

Socioeconomic Impact of A2 Milk Production in Colombia and Its Projection in The International Market

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Abstracts: This study focuses on investigating the socioeconomic impact of A2 milk production in Colombia and its projection on an international scale, with a focus on international business. The main objective is to conduct a comprehensive analysis of the state of the art related to the commercialization of A2 milk in the Colombian dairy sector, exploring its implementation at a global level, consumption trends, sustainability, and target audience, to consolidate current knowledge in this area. The methodology is based on the collection of various sources of knowledge, covering studies from 2010 to 2023, relevant documents, bibliographic references, business magazines, and previous studies on the adoption of the production of this alternative in different countries, using specialized databases. Specific keywords linked to A2 milk, dairy marketing, consumption trends, and the national and international dairy market are used, facilitating the collection of references and the corresponding analysis through an inductive method. The content addresses crucial issues such as diversification of milk production, innovation in dairy products, and consumption alternatives for a wider population, as well as opportunities and challenges present in Colombian dairy production. In essence, this work seeks to provide a detailed analysis of the commercialization of A2 milk internationally and in Colombia, identifying significant patterns that can contribute to its implementation in the Colombian market and facilitate its expansion globally in the context of international business. In conclusion, the comprehensive research addresses the socioeconomic impact of A2 milk production in Colombia and its international projection from an international business perspective. The comprehensive literature review and data collection have provided a complete picture of the consumption trends, sustainability, and target audience associated with the commercialization of this dairy alternative.

Keywords: A2 milk, International market, Socioeconomic impact, Sustainability.

1. INTRODUCTION

The dairy industry is a major sector of the global economy, generating employment for millions of people and contributing significantly to international trade. Based on FAO and OECD reports, there is notable variability in dairy production and trade between nations, while the sector faces challenges such as price volatility and the need to improve environmental sustainability.

To fully understand this sector, it is essential to examine the current trends and challenges in production, trade, and policies associated with the dairy industry. In addition, it is crucial to understand the innovative technologies and practices that are emerging to optimize efficiency and sustainability in the production of milk and dairy products.

The behavior of the dairy industry in Colombia will be explored, including exports and imports. According to the most recent report of the Office of Planning and Economic Studies of Fedegan-FNG, based on data from DANE and referring to the foreign trade of dairy products between January and June 2021, the import of 21,706 tons of various dairy products from the United States was recorded, with a value of over USD 58.8 million. In contrast, exports reached 3,775 tons, generating revenues of USD 14.2 million [1, 37] This situation presents a significant challenge for the Colombian dairy industry, negatively impacting the domestic industry and reducing profit margins. Many small farmers are affected economically, some even operate at a loss or only manage to cover their basic needs.

This scenario has motivated the industry to seek innovations and alternatives that generate added value and improved profits. At the regional level, in Latin America, there is still a lack of theoretical and methodological tools to address the challenges of the dairy sector, which has resulted in a delay in production processes due to the lack of technology and innovation, increasing costs and decreasing profitability [1, 37]

An analysis of production costs and productivity in Colombia shows that they are close to the world average, but higher compared to some Latin American countries. In contrast, Colombian costs are considerably lower than those of the European Union and the United States [8] The free trade agreements signed by Colombia have put additional pressure on the dairy sector, intensifying international competition and emphasizing productivity and production costs as determining factors.

Cow's milk, being a healthy and safe food, provides essential nutrients such as protein, vitamins, and minerals, with an emphasis on calcium. However, consumption of dairy products can trigger the release of the bioactive substance β casomorphin 7 (BCM-7), associated with disorders such as gastrointestinal dysfunction, and increased risk of diabetes, autism, and depression [4]

The dairy industry in Colombia faces additional challenges, including high production prices and natural events that affect yields. In response, the production of A2 milk has been promoted, which seeks to encourage consumption and improve marketing margins. A2 milk is distinguished by having a different amino acid in the polypeptide chain from B Casein, reducing the release of BCM-7, which is linked to adverse health effects. Consumers value price, origin, and quality certification when choosing these dairy products. Internationally, consumers are willing to pay for these products because of their health benefits.

