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QUALITATIVE-COMPARATIVE RESEARCH OF IMPROVEMENT OF APERITIF CHEESE WITH ADDITION OF CURCUMIN

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Abstract

This study aims to assess the technological, organoleptic, and physicochemical quality of two dairy products, Aperitif Cheese and the same type of cheese with curcumin added, manufactured by a production unit in Romania. The research was conducted through a comprehensive evaluation of milk collection, processing, and cheese production techniques. Standard analytical methods were applied to determine moisture, fat, protein, acidity, and salt content. Sensory evaluations provided insights into consumer acceptability. The results highlighted significant differences between the two products in terms of texture, composition, and microbial safety. Aperitif Cheese exhibited a firm consistency due to its thermal processing and lower moisture levels. The addition of curcumin improved organoleptic properties and shelf life, due to its specific colour and antibacterial and antifungal properties. The study confirms the high quality of both products, aligning with national and European dairy standards. These findings support the importance of optimizing production methods to enhance product quality and consumer satisfaction.

Key words*: cheese processing, curcumin, dairy products, organoleptic analysis, physicochemical analysis.*

INTRODUCTION

Milk production holds a significant position in the economy of animal-derived products, ranking second after meat in terms of economic and nutritional importance. It is widely regarded as an affordable and highly valuable source of animal protein. The European Union is a leading producer of milk and dairy products, with Germany, France, Poland, the Netherlands, Italy, and Ireland contributing nearly 70% of total annual production, estimated at 155 million tons (Mihai et al., 2023). In countries with advanced livestock farming, milk production accounts for approximately 30-40% of the gross agricultural income (Malos & Malos, 2022). The consumption of milk and dairy products is considered an essential indicator of living standards, as these products play a crucial role in a balanced diet (Malos & Malos, 2011).

Milk and its derived products are highly nutritious, being fundamental in the diet of infants, pregnant and lactating women, as well as workers exposed to toxic environments (Malos & Malos, 2014). The proteins in milk are rich in essential amino acids, comparable in biological value to egg proteins (Malos & Malos, 2016). Furthermore, lactose contributes to the intestinal absorption of calcium, while milk lipids, due to their composition, provide easily digestible fats. In addition, milk is an important source of vitamins, including vitamins A, B2, B12, and D2, as well as minerals such as calcium and phosphorus, which play a crucial role in coagulation processes (Banu & Colab., 2005)

Given these attributes, milk processing aims to preserve its natural properties while converting it into various dairy products (Georgescu & Colab., 2000). Cheese, in particular, is a concentrated source of milk proteins and fats, enriched through biochemical and microbiological processes during its production and maturation.

Curcumin, the active compound in turmeric (*Curcuma longa*), has gained attention for its potential use in dairy products due to its natural coloring, antioxidant, and antimicrobial properties. When added to cheese, yogurt, or milk-based formulations, curcumin can enhance visual appeal with a rich yellow hue while also contributing to the inhibition of spoilage microorganisms and oxidation of fats,

which may modestly improve shelf life and nutritional value.

The present study aims to evaluate the technological, organoleptic, and physicochemical quality of Aperitif Cheese, with and without addition of curcumin, produced by a production unit in Romania.

MATERIALS AND METHODS

This study was conducted at a dairy processing company that specializes in the collection, processing, and commercialization of milk and dairy products, producing a wide range of dairy products, including pasteurized milk, yogurt, sour cream, fresh cheese etc. The factory is equipped with modern processing lines for milk pasteurization, fermentation, cheese production, and packaging.

Two dairy products, Aperitif Cheese with and without addition of curcuma, were selected for analysis. The study focused on evaluating the entire technological process, from raw milk selection to the final maturation stage.

Raw milk was sourced from local farms and underwent rigorous quality control to ensure it met hygiene and compositional standards. The milk was standardized for fat content, pasteurized at 71±2°C for 30 seconds, and cooled to 34±2°C before further processing.

