













## Scientific Production on Rennet Cheese: Bibliometric Study, Impact, and Trends in the Web of Science Database

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### Abstract

The objective was to analyze, through a bibliometric review, the evolution of scientific production on coalho cheese, with an emphasis on studies involving goat's milk, as well as its functional and probiotic properties, highlighting research trends, key authors, institutions, and countries active in the field. The chosen database was Web of Science, due to its high relevance in the academic field. The research was conducted during the first week of June 2025, using the terms “coalho cheese” or “rennet cheese” as a topic filter, searching within titles, abstracts, and keywords. The search resulted in a total of 176 documents related to the investigated topic. Of these, the majority consists of articles, totaling 164. Additionally, seven review articles were found, along with one meeting abstract, one note, and five documents classified as procedural papers. The sum of these classifications exceeds the 176 returned documents, which can be explained by the fact that the database assigned multiple classifications to some of them. The predominant language found is English, with 149 documents, followed by Portuguese with 21. There are also two documents in Russian and two in Spanish, as well as one in German and one in Polish. Based on data analysis, research on coalho cheese has expanded significantly in recent decades, with a substantial increase in the number of publications and citations. Brazil stands out as the main research center for this product, reflecting its cultural, economic, and scientific relevance in the country.

**Keywords:** Brazil; coalho; microbiological; traditional.

**Practical Application:** Insights into microbiological safety, nutritional quality, and technological innovation can be used by producers to improve the manufacturing of coalho cheese, ensuring greater food safety and sensory quality.

## 1 INTRODUCTION

Goat rearing represents a low-cost alternative for milk production in developing and underdeveloped countries and is an activity of great socioeconomic importance (Haenlein, 2004). In this context, there is growing consumer demand for cheeses made using traditional methods, whose sensory profiles differ from industrial products, offering unique and highly appreciated characteristics (Hirtz et al., 2025).

Goat's milk and its derivatives have gained prominence among consumers due to their well-known health benefits (Haenlein, 2004). Today's consumers value foods that combine quality, food safety, sensory appeal, and nutritional value (Damázio et al., 2020).

Dairy production is a key economic pillar in various regions, primarily supplying the dairy industry and resulting in a wide array of products. However, a significant portion of the milk is directed toward artisanal cheese production, supporting the development of products with high cultural and regional value (Chaves et al., 2021). In Brazil's Northeast, the most prominent cheeses are rennet and butter cheeses, which play a fundamental role in the region's culture and economy. It is estimated that more than 50% of the region's milk production is used for making artisanal rennet cheese, a traditional practice passed down through generations and a vital source of income for many families (Cavalcante, 2023).

Despite its relevance, the artisanal cheese trade often operates informally, lacking proper regulation and inspection.

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This can lead to the commercialization of products contaminated with microorganisms, antibiotics, or pathogens, raising serious concerns about food safety (Colletta, 2007). Such a scenario compromises nutritional quality and puts consumers' health at risk, contributing to the spread of foodborne illnesses (Viana et al., 2025). This underscores the need for public policies and regulations to ensure the quality and safety of artisanal dairy products.

The objective was to analyze, through a bibliometric review, the evolution of scientific production on coalho cheese, with an emphasis on studies involving goat's milk, as well as its functional and probiotic properties, highlighting research trends, key authors, institutions, and countries active in the field.

### 1.1 Relevance of the work

This study is relevant as it maps the scientific production on coalho cheese, highlighting publication patterns, citations, and emerging themes. It underscores Brazil's leading role in research, driven by cultural and economic factors. The analysis of the most recurrent terms reveals trends such as microbiological safety, nutritional quality, and technological innovation, contributing to the development of the sector.

## 2 MATERIAL AND METHODS

The chosen database was Web of Science, due to its high relevance in the academic field. The research was conducted during the first week of June 2025, using the terms "coalho cheese" OR "rennet cheese" as a topic filter, searching within titles, abstracts, and keywords. Since this type of cheese is still underexplored globally, no time filters were applied, thus selecting all studies available on the platform since its inception, totaling 176 documents. Additionally, all document types were included in

the analysis, with no distinction. The methodology was based on the studies by Melo et al. (2021) and Almeida et al. (2021).

