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Article

Quality of peda prepared from mawa with different sugar levels

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Abstract: Peda is a highly nutritious indigenous milk product of Bangladesh containing milk solids added sugar and other additive like cardamom powder. This experiment was conducted to test the feasibility of using mawa (dried milk) for making peda and also conducted to test the impact of sugar level on the quality of peda. Sugar, as traditional sweetener was used to make peda samples at the level of 0 g, 75 g, 150 g and 225 g. Peda samples were prepared with these different sugar ratios were analyzed for sensory attributes, chemical composition and microbiological quality. Analysis of the data for quality such as flavor, body and consistency, color and appearance and chemical analysis such as protein content, carbohydrate content, ash and total solids contents of peda samples revealed significant (P<0.05) difference, but there was no significant (P>0.05) differences for fat content and total viable count of peda samples. The organoleptic quality of 150 g sugar containing peda samples scored better result than control and other treatments. If overall quality aspects were considered, 150 g sugar containing peda samples gave best results than other samples.

Keywords: sugar level; quality; organoleptic evaluation; composition; microbial load

1. Introduction

Peda is a popular dairy product in Bangladesh, and its textural characteristics are influenced by various factors such as composition, raw materials, and manufacturing practices. The process of making peda involves blending and kneading khoa (a concentrated milk product) and sugar. Plain peda is typically prepared at lower temperatures (around 50-60ºC), while brown peda is made at higher temperatures (80-90ºC) to achieve different textures and flavors. Peda is traditionally prepared by heating a mixture of mawa (condensed milk) and sugar until the desired texture and flavor are achieved. The mixture is then dried out to remove moisture. The most common ratio of mawa to sugar used is 3:1, along with a pinch of cardamom seed powder for added flavor. However, there can be variations in the quality of peda depending on the manufacturing technique employed, especially the level of sugar used.

The quality of peda is determined by factors such as flavor, composition, body, texture, appearance, and microbial quality. Limited research has been conducted on the preparation of peda from mawa, and the suitable sugar level for producing high-quality peda is still unknown. Therefore, this research aims to explore the impact of sugar level on the quality of peda. By studying the effects of different sugar levels, researchers can gain insights into the optimal sugar-to-mawa ratio for producing peda with desirable sensory and textural qualities. This research will contribute to improving the overall quality and consistency of peda, enhancing its appeal to consumers in Bangladesh.

2. Materials and Methods

2.1. Ethical approval

This study did not require any ethical approval.

2.2. Preparation of peda

Mawa was prepared at the Dairy Technology laboratory, Bangladesh Agricultural University, Mymensingh from October 2021 to January 2022. About 6 liters of cow milk was filtered and was taken in an open aluminum pan to be heated on fire. When the milk reached a pat formation stage, it was cooled down at room temperature and then preserved in a refrigerator at normal freezing temperature. On the next day, 300 g mawa and 50 ml milk for each of the four treatments were taken in an open aluminum pan and were heated until a thick viscous structure was attained. Then 0 g sugar for treatment A, 75 g sugar for treatment B, 150 g sugar for treatment C and 225 g sugar for treatment D were added to each individual batch, and stirred until a pasty consistency was obtained for each treatment. The hot peda was cooled at room temperature, while worked into a smooth mass. Then the product is shaped into oval shapes. So, four different types of peda were prepared from whole cows' milk with different sugar levels, using following treatments, A = 300 g mawa + 0 g sugar + 50 ml milk; B = 300 g mawa + 75 g sugar + 50 ml milk; C = 300 g mawa + 150 g sugar + 50 ml milk; and D = 300 g mawa + 225 g sugar + 50 ml milk

2.3. Organoleptic evaluation of peda

In the research study, a team of experienced judges conducted a thorough evaluation of the peda samples based on various organoleptic parameters. The judges carefully assessed each sample and assigned scores to evaluate its quality. The first parameter taken into consideration was the smell and taste of the peda, which encompassed the aroma and flavor of the product. This parameter held significant weightage, accounting for 50 points in the overall scoring. The judges also examined the body and consistency of the peda, evaluating its texture, hardness, smoothness, and overall mouthfeel. This parameter was given a weightage of 30 points. Furthermore, the judges assessed the color and appearance of the peda, taking into account factors such as its visual appeal, shape, and color. This parameter contributed 20 points to the overall scoring. By considering these organoleptic parameters, the judges provided comprehensive evaluations of the peda samples, ultimately determining their quality through a total score of 100 points.

