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PHYSICAL, CHEMICAL AND MICROBIOLOGICAL QUALITY IN ARTISANAL CHEESES SOLD IN FREE FAIRS

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Abstract: Artisanal cheese made without the minimum hygiene conditions can become a vehicle for pathogens, assuming a relevant position in public health issues, due to the risk of causing diseases such as hemorrhagic colitis, diarrhea and even meningitis. In this context, the objective was to evaluate the physical, chemical and microbiological quality of artisanal cheeses sold in street markets. A total of 9 samples of cheeses, 8 samples of artisanal cheeses named from A to H and an industrial production control cheese, all acquired in the city of Dourados / MS. After collection, the samples were taken to the laboratories of ``Universidade Federal de Grande Dourados`` for physical, chemical and microbiological analyses. According to the results obtained, with the exception of commercial cheese, none had labels on their packaging, nor official identification, therefore they were not in accordance with resolution n° 259/2002. As for the physical and chemical analyses, the pH values showed that there was no significant difference ($p < 0.05$) between the samples (A, B, C, F, H). For acidity, there was no significant difference with the control between samples (A and H). In the texture parameters, the hardness in the sample E, was the cheese that had greater softness (0.0093 ± 0.09 N)). Only 30% of the cheeses collected were in accordance with the microbiological attributes required by RDC, number: 12/2001. Therefore, there is a need to create awareness projects for stallholders who produce and handle cheese and there is a need for efficient supervision of the corresponding bodies.

Keywords: Artisanal cheese, Texture, *Escherichia coli*

INTRODUCTION OR MAIN SECTION TITLE [IF ANY]

Cheese is a food produced from milk, containing proteins of high biological value,

calcium, lipids, lactose and fat-soluble vitamins. There is a wide access by the consumer public, whose people come from all social levels and age groups. Its production is carried out mainly by small and medium-sized rural producers and represents an important activity in the regional economy (GOMES and DUARTE, 2015).

Among the products derived from milk, artisanal cheese, when made without the minimum hygiene conditions, can become a vehicle for pathogens, due to the manufacturing conditions. Therefore, due to the manufacturing conditions and its rich nutritional content, the product becomes an efficient vehicle of contaminants, assuming a position of relevance in public health issues, due to the risk of causing foodborne illnesses (SANTOS, 2019).

With regard to informal or artisanal cheeses, there are a series of problems related to quality, noting high levels of microbial contamination, generally attributed to excessive manipulation, lack of good practices, problems such as: lack of knowledge about the pasteurization process, high cases of mastitis, lack of hygiene during milking, inadequate facilities, lack of hygiene in the manufacturing process, in product storage, incorrect transportation and handling, exposure of the product during marketing, as well as high levels of humidity that favor the development of microorganisms undesirable, can be sources of contamination of the raw material or the final product, making it a potential cause of poisoning and/or food infections (GERMANO, 2015)

In terms of direct impact on producers, Article 6 of Law number: 13.860/2019, describes that the elaboration of artisanal cheeses from raw milk will be restricted to a cheese factory located in a certified rural establishment, free of tuberculosis and brucellosis, in accordance with the norms of the National Program for the Control

and Eradication of Brucellosis and Animal Tuberculosis (BRAZIL, 2019).

Resolution-RDC number: 259/2002 determines that packaged food labels must obligatorily present: Name of sale of the food; Ingredients list; Net contents; Origin identification; Name or corporate name; Batch identification; Expiration date; Instructions on food preparation and use, if applicable. In addition to this information, the package must show the stamp of the Agricultural Inspection and Inspection Department YES, SIE or SIF, so that it can then be sold (ANVISA, 2002).

According to the guidelines of Decree 9.918/2019 and Law number: 13.860/2019, producers who meet all the established requirements will be able to obtain the Art Seal that authorizes the commercialization of artisanal foods throughout the national territory, provided that they meet the sanitary requirements, manufacturing and good agricultural practices. Although the seal is federal, inspection of food quality will be the responsibility of state agencies (MÁXIMO and VILELA, 2019).

Artisanal cheese is generally produced with raw, unpasteurized milk, which sets it apart from other industrial cheeses. Pasteurization is a process that aims to eliminate the bacteria present there, however, it destroys and alters the good part of the flora and the characteristics of the dairy product (PODESTÀ, 2015). Because it is a perishable food product and that on many occasions it is produced and sold in inappropriate conditions, such as in street markets, there is concern about the quality of these cheeses, especially regarding the occurrence of foodborne diseases (FBD). Most DTA's are caused by bacteria, such as *Escherichia coli*, which can cause diseases such as hemorrhagic colitis, diarrhea and even meningitis (BRAZIL, 2022).

Among the problems related to cheese quality, the most relevant are high bacterial

counts and swelling. This is mainly caused by microorganisms from the coliform group that ferment lactose, producing acids, CO₂ and hydrogen, forming a large number of irregular and small holes, distributed throughout the product. Changes in taste and odor, bad structure of clots and slime in cheeses may also occur. Usually the defect occurs between the manufacturing process and the salting process, becoming noticeable at the end of pressing or during salting in brine. Among the bacteria of the coliform group, *Escherichia coli* is the most frequent cause of early swelling in cheeses (LEÃO, 2018).

According to legislation, cheeses must be inspected by a government agency at all stages, from the rural area where milk is obtained or homemade cheese is produced, to industries and places where they are exposed to consumption. It is believed that such surveys can contribute not only to alert state and municipal health authorities to the high potential risk that this problem can cause to consumers' health, but also to raise awareness of the need to immediately adopt measures that allow the effective inspection and/or supervision of these products (CINTRÃO, 2016).

