EFFECT OF STORAGE ON PHYSICO-CHEMICAL, MICROBIAL AND SENSORY EVALUATION OF SWEET BASED DAIRY PRODUCTS.

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Abstract

Sweet based dairy food products are widely consumed in India and Pakistan. These dairy products are easily contaminated with the growth of other microorganism because of their moisture content and nutritious composition. The present project was focused on the physicochemical, microbial, and sensory quality evaluation of traditional dairy sweet products was analyzed during 30 days of storage periods. Physicochemical properties of the sweet products, including moisture content, protein content, and fat content were decreased during storage. It was observed that an increase in acidity and a decrease in pH during the long-term storage process of traditional sweets due to the growth of microorganisms. The results indicated that the microbial quality of the majority of the samples was high during storage time increased. Besides that, the sensory attributes were decreased significantly during storage. Thus, the storage affected significantly on the quality of traditional dairy sweet products available in the market. **Keywords:** *Traditional Sweets, Microbial, Burfi, Gulabiamun, Rusgullaha*;

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Introduction

The food products that based on milk and sweets such as Rabri, Gulabjamun, Khoa, Rusgullaha, and Burfi are generally manufactured and used by the people in Pakistan and India. These milk-based foods are important part of their diet because they rich in minerals, carbohydrates, proteins, fats, and vitamins. Due to the high nutritious composition, these dairy products have more chance to be an excellent medium for the growth of microorganism (Givens, 2008). Calcium intake from these dairy products is highly encouraged as it helps in the bone formation and control of body weight (Major *et al.*, 2008).

Khoa is important heat desiccated product for making traditional sweets. Khoa is making from condensed milk, commonly through heating properly until water is evaporated. Most of the somatic cells of bacteria are killed by the high temperature of milk during the Khoa making process. However, thermoduric microorganisms might produce during the storage and affect adversely to the quality of products. Thus, quality of raw materials,

hygienic conditions, and storage conditions are the parameters that should focus in the production of traditional sweets. This is because Khoa products are perishable food with shorter shelf-life (Aneja *et al.*, 2002). Time and temperature of pre-treatment during the process of evaporation, contamination level, storage conditions can affect the growth of microorganisms in dairy products.

External drying and mold growth on the surface are the most common collective defects at ambient storage conditions. Packaging is also an important factor to affect the quality of fairy product during storage. Previous study showed that parchment paper used for packaging of Burfi sweets could store at 30°C up to 10 days. On the other hand, Burfi sweets packed in pastoralized cryovac pouches $(0.5\% H_2O_2)$ could increase the shelf life up to 30 days. Addition of 0.1% potassium sorbate in polystyrene packaging, followed by vacuum packaging was more satisfying to preserve the shelf-life of Burfi to over 60 days (Palit and Pal, 2005). In addition, corn syrup inhibited the movement of water in dairy products by exerting a restricting effect on the growth of bacteria. The common preservative agents used in food industry are potassium metabisulfite (K₂S₂O₅) and sodium metabisulfite (Na₂S₂O₅). Previous study stated the shelf life of buffalo milk burfi increased to 50 days at 7±1°C with the addition of these preservatives. There was no fungal growth and no significant changes on the biochemical qualities in the buffalo milk burfi (Sarkar *et al.*, 2003).

The production of these dairy sweet products is normally using the traditional methods regardless of the quality of raw materials used (Soomro *et al.*, 2002). Microorganisms may contaminate with the raw materials in this condition. *Escherichia coli* is the most common contaminated microorganism and is the main indicator of fecal contamination, mainly in food, unsanitary water conditions, milk, and other sweet dairy products. Previous study showed that *E.coli* and other microorganisms were isolated from many dairy based sweet products such as cream, cheese, burfi, butter and Gulabjamun (Kumar and Sinha, 1989). In this study, the physicochemical, microbial, and sensory evaluations of sweet based dairy products were evaluated during storage to examine their qualities.

Material and Methods

There are 20 samples of traditional sweet based dairy products, including Khoa, Burfi, Gulabjamun, and Rasghulla, with five samples of each product, from different regions of Pakistan. All chemicals used were analytical grade.

Physicochemical Properties

The physicochemical properties of traditional sweets, including moisture content, crude protein, crude fat, crude fiber, ash content, pH and acidity, were determined during storage periods of 30 days at 4°C. The samples were taken out for analysis on day 0, 15 and 30.