2.4. Compositional analysis of peda

The composition analysis of the various sample types involved the utilization of established techniques. The total solids and ash content were assessed using the oven drying method in accordance with AOAC (1990) guidelines. The determination of fat content followed the Babcock method, employing the procedure outlined by Aggarwala and Sharma in 1961. For crude protein analysis, the Kjeldahl procedure as described by AOAC (1990) was employed. By employing these standardized methods, the total solids, ash content, fat, and crude protein of the different sample types could be accurately measured and analyzed.

2.5. Microbiological examination of peda

The standard plate count assessment was conducted according to the method described by American Public Health Association (1967).

2.6. Statistical analysis

There was only one treatment (different levels of corn starch). Data were analyzed using ANOVA by Completely Randomized Design (CRD). The SPSS statistical package version 25.0 was used for data analysis. Least significant difference (LSD) values were calculated to rank the means. There were three replications. All the samples were analyzed in triplicate.

3. Results and Discussion

3.1. Flavor

The flavor score of the samples exhibited a significant difference (P=0.012), with sample C (46.28±1.36) obtaining the highest score and sample A (40.11±2.79) receiving the lowest score (Table 1). The statistical analysis indicated a significant variation in the flavor score among the samples, with a P-value below 0.05. The laboratory peda sample attained the highest flavor score, which could be attributed to its higher fat content. These findings align with Varma *et al*. (2005), who observed that an increase in fat level in cow milk resulted in a significant improvement in the flavor and texture score of milk peda. Kavita *et al*. (2015) also supported these

findings, stating that Peda is prepared by heating a mixture of khoa and sugar, incorporating natural and/or artificial color and flavor until the desired texture and flavor characteristics are achieved.

Table 1. Organoleptic parameter of different types of peda containing different sugar levels.

Parameter	Group				*P*-value
	A	B	C	D	
Flavor	40.11^{b}±2.79	44.17^{ab}±1.66	46.28^{a}±1.36	46.00^{a}±1.15	0.012
Body and consistency	23.56^{b}±0.51	25.20^{a}±0.50	26.25^{a}±0.90	25.22^{a}±0.46	0.005
Color and appearance	16.53^{b}±0.65	17.17^{ab}±0.29	18.00^{a}±0.25	17.58^{ab}±0.38	0.014
Overall score	80.20^{b}±2.28	86.53^{a}±2.27	90.53^{a}±2.44	88.81^{a}±1.73	0.002

Values: (mean ± SD); $^{a, b, c}$ Means with different superscripts on the same row differ significantly. Where, A = 300 g Mawa + 0 g Sugar + 50 ml Milk; B = 300 g Mawa + 75 g Sugar + 50 ml Milk; C = 300 g Mawa + 150 g Sugar + 50 ml Milk; D = 300 g Mawa + 225 g Sugar + 50 ml Milk

3.2. Body and consistency

The body and consistency score showed a significant difference (*P*=0.005), with sample C achieving the highest score of 26.25±0.90, while sample A obtained the lowest score of 23.56±0.51 (Table 1). This difference in score could be attributed to the considerable variation in the chemical composition, particularly the levels of fat and sugar. These findings are consistent with the findings of Londhe and Pal (2008), who observed a significant impact on the body and texture score of brown peda with an increase in the fat and sugar levels in milk, albeit up to a certain extent. Similarly, Kavita *et al*. (2015) also concluded that there was a highly significant difference among all the samples. The results of the present study align with these findings.

3.3. Color and appearance

The color score exhibited a significant difference (*P*=0.014), with sample C achieving a high score of 18.00±0.25, while sample A obtained the lowest score of 16.53±0.65 (Table 1). The variation in color and appearance score can be attributed to several factors, including the wide variation in raw materials, the amount of sugar added (which influences the Maillard browning reaction between sugar and amino acids), the method (direct or indirect) employed, and the duration of heat treatment during the manufacturing process of peda. Sharma *et al*. (2001) reported that an increase in the fat percentage in khoa resulted in an improvement in its color. Similarly, Gavhane *et al*. (2014) mentioned that peda is typically whitish yellow in color with a coarse grainy texture, and its quality is determined by various factors such as chemical composition, body and texture, appearance, and microbial quality.

