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Development of goat milk rasgulla incorporation with stevia

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Abstract
The impact of stevia on the chemical, microbiological, and sensory characteristics of rasgulla during storage at ambient temperature and in the refrigerator was examined. Rasgulla were made by using Maida flour as the binding agent and varying concentrations of stevia in the cooking and soaking syrups. There were six different rasgulla samples made. By using syrups with various ratios of sugar, stevia, and honey together with a prepared control sample from 100:0. All samples were kept in refrigerators and at room temperature for 15 days respectively. Analysis of chemical changes for pH, syrup acidity, Rasgulla samples' free fatty acid (FFA) concentration and microbiological burden samples every third day of storage at ambient temperature and in the refrigerator, respectively. Significant protection from the formation of free fatty acids and the rise of acidity have been shown by the stevia level. At high levels of stevia, the number of microorganisms present was lower at room temperature than it was at refrigeration.

Keywords: Goat milk, rasgulla, stevia

Introduction
According to the National Dairy Development Board (2015), India is the world's greatest milk producer, producing over 18.55% of all milk produced worldwide. During the 2015–2016 fiscal year, Indian dairy exports totaled 33,377.16 MT, valued at 754.20 crores rupees (Agricultural and Processed Food Products Export Development Authority, Ministry of Commerce and Industry, Government of India). The main drawback of milk is that it is perishable, a problem that can be solved by turning milk into products with extra value. Over 90% of the country's dairy product consumption is made up of traditional Indian dairy products Aneja *et al*., (2002) [1]. Additionally, 50–55 percent of the milk produced is converted into locally manufactured milk goods like rasgulla, chhana, yogurt, etc.
Rasgulla, a sweet, syrupy cheese ball made from Chhana (coagulated milk precipitate treated with heat and acid), is particularly popular in parts of South Asia. At 25–30 °C, rasgulla remains in good quality for one day. Like other water-oil emulsions, rasgulla is susceptible to rancidity both hydrolytic and oxidative, and many physicochemical changes take place when it is being stored (Kaur *et al*., 2018) [11]. The shelf stability and behavior of food products during storage are the most crucial factors in determining their commercial viability. Food/dairy product shelf stability or shelf life mainly depends on storage temperature, microbial load, etc. After the development of microorganisms in the product, physicochemical changes take place that lower the product's general acceptability after prolonged storage.
The addition of natural antioxidants was used to combat the effects of rancidity during rasgulla storage Bandyopadhyay *et al*. (2008) [3] along with Sengupta & Bhowal, (2017) [4]. Micronutrients known as antioxidants are utilized to slow down or stop the development of rancidity and other flavor deterioration in dairy and food because of oxidation processes (Kaur *et al*., 2018) [11]. The usage of natural antioxidants has drawn attention due to the toxicity and side effects of synthetic antioxidants, and consumer demand for natural goods has grown as well. Researchers Bandyopadhyay *et al*. (2008) [3] discovered that rasgulla' s shelf stability during storage at a cold temperature was impacted by carrot.
Stevia is a natural non-sweetener that contains antioxidants, amino acids, and antimicrobial properties. Stevia is used as a sweetener in soft drinks or fruit drinks, dairy desserts (Kaur & Goswami, 2018) [7], sauces, confectionaries, breads, biscuits, and tabletop sweetener Goyal *et al*. (2010) [10] and Jayaraman *et al*. (2008) [8]. Rasgulla was created by Kaur and Goswami (2018) [7] using various sugar and stevia concentrations, and samples of the rasgulla were also sensory evaluated. Yogurt and seafood had saccharose replaced with stevia Wallin, 2007 [9] and Goyal *et al*. (2010) [10].

Materials and Methods

From the farm, fresh goat milk was procured. Lemon, honey, and stevia were purchased at a nearby market. Table 1 contains information about the milk's chemical makeup. Making cheese balls with stevia and honey syrup for rasgulla. The method used to manufacture experimental Rasgulla was adapted from those described by other scientists. Rasgulla was made from fresh goat milk. Each one was heated to 90 °C and cooled to 70 °C. Sweet curd (chhana) was created by acid coagulation using lemon juice, and whey was removed by applying mild pressure to muslin cloth to drain it. Chhana is kneaded into a smooth mass as part of the preparation process for Rasgulla. Typically, chhana is hand kneaded by being placed on a wooden plate and then formed into tiny balls weighing between 6 and 7 grams apiece. Stevia and honey syrup of different concentration was made to cook the chhana balls.

The syrup was heated, and the balls were added as it began to boil. The chhana balls were cooked for 15 to 25 minutes. About 10 ml of water was added every 5 minutes to make up for the syrup's water loss through evaporation. Rasgulla balls were maintained in sugar syrup after cooking, and all samples underwent analysis.

Ingredients

Table 1: The concentration of ingredients used to prepare rasgulla.