The pasteurized milk was inoculated with starter cultures and calcium chloride ($CaCl_2$) before the addition of rennet to induce coagulation. The coagulum was cut, drained, pressed, and subjected to a dual-stage salting process (wet and dry salting). The cheese was then left to mature for 20-25 days at 15±1°C before analysis.

Aperitif Cheese production involves a two-phase process: initial cheese curd production followed by thermal stretching. After coagulation and cutting, the curd underwent a brief fermentation period before being heated in water at 72-80°C, shaped into strands, and braided. The finished product was then salted and aged under controlled conditions.

A combination of sensory and physicochemical analyses was performed to assess the quality of the selected dairy products. A trained panel conducted an organoleptic assessment, evaluating characteristics such as appearance, texture, taste, aroma, and uniformity using a structured sensory scoring method.

Standard laboratory techniques were used to determine key compositional parameters. Moisture content was measured by drying samples in an oven at 105°C until a constant weight was achieved. Fat content was determined using the Gerber method.

Protein content was assessed by the Kjeldahl method to measure total nitrogen.

Acidity was expressed in degrees Thörner (°Th) to evaluate lactic acid concentration.

Salt content was measured using the Mohr titration method.

Samples were tested for microbial safety by assessing total aerobic mesophilic bacteria count, coliform bacteria, yeast, and mold presence using standard plating techniques.

All results were statistically analyzed using descriptive statistics and comparative methods to determine variations in product quality. The physicochemical results were compared with Romanian and European dairy standards to assess compliance and product consistency.

The findings from these analyses provide insights into the technological effectiveness, quality parameters, and market suitability of Aperitif Cheese, contributing to the broader understanding of dairy processing techniques and their impact on final product attributes.

Determination of Total Proteins (Total Nitrogen) by the Kjeldahl Method

The researched product undergoes mineralization by heating with concentrated sulfuric acid in the presence of a catalyst. During the decomposition of proteins and other nitrogen compounds, ammonium ions are released: $2H + (-NH_2) + e = NH_4$, which combine with sulfuric acid to form ammonium bisulfate (NH_4HSO_4). The ammonia released through strong alkalization is distilled, titrated, and expressed as nitrogen equivalent, which is then multiplied by the conversion factor and expressed as protein equivalent (Popa & Stănescu, 1995).

The nitrogen content of the analyzed sample is calculated using the following formula:

$$\text{Total Nitrogen } \% = \frac{0{,}0014(V - V_1)}{m} \times 4 \times 100,$$

where:

0.0014 = nitrogen amount (g) corresponding to 1 mL of 0.1N sulfuric acid solution;
V = volume of sulfuric acid used for titration in the sample;
V_1 = volume of sulfuric acid used for titration in the blank test;
m = sample mass (g).
By multiplying the total nitrogen percentage by 6.38, the protein content is obtained.

Determination of Crude Fat by the Soxhlet Method

The fat in the analyzed sample is extracted to exhaustion using organic solvents. After removing the extraction solvent, the fat is weighed and expressed as a percentage. To ensure complete extraction, the sample is subjected to moderate heating beforehand, which achieves dehydration and the destruction of the membrane or protein film of the microstructure in which the fat is embedded (Turtoi, 2002).
The fat content of the analyzed sample is calculated using the following formula:

Fat % == m/m_1 x 100,

where:
m = amount of extracted fat (g), determined by the weight of the flask after drying (brought to constant weight) minus the tare weight of the flask;
m1 = weight of the sample used in the analysis.

