

Beliefs about raw milk production and consumption and their relationship with health in Miraflores, Boyacá, Colombia

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Abstract

The consumption of raw milk in Colombia continues despite the regulations issued to standardize or prohibit it. In the municipality where this study was carried out, more than 90% of the population chooses to consume this product, being at potential risk of acquiring diseases. The objective of this study was to understand the beliefs surrounding the production and consumption of raw milk and its relationship with health. It was carried out in 2020. Ethnography was used as a method of data collection and analysis. It was found that this phenomenon is related to the economy, identity, and ecology and is a central axis and articulator of various socio-cultural activities. It is guided by traditional production practices that do not fully respect biosafety and hygiene. Furthermore, the consumption of raw milk is socially approved and is the result of a social construction that arose independently of the physico-chemical and microbiological properties of raw milk. Furthermore, local and national government regulators are not interested in this productive sector or in the consequences that their practices may have on the health of consumers. Thus, the responsibility for the consumption of raw milk and the possible acquisition of diseases passes from the food industry to the consumer. It is up to each consumer to make raw milk a safe food.

Introduction

Formal milk production in Colombia is based on an oligopsony, with many producers or suppliers in the market and few buyers who directly influence milk quality, composition, and hygiene (Álvarez Garzón and Cifuentes López, 2021). In this model, the formal market for milk destined for processing plants is established. So, the dairy industry forces the producers to standardize their production to what is required by current regulations, directly influencing the price paid per liter (1000 mL) of milk and financially rewarding technical producers. In addition, small producers are at a disadvantage, not being able to compete with the big companies in terms of costs and production volumes.

Colombian regulations on raw milk have been focused on the formalization of the dairy sector, prohibiting, regulating, and standardizing the characteristics that the production and marketing of this food must meet in order to be sold for direct human consumption (Ministerio de Protección Social, 2006, 2011); however, these efforts have not achieved the expected results since in the country more than 50% of the milk produced annually is marketed and/or consumed raw (Federación Colombiana de Ganaderos, 2015), demonstrating that despite all efforts aimed at formalizing and prohibiting its sale, it continues to be consumed.

In Colombia, 7414 million liters of milk were produced in

2022, of which 45.45% (3370 million liters) were collected by the formal industry (Federación Colombiana de Ganaderos, 2022). However, a percentage close to 50% was marketed informally (Guzmán Finol, 2013; Gonzales, 2020). This type of production uses hand milking, dual-purpose cattle breeds, and little labor force since productive tasks fall on family members (Guzmán Finol, 2013).

Besides, the dairy supply chain in Colombia shows a high degree of dispersion in raw milk production, a situation that is accentuated by informal collection and distribution (Moshtaghi and Mohamadpour, 2007; Guzmán Finol, 2013; Federación Colombiana de Ganaderos, 2015). Of the 3187 million liters of milk informally marketed, 50% are used to make artisanal cheeses, 38% to make other products, 7% (525 million liters) are consumed on farms, and 12% (382.4 million liters) are for direct human consumption (Gonzales, 2020). This situation is worrisome due to the high prevalence of diseases associated with this practice.

Due to their composition, milk and some dairy products are good mediums for the growth of pathogenic microorganisms (Srinu *et al.*, 2012). Inadequate production practices adopted in the different links of the dairy supply chain can alter the products (Swai and Schoonman, 2011; Jans *et al.*, 2012). As a consequence, the consumption of milk and dairy products has been associated with various health alterations (Gillespie and Brien, 2003; OMS-FAO, 2011).

The diseases with the highest prevalence in Colombia due to the consumption of raw milk stand out as zoonotic, such as brucellosis and tuberculosis, as well as foodborne diseases, such as salmonellosis, listeriosis, hemorrhagic colitis, and poisoning due to the consumption of toxins preformed by *Staphylococcus aureus* (Ministerio de Salud y Protección Social, 2011). The following prevalence was found: *Brucella* spp. 15.8% (Moreno *et al.*, 2007), *Listeria monocytogenes* 50%, *Salmonella* spp. 70%, *Staphylococcus aureus* 100% (Neira and Sivestrini, 2006), and *Mycobacterium bovis* 5.72% (Torres *et al.*, 1982).