The general objective is to analyze the current state of A2 milk marketing in the international market and evaluate its potential implementation in the domestic market, highlighting consumption trends, sustainability, and target audiences. Specific objectives include determining consumption and production trends at national and international levels, evaluating successful marketing strategies in other countries, and defining the sustainability of A2 milk production and marketing.

This research seeks to provide alternatives to the challenges faced by the dairy industry in Colombia, addressing the low consumption of traditional milk (A1) and presenting an innovative and efficient option that does not compromise health. It also seeks to strengthen production and presence in the international market, taking as a reference experiences from developed and Latin American countries. It is expected that the research will serve as a basis for selection, laboratory studies, and the positioning of Colombia as a reference in innovation, production, and trade of A2 milk [8]

2. THEORETICAL FRAMEWORK

Milk, being an essential component of the human diet and a sector of vital importance in the global economy, has undergone significant transformations in its production and marketing at the international level. Factors such as the growing demand for dairy products, consumer preferences, and technological advances have influenced these changes. The international milk trade, which encompasses variants such as A1 and A2 milk, presents a complex and dynamic scenario. Project management plays a crucial role in ensuring operational efficiency and quality of dairy products in global markets. Understanding market trends, and international regulations and implementing innovative strategies are imperative to meet the challenges and capitalize on the opportunities in this constantly evolving industry.

This theoretical framework examines the dynamics influencing global milk production and distribution, with a special focus on A2 milk, an emerging variant of conventional milk. From the growing demand for dairy products to technological advances and changing consumer preferences, crucial aspects outlining the evolution of this industry will be explored.

In the course of this exploration, crucial definitions related to global milk production and marketing will be addressed. In addition, the distinctive characteristics of A2 milk will be explored in depth, assessing its market relevance and possible implications for international dairy trade. This approach will allow a more detailed understanding of trends and changes in the dairy industry, highlighting the importance of adapting to market demands and capitalizing on emerging opportunities.

2.1. Comparative Advantages

Comparative advantages in milk production, according to economic theory, imply that countries specialize in the production and export of goods in which they are more efficient in terms of production costs. This theory postulates that countries with comparative advantages in milk production would be prone to specialize and export this product, while others might choose to import it. However, beyond comparative advantages, international trade in milk is subject to several additional factors, such as trade barriers, trade agreements, and logistical considerations. It is essential to recognize that this theory is a conceptual explanation, and the actual dynamics of milk trade can be influenced by an amalgam of complex factors, including government policies, price variations, sanitary regulations, and changing consumer preferences [4,5]

2.2. Milk Production at the International Level

World milk production has experienced a remarkable increase to meet the growing global demand. Among the main producers are nations such as the United States, India, China, Brazil, and Germany, which stand out for the implementation of advanced technologies such as genetic improvement, specialized feeding, and automated milking systems. These technological innovations have boosted efficiency and productivity in the dairy production chain. In the Latin American context, the dairy industry plays a key role in the regional economy, representing a significant proportion of both total production and participation in international dairy transactions, as indicated by the FAO report in 2019. This sector not only contributes substantially to local supply but also plays a leading role in the global dairy trade.

2.3. International Regulations and Standards

Project management in the milk trade requires a thorough understanding of international regulations. Food safety regulations and quality standards, such as those set by the World Trade Organization, are critical to ensure compliance in the milk trade [36]

2.4. Technological Innovations in Production

Projects that integrate innovative technologies in milk production, such as advanced milking systems and real-time quality monitoring, can improve efficiency and competitiveness in the global marketplace [32]

2.5. Logistics and Distribution Challenges

Project management in the milk trade faces considerable logistical challenges, from proper refrigeration to inventory management. Efficient supply chain strategies are essential to maintain milk freshness and quality in the distribution process [35]

2.6. Logistics and Distribution Challenges

Sustainability has become a determining factor in global trade. Projects that integrate sustainable practices in milk production and distribution can gain competitive advantages, responding to the growing demands of environmentally conscious consumers [31]

2.7. Marketing and Positioning Strategies

Project management must incorporate effective marketing strategies to position milk, including A1 and A2 variants, in international markets. Distinctive branding and effective communication are essential [34]

