













Physicochemical and sensory analysis of spiced rennet cheese made from frozen goat's milk

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Abstract

The aim of this research was to analyze the chemical and sensory composition of seasoned rennet cheese produced from frozen goat's milk. The frozen goat's milk cheeses were divided into five treatments: seasoned with oregano, basil, without seasoning, black pepper, and Calabrian pepper. The average values obtained for dry extract, moisture, fat, and fat in dry extract were 64.94, 35.05, 22.30, and 34.32%, respectively. Significant differences ($p < 0.05$) were found between the different types of seasoning for the sensory attributes: taste, aroma, and overall acceptability. In terms of purchase intention, the cheeses seasoned with oregano and basil were highly accepted by the interviewees with 78.89 and 57.78%, respectively. In this context, it was found that it is possible to produce quality rennet cheese made from frozen goat's milk seasoned with oregano and basil, as they obtained greater acceptance among the treatments, bearing in mind that it is a good alternative to increase the popularity of products from goat farming in Brazil.

Keywords: dairy products; orégano; production; quality; spices.

Practical Application: Among the wide variety of cheeses that can be made from goat's milk, rennet cheese is an alternative.

1 INTRODUCTION

According to the legislation that approves the Technical Regulation on the Identity and Quality of Goat's Milk, Normative Instruction 37 of October 31, 2000, goat's milk intended exclusively for industrialization, understood as its transformation into milk derivatives, can be frozen in cans with a maximum capacity of 50 L and kept at a temperature of less than or equal to -18°C , always using equipment that can reach this temperature in the shortest possible time (Brasil, 2001). Frozen pasteurized goat's milk does not alter its microbiological and physical-chemical characteristics, but the sensory quality of taste and aroma are significantly altered (Gomes et al., 1997).

Its biggest consumers are children who are allergic to cow's milk, the elderly, and convalescents, who consume the product on medical advice (Lima et al., 2017). Among the foods of animal origin used in the human diet, goat's milk occupies a prominent place, providing calories and essential amino acids in proportions equal to or greater than those recommended by the World Health Organization (Santos et al., 2023).

Small producers can also use simple processes to process the raw material, mainly into cheeses, adding value and increasing consumption of goat products (Santos et al., 2011). Curd cheese is the most widespread milk derivative in various regions of the northeast. Curd cheese has been produced for over 150 years and is part of the northeastern culture. Most of these cheeses are produced from raw milk, putting the health of the consumer at risk (Cavalcante et al. 2007). According to Curi and Bonassi (2007), the various types of cheese have their manufacturing stages in common, but among them, there are variations such as the desorption time, resting of the dough, time between stirrings, different temperatures, and during ripening, all of which determine the specific characteristics of each type of cheese.

One option in the preparation of rennet cheese is the addition of spices, as the maturing and smoking process has contributed to the improvement of flavor, aroma, and the insertion of numerous antioxidant properties related to spices, adding nutritional value as well as having antimicrobial action (Egypto et al., 2009). Seasoning rennet cheese, as well as maturing and

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smoking, differentiates the product, helping to improve sensory characteristics (such as taste, aroma, and color), as well as adding specific properties of spices, adding greater nutritional value and antimicrobial action (Alencar et al., 2020).

The aim of this research was to analyze the chemical and sensory composition of seasoned rennet cheese produced from frozen goat's milk.

2 MATERIALS AND METHODS

2.1 Materials used

Milk from Saanen goats was used to make the cheeses. The goats were part of an experiment being carried out in bioclimatic chambers in the Zootechnics Department of the CCA/UFPB. Milking was carried out manually in accordance with Good Milking Practices.

The spices (dehydrated basil and oregano) were obtained from the supermarket and the peppers (black pepper and dehydrated Calabrian pepper) were obtained from the market, all of them from the city of Areia, Paraíba, Brazil. These condiments were not treated in any way, only used after they had been obtained.

2.2 Pasteurization and freezing

The milk was processed by slow pasteurization at 65°C for 30 min in a water bath, with the time marked only after the milk reached the treatment temperature. Immediately after pasteurization, the milk was heat shocked from $\pm 63^\circ\text{C}$ to ± 3 to 5°C and then stored in a common freezer (-18°C) for an average period of 30 days.

2.3 Experimental design

The research consisted of five treatments, so each treatment included the production of rennet cheeses made from frozen goat's milk seasoned with oregano (T1), basil (T2), without seasoning (T3), black pepper (T4), and Calabrian pepper (T5), for the purposes of physicochemical, microbiological, and sensory analyses. For the cheeses with basil and oregano, the concentrations were 1%, and for the cheeses with black pepper and Calabrian pepper, the concentrations were 0.5%. These concentrations were averages obtained based on studies in the field, seeking to achieve the most favorable level for consumer acceptability.