Markets are popular public places where there is a group of people looking for variety of goods and price differentiation. With its rich cultural and biological diversity, in Brazil, street markets assume different functions and social and economic aspects. Its model is open-air retail, where foodstuffs are regularly offered on certain days of the week. Cheese is common among animal products sold in these places. It is a product that stands out among dairy products because it is rich in proteins and other nutrients (SILVA and COSTA, 2020).

MATERIAL AND METHODS

SAMPLE COLLECTION

The samples of artisanal fresh cheeses were purchased at open markets in the East and West regions of Dourados-MS, and were designated as A, B, C, D, E, F, G, H, with A and B collected at the fair (Praça of the fiftieth anniversary); C and D (BNH 1st level); E and F (Alvorada Park); G and H (W5 Izidro Pedroso), and control sample I (supermarket; to carry out the respective comparisons), totaling 9 samples collected.

The collected samples were kept in the original marketing packaging and packed in isothermal boxes containing ice and transported to the laboratories of `Universidade Federal de Grande Dourados` (UFGD), whose plastic packaging was sanitized with 70% alcohol, after which the cheeses were immediately removed from their respective packaging and subjected to physical, chemical and microbiological analyses.

PHYSICAL AND CHEMICAL ANALYSIS

The physical and chemical analyzes that were carried out are: pH; Acidity; Moisture; Water Activity, Fixed Mineral Residue and Texture – according to Normative Instruction number 68, of December 12, 2006, (BRAZIL, 2006). Color quantification was performed using a digital colorimeter, previously calibrated on a white surface according to pre-established standards and following the methodology of Basaglia et al., 2021, all analyzes were performed in triplicate.

TEXTURE ANALYSIS

The texture profile was determined through the compression test of the cylinders in the texture analyzer (Stable Micro Systems Texture

Analyzer, model TA-XT plus). The probe used for compression was the (P36R) and the dimensions of width, height and length of the analyzed cheeses were 3x3x3. The conditions used in this test were: test speed: 2.00 mm/second; distance: 10mm; time: 5 seconds and force: 0.04903 N (SANTOS et al., 2020).

MICROBIOLOGICAL ANALYZES

Microbiological analyzes were performed for total coliforms; Thermotolerant and *Escherichia coli*, according to Normative Instruction, number: 62, of August 26, 2003.

STATISTICAL ANALYSIS

The results obtained will be analyzed by analysis of variance (ANOVA), using the STATISTICA 10.0 software. Tukey's test will be used to compare means, with a significance level of 5%.

RESULTS AND DISCUSSIONS

According to the field research carried out, when acquiring the samples, some of the producers reported that they did not use heat treatment, that is, the cheeses were produced with in natura milk. The sale of these artisanal cheeses takes place at fairs once a week in different neighborhoods of the city of Dourados. Merchants claim that these cheeses are highly valued by consumers due to their unique flavor, odor and texture, as well as their affordable cost.

Table 1 presents the information from the samples acquired from artisanal fresh cheeses and industrial cheese (control).

In Table 1, it is observed that none of the samples acquired presented adequate information or minimum specifications about the commercialized product in their packaging, such as: logo, production date, product validity, conservation method, etc., in such a way to ensure its proper consumption. Therefore, an inspection by the municipal

Notes	Handmade	Industrial	Notes
Place of production	Sites/farms in the region of Dourados-MS	Dairy factory- Dairy, Dourados-MS	Place of production
Seal of inspection	There was not.	SIE/MS	Seal of inspection
Cheese display	No refrigeration, at room temperature	Refrigerated in cold chamber	Cheese display
Package	Low density polyethylene, knotted closed	Nylon Poli and vacuum sealed	Package
Label	No labeling of any kind	It had a printout of the description on its packaging as required by law.	Label

Table 1- Artisan and industrial fresh cheese commercialization

Samples	pH	Acidity%	Moisture %	Aw	Ashes %
A	7,09 ± 0,04 ^e	0,69 ± 0,04 ^e	56,91 ± 0,57 ^a	0,97 ± 0,00 ^{bc}	3,29 ± 0,06 ^e
B	6,38 ± 0,21 ^{bc}	0,76 ± 0,06 ^c	49,57 ± 0,98 ^c	0,97 ± 0,00 ^{cd}	3,16 ± 0,04 ^e
C	6,38 ± 0,06 ^{bc}	0,39 ± 0,04 ^c	45,94 ± 0,67 ^d	0,97 ± 0,00 ^{ef}	3,27 ± 0,08 ^e
D	5,41 ± 0,04 ^d	1,88 ± 0,06 ^c	51,53 ± 0,40 ^b	0,97 ± 0,00 ^{de}	3,61 ± 0,05 ^c
E	5,58 ± 0,03 ^d	1,30 ± 0,06 ^b	51,63 ± 0,59 ^b	0,96 ± 0,00 ^f	3,64 ± 0,04 ^b
F	6,39 ± 0,03 ^b	0,75 ± 0,05 ^c	42,54 ± 0,35 ^e	0,98 ± 0,00 ^a	3,29 ± 0,05 ^b
G	5,88 ± 0,30 ^{cd}	0,59 ± 0,05 ^d	49,55 ± 0,31 ^c	0,98 ± 0,00 ^{ab}	3,23 ± 0,02 ^a
H	6,48 ± 0,06 ^b	0,35 ± 0,00 ^e	58,00 ± 0,79 ^c	0,99 ± 0,00 ^{cd}	3,52 ± 0,07 ^d
I	6,63 ± 0,38 ^{ab}	0,29 ± 0,01 ^e	50,53 ± 0,64 ^{bc}	0,98 ± 0,00 ^a	3,08 ± 0,01 ^e

Table 2- Results of the physical and chemical analyzes (g/100g) of 9 fresh cheeses

*[A a H] Different artisanal fresh cheeses sold at fairs in Dourados-MS;

*[I] Control; *Average of three repetitions ± coefficient of variation in %; * a, b, c, d, e, f, g, h Distinct superscript lowercase letters in the same column indicate a significant difference (p < 0.05) between fresh cheeses according to Tukey's test



Figure 1- Packaging of industrial cheese and artisanal cheese respectively.

