

# Assessment of the compliance with GMP requirements in companies producing Paipa Cheese.

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**Abstract-** Paipa Cheese is a distinguished product of the Boyacá department, with a designation of origin granted according to resolution 70802 of 2011 of the SIC, and with great potential in territorial development due to its link with other activities such as tourism and gastronomy. The commercialization of Paipa Cheese at formal markets requires strict compliance with food safety regulations, not only within the legal regulatory framework but also as an indicator of consumer confidence. For this reason, food safety is ensured through the combined efforts of all stakeholders, such as suppliers, consumers, and the government. In Colombia, the National Institute for Food and Drug Surveillance (INVIMA) is the entity in charge of regulating the standards established by the Ministry of Social Protection concerning the health requirements that establishments where food is processed, must meet. Good Manufacturing Practices (GMP) contemplated in Resolution 2674 of 2013 for Colombia stipulate the standards companies must meet about GMP in the food industry. This research describes the results of the diagnosis made to 10 companies that produce Paipa Cheese linked to ASOQUESOPAIPA, who have participated in projects financed by national and regional entities. As a result of the evaluation, it was possible to show that 90 % of the companies comply with GMP, in percentages ranging from 74% to 95%, where regulations require at least 60% of compliance to obtain a favorable concept to be in operation and market their products. These results contribute to the fact that the products manufactured within the plants do not represent any risk to the health of the consumer, guaranteeing the safety of the food.

**Keywords:** paipa cheese, good manufacturing practices, food safety, food safety management system, food hygiene.

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## I. INTRODUCTION

In Boyacá, Paipa Cheese is one of the region's representative products. It was born in Sotaquirá and marketed in Paipa (Boyacá), becoming a widely recognized product. The producers of this cheese have managed to make their way into the market despite the difficulties they have faced, such as imitations of their product and, more recently, competition from international dairy markets due to globalization and the opening of the market.

All this has led Paipa Cheese producers to seek new strategies to maintain and strengthen their position in the market, and exporting their product is one of the main ideas. As a result, they have managed to commercialize in national retail chains, such as Carulla, Éxito, Jumbo, D1, among others, competing with internationally recognized companies [1].

In 2012 the Paipa Cheese Producers' Association (ASOQUESOPAIPA) was formally incorporated at the Duitama Chamber of Commerce and obtained a single tax registration from the DIAN (Colombian Tax and Customs Department) in Sogamoso. This association was born of the need to train, offer a quality product, promote its marketing and consumption, open new markets, and implement the appellation of origin.

In communication with a member of the ASOQUESOPAIPA, it was noted that none of the Paipa Cheese companies had completed the implementation of Good Manufacturing Practices (GMP). The leading causes attributed are deficiencies in infrastructure to comply with sanitary design requirements, production systems without proper process controls, lack of implementation of sampling programs, and other latent factors at any stage of the process, thus affecting the safety of the products.

Due to the great potential of Paipa Cheese to reach national and international markets [2], thanks to its recent designation of origin, there is a need to prioritize the incorporation of regulations such as GMP to guarantee food safety and improve the product's competitiveness. The commercialization of Paipa Cheese at formal markets, i.e., products with a sanitary registration issued by the National Institute for Food and Drug Surveillance of Colombia (INVIMA), requires strict compliance with food safety regulations. In Colombia, INVIMA is the entity in charge of regulating the standards established by the Ministry of Social Protection about the sanitary requirements that food processing establishments must comply with [3].

Improvements have been made in Paipa Cheese factories to commercialize products at a national level, which have been well accepted in the markets. The Governor's Office of Boyacá has made significant investments in the companies producing Paipa Cheese. Eight out of the ten companies belonging to ASOQUESOPAIPA have participated in projects that INNpulsá and the Ministry of Commerce, Industry, and Tourism have financed around the dairy chain with emphasis on locative adequacies and technology transfer (equipment - machinery) as beneficiaries of the projects FENALCO MLAC001-18, years 2018 - 2019, Chamber of Commerce of Duitama MLAC 013-018 and MLAC 009-017, years 2018 - June 2019, Procolombia and/or the Productive Transformation Program PTP. Such projects contributed to making facility improvements, infrastructure adjustments for the processing of dairy products, technical support to comply with INVIMA Resolution 2674 of 2013 on GMP [4], technical assistance in production costs, and provision of some equipment for obtaining dairy products (Unpublished data).