The data were collected in two different ways. First, the "Analyze Results" tool available on the platform was used to obtain information on the most productive countries, publication years, and leading research institutions. To create graphs based on these data, Excel software was employed. Next, to gather data on the most cited journals and countries, the most frequent terms, and the most recent terms, VOSviewer® software (Java version 1.8.0\_261) was used after exporting document data from the platform through the "Export" tool. To ensure accurate data counting, a merger file was created to unify synonyms of the analyzed terms.

## 3 RESULTS

The search resulted in a total of 176 documents related to the investigated topic. Of these, the majority comprised articles, totaling 164. Additionally, seven review articles were found, along with one meeting abstract, one note, and five documents classified as procedural papers.

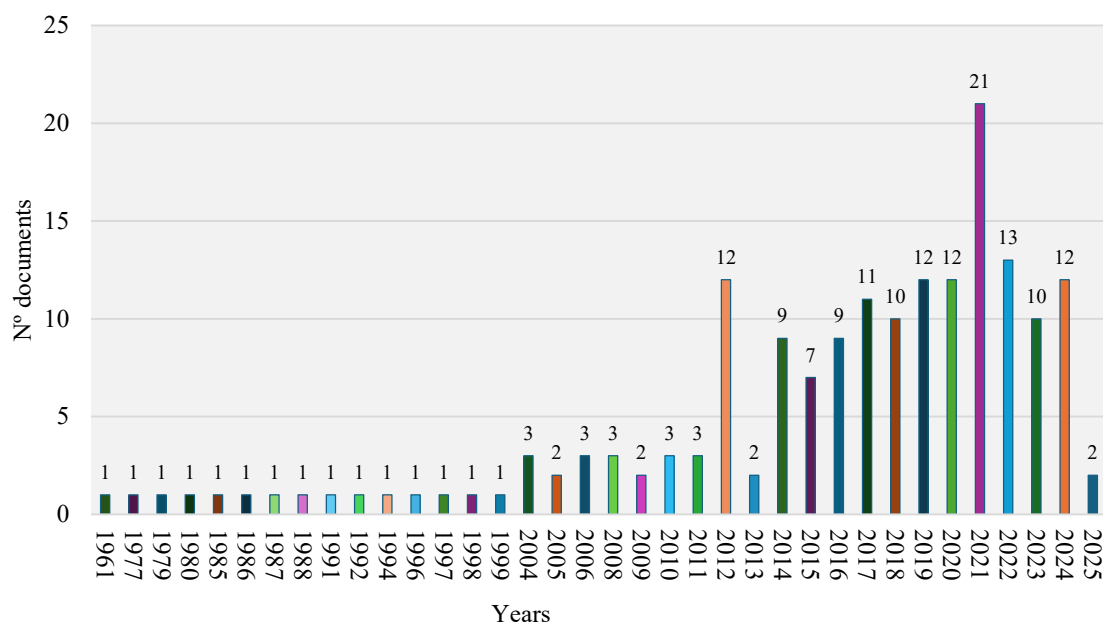
The sum of these classifications exceeds the 176 returned documents, which can be explained by the fact that the database assigned multiple classifications to some of them.

The predominant language found is English, with 149 documents, followed by Portuguese with 21. There are also two documents in Russian and two in Spanish, as well as one in German and one in Polish.

The remaining data are presented in the following sections.

### 3.1 Annual distribution of documents

Studies in this field began in the 1960s, with only one document published per year until 1999 (Figure 1). Entering the



**Figure 1.** Annual distribution of publications on coalho cheese research.

Source: Scopus Data (2025).

new millennium, a slight increase in the number of documents can be observed, ranging between two and three publications per year until 2011.

Starting in 2012, there was a peak in studies, with 12 documents published, followed by a decline in 2013 to only two documents. In the following years, the number of publications exceeded seven per year, reaching a peak in 2021 with 21 publications.

These data indicate a growing trend in research on this product over the decades. It is important to highlight that the peak year (2021) coincided with one of the most impacted periods of the COVID-19 pandemic, which, in some ways, made conducting studies more difficult due to the health crisis. Therefore, the number of publications in 2021 and 2020 could potentially have been even higher.