The aim is to reveal how the inhabitants of Miraflores (Boyacá, Colombia) adopt production practices and possibly dangerous consumption habits, which can potentially affect the health of consumers.

The communities studied live in the municipality of Miraflores, the capital of the Lengupá province, located in the southeast of the department of Boyacá, Colombia. Livestock is the most important economic activity for this population and generates

40% of the gross income of the rural sector. It focuses on the breeding, rearing, and fattening of cattle and milk production. Investment in milk production is low because it is not considered a profitable activity but rather a buffer during a recession (Alcaldía de Miraflores, 2020). Milk production in Miraflores has a low degree of mechanization. The milk produced is used for the domestic processing of value-added products [pressed cheese, leaf cheese, double cream cheese, pear cheese, yogurt, *cuajada* (cow's milk cheese curd), ice cream, and butter], to be sold mostly raw and for self-consumption on the farm.

Materials and Methods

This study was conducted between November 2019 and December 2020 and used ethnography as a data collection and analysis method. The study was carried out with the urban and rural populations of Miraflores (Boyacá, Colombia). The techniques used for data collection were participant observation, semi-structured interviews, and photography.

Participant observation of different activities inherent to the process of primary production, transportation, collection, transformation, marketing, and consumption of raw milk was carried out to learn about the particular scenarios in which this sociocultural phenomenon occurs. A detailed record of each observation session using a field journal was made, and photographs were included. A guide was used to conduct the semi-structured interviews, addressing the following topics: the meaning of milk and the conception of raw milk quality (Figure 1).

The analysis was carried out by coding and categorizing the notes from participant observation (field journal) and the photographs using Atlas.ti software, version 8.0 (ATLAS.ti GmbH, Berlin, Germany).

A total of 10 participant observation sessions were carried out in productive units in 7 villages of Miraflores and 7 interviews with producers (Table 1).

Results

Some peculiarities related to this phenomenon and the health of the inhabitants of Miraflores were identified. Milk production provides cohesion, dynamism, and sociocultural identity in

Table 1. Respondents' characteristics.

Interviewee	Characteristic	Level of education	Age	Village	Gender
E1	Raw milk producer and consumer	Bachelor's degree	36	Urban sector	Male
E2	Owner of milk collection center	Bachelor's degree	34	Urban sector	Male
E3	Owner and manager of dairy company	Technical training	59	Urban sector	Female
E4	<i>Cuajada</i> producer	Technical training	23	Suna Arriba	Male
E5	Employee at milk collection center	Elementary school	50	Urban sector	Female
E6	Raw milk producer and consumer	Bachelor's degree	70	Guamal	Male
E7	Employee at milk collection center	High school	22	Urban sector	Female
E8	Employee at dairy farm	Elementary school	55	Suna Abajo	Male
E9	Raw milk consumer	Technical training	20	Urban sector	Male
E10	<i>Cuajada</i> producer	Elementary school	69	Buenos Aires	Male
E11	Driver	High school	39	Urban sector	Male

Miraflores. It is a structuring factor behind lifestyles and social organization that conditions and shapes particularities of the traditional production practices observed throughout. In this scenario, the perception of raw milk as a healthy product is created, making people consider it beneficial in terms of nutrition, therapeutics, gastronomy, and quality.

Lifestyles

There is a strong milk culture in this territory. The production and consumption of raw milk are factors of cohesion, dynamism, and sociocultural identity that are important for the population's daily activities and essential to the family economy. It becomes an element of identity because it is an essential part of their culture; furthermore, the ecological characteristics of Miraflores favor the production and consumption of raw milk.

Economy

Raw milk production and consumption are important drivers of the municipal and regional economies; many families depend on this activity, which is an essential source of employment and income. For this reason, cattle are the most important animals that farmers raise and the main source of family income since farmers earn enough money from cattle to meet their basic needs. Not only are cattle used to produce milk or dairy products [cuajada (cow's milk cheese curd), cheese, butter, yogurt, and desserts], but cattle fecal matter is also used to fertilize pastures. Besides, the weaned calves are sold or fattened for slaughter. This income is essential for the family's maintenance and upkeep of the farm and its animals. So, farmers see milk production as an important source of daily income, which helps to meet, to a certain extent, basic needs.