The departmental development plan of Boyacá has a program called "We believe in our products" aimed at exporting Boyacá products. This program aims to develop a methodological export route that facilitates the processes and procedures for the benefit of Boyacá business people, which is articulated by the fact that Paipa Cheese is considered among the promising products for the international market, being an ambassador of the Boyacá brand. For this reason, actions have been taken to improve its production and quality [5]. The current departmental government will continue with this "Boyacá Exports" program, focusing on large, medium, and small businesses and entrepreneurs that see exporting as an option for the future and an engine of development for their companies. This activity should be governed by Colombia's new foreign trade regulations [6].

This document evidences the evaluation of compliance with GMP requirements in companies producing Paipa Cheese through the analysis of their capabilities, interests, and experience in food safety practices, which will constitute an opportunity for improvement and advance in the path of GMP implementation, eventually contributing to the fulfillment of departmental government goals [5], about the support of potentially promising products for the international market, among which Paipa Cheese is included.

## II. THEORETICAL FRAMEWORK

Infections and diseases from contaminated food remain and threaten global public health. Food safety awareness remains a significant issue among consumers in developed and developing countries. The latter is affected mainly by foodborne diseases due to low living standards, poor personal hygiene, and lack of access to adequate medical treatment [6].

According to the national economic and social policy council CONPES 2010, the factories or processing plants where milk is processed or transformed to make it suitable for human consumption or as raw material for the production of dairy products such as cheese have limitations: deficiencies in infrastructure to comply with sanitary design requirements, production systems without proper process controls, lack of implementation of good manufacturing practices and the HACCP system (basic safety systems for this link), deficiencies in cold storage systems, access to or availability of laboratories for product quality control, and technological limitations in waste management, which makes them factors in sewage contamination [7].

Food safety is related to the presence and control of hazards focused on ensuring that they will not cause harm to the health of the consumer. Associated hazards can occur at any stage of the food chain, so proper control is essential. Food safety is ensured through the combined efforts of all stakeholders, such as suppliers, consumers, and the government. The principles for a Food Safety Management System harmonize the following generally recognized key elements [8]:

- Interactive communication (p. 7)
- System management (p. 7)

- Hazard Analysis and Critical Control Points (HACCP) (p. 7)
- Prerequisite programs (p. 7)

Since 2015, Resolution 2674 of 2013 [4] has been in force, stipulating the standards that companies must comply with concerning Good Manufacturing Practices (GMP) in the Food Industry, which corresponds to documenting the prerequisite programs. For the implementation of Hazard Analysis and Critical Control Points (HACCP), Decree 60 of 2002 [9] is a crucial element for the implementation of the Food Safety Management System [10].

The two standards described (GMP and HACCP) play an important role in food safety. Thomé Da Cruz and Menasche [11] stipulate that the implementation of these standards generates a high expectation of zero microbiological contamination, thus representing a great challenge for the production and marketing of traditional foods because such contamination endangers the very characteristics that make these foods unique, diverse and desirable [12], [13], [14], [15].

The 2009 Codex Alimentarius has recommended the implementation of Hazard Analysis and Critical Control Point (HACCP) and prerequisite programs (PRP), i.e., GMP and Sanitation Standard Operating Procedures, as food safety systems. In addition to preventing foodborne illness, these hygiene and safety management systems improve consumer confidence in the food supply and provide a regulatory basis for national and international food trade [16].

Quality management programs are often referred to as prerequisite programs in the food industry. A prerequisite is something that must come first before taking the next step. Prerequisite programs support the operation of the business, as is the case with GMP. In product safety, if GMPs are not implemented and followed, there is a potential for unsafe products to be produced, and both consumers and businesses can suffer [15].

In Colombia, Resolution 2674 of 2013 [4] aims to establish the sanitary requirements to be met by natural and/or legal persons engaged in the manufacture, processing, preparation, packaging, storage, transport, distribution, and marketing of food and food raw materials and the requirements for notification, permit or sanitary registration of food, according to the public health risk, to protect the life and health of people.

