chhana are Moisture-55.37%; Fat-23.52%; Protein-17.26%; Lactose-2.21%; Ash-1.66%; and Sucrose-29.86%; (Ravichandra *et al.*, 1997). Sweetmeats are nature's most important contribution to civilization. The first pre-requisite for producing excellent quality of sweetmeats is the availability of high quality chhana. Efforts have been made to manufacture rasogolla from buffalo milk with only limited success and market specimens do not possess the desired body texture (Kanwal *et al.*, 1980). Cow milk is exclusively used for chhana preparation by halwais as it yields a superior and most acceptable quality product suitable from rasogolla making (Suguna Rao *et al.*, 1989).

In most of the markets of Bangladesh rasogollas are more or less available but the quality of rasogolla of various places varies due to varieties in manufacturing procedure followed by persons of different places. Kanwal *et al.* (1980) showed the variation in rasogollas composition which obtained from laboratory and market. The compositional differences which were obtained are given in Table 2.

The persons involved in manufacturing rasogolla, all are not honest. There are some people among them who add some ingredients that gives unsatisfactory quality of rasogolla. Among the factors which affect the quality of rasogolla it is one of them. In the laboratory, the scientific methods are followed to manufacture the rasogolla. That is why, the quality of laboratory made rasogolla are generally superior. Not only laboratory but also have some manufacturer who tries to maintain the quality and also try to develop their quality to keep their goodwill. Considering the above stated facts, the present experiment was undertaken with the following objectives:

i. To study the quality of laboratory made and local market rasogolla
ii. To inform the consumers about the food value of laboratory made and local market rasogolla.
iii. To suggest an appropriate method of rasogolla preparation.

Table 1: Daily requirement of milk and its deficits in our country

Content deficits	Per day requirement and availability		Total requirement and availability		Total deficits	Average
	Requirement	Production	Requirement	Production		
Milk	250 ml	34 ml	9.90 million ton	1.40 million ton	8.02 million ton	86.20 %

Average of five years production (1986-87 to 1990-91), Source: Alam (1994) B.L.R.I. Savar, Dhaka.

Table 2: Composition of rasogolla

Constituents	Rasogolla			ISI. Standards
	Laboratory made	Market samples		
		Yamunanagar	Karnal	
Moisture	37.0	35.2	30.9	55.0(max)
Total solids	63.0	64.8	69.1	-
Sucrose	51.9	53.6	55.1	45.0 (max)
Protein	6.8	6.6	8.0	5.0 (min)
Fat	4.2	4.6	5.7	-

Materials and Methods

This experiment was conducted at the Bangladesh Agricultural University, Dairy Science Laboratory during the period from 26th February to April 12, 2001, chemical analysis was done at the Dairy Science Laboratory and Food Technology Laboratory of Bangladesh Agricultural University, Mymensingh.

For this experiment four samples of market rasogolla from four different markets of Mymensingh district, surrounding areas were chosen. One sample from each market was taken and three replications were made for each sample.

Similarly sample was prepared in the Laboratory under strict hygienic condition and designated as 'L' rasogolla. Market prepared rasogolla were brought to the Dairy Technology Laboratory and were kept in refrigerator under 4 ^{0}C for organoleptic evaluation and chemical analysis.

Preparation of rasogolla in the laboratory: For making chhana, cow milk was collected from Bangladesh Agricultural University (BAU) Dairy Farm. Before making chhana milk sample was analyzed in the laboratory to now their fat and SNF content. It was found that cow milk contains 43 g/kg (4.3%) fat and 84 g/kg (8.4%) SNF respectively.

Physical tests (sensory and organoleptic evaluation): To judge the physical parameter Flavour score, Body and texture, Colour and appearance, Taste score, Total physical score were carried out.