Moisture Content

The moisture content of traditional sweet samples was determined according to the Method No: 977.11 (AOAC, 2000). Sweet sample (5 g) was weighed into a pre-weighed crucible and dried in a drying oven with natural convection (Model: ED-115, Binder, Germany) at 105 ± 5 °C until the constant weight of dry matter was achieved. The moisture content of each sample was calculated by the following equation:

Moisture Content (%)

 $= \frac{\text{Weight of orignal sample (g)} - \text{Weight of sample after drying (g)}}{\text{Weight of orignal sample (g)}} \times 100$

Crude Protein

The crude protein content of the traditional sweets was measured according to the Kjeldahl's method (Method No: 991.20) (AOAC, 2000). Sweet sample (2 g) was taken into the digestion tube, followed by the addition of 20 mL of concentrated sulfuric acid (H₂SO₄, 98%). Two tablets of digestion mixture were added to act as a catalyst. Then, the digestion was conducted in the digestion unit for 3 to 4 hours until transparent residues were formed. After that, distilled water was added to dilute the digested residues to a final volume of 50 mL. NaOH (40%, 70 mL) was used to neutralize the mixture to produce ammonia gas. Kjeldahl's distillation apparatus was used to distill the neutralized solution. The ammonia produced was trapped in 4% boric acid solution. The ammonia content was then titrated against 0.1N sulfuric acid to a purple endpoint with methyl red and ethylene blue indicators. Crude protein was calculated according to the following equation:

Nitrogen (%) = $\frac{\text{Volume of } 0.1\text{N H}_2\text{SO}_4 \times \text{Volume of dilution made (ml)} \times 0.0014}{\text{Wt. of fresh sample (g)} \times \text{Volume of dilution (ml)}} \times 100$

Crude Fat

The crude fat of traditional sweets was determined using Soxhlet extractor by following to the Method No: 995.19 that described in AOAC (2000). Sweet sample (5 g) was weighed into an extraction thimble and extraction was carried out using petroleum ether as a solvent for 3 hours. The fat was recovered by evaporating the solvent using rotary evaporator at 40 °C under a vacuum pressure and expressed in crude fat content (%).

Crude Fiber

The sample after fat extraction was continued for crude fiber analysis according to the Method No. 32-10 that described in AOAC (2000). Sweet sample of 5 g was digested by 200 mL of 1.25% H₂SO₄ at boiling temperature. The mixture was filtered and washed thrice with ethanol. After that, digestion was continued with the sample by 200 mL of NaOH at boiling temperature for 30 minutes. The mixture was filtered and washed thrice with ethanol. The residue was dried at 130 °C for 2 hours and weighed (W₁). The dried residue was ignited at 600 °C, cooled and reweighed (W₂). The crude fiber was calculated according to following equation:

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Crude Fiber (%) =
$$\frac{W1 - W2}{Mass of sample (g)} \times 100$$

Ash Content

Ash is an inorganic residue after the material has been completely burnt at high temperature of 550 °C in a muffle furnace. The ash content of traditional sweets was determined according to the Method No. 08-01 (AOAC, 2000). The sample was measured into a pre-weighed crucible and ashed in a furnace at 550 °C for 4 hours.

Ash Content (%) = $\frac{\text{Weight of ash (g)}}{\text{Weight of sample (g)}} \times 100$

Determination of pH

The pH of all the traditional sweet samples was determined by pH meter (Oakton PH 550 Benchtop pH Meter Kit).

Acidity

Acidity was determined by using a diluted sweets sample (10 g added with 20 mL distilled water) solution. Phenolphthalein solution was added with 2-3 drops to act as indicators. After that, the mixture was titrated against NaOH solution until a light pink color endpoint (AOAC, 2000).

Acidity (%) = $\frac{0.009 \text{ x volume of NaOH used}}{\text{Weight of sample (g)}} \times 100$

Microbial Evaluation

Total Plate Count

The total plate count (TPC) was done by serial dilutions as recommended (FAO, 1992). Four serial dilutions (10-1, 10-2, 10-3, and 10-4) were prepared, and 1 g sample was inoculated on Plate Count Agar (PCA). The number of colonies ranging from 50-250 Cfu/g were enumerated after incubation of 48 hours at 37 °C.

Yeast and Mold Counts

Yeast and mold counts were determined using potato dextrose agar medium (PDA). Chloramphenicol (40 ppm) was added to inhibit the bacterial contamination. The plates were incubated at room temperature (25-28 °C) for 48 hours. Mold colonies from the representative agar plates were picked, isolated and sub-cultured on PDA slants at pH 3.5. The identification of mold and yeast was based on their morphological colony characters and colors. The colony-forming units of yeast and molds (Cfu/g) were counted.

Sensory Evaluation

The sensory attributes of storage samples of traditional sweets were evaluated for appearance, aroma, taste, texture, mouthfeel and overall acceptability by a sensory panel

of 35 faculty members and postgraduate students on the 9-Point Hedonic Scale (Meilgaard, 1999).

Statistical Analysis

All the obtained data was expressed as mean \pm standard deviation. One-Way Analysis of Variance (ANOVA) was analyzed to determine the level of significance and to draw the valued conclusion of this study. The means were compared and significant ranges were further postulated using DMR between quality parameters of different samples, considering the significant level at p < 0.05.