2.8. International Trade Agreements

Analysis of international trade agreements is crucial. Project management must consider the implications of such agreements on milk trade flows, and identify opportunities and challenges [33]

2.9. Research and Development

Projects focused on research and development are essential for continuous innovation in the dairy industry. The creation of differentiated products and process improvement are critical aspects of maintaining international competitiveness [11, 23]

2.10 Research and Development

Project management must consider resilience to crises and changes in demand. Diversification and adaptability strategies are essential to overcome challenges such as extreme weather events or health crises [23]

2.11. Marketing of Milk on the International Market

International milk marketing involves a complex network of distribution and logistics. Major exporters include New Zealand, the European Union, the United States, and Australia, which have developed efficient supply chains and trade agreements to meet international food quality and safety standards [28]

2.12. A2 Milk: Characteristics and Benefits

A2 milk has gained popularity due to its alleged health benefits. Unlike conventional milk, it contains exclusively A2 beta-casein protein, suggesting it to be more digestible and tolerable for some people. However, more research is needed to fully support these purported benefits [11]

2.13. A2 Milk Production and Marketing

A2 milk production and marketing has experienced a remarkable rise in several countries, evidencing a dynamic outlook in the global dairy industry. Leading companies such as A2 Milk Company and Fonterra in Australia and New Zealand have played a crucial role in this trend, recording substantial growth that has positively impacted their revenues and EBITDA. The A2 Milk Company, the most prominent entity in New Zealand, has stood out for significant growth, projecting optimistic prospects for the global A2 milk market [30]

In the Latin American context, the A2 milk market has reached significant figures, especially in Brazil, where initiatives such as 'Beba Mais Leite' have contributed to the promotion of the benefits of milk, including the A2 variant. Visionary companies such as La Ruidosa in Colombia have been pioneers in the production of A2 milk, standing out for their international certification and their focus on the creation of high-quality nutraceutical milk [2, 30]

This promising scenario suggests continued growth in the global A2 milk market, with projections that anticipate an annual increase of close to 8% until 2030, reaching an estimated \$4.8 billion. In Latin America in particular, annual growth of 3.5% is expected, driven by growing interest, especially in the Brazilian market [4] This sustained growth supports the idea that A2 milk is consolidating its position as a significant force in the global dairy industry, with a steady increase in demand and an increasingly noticeable presence in various international markets.

3. CONCEPTUAL FRAMEWORK

The conceptual framework comprehensively addresses the production and marketing of A2 milk, a variant that has gained popularity in the global dairy industry due to its potential health benefits and growth potential in the international market. Various aspects are examined, including definition, geographical distribution, human health effects, identification methods, production in different countries, international market demand, marketing strategies, factors influencing production adoption, associated challenges and opportunities, sustainability, policies and regulations, competitiveness, supply chain, technologies used, consumption patterns, consumption alternatives, profitability, and prospects.

A2 milk is defined as a variant of the beta-casein protein present in cow's milk, which contains exclusively the A2 variant and excludes the A1 variant [8]. The geographic distribution of these variants varies according to cow breed and country of origin [10]. Policies and regulations associated with the production and marketing of A2 milk vary among countries, affecting the viability of its production [18,19, 20]. Competitiveness concerning conventional milk depends on factors such as production costs, product quality, and market demand [19]. The supply chain involves producers, processors, and retailers, affecting the quality and price of the final product [21]

Technologies used include genetic selection of cows, feed management, and separation of A2 milk from conventional milk [22] Consumption patterns vary according to population groups, with an increase in demand for dairy products containing A2 milk in different countries [12, 23]. Profitability depends on factors such as production costs, selling prices, and production efficiency [16]

Prospects indicate growth in international demand due to health benefits and market differentiation [26]. Although it faces challenges such as competition with conventional milk, a continued increase in demand is anticipated [3, 13, 17, 24, 25]. Marketing strategies focus on consumer education on health benefits and differentiation [15]. Factors influencing adoption by producers include available technology, costs, and market demand [16]. Identification methods include immunodetection techniques and genetic analysis [6]. Production has experienced growth in countries such as New Zealand, Australia, and the United States [3, 25]. International demand is expected to continue to increase [14.]Beta-casein: A major protein found in mammalian milk.