A and B) Package with the control fresh cheese label; C) Packaging of artisanal fresh cheese.

Source: the own author.

bodies is important, with the aim of inspecting and supervising it from a hygienic-sanitary and technological point of view. Altogether, during the research, eight (8) artisanal cheeses were collected. Likewise, it was observed that these cheese samples did not have stamps from the State, Municipal or Federal Inspection service. The control sample (I) had the SIE/MS seal, in accordance with the recommendations of the Legislation. According to Silva (2021), the role of inspection bodies is to offer safety to the consumer, avoiding the transmission of foodborne illnesses and avoiding putting public health at risk. Therefore, to guarantee the safety of the product (purchased cheese), even so, the cheeses must have permission and contain the sanitary inspection stamp or seal of some bodies, such as: YES (Municipal Inspection Service); SIE (State Inspection Service) and SIF (Federal Inspection Service). Every product of animal origin for its safe commercialization must be registered in one of the MAAPA bodies (MOTA and CARNEIRO, 2019). According to Law number: 13.680/2019, it determines that the use of fresh or raw milk for the production of artisanal cheeses is limited to cheese dairies located in rural establishments, whose herds have undergone an inspection and are free of tuberculosis and brucellosis, the producers who meet the hygiene requirements can request the Artistic Seal after registering the company in the SIM, SIE or SIF (BRAZIL, 2019), it is believed that it is important that cheese producers can adhere to this law in such a way that the cheese is more valued and can be consumed without endangering the consumer's health.

The eight (8) samples of artisanal cheeses analyzed were produced in rural areas, farms or farms close to the municipality of Dourados. None of the samples surveyed had any type of label on their packaging, nor identification or origin, nor official Art Seal, therefore, this leads

to the understanding that whoever sells and/or produces is subject to penalties according to law number: 13.680/2019, as endangers the health of the consumer, because in the event of an outbreak or transmission of disease, there is no person responsible for the product (BRAZIL, 2019). According to Ferreira (2021), having the seal on cheese demonstrates to the consumer that in that product, there is quality, safety and effectiveness in the production processes. Thus, in order to decide on the legality of selling these cheeses without the seals, the municipality has the responsibility of informing producers about compliance with regulations, so that they can market in a legal manner and in accordance with the legislation.

Figure 1 shows the image of industrial cheese and artisanal cheese with their respective marketing packages.

Figure 1 clearly shows that in the control cheese (I), the packaging label had a clear imprint of the logo, company data, manufacturing date, validity of that specific batch, nutritional information table, consumption guidance after opening, list of ingredients, origin of the product, expiry date, batch and storage method. According to Resolution, number: 259/2002, the product label must contain the day and month of validity for products that have an expiration date of less than three months or the month and year for products that have an expiration date of more than three months, as established by the legislation guidelines (BRAZIL, 2002). In the control sample (I), the package casing was of the Poly Nylon type and vacuum sealed, this type of material has high resistance to mechanical damage and deformation, which increases the efficiency for cheese conservation, in such a way that the sensorial characteristics of the products are preserved. According to Sarantopoulos et al. (2017), food packaging must act as a barrier to water vapor,

oxygen, odors, among others.

In the samples acquired at fairs (artisanal cheese, packaging, were not in accordance with Resolution, number: 259/2002, the cheeses were packaged in common plastic bags (low density polyethylene). This type of polymer is not the most suitable for keeping a product for prolonged periods, due to its low mechanical resistance and density (very thin, with a lower cost), which could easily cause perforation of the packaging and contaminate the product, accelerating the degradation or contamination process, in addition, it did not have a good closing or sealing to maintain the harmlessness of these cheeses, they were only closed with a knot. (BRAZIL,2002).

Likewise, the ``Open Fairs`` in the Municipality of Dourados-MS are planned and organized by the competent body of the City Hall through the registration of the stallholders. Contemplated merchants must go to the Citizen's Center and obtain the merchant license. Law number: 4.380/2019 provides for the regulations of free fairs in the municipality of Dourados, says that products of animal origin must be packaged, labeled and inspected, the sale of products without inspection (SIM, SIE and SIF) is prohibited. The law also says that products of animal origin must be packed in isothermal boxes containing ice in sufficient quantity, freezers or cold chambers. (BRAZIL,2019).

The fairs that take place in the East and West regions of the municipality of Dourados are regulated by the city hall, therefore, law number: 4.380/2019 is not complied with or applied, since all the cheeses purchased at these fairs did not contain an inspection seal and were not stored in refrigerated environments. This way, in addition to failing to comply with the legislation, the municipal law is also infringed. All cheeses purchased at fairs were kept at room temperature for long periods, which facilitates the proliferation

of microorganisms. Since the Ministry of Agriculture says that fresh cheese must be kept at a temperature not exceeding 12° C. The municipal law says that in case of non-compliance, a fine in the amount of 17 Sul (UFERMS), as well as seizing any and all suspicious goods, but in practice this does not occur (BRAZIL, 2019).

Law number 4.380/2019 also states that inspection of the products offered is carried out by authorized employees identified by the Municipal Family Agriculture Department, Posture Inspectors, Health Surveillance, PROCON and Municipal Guard Agents. In practice, these responsible bodies do not efficiently supervise the fairs and the stallholders are free to break the law and constantly sell fresh cheese without a seal and without adequate packaging. (BRAZIL,2019).

Table 2 presents the values of pH, titratable acidity expressed as % lactic acid, % moisture, water activity (A_w) and fixed mineral residue (% ash).