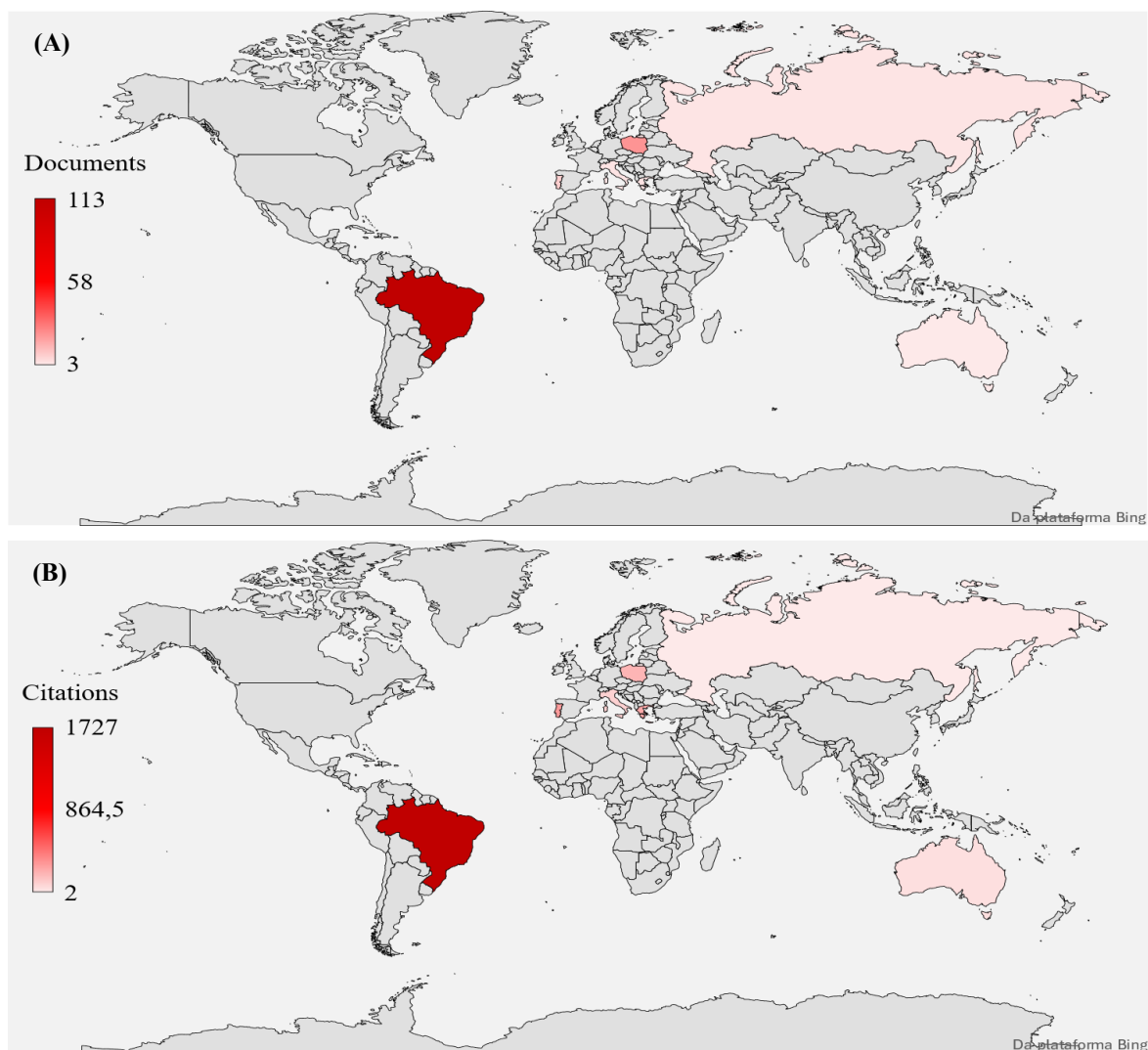
In the current year, only two documents have been published so far, which can be explained by the fact that the year has not yet ended, allowing for the inclusion of new studies in the database.

### 3.2 Most productive and cited countries

A total of 36 countries have published studies on coalho cheese, with only the seven most productive ones presented in the geographic density charts in Figures 2A and 2B, which display the most cited countries.