The following definitions are fundamental in this area:

Gene: Refers to what determines specific hereditary characteristics of animals through DNA. Ebitda: Financial indicator.

B-casomorphin: Protein fragment formed in the digestion of milk protein.

DANE: Departamento Administrativo Nacional de Estadística (National Administrative Department of Statistics), is the entity in charge of Colombia's official statistics.

OECD: Organization for Economic Cooperation and Development. FAO: United Nations Agency.

Trends: In the marketplace, refers to the directions that consumers, industries, or companies form with their behavior concerning a product or service.

Breed: Group of cattle that are of the same species, sharing genetics passed on from generation to generation.

Viability: The ability of a product or service to generate sufficient profit and revenue. Marketing: Focused strategies to sell, promote, and distribute a certain product or service. Lactose: It is the type of sugar found naturally in milk.

Hybrids: Crossing between two different species.

3.1. History of milk production and its benefits for human consumption

3.1.1. Origin

Historically, cows were exclusive producers of Beta Casein A2 protein. However, approximately 10,000 years ago, a cellular alteration led to the appearance of Beta Casein A1 protein in certain European dairy cows. Since then, the predominant presence of Beta Casein A1 protein has been commonly observed in breeds such as Holstein. On the other hand, European breeds such as Guernsey, Jersey, and Brown Swiss, along with African and Indian breeds such as Brahman, Gyr, Sindhi Red, and Rathi, still maintain a significant presence of A2 protein.

Crossbreeding these breeds with bulls carrying the A1 protein has generated hybrids capable of producing both A1 and A2. It is important to note that true A2 milk can only be obtained from cattle possessing two copies of the A2 gene in their DNA [15]

3.1.2. Benefits

Determining the A2 milk for our consumption brings, according to experts, great benefits especially to those people who are lactose intolerant, which are almost 65% of the world population, among the benefits we can find are:

- Its consumption is related to an improvement in metabolism and a considerable increase in energy.
- It remains a source of magnesium, potassium, calcium, and magnesium.
- It contains healthy acids that contribute positively to the skin, the brain, and the entire immune system.

3.1.3. Benefits

- Type A1 milk is responsible for diseases such as type 1 diabetes and arteriosclerosis, as well as other diseases associated with cow's milk consumption, breast cancer was found to be related to the bovine leukemia virus BLV [33]
- Two major breeds of cattle supply milk for human consumption: the "Taurus" breed and the "Indicus" breed. The first type of breed is most found in the Western world (Europe) and the second type is mostly found in Asia, some parts of Africa, and Oceania (Contract 081, 2010). The main difference between the milk varieties that are generated by these two breeds lies in a single amino acid of the 209 that are present in Beta-casein. The Taurus breed produces the type of milk that is identified as A1, and the Indicus breed produces type A2.[28]
- The most feasible method for the identification of milk type A1 and A2 is to establish the genotype of the CSN2 gene in the animals.

3.1.3. Market

The A2 Milk Company founded 23 years ago in New Zealand, markets A2 milk and conducts research on the health effects of Beta-casein type A1. [13, 33]

Australia is the market in which A2 milk is already available with an additional value, the same could begin to implement Colombia and to position itself more in this market in the region and the consumption of A2 milk variants, as we know that the dairy sector in Colombia is facing some problems such as high production costs and also what could be related to the low consumption that may be having due to the medical contrasts presented by consumers such as discomfort or possible diseases due to traditional milk.

Colombia already has a farm called La Ruidosa, located in Palestina (Caldas), which specializes in A2A2 livestock. It is a farm that is certified in the production of this type of milk through a selection process and not using any genetic manipulation; the aim is to obtain milk that is acceptable for human consumption.

The dairy sector represents 12% of the agricultural production in the European Union, this production has been increasing rapidly. The main producers are Germany, France, the United Kingdom, the Netherlands, Poland, Italy, Spain, and Ireland.