"Well, because the milk is more or less enough to sustain the farm and there is some leftover money, and the savings are the offspring." E1

Thus, milk production is a very appealing economic activity; although it does not generate a good profit, money is received weekly. In addition, the offspring are fattened or sold, making extra money. On the contrary, profit is obtained after 2 or 3 years in beef cattle fattening, and animals for fattening are hard to come by. Likewise, it requires a large land extension, good pasture availability, and a large initial investment, making it economically unfeasible for most stockmen in Miraflores.

Miraflores milk producers see this activity as an attractive economic activity that generates the necessary income for the subsistence family economy.

"Yes, every day: Sundays, holidays, Good Friday. Every day. Anyway, people are used to selling the product, because in the current situation of the country, this is very good money income for people and it's a product that is pick-up at home. They don't have to come to the town to sell it. The milk produced daily is picked up." E2

Therefore, milk cannot be lost, wasted, or misspent. In cases where milking the cows is not possible for some reason (illness, absence, or advanced age), business strategies are sought, including making verbal agreements with neighbors with whom the milk is shared. Milk is curdled, refrigerated, and frozen, but never wasted. What really matters is to produce it daily and profit from it. How the milk is produced is of little relevance.

Likewise, the different activities related to producing and consuming raw milk and dairy products are an important source of direct and indirect employment and job creation. Pick-up routes contribute to the economic dynamism created by milk production and consumption and are the fastest and most practical way to transport people, animals, and goods to and from the different villages, serving as a bridge between the rural and urban areas.

Industrial and artisanal processing of dairy products and mar-

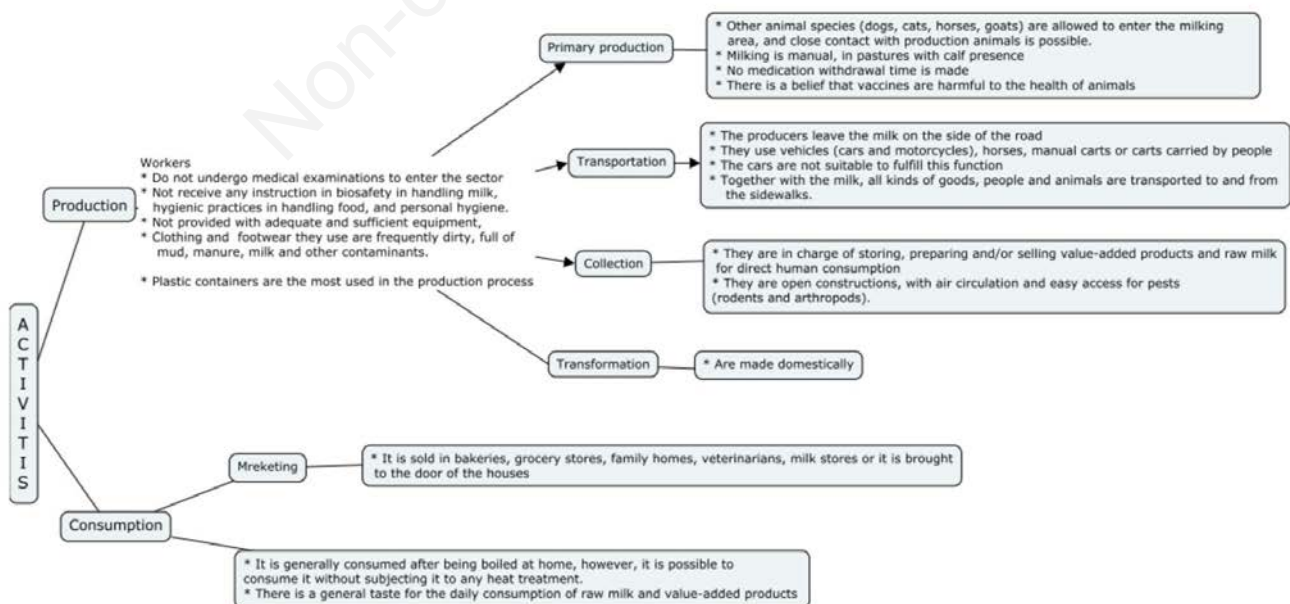


Figure 1. Production and consumption practices of raw milk in Miraflores, Boyacá, Colombia.

keting in other municipalities creates product visibility among customers in nearby towns. This product visibility translates into local development. Milk value-added products are marketed with the help of governmental and private institutions; business development is encouraged; and the efficiency of local businesses is improved by facilitating the development of sales and marketing strategies. Besides, jobs are created, production and technological experiences are shared, new markets are accessed, and innovation in processing and selling dairy products is encouraged.