Chemical tests: To investigate the chemical characteristics Moisture contents (g/kg), Total solids content (g/kg), Protein contents (g/kg), Fat contents (g/kg), Carbohydrate contents (g/kg), Ash content (g/kg), Acidity percentage, and pH were determined

Statistical analysis: Data collected from different parameters were subjected to statistical analysis. Analysis of Variance test (ANOVA) was done to find out the statistical difference between different treatments. In this experiment all experimental materials were completely homogenous and for this reason data were analyzed by using one way analysis of variance test (CRD) as per MSTAT statistical programme. The differences among sample means were compared by calculating LSD value with the help of a Least Significant Difference test. (Gomez and Gomez, 1984).

Results and Discussion

Flavour score: Flavour score of rasogolla L was 41.76 ± 1.15, rasogolla M_1 was 37.82 ± 1.58, rasogolla M_2 was 39.74 ± 0.92, rasogolla M_3 was 39.15 ± 1.06, and rosogolla M_4 was 37.94 ± 1.36 respectively. The statistical analysis showed significant difference

Milk
↓
Heated to boiling temperature
↓
Cooling
↓
Adding whey water at 70^{0}C
↓
The lumps of casein formed and allowed to stay for few minutes for complete coagulation of chhana
↓
Filtering through muslin cloth
↓
Chhana (Coagulum)
↓
Grinding, kneading and cutting into small pieces
↓
Kneading of chhana with flour of subsequent preparation into ball
↓
Preparing and boiling of sugar syrup
↓
Dropping of chhana balls (10-15 pieces) in the boiling syrup
↓
Cooking for 10-15 minutes (during cooking sprinkling of cold water
↓
Swelling of chhana balls after 10-15 minutes
↓
Appearance of desirable colour
↓
After 30 minutes rasogolla was ready to serve and consumption

Fig. 1: Schematic diagram for the preparation of rasogolla

($P < 0.05$) between laboratory and market rasogolla (Table 3). Flavour score of market rasogolla samples were almost similar but laboratory rasogolla showed highest score The result indicates that the laboratory made rasogolla were superior from site of flavour. Bhattacharya and Raj (1980) indicated that flavour of rasogolla was enhanced by cooking. Katra and Bhargava (1994) said that flavour was adversely affected by the addition of soyamilk and Chakrabarti and Gangopadhyay (1990) also said that flavour of soy-bean could considerably be overcome with the use of rose flavour. Flavour may differ with source of milk. Joshi *et al.* (1991) revealed that, chhana from cow and buffalo milk had acceptable flavour where as that from goat milk had acidic flavour.

Body and texture score: The body and texture score for L, M_1, M_2, M_3 and M_4 sources rasogolla were 28.10 ± 0.62, 25.12 ± 1.28, 24.99 ± 0.43, 27.19 ± 1.00 and 26.46 ± 1.55 respectively (Table 3). Statistical analysis showed that there were significant difference ($P < 0.05$) within the body and texture score of different sources of rasogolla samples (Laboratory made rasogolla and market rasogolla). According to Gupta *et al.* (1993) textural quality of market rasogolla was significantly correlated with moisture, fat, protein and calcium contents and Bhattacharya and Raj (1980) said that use of high fat milk leads to higher fat contents in rasogolla

Table 3. Comparison of average score of various physical parameters (organoleptic characteristics) of different sources of rasogolla

Source of variation	Sources of rasogolla					LSD value	Level of significance
	L	M_1	M_2	M_3	M_4		
Flavour score (45)	$41.76^{a} \pm 1.10$	$37.82^{b} \pm 1.58$	$39.74^{ab} \pm 0.92$	$39.15^{b} \pm 1.06$	$37.94^{b} \pm 1.36$	2.25	*
Body and texture (30)	$28.10^{a} \pm 0.62$	$25.12^{b} \pm 1.28$	$24.99^{b} \pm 0.43$	$27.19^{a} \pm 1.00$	$26.46^{ab} \pm 1.55$	1.93	*
Colour& appearance (15)	$14.01^{a} \pm 0.56$	$11.83^{b} \pm 0.95$	$12.11^{ab} \pm 0.35$	$10.98^{b} \pm 0.61$	$10.27^{b} \pm 1.13$	1.99	**
Taste score (10)	$8.93^{a} \pm 0.09$	$6.79^{b} \pm 0.78$	$7.34^{b} \pm 1.04$	$6.65^{b} \pm 1.20$	$7.56^{ab} \pm 0.59$	1.52	*
Total physical score (100)	$92.80^{a} \pm 1.54$	$81.56^{b} \pm 2.19$	$84.18^{b} \pm 0.94$	$83.97^{b} \pm 3.56$	$82.22^{b} \pm 2.27$	5.89	**