Determination of Water Content (Dry Matter)

Quantitatively, water is the main component of natural (unprocessed) animal-derived products (Popa & Stănescu, 1995).
In milk it can reach up to 88%. In processed products, the water content is much lower, sometimes representing only a few percent (dehydrated products) or even less than 1% (melted fats).
The determination of moisture is done for several purposes: Assessing nutritional value (the higher the water content, the lower the nutritional value); Assessing preservation power (the lower the water content, the better the preservation power); Verifying the extent to which the manufacturer has followed the official recipe (if a certain amount of water is allowed to be added); Detecting unauthorized additives; Calculating added substances, as in the case of semi-canned meat in cans.
The sample taken for analysis is exposed to a heat source until a constant weight is reached. The weight loss, calculated as a percentage, represents the water content. Depending on the nature of the heat source and equipment used, the method has several variants.
The moisture content of the sample is calculated using the following formula:

$$\text{Water \%} = \frac{m - m_1}{m_2} \times 100,$$

where:
m = tare of the flask + product before drying;
m1 = tare of the flask + product after drying;
m2 = amount of product taken for analysis, determined by subtracting the tare of the flask + product before drying - tare of the flask.
The result is considered acceptable when the moisture value calculated between the two parallel samples does not exceed 0.05% (for melted fats) or 0.5% (for meat and meat products). If these values are exceeded, the analysis must be repeated.
The described method is considered the most accurate (reference method) for animal-derived food products, so it should represent the standard method in state laboratories. In special situations, when the result must be known very quickly, drying at 125±2°C can be used, except for melted fats. However, drying temperatures above 127°C are not recommended for determining moisture in animal-derived food products.
Then, the content of dry matter is calculated as follows:

Dry Matter % = 100%−Water %

Determination of Sodium Chloride (Mohr Method)

Sodium chloride is added to food products to improve taste, increase preservation capacity, and in meat products, as an aiding agent in the maturation (tenderizing) of meat during the manufacturing process. In the aqueous extract obtained from the analyzed product, chloride ions are directly titrated with a silver nitrate solution in the presence of potassium chromate as an indicator, and the chloride content is

calculated and expressed in sodium chloride equivalent (Popa & Stănescu, 1995).
The total chloride content, expressed in sodium chloride equivalent %, is calculated using the following formula:

$$NaCl = \frac{0{,}00585 \times v \times 10}{m} \times 100,$$

where:
V = volume of 0.1N silver nitrate solution; 0.00585 = amount of sodium chloride (g) corresponding to 1 ml of 0.1N silver nitrate; 10 = ratio between the total volume of the aqueous extract (100 ml) and the volume of extract taken for analysis (10 ml);
m = mass of the sample (g) taken for analysis.

Acidity, as a freshness indicator, is determined only in fresh cow's cheese. The determination is performed using the Thörner method.
Acidity expressed in Thörner degrees (°T) is calculated using the formula:

°T = (V·10)/g,

where:
V = ml of 0.1N sodium hydroxide used for titration; g = grams of cheese taken for analysis.
Depending on the type, the maximum permissible acidity of cow's cheese (at delivery) is: 190°T for very fatty cheese; 200°T for fatty and semi-fat cheese; 210°T for low-fat cheese. In the commercial network, the acidity of fresh cow's cheese may be 10°T higher than the maximum permissible at delivery. For other types of cheese, acidity is not determined as a freshness indicator (Banu et al., 2005).

RESULTS AND DISCUSSIONS

The results obtained from physicochemical (Table 1), microbiological, and organoleptic analyses provided a comprehensive understanding of the quality attributes of Aperitif Cheese. Aperitif Cheese has a firm, elastic consistency due to the stretching and heating process during its production. The addition of curcumin only modifies the overall aspect, colour, taste and improves antibacterial and antifungal activity, offering it a better shelf-life. The fat content was within acceptable ranges, reaching 26-30%, confirming the expected nutritional richness (Sârbulescu et al., 1983).