Brazil is observed to be the most productive country in research on this product, with a citation count proportional to its productivity. It leads in both aspects, being the most cited with 1,727 citations and the top producer of coalho cheese research with 113 documents.

Poland follows with 23 documents and 194 citations, while Portugal, despite having only nine documents, shows a significant volume of 286 citations compared to other countries. Greece and Italy, both with four documents, have 233 and 87 citations, respectively. Meanwhile, Russia and Australia present more modest numbers: Russia has four documents and only two citations, whereas Australia records three documents and 37 citations.



**Figure 2.** (A) Top seven most productive countries and (B) their citations.

Source: Web of Science data, created by the authors (2025).

### 3.3 Most productive research institutions on rennet cheese

The data highlight Brazil's leadership in coalho cheese research, with all 10 most productive institutions being Brazilian (Figure 1 and Table 1). This dominance may be linked to the cultural and historical significance of coalho cheese in the country, as well as its well-developed research infrastructure in food technology and dairy science.

This significant production suggests a high level of specialization, possibly driven by agricultural and technological advancements aimed at improving dairy production and coalho cheese quality. Additionally, research is not concentrated in a single region but rather distributed among multiple academic centers in Brazil, indicating a strong potential for collaboration among Brazilian institutions.

**Table 1.** Most productive Brazilian institutions.

Institutions	Docs	Country
<b>Empresa Brasileira de Pesquisa Agropecuária</b>	22	Brazil
Universidade Federal da Paraíba	22	Brazil
<b>Universidade Federal Rural de Pernambuco</b>	21	Brazil
Universidade Estadual de Campinas	16	Brazil
Universidade Federal de Pernambuco	16	Brazil
Universidade Federal de Campina Grande	9	Brazil
EMBRAPA Tropical Agroindustry	7	Brazil
Universidade Federal de Viçosa	7	Brazil
Universidade Federal do Ceará	7	Brazil
Universidade Federal Fluminense	7	Brazil

Source: Web of Science (2025).

This distribution may encourage multidisciplinary approaches in coalho cheese studies, fostering greater integration between different fields of knowledge and strengthening scientific and technological innovation in this sector.

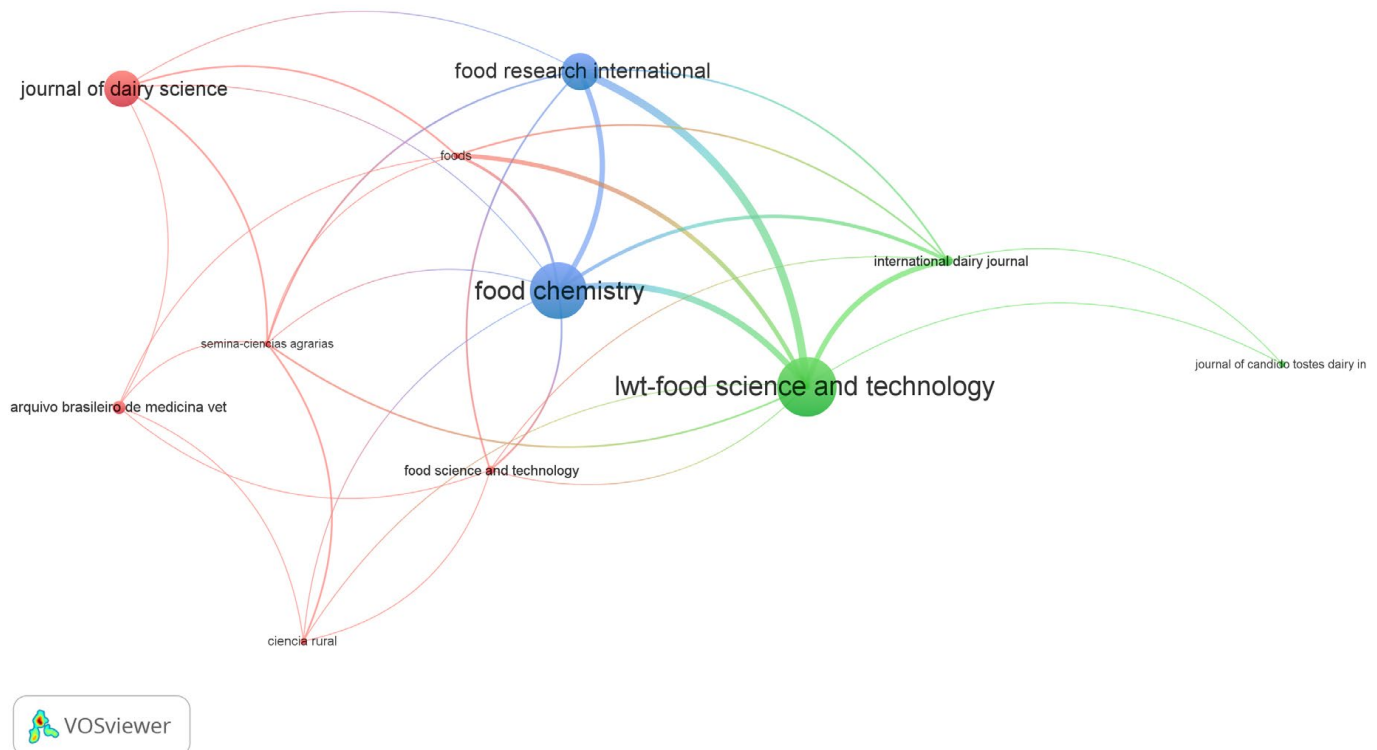
### 3.4 Most impactful journals in terms of citations on this topic