The chapters that comprise the GMP are [4]:

- 1 Building and facilities (p. 7)
- 2 Equipment y Utensils (p. 13)
- 3 Food Handler Personnel (p. 15)
- 4 Hygienic Manufacturing Requirements (p. 18)
- 5 Quality Assurance and Quality Control (p. 22)
- 6 Sanitation (p. 24)
- 7 Storage, Distribution, Transportation, and Marketing of Food and Food Raw Materials (p. 24)

Documentation is an essential part of GMP and will improve the visibility of quality assurance and quality control functions [17]. Integrating basic hygiene and new food safety programs according to national regulations [18], since basic hygiene is a prerequisite of any food safety program, is a way to address the different complexities of foodservice. Training should be continuously evaluated by generating feedback.

Several authors estimate that the two most important reasons for implementing a safety management system are compliant with legislation and response to the demands of the main customers [19], [20], [21]. Numerous studies have found that compliance with legislation is a decisive reason for having a service safety management system, either HACCP or ISO 22000 [22], [10]. In this sense, GMP is the result of explaining "this is how we do things here". Write down what you will do, do it, and document that you did it [23].

On the other hand, Paipa Cheese was granted the Denomination of Origin (DO) in 2011 as an initiative of the municipal government of Paipa, in Boyacá, and with the support of the Ministry of Commerce, Industry and Tourism of Colombia. Paipa Cheese is the only semi-mature Colombian cheese and today has the protection of DO, according to Resolution 70802 of 2011 of the SIC. It means that its distinctive characteristics and link to the area of origin have been legally recognized. Only cheeses produced and processed in Sotaquirá and Paipa following the specifications of the DO can be called Paipa Cheese [24].

In addition, Paipa Cheese was selected as an OVOP (One Village, One Product) initiative by the Japanese International Cooperation Agency (JICA). Paipa Cheese is seen as an axis of territorial development around which tourism, gastronomic and geographical richness can be integrated, initiating a path towards the confluence of productive sectors [24]. The Paipa Cheese initiative in Boyacá, with the recognition of the OVOP Colombia initiative and the protection of the DO, promotes the self-valorization of this product as a wealth of the territory, around which the regional economy is energized, and local identity is revitalized [24].

Globally, reaching the current level of organizations, particularly food manufacturers, has involved a series of changes and evolution of thinking about what is pursued to conquer a consumer [25]. Implementing international standards in the market represents a necessary element in the improvement process to form competitive companies, which could generate an exit towards the global market [8]. The International Organization for Standardization (ISO) conducts an annual survey that aims to identify the progress of ISO management systems worldwide. In Colombia, 80 certifications were achieved in 2017, while the figure increased to 124 in 2018, evidencing the country's growth [26].

Ensuring total safety and high sanitary quality of food in compliance with international standards is of fundamental importance for a society in terms of public health, consumers, and industry [27].

### III. METHODOLOGY OR PROCEDURE

The methodology used to diagnose the level of GMP implementation in the Paipa Cheese producing companies linked to ASOQUESOPAIPA is descriptive. In addition, documentary reviews and interviews with stakeholders were used to support the factors that determine compliance with Good Manufacturing Practices (GMP).

The target population is comprised of 10 companies producing Paipa Cheese. An evaluation instrument was designed based on the INVIMA model, which was applied between July 25 and August 15, 2020.

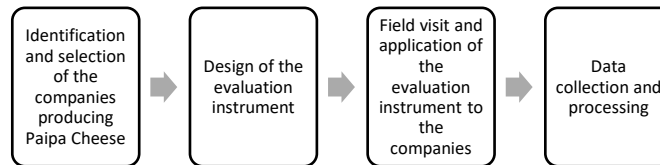


Figure 1: Methodological design.