The pH values found in this research (Table 2) show that there was no significant difference ($p < 0.05$) in relation to the control between samples A, B, C, F, H, although there was a significant difference ($p < 0.05$) with samples D, E, G with the control sample (I) whose values were between 5.41 ± 0.04 (sample D) and 7.09 ± 0.05 (sample A). It is important to emphasize that cheeses with higher pH values have a shorter shelf life, since a pH closer to neutrality favors the multiplication of microorganisms. The data found are very similar to those found by Luz et al. (2022), when researching Minas fresh cheeses produced in the Presidente Prudente region, obtained values of (5.78 - 6.41); Likewise, Da Silva (2022) obtained similar values for artisanal fresh cheeses produced by dairy products in the Midwest of São Paulo. It can be seen that sample D had the lowest pH value (5.41 ± 0.04) and, consequently, the

highest titratable acidity value (1.88 ± 0.06), it is believed that it may have been caused by the use of raw milk of low hygienic sanitary quality, in which the presence of acidifying bacteria, were responsible for the low pH (MAGRI, 2015).

The high acidity found in sample (A) may also be due to the influence of the high temperature at which the cheese was exposed, the lack of temperature control during the commercialization period can lead the product to start the deterioration process, this way it occurs the increase in acidity (FERREIRA, 2018). Sample (A) showed a high pH value (7.09 ± 0.21), a very high pH value indicates that milked cows could have inflamed mammary glands (Mastitis). Embrapa (2021) says that a pH of 7.3 to 7.9 may be an indication of bovine mastitis. Other factors that can raise the pH of the cheese is the production of lactic acid from the degradation of lactose by undesirable microorganisms (BRAZIL, 2021). It can be seen that sample I (control) had a pH value (6.63 ± 0.38) and acidity (0.29 ± 0.01). Queijos Brasil (2015), stated that the pH of fresh cheese must be 5.8 – 6.4, this value was similar to the pH of the control cheese (I). Lima and Leal (2017) when they evaluated the quality of artisanal cheeses sold in Castro-PR and found pH values of 6.01 - 7.85. The values found are close to the values found in cheeses from samples A, B, C, F, H and I analyzed in the present work, which ranged from 6.38 to 7.09.

For acidity, there was no significant difference ($p < 0.05$) with the control between samples (A and H) the other samples showed a significant difference ($p < 0.05$) with the control (I). The legislation does not establish parameters for acidity and pH. This way, the acidity and pH of the cheese are evaluated and compared using data found in the literature. Dias et al. (2016), evaluated the physical and chemical characteristics of artisanal and

industrial fresh cheese, the values found for industrial cheeses that underwent inspection were 0.10 to 0.68 acidity and $\text{pH} = 4.3 - 6.7$. The values found in the literature are close to the pH and acidity found for the control cheese (I) of the present work.

Of the nine samples analyzed, the water activity ranged from 0.96 to 0.99, these values are very similar to those found by Souza et al. (2017), who obtained A_w 0,96, they emphasize that the A_w above 0.91 is a minimum value for the multiplication of bacteria, this is favored by the availability of water, and free water is necessary for the metabolism of microorganisms.

According to Normative Instruction, number: 30/2001, fresh cheese can be classified as medium moisture: 36 - 46%; High humidity: 46.0 - 54.9% and very high humidity: not less than 55.0%. The legislation does not establish parameters for water activity (BRAZIL, 2001).

Moisture content ranged from $42.54 \pm 0.35\%$ (sample F) to $58 \pm 0.79\%$ (sample H). Values similar to those found by Lima and Leal (2017), (49.94% - 43.69%) when they analyzed the moisture content of artisanal cheeses sold in Castro, Paraná. According to Neves et al. (2021), variations in moisture content in cheeses may be related to production processes, as they are artisanal and do not have a specific production standard, even though this may be due to the amount and type of salting used, as well as the light pressing given to some cheeses. High moisture values are favorable for the growth of deteriorating microorganisms. According to Santos et al. (2019), the higher the moisture content of a cheese, the faster proteolysis will occur, resulting in changes in the consistency and flavor of the cheese.

Filho et al. (2015) evaluated the physical-chemical parameters of artisanal fresh cheese produced in Calçado-PE and found moisture values of 44.7% - 53.4%, these values differ

from the values found in the present study whose humidity was between 42, 54% - 58%. Lima and Leal (2017), evaluated the quality parameters of artisanal cheeses sold in Castro-PR and found water activity values of 0.95% - 0.98%, values very close to those found in the present study, which were 0.96% - 0.99%. According to Podesta (2015), the moisture content of cheeses influences the texture and flavor of the product, being difficult to control when it comes to artisanal manufacturing. One of the steps that can influence the moisture content is the pressing time, which, as it is an artisanal production, differ a lot between producers, as well as the salt content, which directly reflects on the moisture content.

According to Table 2, the ash values found in this research ranged from $3.08 \pm 0.01\%$ to $3.64 \pm 0.04\%$. As can be seen, there was no significant difference ($p < 0.05$) in relation to the control sample (I) with samples A, B and C. According to Oliveira et al. (2018), ash in cheese is represented by saline substances and mineral materials present in milk and/or added during cheese manufacturing. The salt added during salting represents a large proportion of the ash and, as the amount and form of addition differ from producer to producer, it contributes to the differences in ash content found. As shown by Brandão (2022), when he evaluated the physical-chemical parameters of artisanal fresh-type cheeses from the cities of Cana Brava, São Bernardo and Magalhães de Almeida-MA, he found ash values of (2.78% to 4.80 %), the same states that the cheese mass constitutes a whole, where calcium forms the structure, playing the role of a binding element.

Table 3 presents the values of the parameters (L^* , a^* , b^*) in the different samples of fresh cheese.