“We sell in Garagoa, Guateque, Paez, Campo Hermoso, Berbeo, and Miraflores. And we’ve been selling in the Llanos for 2 years now, in Villanueva, Barranca de Upia, Monterrey, and Tauramena.” E3

Identity

In Miraflores, raw milk and dairy products are essential to the culture. They are the central axis and articulator of diverse social activities that determine the distinctive and characteristic identity of the inhabitants of Miraflores. This identity gives them a sense of belonging to their social group and their territory, where they not only live together but also share culture, beliefs, meanings, and traditions.

Production practices and division of work, gastronomic traditions, food culture, income and employment sources, expansion of production, the relevance of milk pick-up vehicles in the communication between villages and the urban area, marketing practices, influence on gastronomy, and consumption practices have become the basis of social and economic relations, essential for the daily life of Miraflores. Few foods fulfill such an important articulating function as raw milk and dairy products in this municipality.

These food products play an essential role in the gastronomy of Miraflores. They are indispensable for preparing various dishes and traditional recipes of Miraflores cuisine, valued for their flavor, diversity, and consistency. The way they are prepared, consumed, and shared, as well as the way they are not, is the result of the oral tradition of culinary recipes shared from generation to generation. Dairy gastronomy is, therefore, an expression of the cultural tradition of the municipality, its heritage, its territoriality, and its particular identity, which is undoubtedly correlated with the population’s health status.

“Milk is an enriched matter to process thousands of thousands of things. We have many products that can be made with it, beautiful things.” E3

Ecology

The relationship between the Mirafloreños and their environment facilitates cattle raising. This activity is associated with the arrival of the Jesuits in the region in 1598. At that time, milk was a valuable side product in cattle raising. However, today, dairy cattle raising is more attractive than fattening because it fits the sociodemographic, historical, geographic, and economic conditions of Miraflores, characterized by smallholdings with low-quality pastures where it is not possible to keep large numbers of cattle.

Likewise, milk and dairy products generate daily income and contribute to the adequate nutrition of the local people. In contrast, cattle fattening requires larger land extensions and a significant initial investment; besides, it is necessary to wait 2-3 years to start yielding profits. Therefore, farmers are inclined toward dairy farming, and milk is abundant everywhere on a daily basis. In other

words, the ecological characteristics favor the production and consumption of raw milk. The department of Boyacá is the territory with the highest number of cattle farms.

“I’ve been producing milk since 2008, when I started milk production on the farm, because that farm used to be a feedlot. And in 2008, I started dual-purpose dairy farming. Actually, when male bovines were purchased, they were bought at very high prices, and it was difficult to get them. And when they were sold, the cost benefit was hardly justified; so, it was more profitable to produce milk, to switch to dairy cows.” E1

Traditional production practices

Learning about milking, collection, transport, storage, and distribution occurs mainly through intergenerational transmission. People new to the trade are taught using traditional reference frameworks. Although once active, dynamic, and periodic, external instruction and training are currently scarce in the region. When it does occur, new knowledge often contradicts traditional knowledge, in which case these contradictions are resolved in favor of the latter.

For this reason, the good manufacturing practices defined in protocols and regulatory guidelines on clean and safe milk production are not observed by these traditional modes of production.