Source: Prepared by the authors. [4]

Phase 1. Identification and selection of the companies producing Paipa Cheese: in this phase, the companies associated with ASOQUESOPAIPA were asked to join and participate in the project. The association is formally constituted to obtain multiple benefits for strengthening associates' capabilities, as mentioned in the introduction to this document. The name of each company was coded to maintain the confidentiality of the information: HRL3C, 6CG9G, 2F3KL, 5X5CA, H7HFR, 6QEBP, MM8JG, YH95D, VG4E8, and J8NUX.

Phase 2. Design of the evaluation instrument. Checklists were designed based on current legal regulations: Resolution 2674 of 2013[4] through the instrument sanitary inspection report to food factories identified with code IVC-INS-FM008, Version: 08 of 28/12/2017[28]. The checklists are organized into six sections and 19 categories of analysis, as presented in Table 1.

Table 1: Composition of checklists.

Section	Analysis Category	Number of requirements
Section 1	Physical facilities	7
Section 2	Drinking water supply	4
	Liquid waste management and disposal	3
	Management and disposal of solid waste (garbage)	5
	Pest control (arthropods, rodents, birds)	3
	Cleaning and disinfection	5
	Sanitary facilities	5
Section 3	Hygienic practices and protective measures	10
	Education and training	3
Section 4	Design and construction	12
	Equipment and utensils	8
Section 5	Raw materials and supplies	5
	Containers and packaging	3
	Manufacturing operations	6
	Packaging and packing operations	3
	Finished product storage	5
	Transport conditions	1
Section 6	Control systems	6
	Laboratory access	1

Source: Resolution 2674 of 2013. [4]

Phase 3. Field visit to each of the companies. The checklists were evaluated through an on-site visit to the facilities of the ten companies participating in the project, which were previously arranged with the owner or manager. Verification of compliance with the requirements was carried out in the presence of the owner or his delegate for the activity to obtain reliable information.

Application of the evaluation instrument. Each of the requirements evaluated in the analysis categories could take values between 0, 1, and 2, depending on compliance: Fully complies: 2; Partially complies: 1; Does not comply: 0; Not applicable: NA; Not observed: NO. Thus, the categories can take values between zero and the maximum value presented in Table 2.

Table 2: Maximum values assigned by analysis category.

Analysis Category	Expected score
Physical facilities	14 points
Drinking water supply	8
Liquid waste management and disposal	6
Management and disposal of solid waste (garbage)	10
Pest control (arthropods, rodents, birds)	6
Cleaning and disinfection	10
Sanitary facilities	10
Hygienic practices and protective measures	20
Education and training	6
Design and construction	24

Equipment and utensils	16
Raw materials and supplies	10
Containers and packaging	6
Manufacturing operations	12
Packaging and packing operations	6
Finished product storage	10
Transport conditions	2
Control systems	12
Laboratory access	2
<b>TOTAL EXPECTED SCORE</b>	<b>190</b>

Source: Prepared by the authors. [4]

Phase 5. Data collection and processing. A percentage of compliance with the analysis categories is calculated for each company, applying the following indicator.

$$\%Category\ compliance = \frac{Obtained\ score}{Expected\ score} * 100$$

Next, the sanitary profile of the companies is calculated, which indicates the percentage of compliance with the requirements of GMP regulations, using the following indicator.

$$Sanitary\ profile = \frac{Total\ obtained\ score}{Total\ expected\ score} * 100$$

Finally, an arithmetic average of the compliance percentages in each category is calculated for each of the ten companies participating in the research. This result allows us to identify the level of compliance of the ASOQUESOPAIPA companies with the GMP requirements.

#### IV. RESULTS ANALYSIS AND INTERPRETATION

The results obtained in the applied methodology are presented below. Due to the length of the information, the percentage of compliance in each category for the company identified as HRL3C will be shown as an example of the results obtained in Table 3. Then, the results of the sanitary profile of each participating company are described. Finally, the results of compliance with GMP for all the companies belonging to ASOQUESOPAIPA are presented.

Table 3: Percentage of compliance with requirements and health profile for company HRL3C.