Results and discussion

Moisture content

Moisture content of a food is of great significance in determining the textural, organoleptic, and shelf-life of the product. Moisture content and water activity can act as the indicator to access the shelf-life of a food product. The lower the moisture content of a food product, the more stable of its shelf-life. Low moisture content of a food product provides a better storage stability, processing conditions, and food quality. Table 1 shows the mean values of moisture contents for different sweets samples (Burfi, Khoa, Gulabjamun, and Rusgullaha) during the storage periods of day 0, 15, and 30. All the samples showed a decreasing trend in the moisture content during the storage. The moisture content of Burfi was decreased significantly from 18.9% (day 0) to 17.9% (day 15), and decreased again to 16.8% (day 30). Besides that, the moisture content of Khoa was decreased significantly from 27.6% at day 30, while the moisture content of Gulabjamun was decreased significantly from 27.6% at day 0 to 26.2% at day 30. On the other hand, the moisture content of Rusgullaha was decreased slightly from 31.1% at day 0 to 30.9% after 30 days of storage.

Similar trend of results was observed in the previous studies (Jain *et al.*, 2014; Patel and Shah, 2009). Jain *et al.* (2014) reported the reduction of moisture contents in Gulabjamun and Kalakand (milk-based sweets), respectively during storage periods. The moisture content of Kalakand decreased with increasing storage time, especially at higher temperature (37 °C) compared to 10 °C. Packaging types and conditions would affect its moisture content. For example, the highest reduction of moisture content was occurred in the Kalakand sample packed under air (Jain *et al.*, 2014). This might due to the evaporation of water from the product during the storage period. Besides this, addition of fruits could decrease the moisture content of Burfi samples also. This is because the addition of fiber might increase the solute content of the product, and hence reduce the water content in the product. Thus, the moisture incorporation during the storage period of the milk-based sweets was also reduced. The moisture content of milk-based sweets samples from the laboratory (Patel and Shah, 2009).

Crude Protein

The results of sweet products regarding the protein content are illustrated in Table 1. Khoa sweet showed the highest protein content while Rusgullaha sweet showed the lowest protein content for their initial protein content at day 0. All the milk-based sweets samples showed a significant decreased by around 11.5-20.6% in their protein content. The protein contents of Burfi, Khoa, Gulabjamun, and Rusgullaha were decreased significantly by 18.6%, 11.6%, 20.6%, and 11.5% after 30 days of storage periods. The highest reduction of protein content was Gulabjamun, followed by Burfi, Khoa, and Rusgullaha with protein contents of 5.08%, 8.04%, 13.7%, and 5.62% at day 30. The results showed the protein contents decreased during storage was due to the protein chains form a loose mesh, which holds water within the network. With a loss in moisture content, they become disorganized with the protein chains and soluble nutrients. Also, the reaction between sugars and amino acids leads to the breakdown of protein molecules.

Crude Fat

Table 1 shows the crude fat contents of different sweets samples were differed significantly and decreased significantly during the storage. In Khoa, the highest crude fat of 20.5% was observed and was decreased significantly to 18.6% after 30 days of storage. However, the fat content of Burfi at day 0 was 11.1% and it was decreased significantly to 9.17% at 30 days. The fat contents of Gulabjamun and Rusgullaha were 8.69% and 5.50%, respectively at day 0, and were decreased significantly to 7.24% and 5.41%, respectively after 30 days of storage. Previous study showed the fat content of dairy sweets decreased with the increase in storage period at both ambient and refrigeration conditions. The decrease in fat content of dairy sweets was due to the oxidation of fat and breakdown of triglycerides to free fatty acids with the passage of time (Rangi *et al.*, 1985). The fat contents of Gulabjamun samples were non-significantly different from each other in ambient condition. The results showed a reduction in fat content in all levels of soy flour mix Gulabjamun was significantly different from each other in refrigeration storage (Singh *et al.*, 2011).

Crude Fiber

Dietary fiber brings some physiological functions to human's body. Complex neurohumoral pathways control gut secretion and motility. Dietary fibers that inhibit intestinal digestive processes result in decreased upper GI transit times, which may affect satiety and satiation. In addition, fiber intake increases fecal bulk and prevents constipation. Dietary fiber is also the main energy source for the good bacteria that stay in our intestinal tract, which improves gastro-intestinal health (Brownlee, 2011). Khoa presented the lowest crude fiber content (1.38%) while Rusgullaha presented the highest crude fiber content (2.83%), as shown in Table 1. The crude fiber content of Burfi was

2.93% at day 0 and was decreased significantly to 2.73% after 30 days of storage. On the other hand, the crude fiber contents of Khoa, Gulabjamun, and Rusgullaha were decreased slightly but not significant to 1.36%, 2.78%, and 2.82%, respectively after 30 days of storage. The non-significant result might be attributed to the low fiber content in traditional milk-based sweets.