“Bacteria? Well, in fact, everybody says that milk has bacteria; I mean, there are times when I’m milking and I start to see how the drops of dirt, so to speak, fall there. I rinse my hand, but I’m usually wrestling with calves, I’m wrestling with ropes, and the ropes are smeared with shit, and I go and rinse my hand and I start milking. Of course, as I see the foam, I see that, let’s say, the mud, the dirt starts to drip here. So, when I start to see the drops, one or two drops, what I do is wipe them off. I wipe my hand, rinse it again, and go back and milk. Let’s say that could be the contamination. That’s why I think we can’t drink milk like that, without boiling it first.” E4

Thus, it is possible to observe a generalized use of plastic containers that are scratched and in poor condition. Containers are washed with rainwater, and sick animals are present during milking. In addition, there is no withdrawal time for drugs, no vaccination of cows in production, milk is left on the side of the road for several hours, and milk value-added products are processed in paddocks or kitchens next to rotting food, garbage, animals, and mud. During milking, neither the milker’s hands nor the cow’s udders are washed. In addition, the milker handles dirty ropes, and milk is transported in non-refrigerated vehicles that are not exclusively for transporting milk. The collection and storage centers are built with materials that make disinfection difficult and favor the entry of pests (rodents and arthropods) (Figure 2).

“Those cows are not vaccinated for the same reason, because they say that the vaccine takes away their productivity, apparently it dries up their milk. That’s what they tell us, everyone has told us the same thing. If we are working with milk, the cattle are not vaccinated.” E4

On the other hand, in different parts of the production chain, milk is transported and stored with chemicals such as gasoline, motor oils, household disinfectants, and fumigation chemicals (Figure 3). Similarly, other animals, such as dogs, chickens, cats, equines, and goats, are allowed to enter the milking place. Some

dogs may maintain close contact with production animals, even licking the cow's udders after milking (Figure 4).

Likewise, regulatory agencies' laxity with the supervision of processes like obtaining, transporting, storing, marketing, and distributing raw milk is evident. Each actor does it in their own way, in full view of the competent authorities, governmental institutions, and territorial entities in the municipality.

"Once I took my son with me and put him to wait on customers. Then, the INVIMA [National Institute of Food and Drug Surveillance from Colombia] inspectors arrived when I was preparing lunch at the teacher's house. They inquired about the employees and the owners of the place and wrote in their report that it was forbidden for minors to be selling hot milk. They called my boss and he had to go to the INVIMA office, but luckily nothing bad happened." E5

However, when asked about the effects of these practices on health, the region's inhabitants showed a lack of knowledge of the diseases that can be transmitted by the consumption of raw milk, although they identified possible effects of raw milk consumption, especially digestive effects.

Benefits

There is a positive perception of raw milk as a healthy food and a low perception of the risks associated with traditional production practices. The locals consider that the milk produced in Miraflores is of good quality and has irreplaceable nutritional and certain therapeutic properties. They also consider it basic and essential for the municipality's own gastronomy.

"People don't conceive the existence of bacteria; it's easier to believe in God than in bacteria." E6

Most producers and consumers associate the quality of milk with its compositional characteristics: capacity to form a thick cream layer after boiling, freshness, and cleanliness without physical residues (arthropods, mud, or manure). Most inhabitants choose to boil the milk after it is boiled; however, on occasion, it is consumed without subjecting it to any heat treatment, for example, a sip during milking.



Figure 2. Farmer's kitchen where milk value-added products are processed.



Figure 3. Raw milk left in a shed next to a plastic bottle of fuel.



Figure 4. A, B) Presence of dogs during milking.

Therefore, the way to obtain good-quality milk is to have nourished animals of good breed and filter the milk to remove any physical contaminants that it may contain.

“Milk can be contaminated because sometimes milk can have grass, mosquitoes, and ants, but that milk is strained.” E7

Milk is considered “the best food for everyone,” the most nutritious, and essential for children’s physical and psychological development:

“There is no food that is as good for children’s sustenance.” E1

In addition, it is essential for the sustenance of the elderly. Therefore, it is considered an irreplaceable staple food that should be included in people’s daily diet because it is a good source of calcium, fats, carbohydrates, and proteins.