Sanitary profile	Expected score	Obtained score	HRL3C
Physical facilities	14	14	100,0 %
Drinking water supply	8	6	75,0 %
Liquid waste management and disposal	6	6	100,0 %
Management and disposal of solid waste (garbage)	10	9	90,0 %
Pest control (arthropods, rodents, birds)	6	5	83,3 %
Cleaning and disinfection	10	8	80,0 %
Sanitary facilities	10	9	90,0 %
Hygienic practices and protective measures	20	19	95,0 %
Education and training	6	5	83,3 %
Design and construction	24	21	87,5 %
Equipment and utensils	16	13	81,3 %
Raw materials and supplies	10	9	90,0 %
Containers and packaging	6	6	100,0 %
Manufacturing operations	12	12	100,0 %
Packaging and packing operations	6	5	83,3 %
Finished product storage	10	10	100,0 %
Transport conditions	2	2	100,0 %
Control systems	12	10	83,3 %
Laboratory access	2	2	100,0 %
<b>SANITARY PROFILE</b>	<b>190</b>	<b>169</b>	<b>88,9 %</b>

Source: Prepared by the authors. [4]

The results from the companies allowed for carrying out an analysis, as shown in Table 3, thanks to which the sanitary profile of the participants in the study was obtained, see Figure 2.

Figure 2 shows that 90% of the companies producing Paipa Cheese comply with the requirements of the GMP presented in Resolution 2674 of 2013, i.e., a sanitary profile with compliance equal to or higher than 60%.

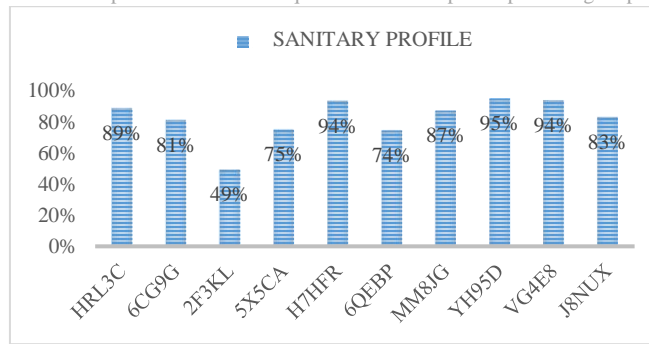


Figure 2: Percentage of compliance with GMP requirements in companies producing Paipa Cheese. Source: Prepared by the authors.

Therefore, the participation of ASOQUESOPAIPA companies allows for identifying the level of compliance of the participating companies with the categories of analysis and requirements of the regulations related to GMP, as shown in Table 4. The scores obtained by each participating company in this research were averaged to obtain a general association profile.

Table 4: ASOQUESOPAIPA's level of compliance with the GMP regulations [4].

Analysis category	Score
Physical facilities	88 %
Drinking water supply	79 %
Liquid waste management and disposal	95 %
Management and disposal of solid waste (garbage)	76 %
Pest control (arthropods, rodents, birds)	87 %
Cleaning and disinfection	80 %
Sanitary facilities	87 %
Hygienic practices and protective measures	94 %
Education and training	85 %
Design and construction	79 %
Equipment and utensils	76 %
Raw materials and supplies	86 %
Containers and packaging	92 %
Manufacturing operations	90 %
Packaging and packing operations	80 %
Finished product storage	83 %
Transport conditions	80 %
Control systems	67 %
Laboratory access	80 %

Source: Prepared by the authors.

## V. SOLUTION PROPOSALS OR IMPROVEMENTS

### a. Physical facilities

The company's physical facilities and manufacturing system are an integral part of the production process and contribute significantly to its success or failure [29]. As a result of the diagnosis applied in GMP to the ten companies producing Paipa Cheese, it is identified that the physical facilities were designed empirically. Hence, the owners end up designing and planning a factory that is not suitable for food production, which causes many problems in the production flow once the factory is in operation. For this reason, it is proposed that future research should determine the minimum plant layout designs, work methods, and technical studies for the expansion of Paipa Cheese production companies.

### b. Drinking water supply

According to the results, some companies should begin to implement the physical-chemical and microbiological analyses within their sampling plan that guarantee the potability of the water used in the process as stipulated in the regulations [30], especially in the cleaning of equipment. Similarly, potable water storage tanks must be maintained at least every six months as required by Resolution 2674 of 2013 [4]. However, it is recommended to consider the source of supply to establish the frequency of washing the tanks, due to the possibility of sludge, as in the case of the aqueducts in rural areas.