A2 milk has been experiencing a significant increase in the economy, so Colombia should begin to promote its marketing in a larger mass, so that the dairy sector has an important economic growth for the region, it should be taken advantage of that the consumer today tends to take care of what they consume to make it healthier and this variant of A2 milk has these important benefits as we have already mentioned [29]

A2 milk by 2021 had a value in Latin America of US\$170 million and is expected to have an annual increase of 3.20% for a period between 2023-2028.

For its distribution and to reach more consumers, it has distribution channels such as supermarkets, traditional stores, and also online to cover a large market.

In Latin America, the country with the largest presence in the A2 milk market is Brazil, which is an example to follow to obtain profits for the Colombian sector and achieve further growth and expansion in the world. The global lactose-free dairy market was \$12.2 billion in 2022.

This market is in high expansion thanks to the diverse needs it satisfies for those who are lactose intolerant, as this market offers a wide variety of options for dairy consumption.

According to New Zealand researcher Keith Woodford, a leading international disseminator of the benefits of A2 milk, large corporations, led primarily by Fonterra, have for years resisted the adoption of A2 milk, viewing it more as a threat than an opportunity. It was not until 2018 that Fonterra, the leading New Zealand company, changed its perspective and opted to introduce its line of A2 dairy products. The transformation of attitude on the part of large international companies was further evidenced by the decision of companies such as Nestlé or Danone to start marketing A2 milk-based infant formulas in some countries [29]

In conclusion, we can foresee that the dairy sector has a great possibility of growth in consumption due to the change in eating habits and the intake of traditional milk has decreased due to the digestive problems it causes in humans, unlike alternative milk [30] such as A2 milk which gives great positive benefits for human health that has the A2 variant and this leads to growth for expansion in the national and international market through highly functional alternatives.

4. METHODOLOGY

This project adopted a methodological approach based on the exhaustive compilation of various sources of knowledge, theories, and company studies, making use of repositories, specialized databases, and specific keywords such as "A2/A2 milk", "dairy marketing", "dairy consumption trends" and "national and international dairy market". The fundamental purpose was to carry out a comprehensive analysis of A2 milk marketing in the Colombian dairy sector, as well as to examine its implementation at the international level, focusing on obtaining updated and substantial information on the state of the market, including consumption trends, sustainable approaches, and target audiences.

The methodology included the application of a literature review approach to gather relevant information from 2010 to 2023. Previous studies, documents, and bibliographic references, such as articles, degree papers, and books, were reviewed to gain an in-depth understanding of A2 milk marketing, as well as consumption trends and associated sustainability.

After the information-gathering phase, an inductive analysis of the literature collected was carried out, focused on defining consumption trends, sustainability, and target audiences linked to the marketing of A2 milk. During this analysis, rigorous criteria were applied to identify the most relevant documents, discarding those that did not meet the relevant content standards. The objective was to ensure the quality of the analysis and to obtain a detailed overview of the main purpose of the project, seeking to identify significant patterns that could contribute to the understanding and possible implementation in the Colombian market.

This methodology, by providing a detailed and rigorous analysis, stands as a study with solid information, comprehensively addressing the central theme of the research. Likewise, it is positioned as a significant contribution to the existing knowledge in the field of dairy product marketing, specifically about A2 milk, an area still little explored in Colombia and globally.

5. RESULTS AND DISCUSSIONS

In this analysis, the state of the art of A2 milk marketing, consumption trends, and target audiences have been examined. Table 1 highlights key findings, including the national and international profitability of A2 milk production. The growing acceptance is attributed to its health benefits, thus generating a remarkable innovation in the dairy industry. It was consolidated with the literature analysis of the references that A2 milk emerges as a crucial player, highlighting its economic viability, consumer acceptance, and its potential role in innovation in today's dairy sector.

Table No. 1: Results and findings.