Ash content

Table 1 shows the ash contents were differed significantly among different types of traditional sweets. The ash content of Rusgullaha sample was the highest (3.70%), followed by Khoa (2.41%), Gulabjamun (0.38%), and Burfi (0.29%). Ash represents the total minerals content in food product. It can affect the texture, stability, appearance, flavor, and nutritional value of a food product. Minerals can be added additionally to the food product to improve the nutritional value of a food product. Thus, different amount of ash content in the traditional sweets might due to different level of enrichment ingredients present in the product. High content of ash in the product indirectly revealed the availability of high mineral content also. The ash contents were increased slightly from 0.29% to 0.32% in Burfi, from 2.41% to 2.42% in Khoa, and from 3.70% to 3.71% in Rusgullaha after storage. The ash content of Gulabjamun was decreased slightly from 0.38% to 0.37% after storage. The changes of ash content for different sweets samples were slightly and not significant throughout the storage period. A significant variation of ash contents in dairy sweets products (Rasogolla samples) was observed in the previous study (Tarafdar et al., 2002). Rasogolla samples prepared from laboratory showed lower ash content compared to the market samples. This was contributed by the different solid content presented in different samples. Higher solid content may contribute to high amount of ash content.

Table 1

Proximate analysis (%) of traditional dairy sweet products

Day	Sample	Moisture Content	Crude protein	Crude Fat	Ash Content	Crude Fiber
0	Burfi	18.9±1.4 ⁱ	9.88±1.59 ^d	11.1±1.73 ^d	0.29±0.07 ^e	2.93±0.57 ^b
	Khoa	26.3±0.8 ^e	15.5±1.11 ^a	20.5±0.73ª	2.41±0.40 ^b	1.38±0.28 ^g
	Gulabjamun	27.6±2.4°	6.40±0.44 ^g	8.69±0.34 ^g	0.38±0.26°	2.79±0.35 ^e
	Rusgullaha	31.1±0.6ª	6.35±0.26 ^h	5.50±0.26 ^j	3.70±0.59 ^a	2.83±0.27°
15	Burfi	17.9±1.4 ^j	8.85±1.63 ^e	10.0±1.67 ^e	0.31±0.06 ^d	2.99±0.56 ^a
	Khoa	25.4±0.8 ^g	14.5±1.12 ^b	19.5±0.74 ^b	2.42±0.41 ^b	1.37±0.27 ^g
	Gulabjamun	26.7±2.4 ^d	5.47±0.43 ^j	7.68±0.37 ^h	0.36±0.27°	2.76±0.37 ^e
	Rusgullaha	31.0±0.6 ^{ab}	5.66±0.52 ⁱ	5.46±0.27 ^j	3.71±0.60ª	2.81±0.27 ^d
30	Burfi	16.8±1.4 ^k	8.04±1.49 ^f	9.17±1.57 ^f	0.32±0.06 ^d	2.73±0.59 ^f
	Khoa	24.5±0.9 ^h	13.7±1.12℃	18.6±0.80°	2.42±0.41 ^b	1.36±0.29 ^g
	Gulabjamun	26.2±2.5 ^f	5.08±0.61 ¹	7.24±0.64 ⁱ	0.37±0.27°	2.78±0.35 ^e
	Rusgullaha	30.9±0.6 ^b	5.62±0.52 ^k	5.41±0.28 ^k	3.71±0.60ª	2.82±0.26 ^c

Means in the same column with different superscripts are significantly different (p < 0.05).

рΗ

Table 2 shows the pH of different milk-based sweets and the pH was significantly different among the different types of milk-based sweets. The pH of different milk-based sweets was ranged in 5.78 to 6.00, and was decreased to 5.73 – 5.92 after 30 days of storage. The highest reduction of pH was occurred in Rusgullaha samples whereby its initial pH was 6.0 and decreased to 5.9 after the storage period. The result showed the pH of different milk-based sweet products decreased during the increased storage time. This result was in agreement with the previous study whereby the pH of cheese was decreased with an increasing of storage time (Shakeel-Ur-Rehman *et al.*, 2004). This is due to the presence of microorganisms in sweets samples, which used the milk sugar as fermentable substrate to carry out fermentation. The production of lactic acid is the main reason contributed to the decrease in pH. The high moisture content of milk-based sweets is also supported the growth of microbial population to carry out more fermentation in the reaction medium (Pandey *et al.*, 2012).

Acidity

Table 2 shows the titratable acidity level of different milk-based sweets and the acidity level was significantly different among the different types of milk-based sweets. Gulabjamun sweet samples presented the highest acidity value at day 0. The initial acidity levels of Burfi, Khoa, Gulabjamun, and Rusgullaha were 0.38%, 0.43%, 1.04%, and 0.93%, respectively. Their acidity levels were increased to 0.39%, 0.46%, 1.07%, and 0.99% after 30 days of storage. This result was in accordance with the determination of pH, whereby the acidity level of the sweets samples increased with the increase of storage period. Previous study also reported the increment of acidity level in Burfi sweets during the storage period (Navale *et al.*, 2014). Besides that, previous study observed a significant difference in the titratable acidity level of peda sweet samples. This might due to the difference in the milk quality used in the preparation of peda sweet samples (Banjare *et al.*, 2015).