### c. Liquid waste management and disposal

This element is the main strength, thanks to the reuse of the whey produced by the process, which does not reach the grease traps. In the cases studied, the most significant source of liquid waste is found in the washing of equipment. Therefore, it is proposed to disseminate and promote strategies to continue with the reuse of byproducts or residues from the transformation process of Paipa Cheese, such as whey, which due to its nutritional value, can contribute to the development of new products and innovation of existing products [31].

It is recommended to start characterizing the discharge to determine that the concentration of substances discharged into water bodies that may affect water quality is within the maximum permissible limits; the environmental authorities are responsible for monitoring and controlling compliance with the regulations [\[32, p. 15\]](#).

#### **d. Management and disposal of solid waste (garbage)**

Among the elements evaluated were the containers, sorting procedure at the source, adequate storage area, and collection frequency. As an improvement, it is necessary to implement color coding in the containers and the bags [\[33\]](#). Additionally, some companies do not have final disposal mechanisms for hazardous waste such as light bulbs, laboratory test residues, and chemical packaging because the amount of hazardous waste generated by the manufacturing process of Paipa Cheese does not allow for profitable collection by the companies that collect this type of waste.

#### **e. Pest control (arthropods, rodents, birds)**

Most companies control pests with physical barriers, but improvements are needed in the drain grids because they would allow crawling animals and insects to enter through the holes in the grids. In addition, some of the pest control problems are caused by inadequate physical plant planning.

#### **f. Cleaning and disinfection**

The companies participating in the study stood out for the cleanliness of their facilities. Maintaining cleanliness levels is possible by recommending that suppliers of cleaning products are asked to provide technical and safety data sheets with recommended dosages according to the surfaces to be cleaned. In these cases, sanitation has been shown to reduce the amount of pathogens, such as *Listeria Monocytogenes*, on food contact surfaces [\[34\]](#).

#### **g. Sanitary facilities**

Most companies have a sufficient number of sanitary facilities per the number of collaborators or personnel involved in the process. However, it is recommended that the sanitary facilities be maintained with enough equipment for personal hygiene.

#### **h. Hygienic practices and protective measures**

In this aspect, it is important to highlight the role of the collaborators, in whom it was possible to demonstrate compliance with the requirements for food handling. In addition, it is important to note that good job satisfaction was also related to the good practices introduced [\[35\]](#). These practices are an essential factor in food safety; however, converting knowledge into good practices is a complex process, but it can reduce the risk of Foodborne Illness (FBI) and, consequently, consumer health care [\[36\]](#).

Food handlers can also be vehicles that carry organisms associated with Foodborne Illnesses (FBIs), such as *Salmonella*, *Staphylococcus*, and *E-coli* [\[37\]](#). In addition, other causes include the likelihood that food handlers may carry pathogens (without showing any symptoms) and transmit those pathogens in food [\[38\]](#), [\[39\]](#). Therefore, it is recommended that hygienic practices and protective measures be maintained among food handlers and required for visitors.

#### **i. Education and training**

Several authors argue that food handler training should focus on the theoretical aspects and be practical to foster positive attitudes toward food safety practices and be part of an established food safety culture. The support, positive reinforcement, and motivation that supervisors, managers, and trainers provide to food handlers are critical to the success of food safety training. The participation of handlers in training is evidence of the creation of a positive culture among handlers [\[40\]](#), [\[41\]](#), [\[42\]](#), [\[43\]](#), [\[35\]](#), [\[18\]](#). Therefore, an annual training plan with methodology, duration, and schedule is recommended, according to the needs of the company, both for old and new personnel.

#### **j. Design and construction**

Food hygiene problems and lack of sustainability can be found in the basic design of the food factory itself [\[29\]](#). Therefore, the main areas for improvement seen in the Paipa Cheese production companies are planning preventive maintenance activities and allocating the required budget for this purpose. In this way, the continuous and permanent adaptation of the facilities to the needs of the process is allowed.