“Milk, for me, is a product that can be a basic necessity for human consumption, [...] it should be included in the daily diet. There is really no replacement for milk because milk is always in the food pyramid; milk and dairy products are always included. It is really essential, because it provides calcium, it provides nutrients, [...] it helps a lot for the growth of children.” E8

Pasteurized milk, on the other hand, is not even considered milk but a beverage with a large amount of water, full of chemical substances harmful to health that allow it to be kept unrefrigerated for several days. In addition, it has a nasty taste and low nutritional content. It is available and sold in most local shops in the municipality at a price of approximately 0.5 EUR; it is not suitable for producing milk value-added products such as yogurt, *cuajada* (milk cheese curd), cheese, *etc.*

“Why don’t I consume the other milk? Because bagged milk has a lot of preservatives in it and must have a lot of stuff to keep it in that bag without spoiling. If I have milk today and I don’t boil it, tomorrow it will go sour. If I boil it, it lasts two days longer. If I refrigerate it, it lasts even longer, so? As a dairy processor, I don’t know what they put in the milk and I don’t go that far, because I don’t process bagged milk. It must have some very strong preservatives, or I don’t know what it has because sometimes they leave it unrefrigerated, or you find milk bags on the floor most of the time. That’s rough!” E3

Milk is considered a healthy food if it is boiled. It is essential for the physical and psychological development of children and is good for treating gastric ulcers, intoxications, massive bleeding, hepatitis, and insomnia. It is helpful for physical recovery, provides calcium to the bones, and is recommended even for nursing infants. Its consumption is not recommended in cases of parasitic infections.

“I can stop consuming it, but consuming cow’s milk is clearly beneficial for my health. Milk is essential, beneficial, and it contributes to my health. Every day there must be milk at home.” E9

“You have to eat dairy products for life to be good, blood and everything to gain strength, if you don’t you are *baido*.” E10

At the same time, no epidemic outbreaks or foodborne illnesses caused by consuming raw milk have been reported in Miraflores. Therefore, most consumers and producers are unaware

that diseases can be transmitted by drinking raw milk or its value-added products.

Discussion

Traditional food production and consumption forms derive from people’s social histories (Ministerio de Salud y Protección Social, 2011) and society-nature interactions. These interactions occur in a complex system of social, economic, cultural, ideological, and political relations based on articulated and interdependent processes that determine the ways of life in human societies (Breilh, 2010). Although lifestyles result from particular ethnic and cultural manifestations, they can potentially become generators and explainers of health problems in the inhabitants of Miraflores because production practices are, in a certain way, the result of a historical and cultural process in the communities. Therefore, the culture of producing and consuming raw milk is learned, assumed, and transmitted, guiding the thoughts, decisions, and actions of producers and consumers (Rossi and O’Higgins, 1981).

This idea reinforces what Breilh (2003) said: that by “articulating the biological-social processes involved in health, it is possible to associate society’s general behavior with the lifestyles of the groups and individuals that comprise it”. It is also possible to approach and understand the different culture-dependent and distinct mechanisms of exposure that a particular society has, allowing us to understand practices and beliefs built around a social object (Breilh, 2003). In this sense, the health-disease phenomenon is found in socially constructed and accepted knowledge, practices, and beliefs; it occurs in symbolically mediated fields where the different actors of the dairy supply chain reproduce, construct, and transform through social, contextual, and historical relationships. Furthermore, the adoption of practices that can potentially affect consumers’ health is due to ignorance, misinformation, and underestimation (Areosa Aldama, 2017). Or a way of resistance by the people of Miraflores against industrialization, opting for what they consider natural and healthy based on their knowledge and beliefs. This unruly behavior against milk hygiene practices may be a way to protect their localities and traditions.

To maintain the demand for raw milk, there must be a culture of consumption and a territory that allows the materialization of the rural culture, built and rebuilt around permanent communication and contact between consumers, marketers, transporters, and producers. Thus, the culture of rural inhabitants is one of the foundations that establishes and preserves the demand for raw milk.

In addition, by observing the production and consumption of raw milk and its value-added products as the basis of social organization, important in daily activities, and with a favorable cost-benefit ratio, it is possible to explain why people in Miraflores choose to consume these products. It is also possible to address favorable or unfavorable processes for health involved in these economic activities. Choosing raw milk as the basis of nutrition and feeding practices is not only a biological decision. It is the result of complex interactions between ecological, ideological, political, technical, and economic circumstances, technological resources, and social organization. It is a generational accumulation of knowledge and skills that has made it possible to determine, based on tradition and experience, that raw milk and its value-added products are ideal and necessary foods.

