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The global patent landscape of cheesemaking: analysis of recent trends

Abstract

This article presents a retrospective analysis of global trends in cheesemaking based on patent activity over the period 2004-2024. The study was conducted using patent databases from 18 countries and relevant International Patent Classification (IPC) codes covering various aspects of cheese production. The findings indicate that the United States, Japan, and China are the leaders in the number of patent documents, with China demonstrating exponential growth in patent activity. The specific nature of the Chinese market is revealed, where, alongside local companies and universities, foreign corporations are also actively filing patents. The main trend over the past two decades is the shift in the center of innovative activity in cheesemaking towards the Asia-Pacific region, primarily China.

Keywords: biotechnology, cheesemaking, innovations, patent search, trends

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Introduction

The modern food industry, particularly the cheesemaking sector, is undergoing a period of profound transformation driven by the globalization of markets, shifting consumer preferences towards healthy eating, and the need to adopt resource-efficient technologies. Cheesemaking, as an important sector of the agro-industrial complex, contributes significantly to the economy of many countries and plays an important role in ensuring food security. In this context, the capacity for innovation has become a key factor in the competitiveness of both individual companies and entire countries.[1-3] However, traditional approaches to assessing technological development, based on data about production capacity or sales volumes, often fail to capture nascent technologies that will define the future of the industry.[4]

Patent information, as one of the most objective indicators of technological advancement, provides a unique opportunity for such forward-looking analysis.[5,6] Unlike scientific publications, patents are directly aimed at commercialization, and their landscape reflects not only scientific but also the market and strategic interests of the players. Despite the long history of cheesemaking in Europe and North America, the shift of innovative activity to new centers[7] remains understudied in academic literature. The existing gap lies in the lack of comprehensive retrospective studies that would quantitatively and qualitatively describe this dynamic on a global level over an extended period.

Therefore, the relevance of this study is determined by the need for a systematic analysis of the changing geography of innovation in cheesemaking, identifying new centers of technological development, and understanding the strategies of key players. The results of this work will enable producers, investors, and policymakers to make more informed strategic decisions in a rapidly changing global competitive environment.

The aim of this study was a retrospective analysis and structuring of the global patent landscape in cheesemaking to identify key trends, geographical centers of innovative activity, and major players over the past 20 years.

Patent analysis is recognized as one of the most objective tools for assessing the state and dynamics of technological fields. A retrospective analysis of patent documents not only helps to identify established trends and patterns but also to pinpoint promising research directions, thereby minimizing the risks of duplicating developments and optimizing research activities.

Methodology

The research methodology involved a retrospective search and analysis of patent documents over a 20-year period (from January 1, 2004, to December 31, 2024). The search was conducted using relevant International Patent Classification (IPC) codes related to the biotechnological aspects of cheesemaking, namely: A23C 19/00, 19/02, 19/024, 19/028, 19/032, 19/04, 19/045, 19/05, 19/055, 19/06, 19/064, 19/068, 19/072, 19/076, 19/08, 19/082, 19/084, 19/086, 19/09, 19/093, 19/097, 19/10, 19/11, 19/14, 19/16. To ensure data representativeness, the search was performed across patent databases from 18 countries representing the world's main centers of cheese production and consumption Table 1. Russia was selected as a reference level for comparative analysis.

Table 1 Countries of search

Australia	Spain	USA
Austria	Italy	Ukraine
Belarus	China	Finland
Great Britain	Netherlands	France
Germany	New Zealand	Switzerland
Denmark	Russia	Japan

The search for patent information was conducted in the databases of the European Patent Office (worldwide.espacenet.com); for Belarusian patents, the databases of the National Center of Intellectual Property (www.belgospatent.org.by) were used. The esp@*cenet* patent information network, created by the European Patent Office, provides access to the worldwide patent information database and patent collections of various countries and international organizations. Russian patent documents were searched using the information retrieval system of the Federal Institute of Industrial Property (www1.fips.ru).

The obtained data array was processed using quantitative (statistical) methods and selective qualitative analysis of patent metadata (applicant affiliation and category). The analysis was conducted in two stages: first, the overall picture and geographical distribution of patent activity were assessed, and then a detailed study of the sample of Chinese patents was carried out.

Results and discussion

An information array for analysis was obtained. Subsequently, we identified which countries had the highest number of patent documents in the field of cheesemaking over the past 20 years. For this purpose, the total number of such patent documents (across all countries, over 20 years) was taken as 100%, and each country's share of this total was calculated. According to the obtained data (the figures are estimates calculated by the authors based on the conducted search), the largest contribution to innovations was made not by the countries with long-standing cheesemaking traditions (France, Switzerland, Italy, Denmark, Finland, Netherlands, Great Britain). Ukraine and Belarus also show modest results. The largest shares were held by the USA (18%), Japan (15%), China (9%), Australia and New Zealand (13% and 5% respectively), Germany (9%), Russia (7%), Spain and Austria (6% each).