** = Significant at 1% level ; * = Significant at 5% level; L = Laboratory made rasogolla ; M_1 = Rasogolla collected from Trisal market; M_2 = Rasogolla collected from Muktagacha market; M_3 = Rasogolla collected from Sodeshibazar; M_4 = Rasogolla collected from Sutiakhalibazar

which softness the body and improve the texture. Body and texture of rasogolla may vary with various factors. Joshi *et al.* (1991) observed that chhana prepared from buffalo milk had hard body and coarse texture. Cow and goat milk produced chhana with soft body and smooth texture. Texture also decreased with increased temperature and length of storage (Arora *et al.*, 1996). The body and texture of rasogolla was better in laboratory made rasogolla than the market rasogolla and it may due to the above factors mentioned by the different author.

Colour and appearance score: The colour and appearance score of L, M_1, M_2, M_3 and M_4 sources rasogolla were 14.01 ± 0.56, 11.83 ± 0.95, 12.11 ± 0.35 and 10.98 ± 0.61 respectively, which is shown in the (Table 3). Statistical analysis showed that there was significant difference ($P < 0.01$) within the colour and appearance score of different sources of rasogolla samples. The highest mean value (14.01) of colour and appearance was recorded for laboratory made rasogolla than other rasogolla samples collected from markets. The variation of colour and appearance were probably due to fat% in milk. According to Mini *et al.* (1995) rasogolla prepared from whole milk score higher than the skim milk for colour and appearance. Tambat *et al.* (1992) showed effect of fat and maida levels gives acceptable colour and appearance when rasogolla were prepared. Some times cooking time might enhanced the colour of rasogolla (Bhattacharya and Raj, 1980).

Taste score: The average mean value for laboratory made rasogolla (L) and markets rasogolla (M_1, M_2, M_3 and M_4) were observed 8.93 ± 0.09, and 6.79 ± 0.78, 7.34 ± 1.04, 6.65 ± 1.20 and 7.56 ± 0.59 respectively (Table 3). Statistically the differences within the values were highly significant ($P < 0.01$). Highest score was noticed for laboratory made rasogolla and market rasogolla score were more or less similar. During preparation of rasogolla in laboratory all of the ingredients used as standard levels. Actually taste of rasogolla depends on the ingredients used for. Soni *et al.* (1979) reported that the rasogolla contained 37% moisture, 51.9% sucrose, 6.8% protein and 4.2% fat. The rasogolla prepared in laboratory was better than the market rasogolla.

Total physical score: Total physical score showed in Table 3 for rasogolla were 92.80 ± 1.54 for laboratory made (L) and 81.56 ± 2.19, 84.18 ± 0.94, 83.97 ± 3.56 and 82.22 ± 2.27 for market rasogolla, M_1, M_2, M_3 and M_4 respectively. As the all physical parameters for laboratory made rasogolla were higher than the market rasogolla that is why total physical score gone highest. And this highest value indicated that the laboratory made rasogolla was superior than the market sources. Total score for market rasogolla were near for each other, as all physical parameters score, were near. The difference between the laboratory made rasogolla and market rasogolla were highly significant ($P < 0.01$). Total physical score of rasogolla may vary with different factors. According to Puranik *et al.* (1997) for pure recombined milk chhana was not acceptable and according to Mini *et al.* (1995) milk sources (whole milk, skim milk, coconut milk) were responsible for overall quality of rasogolla and in this case they showed control rasogolla gave higher score than the others. Tarafdar *et al.* (1988) obtain that overall quality scores of rasogolla prepared with mechanically kneaded chhana were 7.5% lower than those market rasogolla.