<ul style="list-style-type: none"> ● LACCEI (2012) ● Goddard and Waters (2017) ● Garcia-Martinez et al (2018). ● Haenlein and Wendorff (2006) ● Grosclaude et al. (2008). ● Carvalho (2020) 	<p>Together, these bibliographical references offer a comprehensive perspective that ranges from economic and technological aspects to regional and contemporary considerations. Integrating these studies into research will provide a solid and diversified basis for addressing the socioeconomic impact of A2 milk production in Colombia and its projection at the international level. Where:</p> <p>LACCEI, 2012: to provide a particular insight into the marketing of A2 milk, especially if it focuses on the specific implications and considerations in the Latin American context. Offering insights on practices and strategies in the region [27].</p> <p>Goddard and Waters, 2017: The study is fundamental to understanding the competitiveness and profitability of A2 milk production compared to conventional milk. Their findings inform key economic aspects.[16]</p> <p>Garcia-Martinez et al., 2018: address contemporary aspects of A2 milk marketing and consumption trends. It can provide up-to-date and relevant information to understand the market landscape. [18]</p> <p>Haenlein and Wendorff, 2006: the study is essential to examine the geographical distribution of A1 and A2 variants of the beta-casein protein. It can provide information on the presence of these variants in different</p>	<ul style="list-style-type: none"> ● Possibility of exporting traditional milk alternatives. ● Important contributions of the dairy sector to international agribusiness. ● Factors influencing competitiveness and milk production.

	<p>regions and cattle breeds. [10]</p> <p>Grosclaude et al., 2008: This reference focuses on the technologies used in A2 milk production. It could be crucial to understand the methodologies used and their impact on product quality. [22]</p> <p>Carvalho, A., 2020: This study provides an updated perspective on A2 milk consumption trends and possibly explores aspects related to the target audience. [28]</p>	
<ul style="list-style-type: none"> ● Bocanegra (2022). ● Grosclaude (2008). ● Davis, J., et al. (2020). ● Sadhana Farm ● Carulla and Ortega (2016) 	<p>Based on the literature references cited above, the remarkable 38% increase in dairy production in Latin America during the period between 2009 and 2018 is particularly noteworthy. It is imperative to recognize, however, that the dairy sector in Europe and North America has experienced a decline, largely attributed to the increasing adoption of plant-based milk. This transition in consumption habits has generated the need for innovation in dairy production, focusing efforts on areas that are more profitable. In this context, A2 milk emerges as a strategic alternative, highlighting its benefits for human health and its profitability, especially evidenced in countries such as New Zealand, where its implementation at the international level has been consolidated. The studies reviewed underline the importance of adapting to the changing dynamics of the global dairy market, proposing A2 milk as a strategic response to boost profitability and health in the sector.</p>	<ul style="list-style-type: none"> ● A2 Milk, as a profitable innovation in the international dairy sector, stands out for its success and health benefits, responding effectively to the changing demands of the global dairy market. ● Emphasis on the international profitability of A2 milk and the possibility of production in countries such as Colombia. ● Many substitutes for dairy consumption, as a more favorable alternative for human health.
<ul style="list-style-type: none"> ● Carvalho (2020) ● Haug et al. (2007) ● Ho et al. (2014) 	<p>This paper addresses the exponential growth of 30% experienced by the dairy sector worldwide, compared to 2010, with particular emphasis on the dynamics of the marketing of substitute products for traditional milk. It highlights the identification of key motivations that influence the choice of a type of milk, especially to the detriment of conventional milk. Among these considerations are factors such as acquisition cost, which encompasses both price and product quality, the concept of "smart pleasure" that amalgamates accessibility with health benefits, food safety linked to concerns about food contamination, health in terms of general well-being, and the relevance of having reliable nutritional information. The comprehensive analysis of these referents provides an in-depth understanding of the motivations and preferences that influence consumer choice in today's dairy market.</p>	<ul style="list-style-type: none"> ● Key reasons are identified for opting for one type of milk, especially to the detriment of traditional milk. These include economic considerations (cost of acquisition), the concept of "smart pleasure" (accessibility and health benefits), food safety, general health, and the importance of reliable nutritional information. ● Increased marketing of substitutes for traditional milk.
<ul style="list-style-type: none"> ● Boland (2018) ● Harris and James (2017) ● Haug et al (2007) ● Lengua, W, Ortiz, S, Valverde, E, García, Y. and Cantillo, E, (2012) 	<p>These references especially highlight the remarkable profitability of A2 milk production compared to traditional milk. A2 milk has attracted considerable interest in the dairy industry due to its considerable benefits and significant impact on Colombian dairy production, with significant contributions to the country's economy. The compilation of these bibliographic references supports the assertion that A2 milk production not only presents remarkable benefits but is also perceived as a valuable contribution to the Colombian economy, consolidating its position in the industry.</p>	<ul style="list-style-type: none"> ● Health benefits. ● Great value in the market. ● Increased profitability. ● Diversification opportunity. ● Employment generation. ● Growth for the dairy industry. ● Variety and innovation in products.