Another important social and cultural aspect is how the different social actors involved in the dairy chain conceptualize and perceive the benefits and quality of raw milk, on the one hand, and

how they associate milk production and consumption with effects on consumers' health, on the other. These perceptions are closely related to the daily practices of obtaining, handling, processing, distributing, and consuming milk.

As well, according to CODEX and FDA guidelines for food processing, food cannot be produced without adhering to good manufacturing practices. The control of food hazards must be carried out throughout the entire food chain (from primary production to the final consumer) to achieve the objective of making food safe and suitable for human consumption. Primary production is, undoubtedly, a core point, especially if one takes into account that the greatest food alerts in recent years have arisen due to the contamination of products in the field (FAO and WHO, 2023).

However, small dairy businesses face many challenges in implementing good practices and safety management systems and thus guaranteeing the health of consumers because they are located in remote rural territories that are difficult to access, with a lack of infrastructure, sanitation, transportation, and trained personnel. The functions generally fall to a single person or family.

Conclusions

The reluctance to adopt hygienic practices that guarantee the safety of raw milk and its value-added products seems to be based on a model where economics prevails over health. Investing time and resources in improving milk's hygienic and sanitary quality does not represent any economic benefit to producers. Apart from that, milk must be produced every day because it is a vital part of the family subsistence economy and the driving force of the local and regional economies. In addition, raw milk consumption has not caused or been associated with health alterations in consumers.

The inclusion of children and adolescents is suggested in future investigations to demonstrate whether the meanings, practices, and beliefs found in this investigation regarding the production of these foods, as well as the relationship between health and disease, are still valid in these new generations, or if, on the contrary, they have been permeated by information that discourages their consumption.

It is important to note that the dispersion of production and the small volumes produced are not attractive to the dairy industry, making it very difficult to formalize milk production.

A limitation that is evident in the study is the fact that the diseases that can be transmitted to raw milk consumers and their prevalence were not addressed; however, it opens a window for future research to discuss this topic.

Producers and consumers have not identified productive practices as potential sources of health alterations; they are unaware of the diseases that can be transmitted by the consumption of this food; however, they highlight the importance of boiling milk as a conservation measure and, in a contradictory way, the method that guarantees that its consumption is sure.

The artisanal nature of production, the difficult living conditions of the farmers, the low price paid per liter of milk, the reluctance, ignorance, and trivialization of improving hygiene in production practices, as well as the lack of capital, make it impossible to comply with legal requirements regarding hygiene. Compliance with these demands requires the transformation of establishments, working conditions, and traditional production practices, which implies the reorganization of the productive structure through training and periodic transfer of knowledge and technology to small raw milk producers.