	Control T_1	T_2	T_3	T_4	T_5	T_6
Chhana (g)	80	80	80	80	80	80
Maida (g)	20	20	20	20	20	20
Stevia (%)	50	60	70	80	90	100
Honey (%)	50	40	30	20	10	0

Physico chemical parameters

Physico-chemical characteristics were examined in Rasgulla cheese samples. According to AOAC (2009.1), total solids, fat, crude protein, and ash were measured. A carbohydrate calculation was made. Using a pH meter, the pH value was determined. By subtracting the weight of the rasgulla after soaking from the weight of the milk, the yield of rasgulla (g/L of milk) was determined.

Microbiological examinations

Yeast and mold counts, total coliform counts, and total bacterial counts (T.B.C.) are also included. According to Marshall (2009) [4] Listeria monocytogenes and Bacillus cereus were found.

Organoleptic properties

Nine judges from the Animal Production Research Institute's dairy department employees evaluated the organoleptic qualities. Rasgulla samples were judged by a panel of experts using 9 point hedonic scale.

Statistical analysis

The data were statistically analyzed using the MSTAT program's Completely Randomized Design (CRD) using one factor. The Least Significant Difference (LSD) value was used to compare the variations in sample means (Gomez and Gomez, 1984) [15].

pH and acidity measurements of syrups

A digital pH meter was used to determine the pH of the syrup. Using the method described in Indian Standards Institution ISI: 4079 (1967), the acidity of syrup was tested. Using phenolphthalein as an indicator, 30 ml of filtered syrup from each treatment was titrated against 0.1 N NaOH solution. 100 ml of 0.1N NaOH was used to measure the acidity of the syrup.

Free fatty acid content determination of rasgulla

The amount of free fatty acids (FFAs) was measured using a modified version of the (Kaur *et al*., 2018) [11] procedure. In a mechanical blender, 70 ml of chloroform and the rasgulla sample (30.0 0.5 g) were blended for 5 minutes. The combined mixture was centrifuged at 10,000 rpm for 30 minutes in a cooling centrifuge (4 °C) to separate the filtrate. The filtrate (25 ml) was combined in the same volume with neutralized ethyl alcohol (99.9%), then the solution of 0.1 M NaOH was used to measure the results. Oleic acid present was used to calculate the FFA content per 100 g of sample.

Results and Discussion

Rasgulla's acceptability is influenced by variations in pH, acidity, FFA content, etc. during the storage period.

Changes in pH and acidity of syrups

The impact of stevia content on the pH value of rasgulla syrups after storage at room temperature and refrigeration, respectively, is depicted. Rasgulla syrup's pH value significantly decreased for all samples as storage time at room temperature increased, as indicated in Table 2. Although there was a somewhat higher pH in the SR sample than the CR sample (p>.05), this difference was not statistically significant. The presence of defatted soy flour in the chhana balls may be to blame. In comparison to the other samples, the pH value of the syrup increased significantly (p .05) during the course of the storage period and with increasing stevia concentration in rasgulla syrup.

Table 2: Chemical composition in percentage (%)

S.No.	Physico-chemical Parameters	Fresh	After 15 Days
1	Moisture	51.55±0.03ab	50.23±
2	Protein	5.61±0.01e	5.58±0.07c
3	Fat	5.8±0.03de	5.9±0.08bc
4	Ash	0.91±0.02f	0.98±0.02a
5	Carbohydrate	33.55±0.01e	33.84±0.07b
6	Yield	51.9±0.02d	5.59±0.04d
7	Total bacterial count	11±0.05b	18±0.08cd

Table 3: Sensory score obtained by the products

S.No.	Sensory Properties	Fresh	After 15 Days
1	Body& Texture (45)	42±0.02a	40±0.06c
2	Flavour (35)	33±0.08c	30±0.02b
3	Color &Appearance (20)	15±0.06b	17±0.05a
4	Overall acceptability (100)	90±0.05c	87±0.08b

Sensory evaluation of rasgulla

The table shows the sensory ratings of samples stored in room and chilled temperatures. As storage time in the room and chilled temperatures increased, the sensory score dropped. Dongare *et al*., (2019) [16] reported that variations in sensory score over the storage time were similarly found. Sensory score changed less at refrigerated temperature than at room temperature. For the first time, sensory evaluation of rasgulla under various storage times and temperatures was reported.

Conclusion

According to the findings of the current study, adding stevia to cooking and soaking syrups decreased the acidity and pH, and rasgulla syrup's acidity decreased over the course of storage. Stevia was added, which slowed the creation of FFA and reduced the number of alterations that could be seen at a chilled temperature. It can be said that stevia displayed antioxidant properties at both room temperature and cold temperatures. The number of microbiological criteria gradually decreased as the amount of stevia in rasgulla increased. Rasgulla shift in sensory score throughout the course of the storage period was lessened by stevia. Treatment T_3 was generally acceptable, and shelf stable up to the third day while other samples acceptability was seen to last for fewer than three days while storage at ambient temperature. Overall, rasgulla samples with all treatments were acceptable up to day 10 of storage, while Treatment T_4 was acceptable up to day 15 of storage at a chilled temperature. Rasgulla demonstrated greater shelf durability at increased stevia concentrations at chilled temperatures across all storage times.

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