		<ul style="list-style-type: none"> ● Consumption alternatives.
<ul style="list-style-type: none"> ● Carulla and Ortega (2015) ● García and Gómez (2012). ● Lopez (2019). 	<p>The analysis of the high production costs in the Colombian dairy industry about other Latin American countries has been addressed in depth by reviewing various references. Carulla and Ortega [8], in their study, provide a detailed assessment of the costs associated with milk production in Colombia, highlighting disparities compared to other nations in the region. In addition, Garcia, and Gomez and Lopez [20], have contributed significantly to this analysis, providing valuable information on the specific factors contributing to production costs in the Colombian context. These studies allow for a deeper understanding of the economic challenges facing the dairy industry in Colombia compared to its counterparts in Latin America.</p>	<ul style="list-style-type: none"> ● World average production costs. ● Impact of free trade agreements for the Colombian dairy sector. ● Competitiveness and productivity of the national sector with the rest of the Latin American countries.
<ul style="list-style-type: none"> ● Food magazine (2022) ● Field (2021) ● García and Gómez (2012). ● Food Magazine (2019) ● Vailati, P, Fuentes Cuiñas, A, and Gomis, J, (2022) 	<p>The practice of milk consumption has been ingrained in human life for many years, being recognized as a fundamental source of nutrients. These studies have contributed significantly to the understanding of the nutritional benefits derived from milk consumption. The consultation of these bibliographic sources has made it possible to scientifically address the historical and nutritional role that milk plays in the lives of individuals, consolidating an informed perspective on this crucial aspect of human nutrition.</p>	<ul style="list-style-type: none"> ● Healthy food with nutrients for health. ● Milk consumption is due to consumer interest. ● A general increase in consumption in the world.

CONCLUSIONS AND/OR RECOMMENDATIONS

After a thorough analysis of the state of the art in the Colombian dairy sector, it can be concluded that A2 milk production in Colombia emerges as a highly promising prospect with the potential to exert a positive influence both nationally and internationally. The innovative and efficient capacity of A2 milk can not only attract new consumer segments, fostering an increase in milk consumption at the national level but also has the potential to positively boost both the dairy sector and the agri-food industry in the country. In addition, the human health benefits associated with A2 milk position it as an attractive option for implementation in Colombia, in line with the imperatives of market innovation, sustainability, and consumer welfare.

Diversification of dairy production by incorporating A2 milk can not only generate new market opportunities but also has the potential to improve profitability for producers. Despite these positive aspects, there are notable challenges, such as a lack of awareness among consumers, the high costs associated with beef production, and the lack of political support for the dairy sector. These challenges highlight the urgency of implementing educational campaigns aimed at promoting awareness of the substantial benefits of A2 milk.

In summary, the successful implementation of A2 milk production in Colombia demands an active and synergistic collaboration between the dairy industry, the government, and other relevant stakeholders. Only through this joint effort can a positive socio-economic impact be generated, characterized by a sustained increase in milk consumption, an effective diversification in production, and the offer of a healthy and attractive alternative for consumers. This holistic approach is essential to address existing challenges and fully capitalize on the opportunities that A2 milk presents for the sustainable development of the Colombian dairy sector. It can be concluded that A2 milk production in Colombia is promising for both domestic and international markets. The challenges are a lack of consumer awareness and high production costs. Therefore, successful implementation requires collaboration between the dairy industry, government, and stakeholders.

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