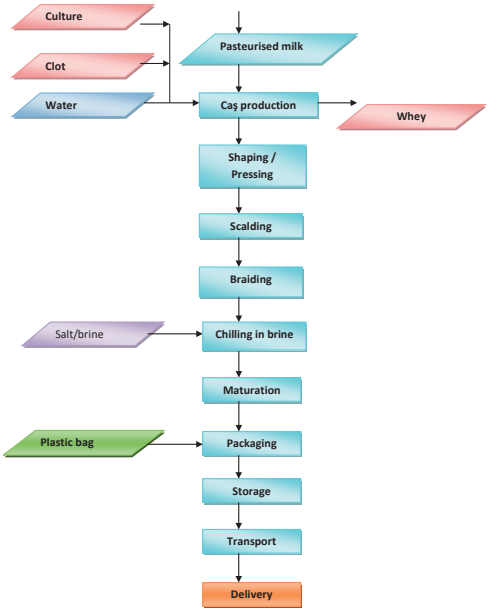

Figure 1. Technological flux for Aperitif Cheese

The protein content analysis revealed a concentration in our type of Cheese of 27-30%, which is attributed to the cheese curd maturation and processing method. Acidity levels were also analyzed, the Cheese having lower acidity (150-180°Th), which contributed to its mild and creamy taste. The salt content in Aperitif Cheese is 2-3%, due to it undergoing minimal direct salting (Figure 1), while in the sortiment with added curcumin, the salt percent goes down to 1%.

Table 1. Physicochemical properties of Aperitif Cheese

SPECIFICATION	Standard	Obtained results		
		$\bar{X} \pm s_X$	Minimum	Maximum
Acidity (°T)	**17**	16.20±0.37	15	17
Protein (%)	**30** (STAS 6355)	29.34±0.33	28.20	30.10
Fat (%)	**28**(STAS 6352/2)	25.94±0.11	25.49	26.13
Salt (%)	**Max 3%**(STAS 6344)	2.83±0.04	2.77	2.98

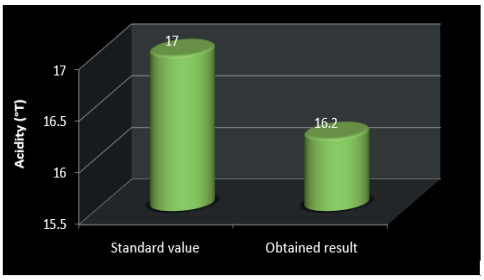

Figure 2. Acidity of the Aperitif Cheese

The acidity in the company standard is found with a value of 17°T. The results of the determinations obtained in the unit's laboratory ranged from a minimum of 15°T to a maximum of 17°T. The average of the determinations is 16.20±9.37, and a very small difference is observed compared to the standard value (Figure 2).

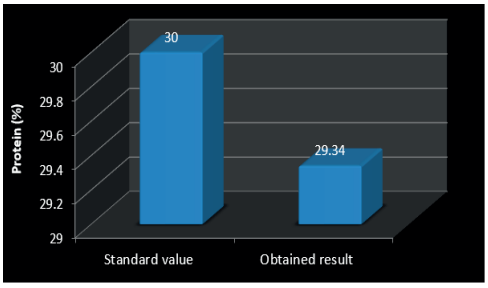

Figure 3. Protein content of the Aperitif Cheese

The total protein content of the finished cheese, in the company standard, has a value of 30%. The laboratory analysis results ranged from a minimum value of 28.20% to a maximum value of 30.10%. It can be observed that the average of the determinations was 29.34±0.33%, with a very small difference compared to the standard value (Figure 3).

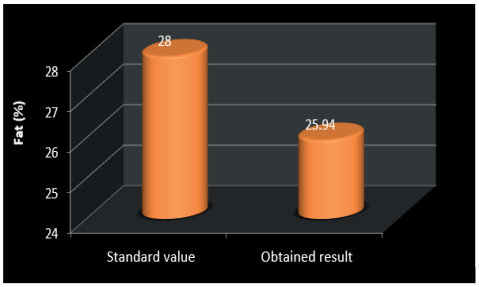

Figure 4. Fat content of the Aperitif Cheese

Fat - according to the company standard, the finished cheese must have a minimum fat content of 28%. Following the obtained results, it was found that the average of the determinations was 25.94±0.11% fat, with variation limits ranging from a minimum value of 25.49% to a maximum value of 26.13% (Figure 4). From the analysis of the graph, a significant difference is observed between the standard values and the average of the determinations obtained on the finished product, which can be explained either by the inconsistency of the raw material or by deficiencies in the coagulum processing (turning the coagulum).