Chemical parameters:

Moisture content: The average amount of moisture of rasogolla samples L, M_1, M_2, M_3 and M_4 were 525.80 ± 9.60, 433.63 ± 8.56, 450.03 ± 12.04, 487.00 ± 8.07 and 479.40 ± 15.25 g/kg respectively. Statistically there were significant differences ($P < 0.01$) between the moisture of different sources of rasogolla (Table 4). Higher moisture content was noticed in laboratory made rasogolla whereas market rasogolla samples noticed lesser amount of moisture. Bhattacharya and Raj (1980) reported that acceptable quality rasogolla contain 49.85 to 53.80% moisture. The higher amount of moisture indicate good quality rasogolla and sometimes it may give good flavour. Tewari and Sachdeva (1991) observed good flavour in the products whereas chhana containing 62.5 and 63.5 % moisture. Gupta *et al.* (1993) said overall textural quality was significantly correlated with moisture. Hardness of rasogolla also influenced by moisture contain and this type of comments was drown by Ravichandra *et al.* (1997). So that it may expressed that laboratory made rasogolla was superior than market rasogolla.

Total solids content: The total solids content for L, M_1, M_2, M_3 and M_4 sources of rasogolla were 474.25 ± 9.56, 566.33 ± 8.62, 549.97 ± 12.04, 513.00 ± 8.07 and $520.60 \pm 60 \pm 15.25$ g/kg respectively (Table 4). Statistical analysis showed that there were significant differences ($P < 0.01$) within the total solids content of laboratory made rasogolla and market rasogolla. Sur *et al.* (1999) reported standard total solids for rasogolla 44.83% which was more or less similar with the laboratory made rasogolla (474.25 g/kg). The total solids contents of market rasogolla were higher than laboratory rasogolla indicating inferiority of the sources. Kanwal *et al.* (1980) also showed total solids of 63.0% for laboratory made rasogolla and 64.8% for market rasogolla which also indicated higher percent of total solids content in market rasogolla. So the results obtained by the scientists are more or less agreed with the result got this research.

Protein content: Protein contents of different sources of rasogolla are presented in Table 4. From this table it was found the mean protein content of rasogolla samples were 59.50 ± 1.87, 54.33 ± 4.36, 52.77 ± 2.96, 52.37 ± 2.32 and 51.37 ± 1.86 g/kg for L, M_1, M_2 , M_3 and M_4 sources sample respectively. Statistical analysis showed that protein content of rasogolla samples varies significantly ($P < 0.05$). Laboratory made rasogolla contain higher protein level as compare to market rasogolla though all this sources (Laboratory made rasogolla and market rasogolla) content protein level according to BSTI. As per the Bangladesh Standard Testing Institute (BSTI, 1993) specification of minimum protein content of rasogolla should be 5%. Higher protein percent increase the quality of rasogolla. Sur *et al.* (2000) stated that protein percent 6.62 and Desai *et al.* (1993) also observed 6.7% protein in better quality of spongy rasogolla. Kanwal *et al.* (1980) revealed that laboratory rasogolla and market rasogolla content 6.8 and

Table 4. Comparison of average chemical composition of different sources of rasogolla