As can be seen in Table 3, regarding the L^* parameter, there was no significant difference ($p < 0.5$) between the sample (A), but there

was a significant difference ($p < 0.05$) with the samples (B, C, D, E, F, G, H) when compared to the control sample (I). According to Lemos et al. (2019), the L^* parameter indicates luminosity and indicates the ability of an object to reflect light, that is, the higher the L^* value, the whiter the food. Thus, cheese A had a value of $L = 90.36 \pm 1.52$, and the control sample (I) had $L = 92.18 \pm 1.04$. These two samples showed greater luminosity with a tendency towards whiter. Color is a parameter that indicates product quality and directly influences consumer acceptance (MARCA et al., 2022; SANTOS et al., 2016; FITZTUM, 2022).

Costa (2021), developing fresh cheese, found luminosity values of ($L^* = 90.77$ to $L^* = 92.95$). These values were close to the values found in the present research with fresh cheeses in the city of Dourados.

As for the a^* parameter, it is noted that there was no significant difference ($p < 0.05$) between sample L (control) and samples E, B, D. The other samples showed a significant difference ($p < 0.05$) with the control sample (I). The values of the a^* parameter ranged from -1.37 ± 0.08 to -1.75 ± 0.07). According to Costa (2021), the lower the value of a^* , the greater the intensity of green in the sample, the parameter a^* being negative in all samples demonstrates the white color that is characteristic of fresh cheeses, as found by Andrade et al. (2015), when evaluating artisanal fresh cheeses, found values for $a^* = -1.47$ to -1.84) values similar to those found in the present study.

Through Table 3, it can be seen that for the parameter b^* , the samples (G, H) had no significant difference ($p < 0.05$) when compared with the control sample (I), it can be noted that with the other samples there was a significant difference ($p < 0.05$). The greater the value of b^* , the greater the intensity of the yellow color. The tendency to yellowness may be due to the high fat content in the milk, as

the producers do not skim the milk.

The highest b^* value was found in sample F (21.73 ± 0.60) and the lowest value was found in sample C (15.67 ± 0.36), which tended to be closer to a lighter color, slightly yellowish, such as Normative Instruction, number: 30/2001 says that fresh cheese must be white and slightly yellow. Andrade et al. (2015) evaluated artisanal fresh cheeses and found values of $b^* = 18.54$ to 23.98 , values within the range found in the present research.

The texture is fundamental in the quality of the product and can be decisive in its acceptability by the consumer. Table 4 presents the parameters found in the instrumental analysis of the texture profile in the fresh cheese samples.

As it can be seen in Table 4, all the cheeses evaluated for hardness did not show a significant difference ($p < 0.05$) by the Tukey test. The control sample (I) obtained a hardness of 0.1527 ± 0.12 N. Normative instruction nº 30/2001 says that fresh cheese must have a compact and soft texture, but it does not bring the values for standardization). Sample E had a hardness value of (0.0093 ± 0.09 N), so we can say that it was the very soft cheese evaluated. This fact of the softness of fresh cheeses may be due to the fact that during storage the network of casein weakens and increases proteolysis caused by residual coagulant in the cheese, resulting in a less firm texture. Andrade et al. (2015), found values of (26.63 to 56.24 N) for hardness in fresh cheeses in the city of Mossoro-RN.

As for the cutoff force = 0.1093 ± 0.11 , it is observed that there was no significant difference ($p < 0.05$) for all samples compared to the control sample (I). According to Gomes et al. (2015), when evaluating Minas fresh cheese with soy derivatives, found cut-off values from 0.1927 to 0.1998 N. According to Table 3, regarding the parameter elasticity and adhesiveness, there was no significant

difference ($p < 0.05$) in the samples when compared to the control sample, the elasticity of sample I was (0.8917 ± 0.00 N) and the adhesiveness (-5.753 ± 4.18). Andrade et al. (2015), found elasticity values (0.79 to 0.89 N), these values were close to those found for elasticity in the present research that were in the range (0.8217 ± 0.12 to 0.9047 ± 0.01 N). Fitztum (2022), found values for adhesiveness from -0.17 to -0.03 N.

Cohesiveness is a texture mechanical attribute relating to the extent to which a material can be deformed before failure. Note that there was no significant difference ($p < 0.05$) with the samples (A, C, E, F, G, H) when compared to the control sample (I = commercial fresh cheese), and with the samples (B and D) differ significantly ($p < 0.05$) with the control sample (I). The results found for cohesiveness ranged from 0.8023 ± 0.01 to 0.6527 ± 0.05 N. These values differ from those found by Gomes et al. (2015), whose cohesiveness values found by them were 0.49 to 0.65 N. Luz et al. (2022), found cohesiveness values (0.51 to 0.55 N) and Silva (2022) found values of 0.34 to 0.13 N. Through the analyzes carried out for chewability, it was verified that there was no significant difference ($p < 0.05$) between the samples compared to the control sample (I). Sample I showed the highest resistance to chewing (0.1053 ± 0.09) and sample E the lowest resistance (-0.0057 ± 0.06). These values differ from those found by Andrade et al. (2015) who found (14.85 to 31.68 N). Luz et al. (2022), found a value of (591.45 N) for chewiness in fresh artisanal cheeses, as well as Fitztum (2022), found values of (6.83 to 32.02 N).

Table 5 shows the results found in the microbiological analyzes of samples of fresh cheese purchased.