2.4 Goat's rennet cheese

- To make the cheese, the frozen milk was thawed in a cold room at 4°C for approximately 24 h. After thawing, it was immediately heated to 37°C to add the ingredients;
- Addition of lactic yeast (1.5% w/v) made up of the mesophilic fermentative culture (*Lactococcus lactis* subsp. *cremoris*, *Lactococcus lactis* subsp. *lactis*), calcium chloride (0.4 mL/L), and addition of rennet according to the manufacturer's recommendations;

- Cutting the dough after resting for 40 min;
- Homogenization;
- Desorbing;
- Addition of 50% of the total whey, heated to 75°C to pre-cook the dough;
- Second homogenization;
- Second draining;
- 45 g per 10 L of milk used to salt the dough;
- Addition of seasonings;
- Forming and pressing;
- Vacuum packing and storage at 4°C ;
- The cheeses were stored for around 21 days before being analyzed, thus maturing them.

2.5 Physicochemical analysis of cheese

After production, the cheese was analyzed for total dry extract (TDE), fat in dry extract (FDE), fat, and protein. All these analyses were carried out at the Food Analysis and Animal Nutrition Laboratory at the CCA/UFPB.

The curd cheese samples were analyzed in duplicate according to the methodology of MAPA Normative Instruction 68 (Brasil, 2006) for fat content (using Gerber's lactobutyrometer), protein (Micro-Kjeldahl method), and total dry extract (oven drying at 105°C). FDE was obtained using the Equation 1:

$$\frac{FDE = fat(\%) \times 100.}{TDE(\%)} \quad (1)$$

2.6 Sensory analysis

The sensory analysis was carried out in individual booths away from noise and odors at pre-established times, excluding 1 h before and 2 h after lunch. The samples were served at room temperature in cubes of approximately 3 cm^3 , presented in coded disposable cups (50 mL), and accompanied by a cream cracker cookie, water, and an evaluation form.

For the sensory evaluation, the acceptance test was applied following the methodology described by Faria and Yotsuyanagi (2002). The following attributes were evaluated: appearance, smell, texture, taste, consistency, and overall acceptance, using a structured 9-point hedonic scale ranging from one (I disliked it extremely) to nine (I liked it extremely). Finally, the purchase intention test was carried out using a structured 5-point scale ranging from one (Would never buy) to five (Would buy).

2.7 Statistical analysis

Data were subjected to an analysis of variance (ANOVA), and Tukey's test compared the averages at 5% probability through the PROC GLM of the SAS statistical package (SAS, 2001). The test Ryan-Einot-Gabriel-Welsch compared the means of the sensorial attributes 5% probability level.

3 RESULTS

Fat and fat in dry extract showed significant differences ($p < 0.05$) depending on the seasoning. Treatments 2 and 5 showed the highest values for fat and the lowest values in treatment 3. For fat in dry extract, treatment 3 showed the lowest value, and the other values were statistically equal and high (Table 1). The average values for fat in dry extract (34.32%), which are shown in Table 1, were slightly lower than those established by MAPA Normative Instruction 30 (Brasil, 2001), which deals with the technical regulations for the identity and quality of rennet cheese, with a standardized fat content in total solids of between 35% and 60%.

Aroma and flavor were significantly different between the treatments ($p < 0.05$), probably because they are characteristics of the seasoning used (Table 2). Cheese produced from goat's milk has a characteristic smell and taste, which is not very well accepted by some consumers due to the lack of daily consumption and even the culture itself.

With regard to overall acceptance, the seasoning treatments with oregano and basil were given scores between 7.64 and 8.06, which on the hedonic scale are scores between "I liked it moderately" and "I liked it very much," which can be considered an excellent result (Table 2). This indicates that the condiments are able to give the cheese different characteristics in terms of

taste and specific smell, favoring acceptance by people who are not used to eating it.

Lower values were found in treatments T3, T4, and T5. Scores ranged from 7.05 to 7.15, which on the hedonic scale refers to "I liked it moderately," showing a good result. This may be due to the low acceptance of goat's milk products, the spicy taste of the pepper, and the fact that the peppers used did not diversify the characteristics of the goat's rennet cheese.

The cheese seasoned with oregano (T1) was the best accepted, which can be attributed to its frequent use in cooking. On the contrary, the cheese seasoned with basil was less accepted than the previous one, which may be due to the fact that it is not commonly used and is not very widespread.

The cheese seasoned with Calabrian pepper had a lower score than the others and a higher score than the one with black pepper, which could be due to the fact that not everyone likes pepper, as it was in large pieces, making the spicy flavor more evident. The cheese seasoned with black pepper had the lowest score, as the black pepper did not change any of the characteristics compared to the cheese without seasoning, which may be due to the fact that the concentration of 0.5% was insufficient to favor the spicy characteristic.

In the evaluation of the intention to buy the frozen goat's milk seasoned rennet cheese, it was observed that treatment 1 was the cheese with the best acceptance (Table 3). The majority of those interviewed, around 78.89%, said they would buy it, and consequently, the lowest percentage (6.67%) said they would not buy it. The least acceptable cheese was treatment 4, with 37.78% saying they would buy it and 24.44% saying they would not buy it. This result is consistent with those obtained in the sensory tests.