Source of variation	Sources of rasogolla					LSD value	Level of significance
	L	M_1	M_2	M_3	M_4		
Moisture (g/kg)	$525.80^{a} \pm 9.60$	$433.63^{c} \pm 8.56$	$450.03^{c} \pm 12.04$	$487.00^{b} \pm 8.07$	$479.40^{b} \pm 15.25$	28.53	**
Total solids (g/kg)	$474.25^{c} \pm 9.56$	$566.33^{a} \pm 8.62$	$549.97^{a} \pm 12.04$	$513.00^{b} \pm 8.07$	$520.60^{b} \pm 15.25$	28.54	**
Protein (g/kg)	$59.50^{a} \pm 1.87$	$54.33^{b} \pm 4.36$	$52.77^{b} \pm 2.96$	$52.37^{b} \pm 2.32$	$51.37^{b} \pm 1.86$	5.15	*
Fat (g/kg)	$49.30^{a} \pm 0.66$	$41.07^{b} \pm 1.20$	$42.87^{b} \pm 4.08$	$40.63^{b} \pm 1.18$	$40.53^{b} \pm 3.04$	6.25	**
Carbohydrate (g/kg	$357.07^{c} \pm 10.98$	$461.90^{a} \pm 11.87$	$445.23^{a} \pm 13.03$	$408.60^{b} \pm 2.35$	$417.27^{b} \pm 10.84$	27.24	**
Ash (g/kg)	$8.37^{b} \pm 0.42$	$9.16^{a} \pm 0.43$	$9.13^{a} \pm 0.13$	$9.26^{a} \pm 0.33$	$9.45^{a} \pm 0.41$	0.656	*
Acidity (%)	0.82 ± 0.10	0.86 ± 0.21	0.85 ± 0.17	0.90 ± 0.23	1.01 ± 0.13		NS
PH	6.5 ± 0.10	6.3 ± 0.26	6.4 ± 0.30	6.23 ± 0.57	6.10 ± 0.32		NS

** = Significant at 1% level; * = Significant at 5% level; NS = Not significant

6.6% protein respectively. Whereas Gangopadhyay *et al* (1996) indicated laboratory made rasogolla content 7.0-7.2% protein. This study also showed higher amount of protein level in laboratory made rasogolla than market rasogolla like the results drown by varies scientists given above.

Fat content: The amount of mean fat contents of L, M_1, M_2, M_3 and M_4 sources rasogolla sample were 49.30 ± 0.66, 41.07 ± 1.20, 42.87 ± 4.08, 40.63 ± 1.18 and 40.53 ± 3.04 g/kg respectively which are demonstrated in Table 4. Differences were highly significant ($P < 0.01$) among those mean values (Table 4). From this result it was observed that laboratory made rasogolla had significantly highest amount of fat and market rasogolla had the lowest amount of fat (Table 4). Quality of rasogolla mainly influences by the quality of milk Bhattacharya and Raj (1980) reported in a study that use of high fat milk leads to a higher fat content in the rasogolla which softness the body and improve the texture. Kanwal *et al.* (1980) studied that laboratory made rasogolla and market rasogolla contain 4.2 and 4.6% had respectively. In another study Sur *et al.* (2000) showed that fat percent of rasogolla was 5.39 when rasogolla was prepared from buffalo milk. So the result obtained by this research was almost satisfactory in relation to fat content. As the fat content of laboratory made rasogolla was higher than market rasogolla, it gave the good score compared to market rasogolla.

Carbohydrate content: The average amount of carbohydrate of rasogolla L was 357.07 ± 10.98, M_1 was 461.90 ± 11.87, M_2 was 445.23 ± 13.03, M_3 was 408.60 ± 2.35 and M_4 was 417.27 ± 10.84 g/kg respectively (Table 4). Statistical analysis indicated that there were significant differences ($P < 0.01$) within the carbohydrate content of different sources of rasogolla samples. Market sample of rasogolla may have adulteration and most of the ingredients which are used in rasogolla as aduterated materials generally content higher amount of carbohydrate that give the market rasogolla higher levels of carbohydrate content. Adhikari *et al.* (1992) said that chhana content with higher percent of lactose contributed this higher percent of lactose within the rasogolla when rasogolla was prepared from that chhana. Kanwal *et al.* (1980) indicated that rasogolla prepared in laboratory had sucrose of 51.90% whereas market rasogolla had 53.60% sucrose. In another study Sur *et al.* (2000) noted 32.13% sucrose in rasogolla which were prepared from buffalo milk. Carbohydrate content of laboratory made rasogolla was obtained by this study was close to noted by Sur *et al.* (2000). As carbohydrate content of laboratory made rasogolla was lesser amount than market rasogolla, so laboratory made rasogolla regarded as superior than market rasogolla.