In Table 5 it is noticed that for total and thermotolerant coliforms the samples (C, H) had no significant difference ($p < 0.05$)

Cheeses	L*	a*	b*
A	90,36±1,52 ^a	-1,42±0,04 ^a	19,39±0,27 ^b
B	86,49±0,40 ^b	-1,73±0,17 ^{bc}	19,85±0,24 ^b
C	86,36±0,42 ^b	-1,37±0,08 ^a	15,67±0,36 ^c
D	83,06±0,54 ^c	-1,73±0,09 ^{bc}	19,53±0,19 ^b
E	85,55±0,28 ^{bc}	-1,68±0,02 ^{bc}	19,50±0,50 ^b
F	84,85±0,67 ^{bc}	-1,51±0,13 ^{abc}	21,73±0,60 ^a
G	86,10±0,95 ^b	-1,56±0,04 ^{abc}	16,30±0,49 ^c
H	85,65±1,44 ^{bc}	-1,49±0,04 ^{ab}	16,30±0,31 ^c
I	92,18±1,04 ^a	-1,75,±0,07 ^c	17,93±1,80 ^b

Table 3- Parameter values (L*, a*, b*) in artisanal cheese samples

*[A a H] Different artisanal fresh cheeses sold at fairs in Dourados-MS;

*[I] Control; *Average of three repetitions ± coefficient of variation in %.; * a, b, c, d, e, f, g, h Distinct superscript lowercase letters in the same column indicate a significant difference (p < 0.05) between those of fresh cheeses according to Tukey's test.

Samples	Hardness (N)	Cut (N)	Adhesiveness (N)	Elasticity (N)	Cohesion (N)	Chewability (N)
A	0,0443±0,03 ^a	0,0297±0,00 ^a	-3,027±1,58 ^a	0,8893±0,02 ^a	0,8023±0,01 ^a	0,0313±0,02 ^a
B	0,0560±0,03 ^a	0,0370±0,01 ^a	-4,178±2,07 ^a	0,8807±0,01 ^a	0,7377±0,03 ^{ab}	0,0367±0,02 ^a
C	0,0447±0,02 ^a	0,0273±0,00 ^a	-1,921±1,52 ^a	0,8217±0,12 ^a	0,7990±0,05 ^a	0,0280±0,01 ^a
D	0,0257±0,00 ^a	0,0280±0,00 ^a	-16,907±10,10 ^a	0,8440±0,01 ^a	0,6527±0,05 ^b	0,0143±0,00 ^a
E	0,0093±0,09 ^a	0,0040±0,05 ^a	-49,807±59,49 ^a	0,8617±0,02 ^a	0,7627±0,04 ^a	0,0057±0,06 ^a
F	0,0373±0,02 ^a	0,0263±0,00 ^a	-5,501±5,00 ^a	0,8853±0,01 ^a	0,7767±0,04 ^a	0,0253±0,01 ^a
G	0,0507±0,02 ^a	0,0273±0,01 ^a	-18,478±26,60 ^a	0,8913±0,01 ^a	0,8007±0,01 ^a	0,0360±0,01 ^a
H	0,0250±0,01 ^a	0,0483±0,03 ^a	-6,146±5,41 ^a	0,9047±0,01 ^a	0,7963±0,02 ^a	0,0180±0,00 ^a
I	0,1527±0,12 ^a	0,1093±0,11 ^a	-5,753±4,18 ^a	0,8917±0,00 ^a	0,7723±0,04 ^a	0,1053±0,09 ^a

4- Texture parameters found in artisanal fresh cheese samples

*[A a H] Samples of artisanal fresh cheese sold at fairs in Dourados-MS; *[L] Control;

*Average of three repetitions ± coefficient of variation in %.; * a, b, c, d, e, f, g, h Distinct superscript lowercase letters in the same column indicate a significant difference (p < 0.05) between fresh cheeses according to Tukey's test.

Cheeses	Thermotolerant coliforms (NMP/g)	Differentiation of <i>E. Coli</i>	Total coliforms (NMP/g)
A	1,1x10 ^{3b}	Presence	>1,1x 10 ^{3b}
B	1,1x 10 ^{3b}	Presence	>1,1x10 ^{3b}
C	3x10 ^a	-	2,4x10 ^{3a}
D	1,1x 10 ^{3b}	Presence	>1,1x10 ^{3b}
E	>1,1x10 ^{3b,c}	Presence	>1,1x10 ^{3b}
F	1,1x10 ^{3b}	Presence	>1,1x10 ^{3b}
G	1,1x10 ^{3b}	Presence	1,1x10 ^{3c}
H	85,65±1,44 ^{bc}	-1,49±0,04 ^{ab}	16,30±0,31 ^c
I	92,18±1,04 ^a	-1,75,±0,07 ^c	17,93±1,80 ^b

Table 5- Results of the microbiological evaluation of fresh cheeses

*[A a H] Samples of artisanal fresh cheese sold at fairs in Dourados-MS; *[I] Control. *Average of three repetitions ± coefficient of variation in %.; * a, b, c Distinct superscript lowercase letters in the same column indicate a significant difference ($p < 0.05$) between fresh cheeses according to Tukey's test.

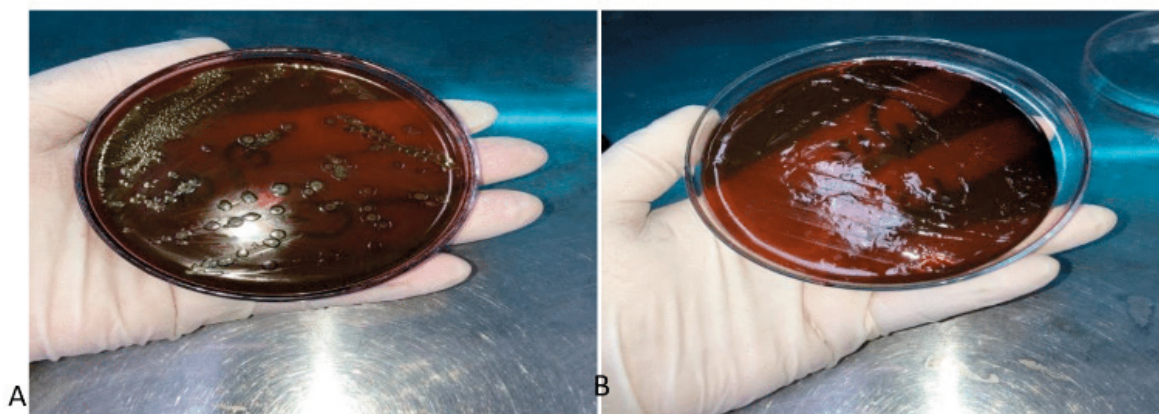


Figure 2- Cultures on plates for differentiation of *Escherichia Coli*

A) Positive plate B) Negative plate for *Escherichia Coli*.