3.4. Overall score

The overall score showed a significant difference (*P*=0.002), with sample C achieving the highest score of 90.53±2.44, while sample A obtained the lowest overall score of 80.20±2.28 (Table 1). The variation in the overall score can be attributed to the wide variation observed in factors such as color and appearance, body and texture, flavor, and sweetness of the peda samples. The laboratory-prepared peda samples exhibited considerable variation, which could be attributed to the use of admixed milk of varying quality, differences in the preparation methods, and varying levels of sugar and moisture content. These factors contribute to the overall quality of the peda. Gavhane *et al*. (2014) mentioned that peda is typically whitish yellow in color with a coarse grainy texture, and its quality is influenced by various factors, including the chemical composition, body and texture, appearance, and microbial quality.

3.5. Fat content

The fat content of the prepared peda samples A, B, C, and D were determined to be 11.67±0.58, 16.33±0.58, 12.50±0.87, and 14.00±2.65, respectively, showing significant differences (*P*=0.019) (Table 2). Sample B had the highest fat content of 16.33±0.58, while sample A had the lowest fat content of 11.67±0.58. The variation in fat content among the peda samples could be attributed to factors such as the type of milk used (morning or afternoon milking of cow) and their respective fat content, the amount of sugar added, and the duration of desiccation. These findings align with the results of Sarkar and Ghatak (2001), who reported fat content ranging from 3.3% to 28.5% in peda samples, and Jadhav (2004), who reported a fat content of 17.84% in kandi peda.

Table 2. Chemical & Microbial parameters of different types of peda containing different sugar levels.

Parameter	Group				*P*-value
	A	B	C	D	
Fat (%)	11.67^{b}±0.58	16.33^{a}±0.58	12.50^{b}±0.87	14.00^{ab}±2.65	0.019
Protein (%)	7.19^{b}±0.88	12.29^{a} ±1.41	14.52^{a}±2.29	15.23^{a}±1.25	0.001
Carbohydrate (%)	46.80^{c}±6.20	66.94^{b}±3.21	75.15^{b}±2.55	92.33^{a}±4.45	0.000
Ash (%)	5.67^{a}±0.43	4.05^{b}±0.27	3.28^{b}±0.34	3.02^{b}±0.96	0.002
Total solids (%)	71.33^{c}±5.39	99.61^{b}±4.03	105.46^{b}±1.09	124.59^{a}±1.66	0.000
Total viable count (Log value)	5.27±0.09	5.26±0.40	5.14±0.12	5.29±0.24	0.861

Values: (mean ± SD); $^{a, b, c}$ Means with different superscripts on the same row differ significantly. Where, A = 300 g Mawa + 0 g Sugar + 50 ml Milk; B = 300 g Mawa + 75 g Sugar + 50 ml Milk; C = 300 g Mawa + 150 g Sugar + 50 ml Milk; D = 300 g Mawa + 225 g Sugar + 50 ml Milk.

3.6. Protein content

The average protein content of the prepared peda samples A, B, C, and D were determined to be 7.19±0.88, 12.29±1.41, 14.52±2.29, and 15.23±1.25, respectively, with highly significant differences (*P*=0.001) (Table 2). Sample D had the highest protein content of 15.23±1.25, while sample A had the lowest protein content of 7.19 ± 0.88. The protein content varied from 7.19±0.88 to 15.23±1.25, which could be attributed to factors such as the sugar level, which may have influenced the yield of peda. These findings are consistent with the study conducted by Sarkar and Ghatak (2001), who reported protein content ranging from 1.4% to 19.5% in peda samples. The variation in protein content could be attributed to the type of milk used, the extent of desiccation, and the addition of adulterants. Ray *et al*. (2002) reported protein content in the range of 15.26% to 16.79% in peda, which is similar to our observations. Similar findings have also been reported by Patel *et al*. (2006) in their study on peda.