Ash content: Amount of ash of different rasogolla samples were 8.37 ± 0.42, 9.16 ± 0.43, 9.13 ± 0.13, 9.26 ± 0.33 and 9.45 ± 0.41 g/kg for L, M_1, M_2, M_3 and M_4 sources rasogolla sample respectively (Table 4). Statistical analysis showed that there were significant differences ($P < 0.05$) between the ash content of different sources of rasogolla samples. Laboratory made rasogolla had lower level of ash as compared to market rasogolla. Generally the rasogolla which content higher amount of total solids may have higher levels of ash. In Table 4 total solids of laboratory rasogolla was lower (474.25 g/kg) than market rasogolla (around 540.00 g/kg), so market rasogolla had higher levels of ash. Sur *et al.* (2000) mention that 0.33% ash in rasogolla prepared from buffalo milk. Katra and Bhargava (1990) said higher ash and total carbohydrate decreased the sponginess.

Acidity percentage: The acidity percentage of different sources of rasogolla samples are shown in (Table 4). It was found that the average acidity for L, M_1, M_2, M_3 and M_4 sources rasogolla were 0.82 ± 0.10, 0.86 ± 0.21, 0.85 ± 0.17, 0.90 ± 0.23 and 1.01 ± 0.13 respectively. Statistically there were no significant differences between the acidity of different sources of rasogolla. Acidity of market rasogolla samples were higher than that of laboratory prepared rasogolla. Haque (2000) showed the acidity of rasogolla were 0.75, 0.70 and 0.71% respectively which are prepared from cow, buffalo and equal mixture of cow and buffalo milk. Chanda (1999) observed acidity of rasogolla 0.60, 0.70, 1.10 and 1.40% respectively which are prepared from cow milk chhana, 10% soya chhana, 20% soya chhana and 30% soya chhana. The result obtained by this research work were more or less nearest with the result obtained by Haque (2000) and Chanda (1999). So the results were within the accepted level. Arora *et al.* (1996) said that the lactic acidity was increased during the storage. Laboratory made rasogolla were not stored whereas market rasogolla may be stored, that is why, acidity of laboratory made rasogolla was relatively lower in value than market rasogolla.

pH value of different rasogolla sample: The average pH value of different rasogolla samples are presented in Table 4. From the table it is observed that mean pH for L, M_1, M_2, M_3 and M_4 sources of rasogolla were 6.5 ± 0.10, 6.3 ± 0.26, 6.4 ± 0.30, $6.2\text{-}3 \pm 0.57$ and 6.1 ± 0.32 respectively. Statistical analysis showed that there were no significant differences within the pH value of different sources of rasogolla samples. The pH of laboratory made rasogolla and market rasogolla were within the accepted level whereas pH of laboratory made rasogolla was slightly higher than market samples. Haque (2000) reported pH of rasogolla made from cow and buffalo milk were 6.60 and 6.73 and Chanda (1999) reported the pH of rasogolla within the range of 5.92 to 6.36. So, in relation to pH of market rasogolla specially the laboratory made rasogolla were within the standard value and quality of rasogolla were good.

Considering the chemical properties the laboratory made rasogolla were superior to market rasogolla from any point of view. As the laboratory made rasogolla was prepared with special care, so, the factor of preparation contributed to make the laboratory made rasogolla good in quality.

Conclusion: The experiment was conducted in the Department of Dairy Science, Bangladesh Agricultural University, Mymensingh with the facility available in the Dairy Technology Laboratory. The objective of the experiment was to compare physical and chemical characteristics of market rasogolla found in Mymensingh district with that of laboratory made rasogolla.

The experiment was conducted through collection of rasogolla from four local markets of Mymensingh district and with that of the prepared in the laboratory. The rasogolla, both commercially produced and laboratory made, were judged by a panel of expert judges for organoleptic test. The samples were also analyzed for chemical qualities. Data obtained were analyzed statistically using

Completely Randomized Design (CRD).