It is observed that the most frequently cited journal in this subject area is *LWT – Food Science and Technology*, with 282 citations, followed by *Food Chemistry* with 268, *Food Research International* (179), and the *Journal of Dairy Science* (174). These are considered the most relevant and high-impact journals in this thematic area. Other journals also appear, though with fewer citations, with a notable presence of some Brazilian publications (Figure 3).

The *Arquivo Brasileiro de Medicina Veterinária* stands out with 64 citations, followed by the *International Dairy Journal* (50), *Food Science and Technology* (40), *Foods* (29), *Semina – Ciências Agrárias* (10), *Ciência Rural* (18), and the *Journal of Candido Tostes Dairy Institute*, which completes the list of the 11 most cited journals, with two citations.

The figure uses circles to represent the quantitative density of citations per journal, while the thickness of the connecting lines reflects the number of co-citations between journals.

Journals serve as the primary vehicles for disseminating research, which may indicate that studies on coalho cheese maintain a high methodological rigor and have a significant impact on the scientific community. Additionally, their



**Figure 3.** Top 11 most cited journals in coalho cheese research.

Research Source: Created by the author in VOSviewer using data from Web of Science (2025).

publication in these journals can promote greater internationalization of research, increasing visibility and collaboration with foreign institutions.

Another relevant aspect is the analysis of co-citation patterns, represented by the links in the figure. The thickness of these links reflects the connection between studies and may indicate research trends, such as specific focuses on microbiology, food safety, technological properties, and nutritional aspects of coalho cheese. This suggests a consolidated dialog between different areas of study within the topic, which can enrich future investigations and foster more integrated approaches.

### 3.5 Most frequent and recent terms in studies on coalho cheese (2012–2025)

The author keywords selected in VOSviewer were analyzed, totaling 493 terms (Figure 4). From these, a selection was made based on a minimum occurrence criterion of three, resulting in 31 terms. After identifying synonyms and using the thesaurus file, as well as eliminating more general terms such as “dairy products,” “cheeses,” and “coalho cheese,” as done by Almeida et al. (2021), the number was reduced to 25 terms.

Figure 4 presents the most frequent terms in this field over the past 13 years of studies on coalho cheese. The circles reflect the density of term occurrences, the links represent interactions between them, and the colors indicate the temporal distribution across the analyzed years.

Through this analysis, it was possible to identify the most recent terms within the researched topic.