3.7. Carbohydrate content

The carbohydrate content of the prepared peda samples A, B, C, and D were determined to be 46.80±6.20, 66.94±3.21, 75.15±2.55, and 92.33±4.45, respectively, with highly significant differences (*P*=0.000) (Table 2). Sample D had the highest carbohydrate content of 92.33±4.45, while sample A had the lowest carbohydrate content of 46.80 ± 6.20. The carbohydrate content varied from 46.80±6.20 to 92.33±4.45. The significant differences in the total sugars of the peda samples could be attributed to factors such as the amount of sugar added, the duration of desiccation, and the composition of the base material used during preparation. Similar relationships were observed by Sarkar and Ghatak (2001), who found carbohydrate content ranging from 4.0% to 18.6% in peda samples. Desale *et al*. (2007) studied the effect of compositional variables on the quality of peda and suggested that peda with 30% sugar, 15% moisture, and 25% fat obtained the maximum sensory scores.

3.8. Ash content

The ash content of the prepared peda samples A, B, C, and D were determined to be 5.67±0.43, 4.05±0.27, 3.28±0.34, and 3.02±0.96, respectively, with significant differences (*P*=0.002) (Table 2). Sample A had the highest ash content of 5.67±0.43, while sample D had the lowest ash content of 3.02±0.96. The ash content varied from 3.02±0.96 to 5.67±0.43. The results of the ash content in this study are consistent with the findings of Shinde *et al*. (2015) and Pal (2000), who reported ash content values of 2.57% and 1.40% to 3.40%, respectively. Narwade et al. (2007) also observed an ash content of 3.52% in peda. The variation in ash content could be attributed to factors such as the type of milk used, the extent of desiccation, and the addition of adulterants. These results align with the findings of Sarkar and Ghatak (2001), who noted that peda had an ash content ranging from 1.4% to 3.4%.

3.9. Total solids content

The total solids content of the prepared peda samples exhibited significant differences (*P*=0.000) (Table 2). Sample D had the highest total solids content of 124.59±1.66, while sample A had the lowest total solids content of 75.32±2.30. The total solids content ranged from 71.33±5.39 to 124.59±1.66. These findings are consistent with the investigation conducted by Pal (2000), who reported total solids content ranging from 81.80% to 95.80% in peda. Jadhav (2004) also reported a total solids content of 84.18% in kandi peda. Ray *et al*. (2002)

observed a wide variation in the total solids content of peda samples from the Kolkata market, ranging from 68.26% to 85.88%.

3.10. Microbial analysis

The total plate count (TPC) results of the prepared peda samples A, B, C, D showed no significant differences (P=0.861) (Table 2). Sample D had the highest TPC result of 5.29±0.24, while sample C had the lowest TPC result of 5.14±0.12. The TPC ranged from 5.14±0.12 to 5.29±0.24. The slight variation in TPC among the peda samples may be attributed to unhygienic conditions during the manufacturing process and the quality of raw materials used. The increase in TPC during storage can be attributed to the proliferation of microorganisms and the subsequent increase in acidity. Londhe *et al*. (2012) reported an increase in the total viable count during storage at 30°C. The presence of higher bacterial contamination can be attributed to the lack of hygienic practices followed during production. Considering the potential impact on public health, the Hazard Analysis and Critical Control Points (HACCP) should be implemented during the production process. The analysis from raw material to the final product indicates that although the microbiological quality of khoa may be satisfactory at the time of production, it deteriorates over time before being available for sale in the market (Bhat *et al*., 2000).

4. Conclusions

The composition of peda is influenced by various factors, including the type and quality of milk, the quality of khoa (if used), the amount of sugar added, the production method, optional ingredients, flavors added, and storage conditions. Sugar serves as both a preservative and a source of flavor in peda. However, an excessively high sugar content can negatively affect the organoleptic quality and texture of the product. In sensory evaluations, peda prepared with 150 g sugar showed the best results in terms of organoleptic tests and sensory properties. On the other hand, compositional analysis, such as carbohydrate, total solids, and protein contents, indicated that peda containing 225 g sugar yielded the best results. It should be noted that peda made with 150 g sugar exhibited a better texture profile.

Data availability

All relevant data are within the manuscript.

Conflict of interest

None to declare.

Authors' contributions

Mohammad Ramzanur Rahman collected data and drafted manuscript. Mohammad Rezaul Karim and Mohammad Shohel Rana Siddiki contributed in data analysis and editing the manuscript. Raihan Habib supervised the work. All authors have read and approved the final manuscript.

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