The total final score of physical parameters (consisting flavour, body and texture, colour and appearance, taste) of laboratory made rasogolla was 92.80 ± 1.54 and the same score of market rasogolla (Surrounding Mymensingh) were 81.56 ± 2.19, 84.18 ± 0.94, 83.97 ± 3.56, 82.22 ± 2.27 respectively. According to panelists, the highest score was obtained in laboratory made rasogolla and lower score was obtained in market rasogolla. Statistically significant differences ($P < 0.01$) were found among those mean values.

From chemical analysis it was observed that average moisture contents of L, M_1, M_2, M_3 and M_4 rasogolla samples were 525.80 ± 9.60, 433.63 ± 8.56, 450.03 ± 12.04, 487.00 ± 8.07 and 479.40 ± 15.25 g/kg respectively. On the other hand total solids content of the above samples in the same order were 474.25 ± 9.56, 566.33 ± 8.62, 549.97 ± 12.04, 513.00 ± 8.07 and 520.60 ± 15.25 g/kg respectively. Statistically the levels of moisture and total solids content differ significantly ($P < 0.01$) among the different samples.

The protein contents of L, M_1, M_2, M_3 and M_4 rasogolla samples were 59.50 ± 1.87, 54.33 ± 4.36, 52.77 ± 2.96, 52.37 ± 2.32 and 51.37 ± 1.86 g/kg respectively. There was significant difference ($P < 0.05$) among them in respect of protein content. The fat contents of L, M_1, M_2, M_3 and M_4 rasogolla samples were 49.30 ± 0.66, 41.07 ± 1.20, 42.87 ± 4.08, 40.63 ± 1.18 and 40.53 ± 3.04 g/kg respectively. Statistical analysis showed that there was significant difference ($P < 0.01$) among them.

The carbohydrate contents of rasogolla samples of L, M_1, M_2, M_3 and M_4 were 357.07 ± 10.98, 461.90 ± 11.87, 445.23 ± 13.03, 408.60 ± 2.35 and 417.27 ± 10.84 g/kg respectively. Significant difference ($P < 0.01$) was observed among the carbohydrate contents of various sources of rasogolla.

The ash content of L, M_1, M_2, M_3 and M_4 rasogolla samples were 8.37 ± 0.42, 9.16 ± 0.43, 9.13 ± 0.13, 9.26 ± 0.33 and 9.45 ± 0.41 g/kg respectively. Statistically the difference within the values were significant ($P < 0.05$).

The average acidity and pH value of rasogolla sample of L, M_1, M_2, M_3 and M_4 were 0.82 ± 0.10, 0.86 ± 0.21, 0.85 ± 0.17, 0.90 ± 0.23, 1.01 ± 0.13 % and 6.5 ± 0.10, 6.3 ± 0.26, 6.4 ± 0.30, 6.23 ± 0.57, 6.1 ± 0.32 respectively. No significant differences were found within the different samples.

From the results of all parameters (physical and chemical) it was observed that the laboratory made rasogolla was better than the market rasogolla. This may be attributed to addition of pure chhana obtained from fresh milk, optimum level of sugar, control heating and maintenance of strict hygienic measures during preparation of rasogolla in the laboratory. With higher total solids and carbohydrate content and with lower protein and fat level in market rasogolla indicated that the manufacturers might have adulterated their products. The possible adulteration may be addition of skim milk chhana, wheat flour and high level of sugar in the rasogolla formulation. Hence, it is concluded that to produce better quality rasogolla the following recommendations may strictly be followed:

i. Suggested appropriate technique for rasogolla making with specific proportion of ingredients should be followed.
ii. Should have a authorized organization who will try to control the quality of milk products (rasogolla) by checking the quality of products (physical and chemical point of view, if possible).
iii. Extension work may be done among the producers "To teach them to produce better quality rasogolla".
iv. Better quality rasogolla should have the following composition: The moisture content should be within the range of 500-550 g/kg; total solids 450-500 g/kg; protein 50-75 g/kg; fat 40-60 g/kg; carbohydrate 350-380 g/kg and ash content 8-9 g/kg level.
v. Hygienic and sanitary measures should strictly be followed during preparation of rasogolla.

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