References

- Alcaldía de Miraflores, 2020. Plan de desarrollo Miraflores Boyacá 2020-2023. Unidos con honestidad, miraflores progresa más, por miraflores por nuestra tierra. [Material in Spanish].
- Álvarez Garzón K, Cifuentes López JC, 2021. Análisis del mercado lácteo en Colombia en el periodo 2015 – 2020 según el índice de Herfindahl - Hirschman: ¿Es un oligopolio? Available from: <https://repositorio.unicolmayor.edu.co/bitstream/handle/unicolmayor/5515/AS013ASector%20lacteo.PDF?sequence=1&isAllowed=y>. [Material in Spanish].
- Areosa Aldama P, 2017. Estudio del sistema de innovación agrario para el desarrollo de la lechería remitente en la región este de Uruguay. Tesis de maestría. Universidad de la República (Uruguay). Facultad de Agronomía. Available from: <https://www.colibri.udelar.edu.uy/jspui/bitstream/20.500.12008/22799/1/AreosaAldamaPabloAriel.pdf>.
- Breilh J, 2003. Epidemiología crítica: ciencia emancipadora e interculturalidad. Lugar Editorial, Buenos Aires, Argentina. [Book in Spanish].
- Breilh J, 2010. La epidemiología crítica: una nueva forma de mirar la salud en el espacio urbano. *Salud Colectiva* 6:83-101. [Article in Spanish].
- FAO, WHO, 2023. Codex Alimentarius commission procedural manual. 28th ed. Rome, Italy. Available from: <https://doi.org/10.4060/cc5042en>.
- Federación Colombiana de Ganaderos, 2015. El consumo per cápita de leche en Colombia. Available from: https://www.federacion.org.co/estadisticas/consumo-0_
- Federación Colombiana de Ganaderos, 2022. Balance y perspectivas del sector ganadero colombiano (2022-2023).
- Gillespie IA, Adak GK, O'Brien SJ, Bolton FJ. Milkborne general outbreaks of infectious intestinal disease, England and Wales, 1992-2000. *Epidemiol Infect* 2003;130:461-8.
- Gonzales A, 2020. Cadena láctea Colombiana. Available from: http://www.andi.com.co/Uploads/20200430_DT_AnalSitLecheLarga_AndreaGonzalez.pdf. [Material in Spanish].
- Guzmán Finol K, 2013. La industria de lácteos en Valledupar: primera en la región Caribe. Available from: https://www.banrep.gov.co/sites/default/files/publicaciones/archivos/dtser_184.pdf. [Material in Spanish].
- Jans C, Bugnard J, Njage PMK, Lacroix C, Meile L, 2012. Lactic acid bacteria diversity of African raw and fermented camel milk products reveals a highly competitive, potentially health-threatening predominant microflora. *LWT* 47:371-9.
- Ministerio de Protección Social, 2006. Decreto Numero 616 de 2006 por el cual se expide el Reglamento Técnico sobre los requisitos que debe cumplir la leche para el consumo humano que se obtenga, procese, envase, transporte, comercializa, expendia, importe o exporte en el país. Available from: <https://www.ica.gov.co/getattachment/15425e0f-81fb-4111-b215-63e61e9e9130/2006D616.aspx>. [Decree in Spanish].
- Ministerio de Protección Social, 2011. Decreto 1880 de 2011 por el cual se señalan los requisitos para la comercialización de leche cruda para consumo humano directo en el territorio nacional. Available: <https://www.minsalud.gov.co/sites/rid/Lists/BibliotecaDigital/RIDE/DE/DIJ/Decreto-1880-de-2011.pdf>. [Decree in Spanish].
- Ministerio de Salud y Protección Social, 2011. Identificación de riesgos biológicos asociados al consumo de leche cruda bovina en Colombia. Available from: <https://www.minsalud.gov.co/sites/rid/Lists/BibliotecaDigital/RIDE/IA/INS/Er-peli>

- gros-biologicos-en-leche.pdf. [Material in Spanish].
- Moreno FC, Rodríguez Martínez G, Méndez Mancera V, Osuna Ávila LE, Vargas MR, 2007. Análisis microbiológico y su relación con la calidad higiénica y sanitaria de la leche producida en la región del Alto de Chicamocha (Departamento de Boyacá). *Rev Med Vet* 14:61-83. [Article in Spanish].
- Moshtaghi H, Mohamadpour AA, 2007. Incidence of *Listeria* spp. in raw milk in Shahrekord, Iran. *Foodborne Pathog Dis* 4:107-10.
- Neira B, Silvestrini J, 2006. Análisis del proceso de ordeño y de la calidad higiénica de la leche utilizada en la fabricación del queso paipa en Paipa (Boyacá). *Revista de Investigación U La Salle* 6:163-170. [Article in Spanish].
- OMS-FAO, 2011. *Codex alimentarius: leche y subproductos lácteos* (segunda edición). Available from: <https://www.fao.org/3/i2085s/i2085s.pdf>. [Material in Spanish].
- Rossi I, O'Higgins E, 1981. *Teorías de la cultura y métodos antropológico*. Editorial Anagrama, Barcelona, Spain. [Book in Spanish].
- Srinu B, Kumar AV, Kumar MS, Narayana BVL, Rao TM, 2012. Assessment of microbiological quality and associated health risks of raw milk sold in and around Hyderabad city. *Int J Pharm Bio Sci* 3:609-14.
- Swai ES, Schoonman L, 2011. Microbial quality and associated health risks of raw milk marketed in the Tanga region of Tanzania. *Asian Pac J Trop Biomed* 1:217-22.
- Torres C, Clavijo R, Cotrino V, 1982. Aislamiento de *Mycobacterium bovis* en leches de bovinos tuberculino positivos con presencia de mastitis crónica. *Rev Med Vet Zoot* 35:31-7. [Article in Spanish].

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