Table 2

pH and acidity of traditional dairy sweet products

Day	Sample	pH	Acidity (%)
0	Burfi	5.78±0.21 ⁱ	0.38±0.04 ^k
	Khoa	5.95±0.17℃	0.43±0.11 ⁱ
	Gulabjamun	5.81±0.29 ^g	1.04±0.14°
	Rusgullaha	6.00±0.17 ^a	0.93±0.21 ^f
15	Burfi	5.76±0.20 ^j	0.39±0.04 ^j
	Khoa	5.94±0.16 ^d	0.45±0.12 ^h
	Gulabjamun	5.79±0.28 ^h	1.05±0.15 ^b
	Rusgullaha	5.96±0.16 ^b	0.96±0.22 ^e
30	Burfi	5.73±0.19 ¹	0.39±0.04 ^j
	Khoa	5.92±0.16 ^e	0.46±0.12 ^g
	Gulabjamun	5.75±0.27 ^k	1.07±0.15ª
	Rusgullaha	5.90±0.15 ^f	0.99±0.22 ^d

Means in the same column with different superscripts are significantly different (p < 0.05).

Microbial analysis of traditional sweet products Total plate count

Table 3 presents the results of TPC for different types of traditional dairy sweet products. The TPC of different types of traditional dairy sweet products showed different variations among samples. Khoa and Burfi showed the highest microbial contamination with 7900.0 Cfu/g and 6890.7 Cfu/g, respectively, in their initial TPC. On the other hand, Rusgullaha and Gulabjamun showed the lowest microbial contamination with 5957.3 Cfu/g and 6232.0 Cfu/g, respectively, in their initial TPC. The TPC of these different traditional dairy sweet products were increased significantly to 9905.3 Cfu/g (Burfi), 9812.0 Cfu/g (Khoa), 8301.3 Cfu/g (Gulabjamun), and 8000.0 Cfu/g (Rusgullaha) after 30 days of storage period.

Qualities of raw materials, preparation conditions, and packaging conditions are the factors that affect the microbial analysis of traditional sweets. High microbial load in the sweet products might due to the unhygienic situations in the shops or without working under sterile conditions. This result was supported by the previous study, which reported an increment in the TPC of Khoa after one week (Kumar and Prasad, 2010). This is due to the shorter shelf-life of dairy products that leads to the biochemical changes occurred during storage. High moisture content and water activity, as well as nutritious composition in the dairy products undergo an increment in the microbial evolution. Thus, traditional dairy sweet products undergo an increment in the microbial population during storage (Londhe *et al.*, 2012).

Table 3

Microbial count (cfu/g) in traditional dairy sweet products during 30-days storage

Days	Sample	Total Plate Count	Mold and Yeast count
0	Burfi	6890.7±1205 ⁱ	5493±1054 ^g
	Khoa	7900.0±1093 ^f	5385±1007 ^h
	Gulabjamun	6232.0±1098 ^j	5208±893 ⁱ
	Rusgullaha	5957.3±1016 ^k	4422±1119 ^j
15	Burfi	8901.3±848°	6496±1055 ^d
	Khoa	8898.7±1065 ^c	6385±1008 ^e
	Gulabjamun	7244.0±1080 ^g	6210±889 ^f
	Rusgullaha	6997.3±1009 ^h	5422±1119 ^g
30	Burfi	9905.3±859 ^a	7496±1055ª
	Khoa	9812.0±969 ^b	7354±950 ^b
	Gulabjamun	8301.3±1073 ^d	7116±822°
	Rusgullaha	8000.0±1013 ^e	6462±1096 ^d

Means in the same column with different superscripts are significantly different (p < 0.05).

Yeast and mold count

The results of microbial analysis by yeast and mold count are presented in Table 3. The results showed that the different types of traditional dairy sweet products had different variations in terms of yeast and mold count among samples. The highest yeast and mold count were observed in Burfi and Khoa, while the lowest yeast and mold count were observed in Rusgullaha and Gulabjamun. The highest increment (46.1%) in the yeast and mold count (4422 Cfu/g) was increased significantly to 6462 Cfu/g after storage. Significant increment in yeast and mold count was also observed in other samples, whereby increment of 36.5%, 36.6%, 36.6% occurred in Burfi, Khoa, and Gulabjamun, respectively. Nutritious composition and water activity present in the traditional dairy sweet products supported the growth of yeast and mold. The traditional dairy sweet products represent a suitable medium for the growth of yeast and mold. Previous study found the same result in the microbial study of Khoa with the finding of increase in the yeast and mold count (Bhatnagar *et al.*, 2007).

Sensory evaluation of traditional sweet products

Sensory evaluation is a very important quality criterion in the food industry to access consumer's perception towards the food product. Sensory evaluation is conducted by using a 9-point hedonic scale that rated by the sensory panels. Different types of traditional sweets samples (Burfi, Khoa, Gulabjamun, Rusgullaha) were evaluated by a faculty member and students panel for different sensory characteristics, included color, flavor, taste, texture, and overall acceptability on day 0, 15, and 30 upon the storage test.