Source: the own author.

regarding the control sample, the other samples differed significantly with the control sample (I). Souza et al. (2017), analyzing fresh cheeses in ``Zona da Mata Mineira``, observed that 20 samples exceeded the maximum limit recommended by current legislation. Likewise, Benincá et al. (2022), found results that indicated that 90% of colonial cheese samples did not meet the standard of Brazilian legislation.

According to Podesta (2017), *Escherichia coli* is the dominant species of thermotolerant coliforms and is considered the best indicator of fecal contamination. According to the microbiological standard established by RDC, number: 12/2001, it states that the maximum limit of total and thermotolerant coliforms is 5×10^2 nmp/g. Therefore, the samples that were within the standard required by the legislation were the samples (C, H, I) the others were above the recommended value.

Figure 2 shows plates with streaked cultures for the differentiation of *E. Coli*. It is considered positive if the culture shows a metallic green glow.

Of the nine samples acquired and analyzed as shown in Table 5, the samples (C, H, I) did not show the presence of *E. Coli*, the other samples confirmed the presence of this enterobacteria.

In view of this, the potential risk that the consumption of these cheeses can entail for public health is evident. The high count of total and thermotolerant coliforms indicate a deficiency in the hygienic-sanitary quality of the cheeses. Several factors may have contributed to this fact, it is believed that the presence of microorganisms may have contributed to inadequate milking, poor hygiene of the animal's teats before the milking procedure, lack of equipment hygiene, inadequate milk storage and lack of Good Manufacturing Practice. Sobral et al. (2017) when evaluating industrial and

artisanal cheeses and in the survey of total coliforms, it was observed that all samples (100%) of industrialized and artisanal cheese disagreed with the standards established by legislation. In the study carried out by Silva (2016), the presence of thermotolerant coliforms was observed in 60% of the analyzed samples, these percentages were close to those found in this study, with 70% being outside the recommended standard and 30% in compliance with the norms. of the legislation.

Although in Brazil it is considered illegal to sell artisanal cheeses without seals and inspections, the sale of these cheeses is common at fairs in Dourados-MS. Its prohibition can cause social problems for producers who survive from the activity. Thus, taking into consideration, the great demand for artisanal cheeses as a consumer preference, it is undeniable the creation of training and awareness programs for cheese producers and sellers, combined with the effective inspection action of the City Hall of Dourados-MS and responsible bodies. of products of animal origin. Most people involved with the production and handling of food in free markets lack knowledge regarding hygienic-sanitary care that must be followed during and after processing the product.

CONCLUSION

According to the results obtained, it is noted that there is a divergence when it comes to handcrafted products, lack of hygiene (good manufacturing practices), herd management, as well as the lack of awareness for safe production, this lack of care can lead to major problems for the frequent consumer of fresh cheese. Only the control sample (industrial fresh cheese) followed the legislation. As for the microbiological quality, 70% of the cheeses analyzed were not in compliance with the legislation, the high microbiological indexes show inadequate hygienic production

conditions, which can cause food poisoning and put the population at risk. Only 30% of the cheeses collected were in accordance with the microbiological quality required by law. Given the above, it is evident the need to create awareness projects for stallholders who

produce and handle artisanal cheeses. There is a lack of supervision by the relevant bodies to verify adequacy and compliance with the standards and practices of production and marketing of these products.

REFERENCES

- ANDRADE, A. S. A.; RODRIGUES, M. C. P.; NASSU, R. T.; NETO, M. A. S. **Medidas Instrumentais de Cor e Textura em Queijos de Coalho**.2015.
- ARAÚJO, J. P. A.; CAMARGO, A. C.; CARVALHO, A. F.; NERO, L. A. **Uma análise histórico-crítica sobre o desenvolvimento das normas brasileiras relacionadas a queijos artesanais**. 2020.
- BOARI, C, A. **História dos Queijos Artesanais do Brasil**. Sertadobras.org.br, 2017.
- BRASIL, Agência Nacional de Vigilância Sanitária. Resolução-RDC nº259/2002. **Dispõe o Regulamento Técnico sobre Rotulagem de Alimentos Embalados**.2002.
- BRASIL, Diário Oficial da União. Decreto nº9. 918, de 18 de julho de 2019. **Dispõe Sobre o Processo de Fiscalização de Produtos Alimentícios de Origem Animal Produzidos de Forma Artesanal**. Brasília, 2019.
- BRASIL, Diário Oficial da União. Lei nº13.860, de 18 de julho de 2019. **Dispõe Sobre a Elaboração e a Comercialização de Queijos Artesanais e dá Outras Providências**. Brasília, 2019.
- BRASIL, Diário Oficial Lei nº 4.380/2019. **Dispõe sobre regulamentação das feiras livres no município de Dourados**.2019.
- BRASIL, Ministério da Agricultura e do Abastecimento. Instrução Normativa Nº 30, DE 26 DE JUNHO DE 2001. **Aprova os Regulamentos Técnicos de Identidade e Qualidade do Queijo de Coalho**.2001.
- BRASIL. Ministério da Agricultura e do Abastecimento. Instrução Normativa Nº 30, de 26 de Junho de 2001. **Regulamentos Técnicos de Identidade e Qualidade de Manteiga da Terra ou Manteiga de Garrafa; Queijo de Coalho e Queijo de Manteiga**. Brasília: Ministério da Agricultura e do Abastecimento, 2001.
- BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. Instrução Normativa nº 68, de 12 de Dezembro de 2006. **Métodos Analíticos Oficiais Físico-Químicos Para Controle de Leite e Produtos Lácteos**. Brasília. Secretaria de Defesa Agropecuária, 2006.
- BRASIL. Ministério da Agricultura, Pecuária e Abastecimento. Instrução Normativa nº62, de 26 de Agosto de 2003. **Métodos Analíticos Oficiais para Análises Microbiológicas para Controle de Produtos de Origem Animal e Água**. Brasília, Secretaria de Defesa Agropecuária, 2003.
- BRASIL. Ministério da Saúde. **Doenças Transmitidas por Alimentos**. Saúde.gov.br, 2022. Disponível em: < <https://www.gov.br/saude/pt-br/assuntos/saude-de-a-a-z/d/dtha>>.
- BRANDÃO, A. S. **Avaliação dos Parâmetros Físico-Químicos dos Queijos do Tipo Coalho Artesanal Comercializados nas Localidades de Cana Brava, São Bernardo e Magalhães de Almeida-MA**.2022.
- CINTRÃO, R, P. **Segurança, Qualidade e Riscos: a Regulação Sanitária e os Processos de (i)legalização dos Queijos Artesanais de Leite Cru em Minas Gerais**. 2016.
- COSTA, A. M. F. **Avaliação Físico-Química de Queijo de Coalho Misto de Leite de Cabra e Vaca em Diferentes Proporções**.2021
- FEITOSA, S. B; BORGES, M. P; PAULA, P. A; BARBOSA, M. S.; BRAGA, C. A. B.; CARNEIRO, L. C. **Caracterização Microbiológica do Queijo Minas frescal Comercializado em Feiras Livres**. Saúde & ciência em ação. Revista Acadêmica do Instituto de Ciências da Saúde, 2016.