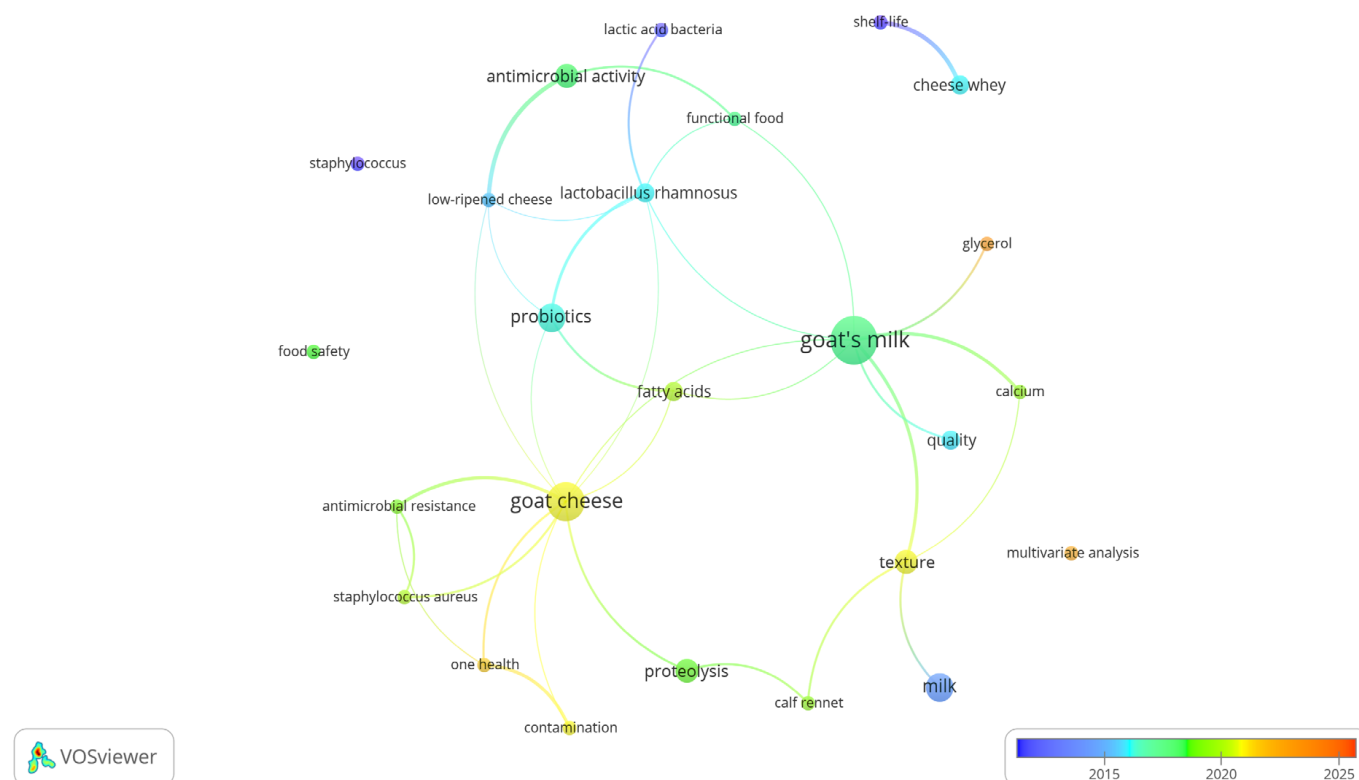
Among the most recurrent terms are “goat’s milk” (10 occurrences), “goat cheese” (eight occurrences), “probiotics” and “milk” (six occurrences each). Additionally, “antimicrobial activity,” “texture,” and “proteolysis” stand out among the most frequent, with five occurrences each. The remaining terms appear with lower frequency.

There is also a notable interaction between studies on goat cheese and microbiota, as indicated by terms related to “goat cheese,” including microbial resistance and *Staphylococcus aureus*, which is the microorganism of greatest interest in this type of cheese. Furthermore, terms such as “health” and “contamination” reinforce the interest in the microbiological safety of goat coalho cheese.

Additionally, terms such as “probiotics” and “proteolysis” indicate nutritional and technological aspects of goat cheese.

Moreover, studies focused on raw materials were also identified as the most recurrent, specifically goat milk. Terms such as “antimicrobial activity,” “functional food,” “calcium,” “texture,” “quality,” and “probiotics” suggest a focus on the functional properties and health benefits of goat milk.

Other terms, such as “*Lactobacillus rhamnosus*,” “probiotics,” and “low-ripened cheese,” highlight studies aimed at the development of cheeses with probiotic properties.



**Figure 4.** Temporal overlay visualization of term occurrence in coalho cheese research from 2012 to 2025.

Source: Created by the author in VOSviewer using data from Web of Science (2025).