Table 1. Physico-chemical characteristics of spiced rennet cheese made from frozen goat's milk.

| Variable (%) | Treatment | | | | | SEM | P-value |
|--------------------|-----------|--------|--------|--------|--------|-------|---------|
| | 1 | 2 | 3 | 4 | 5 | | |
| Total dry extract | 65.45 | 64.69 | 64.07 | 65.43 | 65.09 | 1.043 | 0.5647 |
| Moisture | 34.55 | 35.31 | 35.93 | 34.57 | 34.91 | 1.638 | 0.8769 |
| Fat | 22.47ab | 23.13a | 20.30c | 22.52 | 23.09a | 0.330 | 0.0345 |
| Fat in dry extract | 34.32a | 35.74a | 31.66b | 34.40a | 35.48a | 1.270 | 0.0487 |

Averages followed by different letters on the same line differ by the Tukey's test at 5% probability; SEM: standard error means; T1: oregano; T2: basil; T3: no seasoning; T4: black pepper; T5: Calabrian pepper.

Table 2. Mean values of the evaluation scores obtained for the various sensory attributes of spiced rennet cheese produced from frozen goat's milk.

| Attributes | Treatment | | | | | SEM | P-value |
|-------------------|-----------|--------|--------|-------|-------------------|------|---------|
| | 1 | 2 | 3 | 4 | 5 | | |
| Appearance | 7.93a | 7.64a | 7.90a | 7.70a | 7.50a | 1.06 | 0.567 |
| Color | 7.95a | 7.61a | 7.91a | 7.62a | 7.58a | 1.10 | 0.586 |
| Aroma | 8.02a | 7.68a | 7.01b | 6.94b | 6.87b | 1.82 | 0.034 |
| Flavor | 7.97a | 7.41ab | 6.90bc | 6.57c | 6.87bc | 1.78 | 0.0243 |
| Texture | 7.90a | 7.64a | 7.47a | 7.44a | 7.37 ^a | 1.08 | 0.789 |
| Global acceptance | 8.06a | 7.64ab | 7.07b | 7.05b | 7.15b | 2.01 | 0.0298 |

SEM: standard error means; means followed by different lowercase letters in the same row indicate significant differences according to the Ryan-Einot-Gabriel-Welsch test at a 5% significance level; T1: oregano; T2: basil; T3: no seasoning; T4: black pepper; T5: Calabrian pepper.

4 DISCUSSION

According to the results, the average values for moisture and fat in the total dry extract were in line with the Technical Regulation for the Identity and Quality of Rennet Cheeses (Brasil, 2001). These regulations establish moisture contents for rennet cheese ranging from 36 to 54.9% and fat in the total dry extract ranging from 35 to 60%, which classifies these samples as fatty cheese with high moisture content.

Souza et al. (2011) evaluated the physical-chemical characterization of goat's milk rennet cheese seasoned with cumaru (*Amburana cearensis* A.C.Smith) and observed that the moisture, fat, total dry extract, and fat in dry extract had averages of 46.49, 25.33, 53.51, and 47.53%, respectively. Alencar et al. (2020) observed a moisture content of 50.67% in seasoned

Table 3. Purchase intention (%) of spiced rennet cheese made from frozen goat's milk.

| Purchase intention (%) | Treatment | | | | |
|------------------------|-----------|-------|-------|-------|-------|
| | 1 | 2 | 3 | 4 | 5 |
| Would buy | 78.89 | 57.78 | 44.44 | 37.78 | 47.78 |
| Maybe yes/Maybe no | 14.44 | 34.44 | 31.11 | 37.78 | 30.00 |
| Would not buy | 6.67 | 7.78 | 24.44 | 24.44 | 22.22 |

T1: oregano; T2: basil; T3: no seasoning; T4: black pepper; T5: Calabrian pepper.

rennet-type goat's cheese. According to Lima et al.'s (2017) study, when carrying out the physicochemical characterization of goat's milk cheese type Coalho seasoned with cumaru, the moisture content of the cheese was 46.49% and the acidity was 0.09%, while in this study, the moisture content was 50.67% (Cheese A) and 46.36% (Cheese B), and the acidity was 0.056% (Cheese A) and 0.053% (Cheese B).

In Brazil, seasoning is responsible for improving the public's acceptance of goat's cheese, as it is used to minimize the characteristic taste and smell of goat's milk since there is no culture of regular consumption. In addition, according to Barbosa et al. (2012) and Praela-Pantano et al. (2009), oregano and pepper have antioxidant and bactericidal properties, thus helping to maintain the quality of the cheese and consequently enabling it to have a longer shelf life.

In addition, curd-cutting procedures, type of forming, and pressing time can also influence the products' ability to retain fat and moisture (Nassu et al., 2003). In an analysis comparing the sensory attributes of Coalho cheese seasoned with 2% oregano and Coalho cheese without added seasoning, Nascimento et al. (2004) found an average score of 8.06 for the cheese seasoned with oregano, with the hedonic term ranging from "I liked it very much" to "I liked it a lot." Souza et al. (2011) found that in the purchase intention test for goat's milk rennet cheese seasoned with cumaru, the majority (68%) of the tasters said they would buy the cheese under analysis, with only 6.7% of the tasters reporting that they would not buy the product.

5 CONCLUSION

Obtaining quality rennet cheese made from spiced frozen goat's milk is a good alternative for increasing the popularity of products from dairy goat farming.

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