- FERREIRA, A. S. F. **Aspectos Físico-Químico, Microbiológico e Sensorial do Queijo de Coalho Defumado com Borra de Café.** 2018.
- FERREIRA, T. **Vigilância Sanitária: Os diferentes tipos de selos de inspeção no mercado e como eles podem impulsionar o seu negócio.**2021.
- FILHO, J. R; FILHO, J. S. S; ARCANJO, H. G. S; OLIVEIRA, H. B; LINO, F. R. L; BEZERRA, J. I. L.; SILVA, J. J. P. **Avaliação dos Parâmetros Físico- Químico do Queijo Coalho Artesanal produzido em Calçado-PE.** 2015.
- FITZTUM, A. C. **Estudo Comparativo Entre Denominações com Base nas Principais Características de Queijos Semi-Duros Tradicionais Brasileiros: Uma abordagem Quimiométrica.**2022.
- GERMANO, P. M. L; GERMANO, M. I. S. **Higiene e Vigilância Sanitária de Alimentos.** 5ª.ed. Manole. p.153-169. Barueri – São Paulo. 2015.
- GOMES, F. D; ALVES, A; PIMENTEL, T. C; KLOSOSKI, S. J. **Avaliação da Composição Química em Queijo Parmesão Comercializado em Paranavaí-Paraná.**2015.
- LIMA, B. B; LEAL, M. M. **Parâmetros Indicadores de Qualidade de Queijos Artesanais Comercializados em Castro-PR.** 2017.
- LUZ, P. A; SILVA, G; ZANETTI, L. H; VIEIRA, N. C; ANDRIGHETTO, C. **Qualidade Física, Química e Microbiológica do Queijo Minas Frescal Produzido Artesanalmente e por Diferentes Laticínios da Região de Presidente Prudente.**2022.
- MAGRI, L. P. **Quantificação de acidez titulável e pH utilizando técnica potenciométrica como indicador de qualidade do leite bovino.** Dissertação de Mestrado apresentada a Universidade Federal de Juiz de fora. Universidade Federal de Juiz de Fora. Juiz de Fora, Brazil, 78.2015.
- MÁXIMO, W; VILELA, P. R. **Selo Arte vai beneficiar 170 mil produtores de queijos artesanais.** Agência Brasil, 2019. Disponível em: <https://agenciabrasil.ebc.com.br/economia/noticia/2019-07/selo-arte-vai-beneficiar-170-milprodutores-de-queijos-artesanais>.
- MOTA, A. S; CARNEIRO, C. S. **Principais Causas de Condenação de Carcaças e Visceras de Bovinos e Bubalinos Inspeccionados Pelo SIF e SIE no Pará.** 2019.
- PINTO, M. S. **Principais Defeitos em Queijos Minas Artesanal: Uma Revisão.**2017.
- PODESTÀ, M. **Queijos Artesanais.** Slowfood Brasil, 2015. Disponível em: <https://www.slowfoodbrasil.com/queijos-artesanais>. Acesso em: 04 de agosto, 2022.
- SILVA, C. C. **Desafios da Gestão da Segurança dos Alimentos em estabelecimentos.** 2021.
- SILVA, L. N. R. da; COSTA, M. de. R. **Condições de Comercialização e Qualidade de Queijos Minas Frescais em Feiras Livres e Mercado Municipal de Campo Grande, MS.** 2020
- SILVA, M. E. G. **Qualidade do Queijo Minas Frescal Produzido Artesanalmente e por Laticínios do Centro-Oeste Paulista.**2022
- SOBRAL, S; COSTA, R. G. B; PAULA, J. C. J; TEODORO, V. A. M; MOREIRA, G. M. M; SOUZA, I. A; GIOVANNETTI, A. C. S; SANTOS, L. G. F; GANDRA, S. O. S; MARTINS, M. L; RAMOS, A. L. S. **Qualidade Microbiológica de Queijo Minas Frescal Comercializado na Zona da Mata Mineira.** 2017.