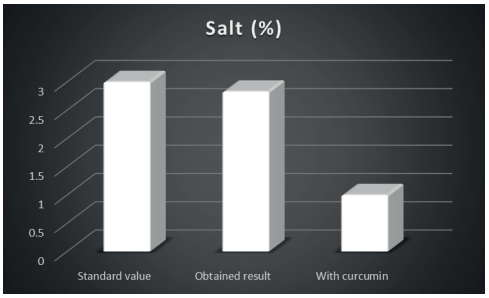

Figure 5. Salt content of the Aperitif Cheese

The organoleptic examination of the analyzed cheeses involves the evaluation of the following characteristics: appearance, color, consistency, smell, and taste. All these indicators vary depending on the type, as it is almost impossible to present the organoleptic indicators for each variety individually.

Sensory analysis highlighted clear differences in appearance, taste, and texture between the two cheeses (Tables 2 and 3; Figure 6). The simple Aperitif Cheese displays a pale yellow hue with a firm, elastic structure. The Aperitif Cheese with added curcumin has its colour intensified and has a stronger aroma. Aperitif Cheese is mild and creamy, suitable for melting and culinary applications. The aroma of both cheeses was well-received, with the sortiment with added Curcumin having a more pronounced dairy scent and taste - a slightly nutty and buttery aroma from its thermal processing.

The results confirm that both products meet consumer expectations and industry standards, making them valuable options in the dairy

market. The slight differences in composition contribute to their qualities, offering consumers two choices based on texture, colour and taste preferences.

Table 2. Sensorial analysis of Aperitif Cheese

Aperitif Cheese	Exterior aspect	Taste	Smell	Colour	Consistency
Taster 1	4	5	4	5	5
Taster 2	5	5	4	4	4
Taster 3	5	4	5	4	5
Taster 4	5	4	5	4	5
Taster 5	4	4	4	4	4
Average	4.6	4.4	4.4	4.2	4.6

Table 3. Sensorial analysis of Aperitif Cheese with added curcumin

With added curcumin	Exterior aspect	Taste	Smell	Colour	Consistency
Taster 1	5	5	5	4	5
Taster 2	4	4	5	5	5
Taster 3	4	5	4	5	4
Taster 4	5	4	5	5	5
Taster 5	4	4	5	5	4
Average	4.4	4.4	4.8	4.8	4.6

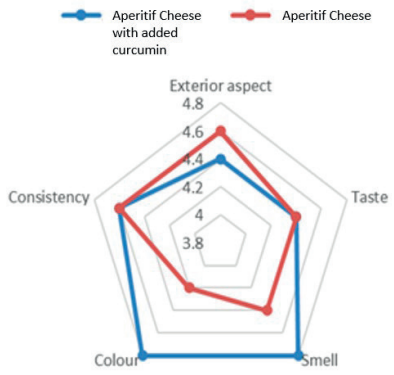

Figure 6. Comparative sensorial analysis between the two products

CONCLUSIONS

This study successfully evaluated the technological, physicochemical and sensory characteristics of Aperitif Cheese. The results indicate that both products, the standard and the improved recipe of the chosen cheese align with national and European dairy quality standards, ensuring safety and nutritional value. Aperitif Cheese, with its lower moisture content and firmer consistency, is suited for culinary applications requiring melting properties and has a pleasant aspect and taste in both cases.

Microbiological analyses confirmed the safety of both products, with no presence of harmful contaminants.

In conclusion, optimizing production techniques and ensuring strict quality control measures are essential for maintaining high product standards. The findings of this study contribute to the broader understanding of dairy processing and provide insights into improving cheese manufacturing practices. Future research should explore the impact of aging conditions and ingredient variations on product characteristics to further enhance consumer satisfaction and market competitiveness.

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