## 4 DISCUSSION

The analysis of the most productive and cited countries in coalho cheese research reveals Brazil's strong dominance in scientific production on the topic. With 113 published documents, the country accounts for 64.2% of the total publications. Additionally, it leads in citations, with 1,727 references, corresponding to 66.3% of the total. This prominence can be attributed to Brazil's tradition in coalho cheese production and consumption, as well as its investment in agri-food research.

The distribution of studies and citations highlights Brazil's predominance in coalho cheese research but also underscores the relevance of European countries whose studies have a significant impact. This analysis can be further explored by investigating factors such as collaborative networks between universities, research funding, and the relevance of the journals where these studies are published.

Journals serve as the primary vehicles for disseminating research, which may indicate that studies on coalho cheese maintain a high methodological rigor and have a significant impact on the scientific community. Additionally, their publication in these journals can promote greater internationalization of research, increasing visibility and collaboration with foreign institutions.

Another relevant aspect is the analysis of co-citation patterns, represented by the links in the figure. The thickness of these links reflects the connection between studies and may indicate research trends, such as specific focuses on microbiology, food safety, technological properties, and nutritional aspects of coalho cheese. This suggests a consolidated dialog between different areas of study within the topic, which can enrich future investigations and foster more integrated approaches.

The analysis of the most frequent and recent terms in studies on coalho cheese reveals important trends in academic research on the topic. The selection and filtering of terms allowed for the identification of key concepts that have guided investigations over the past 13 years. There is a strong emphasis on goat milk and its derivatives, with terms such as "goat's milk" and "goat cheese" appearing among the most recurrent. This suggests a growing interest in the composition and properties of goat milk, possibly driven by its distinct nutritional characteristics and its relevance in the production of artisanal cheeses.

Additionally, the emergence of terms such as "probiotics," "antimicrobial activity," and "proteolysis" points to a focus on the functional and technological aspects of coalho cheese. The presence of probiotics in cheese formulations may be associated with the development of healthier and more functional products, while antimicrobial activity relates to research on food safety and product preservation.

Another relevant point is the interaction between microbiota and goat cheese, evidenced by terms linked to "goat cheese," such as "microbial resistance" and "*Staphylococcus aureus*." This connection reflects an interest in understanding the relationship between microorganisms present in cheese and its food safety. Studies on contamination and microbial resistance are essential to ensure product quality and meet regulatory requirements.

Finally, the presence of terms such as "functional food," "calcium," "texture," and "quality" suggests a focus on enhancing the sensory and nutritional properties of coalho cheese, indicating a research direction aimed at meeting consumer demands and improving product quality. This set of information demonstrates that the field of coalho cheese studies is evolving toward more multidisciplinary approaches, incorporating nutritional, technological, and microbiological perspectives. The continuous refinement of these studies may contribute to innovations in the production, safety, and functionality of this type of cheese.

Regarding the most recent terms, which highlight a certain academic path of interest, "glycerol" stands out. The study by Leandro et al. (2021) investigated films developed with different concentrations of glycerol applied to coalho cheese to evaluate their physicochemical and microbiological characteristics.

The study by Andrade et al. (2024) analyzed the impact of the gradual dietary inclusion of crude glycerin on the productive characteristics of dairy goats and the quality of their milk and cheese. Meanwhile, the study by Freire et al. (2022) examined the impact of bidistilled glycerin supplementation on the quality of goat milk and cheese.

Another recent term presented is "multivariate analysis," as seen in the study by Margalho et al. (2020), which researched 220 isolates of *Lactobacillus sp.* from Brazilian artisanal cheeses. The study evaluated their technological, biopreservative, and safety potential, correlating the data with their geographical origin through multivariate analysis.

Additionally, other recent terms appear in prominence, especially those related to coalho-type goat cheese and its aspects concerning microbiological, technological, and nutritional safety.

## 5 CONCLUSIONS

Based on data analysis, research on coalho cheese has expanded significantly in recent decades, with a substantial increase in the number of publications and citations. Brazil stands out as the main research center for this product, reflecting its cultural, economic, and scientific relevance in the country. Additionally, the predominance of Brazilian institutions among the most productive reinforces the country's role in innovation and technological development related to coalho cheese.

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