Color

Color is very important as one of the sensory attributes as color may affect the appearance of a food product. Hence, color is always the first sensation that received by the consumer, and it is critical to product acceptability. Table 4 shows the results of sensory evaluation for different sweets samples of Burfi, Khoa, Gulabjamun, and Rusgullaha, in terms of color, appearance, flavor, taste, and overall acceptability. The results showed Burfi received the highest color score for initial sample, followed by Khoa, Rusgullaha, and Gulabjamun. After 15 days of the storage, the average score of color for four different types of the sweets samples were decreased significantly to 5.53-5.55, which were not significant among different types of the sweets samples at day 15. After that, the average score of color for four different types of the sweets samples were decreased again to 5.14-5.17 after 30 days of storage. The result was in agreement with the previous research (Galande, 2007; Gargade, 2004; Matkar, 2006). The decreased color score might due to the biochemical changes occurred in the sweet products, such as breakdown of fats and protein during storage to cause the fading of color. Besides that, microbial growth can affect the color of sweet products also during storage (Kolhe, 2003).

Appearance

The appearance of food plays an important factor to affect the customer's decision on food purchasing and acceptance. Table 4 shows Burfi received the highest average score in term of the appearance, followed by Khoa, Rusgullaha, and Gulabjamun. The average score for appearance of traditional sweet products was decreased significantly throughout the storage period. The average score for appearance was decreased significantly from 8.26 to 5.54 (Burfi), 7.98 to 5.55 (Khoa), 6.68 to 5.54 (Gulabjamun), and 7.72 to 5.53 (Rusgullaha) after 15 days of storage. The appearance score was decreased slightly to 5.15 (Burfi), 5.17 (Khoa), 5.16 (Gulabjamun), and 5.14 (Rusgullaha) after 30 days of storage, which were non-significant among different types of sweet products.

During storage, the fading of color in sweet products affected its appearance. Besides that, loss of moisture due to evaporation in sweet products during storage resulted in drier sample and lacked of greasy appearance. Previous study showed that the appearance of different sweet products started to appear brown or dark color with moldy surface. This is because of the growth of microbial population during the storage period of sweet products with nutritious composition and moisture content provided (Kolhe, 2003). Besides that, different quantities and qualities of raw material used and heat processing methods in the making of sweet products may affect the difference in color and appearance (Sharma *et al.*, 2001).

Flavor

Flavor is a sensory attribute that contributed by taste and smell impressions, as well as together with the texture. Table 4 shows the average flavor score was significant different among different types of sweets samples, with Burfi presented the highest flavor score (8.24) at day 0, followed by Khoa (7.66), Rusgullaha (7.34), and Gulabjamun (6.67). The average flavor scores of different types of sweets samples were decreased significantly throughout the storage period, as shown by the values at day 15 and day 30. The average flavor score decreased might due to the acidity increased throughout the storage period, as shown by the values. This contributed to the increase in sour or acidic flavor, which cannot accept by most of the consumers. Previous study showed that the development of sour or acidic flavor, as well as rancid during the storage of sweet products (Gargade, 2004).

Taste

Table 4 shows the average taste scores for different types of traditional sweets were significant different with each other. Khoa received the highest taste score (8.22), followed by Burfi (8.18), Rusgullaha (7.98), and Gulabjamun (6.79). The average taste scores for these samples were significantly decreased to 5.81-5.98 after 15 days of storage, and decreased again to 5.48-5.51 after 30 days of storage. The average taste scores for these samples were not significant difference among different samples at day 15 and day 30. The decreasing trend in average taste scores of sweet products was certainly caused by

the effects of storage to the quality of the sweet products. The microbial and biochemical changes took place in the product during the storage was definitely affected the taste and smell of the sweet products (Chavan *et al.*, 2014; Karunaithy *et al.*, 2007).

Table 4

Sensory evaluation of sweets based dairy products during 30-days storage

Days	Sample	Color	Appearance	Flavor	Taste	Overall acceptability
0	Burfi	8.56±0.69ª	8.26±0.87 ^a	8.24±1.15 ^a	8.18±1.19ª	7.88±0.82 ^b
	Khoa	8.16±0.47 ^b	7.98±0.78 ^b	7.66±0.78 ^b	8.22±0.42 ^a	7.86±1.26 ^b
	Gulabjamun	7.36±0.81 ^d	6.68±1.17 ^d	6.67±1.15 ^d	6.79±0.96°	7.54±0.91°
	Rusgullaha	7.86±1.03°	7.72±1.61 ^e	7.34±1.26°	7.98±1.28 ^b	8.02±0.73ª
15	Burfi	5.53±1.42 ^e	5.54±0.78 ^e	5.57±0.78 ^e	5.98±0.87 ^d	6.48±0.82 ^d
	Khoa	5.53±1.31 ^e	5.55±0.99 ^e	5.56±0.82 ^e	5.97±0.86 ^d	6.49±0.69 ^d
	Gulabjamun	5.53±1.31 ^e	5.54±0.73 ^e	5.54±0.87 ^e	5.81±0.87 ^d	6.47±0.82 ^d
	Rusgullaha	5.53±1.32 ^e	5.53±0.73 ^e	5.56±0.86 ^e	5.81±0.89 ^d	6.50±0.83 ^d
30	Burfi	5.09±1.08 ^f	5.15±0.73 ^f	5.19±0.67 ^f	5.48±0.87 ^e	5.88±0.52°
	Khoa	5.13±1.07 ^f	5.17±1.05 ^f	5.17±0.96 ^f	5.49±1.00 ^e	5.95±0.83 ^e
	Gulabjamun	5.15±1.07 ^f	5.16±1.04 ^f	5.20±0.97 ^f	5.50±1.02 ^e	5.94±0.83 ^e
	Rusgullaha	5.13±1.37 ^f	5.14±1.41 ^f	5.18±0.94 ^f	5.51±0.96 ^e	5.94±0.67°