#### **k. Equipment and utensils**

At the time of acquiring equipment and/or utensils, companies should require suppliers to comply with good manufacturing practices [\[44\]](#) and, depending on the material, comply with the resolutions [\[45\]](#) and [\[46\]](#) for verification of the total migration limits that they may have into the food. Similarly, suppliers must ensure that "objects, containers, materials, and equipment intended to come into contact with food and beverages must be on the positive lists of the FDA (Food and Drug Administration), United States (EU); EC (European Union or the Member States of the European Union) or Mercosur" [\[44, p. 13\]](#).

#### **l. Raw materials and supplies**

Considering that Paipa Cheese is a raw milk-based product, raw materials and inputs must undergo strict quality controls following sampling protocols before their use in the process to ensure the safety of the final product from the reception of the raw material. It is also vital to strengthen supplier selection plans and follow milking practices.

**m. Containers and packaging**

As in the evaluation of equipment and utensils, it is important to follow up on suppliers that meet the requirements mentioned above. Although, in this case, we found companies that have innovated in packaging material, so the applicable regulations for each material should be considered [44], [46], [47].

**n. Manufacturing operations**

Food handling includes all stages of food processing and storage, from the reception of raw materials to the final products and their distribution, i.e., from farm to table [48]. For the manufacturing operations of Paipa Cheese, a continuous production flow that prevents the proliferation of undesirable microorganisms is considered convenient, in addition to counting on temperature and time controls. In Paipa Cheese, it is important to have the necessary ripening times to minimize the microbial load.

**o. Packaging and packing operations**

Recommendations to ensure product traceability include having a documented record of the necessary processes, from receiving raw materials to delivering the finished product. In addition, it is essential to retain the nutritional table on the labels of Paipa Cheese to comply with regulatory requirements due to its nutritional composition [49], [50], [51].

**p. Finished product storage**

In the manufacture of Paipa Cheese, there is no finished product storage in the plant because the products can continue to mature. The area set aside for finished product storage is only used to prepare customer orders. However, it is recommended that if there are product returns, traceability be performed to identify the causes of the returns.

**q. Transport conditions**

During the fieldwork for this study, the transportation conditions were not evident. However, the companies had the supporting documents that the distribution vehicles have the operation and maintenance characteristics for food distribution, issued by regulatory entities such as the local Health Secretariat. Some companies do not have transportation services since their customers pick up the finished product at the plant.

**r. Control systems**

Researchers have shown that consumption of unpasteurized dairy products can be 150 times riskier than consumption of pasteurized products [52] since pathogens are more frequently found in raw milk [53]. Hence, it is important to continue strengthening sampling plans, equipment calibration, and documentation to support the implementation and monitoring of control procedures. In addition, to comply with the regulations, it is necessary to have qualified full-time technical personnel [4, p. 23]. This weakness has led the participating companies in the study to obtain the lowest score.

**s. Laboratory access**

It is noteworthy that most of the companies participating in the study have laboratories to perform the platform tests "alcohol test, absence of preservatives, adulterants and neutralizers by selective sampling, density test, lactometry or cryoscopy test, acidity test, absence of antibiotics and microbial count" [54, p. 23]. It is necessary to strengthen the application of tests for the absence of antibiotics and microbial count, given their importance in guaranteeing the safety of Paipa Cheese in both chemical and biological risks.

**VI. RECOMMENDATIONS**

With the results obtained, the continuity of government policies for strengthening the dairy sector in Boyacá is recommended, which has impacted the creation of competitive advantages for the companies producing Paipa Cheese, which were included in this study.

Likewise, it is recommended to follow up on the investments made by governmental entities and the companies themselves to promote the sector's growth, especially investments in physical infrastructure and equipment that may become obsolete due to their useful life.

Additionally, it is essential to highlight the need to improve the GMP evaluation category on Education and Training, where the participation of the community around Paipa Cheese is necessary to enhance the levels of GMP implementation.

Encourage programs for the selection, training, and recognition of milk suppliers to guarantee food safety, starting with the raw material.

Conduct market studies to market the byproducts of the process, such as the sweet whey that is used as raw material for butter, cottage cheese, milk beverages, and sometimes byproducts for animal feed.

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