Means in the same column with different superscripts are significantly different (p < 0.05).

Overall Acceptability

Table 4 shows Rusgullaha received the highest score in overall acceptability (8.02), followed by Burfi (7.88), Khoa (7.86), and Gulabjamun (7.54). The overall acceptability scores of sweet products were significantly affected by the storage periods. It was shown that the scores were decreased significantly to 6.47-6.50 at day 15 for 4 different types of sweets samples, and decreased significantly to 5.88-5.95, which were not significant different types of sweets samples. Storage test caused a significant effect on the quality

of sweet products and affected its overall acceptability. This result was in accordance with the previous studies (Chavan *et al.*, 2014). Karunaithy *et al.* (2007) reported a gradual decrease in overall acceptability of sweet products. This can be seen the overall acceptability was taken into account based on color, appearance, flavor and taste of the sweet products. Overall, the storage test caused a significant negative effects towards the quality of the sweet products in terms of the microbial growth and sensory characteristics.

Conclusion

This study examined the quality of traditional sweet products (Burfi, Khoa, Gulabjamun, and Rusgullaha) in terms of their physicochemical properties, microbial analysis, and sensory characteristics. Physicochemical properties of the sweet products, including moisture content, protein content, and fat content were decreased during storage. This showed the biochemical changes took place in the sweet products during storage, such as breakdown of triglycerides to free fatty acids and breakdown of protein chains to form a loose mesh. Besides that, pH was decreased in the traditional sweet products coupled with an increase in acidity due to the growth of microorganisms. The microbial evaluation showed that the microbial quality for most of the samples was unsatisfactory. The significant growth of microbial population in traditional dairy sweets samples was observed during 30 days of storage period. Unhygienic conditions, unhygienic food handling practices, guality of raw materials used, and not working under sterile conditions might be the factors to cause the microbial contamination of sweet products. Sensory characteristics, including color, appearance, flavor, taste, and overall acceptability of the different traditional sweet products had been decreased significantly after 15 days of storage. Thus, the traditional sweet products were not suggested to store for more than 15 days without any addition of preservatives.

References

Aneja, R. P., Mathur, B. N., Chandan, R. C., & Banerjee, A. K. (2002). *Technology of Indian milk products: handbook on process technology modernization for professionals, entrepreneurs and scientists.* Dairy India Yearbook.

Association of Official Analytical Chemists. (2000). *Official methods of analysis* (17th edition). Washington DC, USA.

Banjare, K., Kumar, M., Goel, B. K., & Uprit, S. (2015). Studies on chemical, textural and sensory characteristics of market and laboratory peda samples manufactured in Raipur

City of Chhattisgarh. Oriental Journal of Chemistry, 31(1), 231-238. Retrieved from http://dx.doi.org/10.13005/ojc/310125.

Bhatnagar, P., Khan, A. A., Jain, M., & Jain, S. K. (2007). Bacteriological study of khoa sold in Gwalior and Morena City in Relation to Public Health. *Asian Journal of Experimental Sciences*, *21*(1), 55-62.

Brownlee, I. A. (2011). The physiological roles of dietary fibre. *Food hydrocolloids*, 25(2), 238-250. https://doi.org/10.1016/j.foodhyd.2009.11.013.

Chavan, R. S., Prajapati, P. S., Chavan, S. R., & Jana, A. (2014). Technology for the manufacture of diabetic rosogolla. *Critical reviews in food science and nutrition*, *54*(7), 863-868. https://doi.org/10.1080/10408398.2011.614362.

FAO. (1992). *Manual of food quality control* (4th edition). Food and Agriculture Organization of the United Nation, Rome.

Galande, S.S. (2007). *Studies on preparation of sweet orange burfi.* (M.Sc. thesis, Vasantrao Naik, Marathwada Krishi, Vidyapeetham, Maharashtra, India).

Gargade, D. A. (2004). Use of orange concentrate in preparation of burfi. (MSc (Agri) thesis, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharastra, India).

Givens, D.I. (2008). Session 4: Challenges facing the food industry in innovating for health. Impact on CVD risk of modifying milk fat to decrease intake of SFA and increase intake of cis-MUFA. *Proceeding of Nutrition Society, 67*, 419-427. https://doi.org/10.1017/S0029665108008707.

Jain, V., Rasane, P., Jha, A., Sharma, N., & Gautam, A. (2014). Effect of modified atmospheric packaging on the shelf life of Kalakand and its influence on microbial, textural, sensory and physico-chemical properties. *Journal Food Science and Technology*, *52*, 4090-4101. https://doi.org/10.1007/s13197-014-1501-9.

Karunaithy, C., Varadharaju, N., & Kailappan, R. (2007). Studies on development of kneader and ball former for chhana in rosogolla quality parameters of Rosogolla. *J Food Engineering*, *80*, 966-971. https://doi.org/10.1016/j.jfoodeng.2006.06.032.

Kolhe, P. Y. (2003). *Utilization of papaya pulp in preparation of burfi*. (MSc (Agri) thesis, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharastra, India).

Kumar, R., & Prasad, A. (2010). Detection of E. coli and Staphylococcus in milk and milk products in and around Pantnagar. *Veterinary World*, *3*(11), 495.

Kumar, V., & Sinha, R.N. (1989). Incidence of coliforms in indigenous milk products. *Indian Journal of Dairy Science*, 42, 579-580. http://krishikosh.egranth.ac.in/handle/1/54842.

Londhe, G., Pal, D., & Raju, P. N. (2012). Effect of packaging techniques on shelf life of brown peda, a milk-based confection. *LWT-Food Science and Technology*, *47*(1), 117-125. https://doi.org/10.1016/j.lwt.2011.12.025.

Major, G. C., Chaput, J. P., Ledoux, M., St-Pierre, S., Anderson, G. H., Zemel, M. B., & Tremblay, A. (2008). Recent developments in calcium-related obesity research. *Obesity reviews*, *9*(5), 428-445. https://doi.org/10.1111/j.1467-789X.2007.00465.x.

Matkar, S.P. (2006). Preparation of fig burfi. (M.Sc. thesis, Vasantrao Naik, Marathwada Krishi, Vidyapeeth, Maharashtra, India).

Meilgaard, M.C., Carr, B.T., & Giville, G.V. (1999). *Sensory evaluation of techniques.* (3rd edition). CRC Press, Boca Raton.

Navale, A. S., Deshmukh, B. R., Korake, R. L., Narwade, S. G., & Mule, P. R. (2014). Production profile, proximate composition, sensory evaluation and cost configuration of wood apple burfi. *Animal Science*, *8*(3), 114-120.

Palit, C. & Pal, D. (2005). Studies on mechanized production and shelf life extension of burfi. *Indian Journal of Dairy Science*, *58*(1), 12-16.

Pandey, S., Jha, A., Khemariya, P., Kumar, S., & Rai, M. (2014). Shelf-life and microbiological safety studies of refrigerated petha sweet. *Journal of food science and technology*, *51*(11), 3452-3457. https://doi.org/10.1007/s13197-012-0856-z.

Patel, J.H., & Shah, P.U. (2009). Nutrient content of market and laboratory Khoa samples. *Indian Journal Dairy Science*, *2*(7), 232-234. Doi=10.1.1.392.5964&rep=rep1&type=pdf.

Rangi, A., Minhas, K.S., & Sidhu, J. (1985). Indigenous milk products. I. Standardization of recipe for Gulabjamun. *Journal of Food Science Technology (Mysore), 22*(3), 191-193.

Sarkar, K., Sikder, B., Ray, P. R., & Ghatak, P. K. (2003). Enhancement of shelf-life of buffalo milk burfi with sodium and potassium metabisulphites. *The Indian Journal of Nutrition and Dietetics*, *40*(5), 174-178.

Shakeel-Ur-Rehman., Farkye, N.Y., & Drake, M.A. (2004). The effect of application of cold natural smoke on the ripening of Cheddar cheese. *Journal of Dairy Science*, 86, 1910-1917.

Sharma, V., Sharma, S., Mathur, O. P., & Purohit, G. R. (2001). Rate and Extent of Dry Matter and Nitrogen Degradability of some Protein Sources in Goats. *Indian Journal of Animal Nutrition*, *18*(1), 90-92.

Singh, A.K., Dattatreya, M.K., Saxena, M., & Singh, R.P. (2011). Effect of soy flour supplementation on the quality and shelf life of gulabjamun. *International Journal of Food Science and Nutrition Engineering*, *1*(1), 11-17.

Soomro, A.H., Arain, M.A., Khaskheli, M., & Bhutto, B. (2002). Isolation of *Escherichia coli* from raw milk and milk products in relation to public health sold under market conditions at tandojam, *Pakistan. Pakistan Journal of Nutrition*, *1*(3), 151-152.

Tarafdar, S.U., Pramanik, M.A.H., Basak, B., Rahman, M.S., & Biswas, S.K. (2002). A comparative study on the quality of Rusgullaha made in laboratory and collected from markets, Bangladesh. *Pakistan Journal of Nutrition, 1*(3), 156-160.