The obtained data demonstrate a shift in the centers of innovative activity in cheesemaking from traditional European countries to the USA and the Asia-Pacific region (APR), particularly Japan and China. To explain this dynamic, the following hypothesis can be proposed. In traditional cheesemaking nations (France, Switzerland, Italy), many technologies are well-established and are protected primarily through geographical indications and trade secrets (know-how), which does not require active patenting. At the same time, leading international corporations holding patents often enter APR markets through licensing agreements.

For a more objective assessment of innovative activity, a comparative analysis of the number of potential inventors/applicants relative to the population size was conducted. Based on official data (United Nations, Department of Economic and Social Affairs, World Population Prospects 2022) on population size, we compiled Table 2. Thus, among the countries active in the cheese industry, only the USA and China exceed Russia in population size, while Japan is close. All other countries (Australia, Germany, Spain, Austria) are much smaller. For instance, Germany's population is almost half that of Russia, yet the number of patent documents obtained in Germany over the past 20 years is almost equal to that in the Russian Federation.

Table 2 Population comparison (based on UN data for 2024)

Country	Population, thousand people	Population, as % of Russia's
USA	345 082	238
Japan	122 631	85
China	1 425 178	984
Australia	26 699	18
Germany	83 252	57
Russia	144 867	100
Spain	47 473	33
Austria	8 977	6

In recent years, China has been leading by a wide margin in the number of patent documents in the field of cheesemaking. Let us examine the Chinese phenomenon more closely. Over the past 20 years, China has demonstrated exponential growth in patent activity in cheesemaking.

For a more detailed analysis of this trend, all patent documents filed in China over 20 years under the «cheesemaking» IPC codes were selected. The resulting array was converted into a table with column headings: Patent Document Title, Publication Number, Publication Date, Applicant. Due to the large volume of the table (over 20 pages), it is not provided here. Based on the analysis of this table, applicants were grouped by nationality.

Judging solely by the nationality of the applicants, the leading role in patenting in China belongs to firms from the USA and Japan, followed closely by the Netherlands and Denmark. Applicants from Switzerland, New Zealand, France, and Germany hold approximately the same number of patent documents. The most frequent applicants are the following companies (in descending order): «Kraft Foods Inc.» (USA, split into two companies in 2012 – «Mondelez International» and «Kraft Heinz Company»), «DSM IP Assets B.V.» (Netherlands), «Meiji Dairies Corporation» (Japan, after 2009 – «Meiji Co., Ltd.»), «Nestle S.A.» (Switzerland), «Danisco» (Denmark, acquired by the American corporation «DuPont» in 2011 and later integrated with «International Flavors & Fragrances»), and «Fonterra» (New Zealand). An interesting trend is that applicants from the Netherlands, Denmark, Switzerland, France, and New Zealand more often prefer to obtain patents in China than in their home countries.

The exponential growth of China's patent activity in cheesemaking is a direct consequence of targeted state policy. An important turning point was the nationwide program initiated in 1999 aimed at popularizing milk consumption among children. Subsequently, the Chinese government continued to provide extensive support to the domestic dairy market, including subsidizing the production of scarce raw milk. The result was an increase in milk production volume in the country by ~20% annually, allowing China, which was not a significant player in the dairy market at the end of the 20th century, to enter the top three world leaders (alongside the USA and India). This transformation created a powerful incentive for the development of related technologies, including cheesemaking, and led to a boom in both production and innovation activities. China is making significant bets on self-sufficiency and technological sovereignty in key industries, including food.

China has not only started to produce and consume a colossal amount of milk but also to show substantial activity in patenting its developments. Approximately half of the applicants in Chinese patent documents are Chinese. They can be divided into two main groups. The first is Chinese companies that are leaders in milk production and processing, and the second is educational institutions. Let us briefly focus on the applicants from the first group. The largest number of patent documents belongs to «Bright Dairy & Food Co., Ltd» (www.brightdairy.com). This company is one of the largest Chinese dairy producers. The Chinese company «China Mengniu Dairy Company Limited» and its subsidiaries are also one of the leading dairy product manufacturers in China, with «Mengniu» as the main brand (www.mengniu.com.cn). A large number of patents list «Inner Mongolia Yili Industrial Group Co., Ltd» (www.yiligroup.com.cn) as the applicant. Among Chinese universities, the following applicants stand out in terms of the number of patent documents (in descending order): Tianjin University of Science & Technology, Shanghai University of Science and Technology, Jiangnan University, China Agricultural University, Northeast Agricultural University, Gansu Agricultural University, Yunnan Agricultural University.

Research limitations

The conducted analysis reflects quantitative trends, which is a standard first step in studying a patent landscape; a separate study analyzing the content of patent documents is required to assess the quality and technological significance of these innovations.

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Conclusions

1. The analysis of patent landscapes across 18 countries over a 20-year period has identified new leaders in the field of cheesemaking. At the current stage, the key centers of innovation are the USA, China, and Japan, which must be considered when conducting patent research and analyzing the state of the art in this industry. The list of leading countries also includes Australia, Germany, Spain, and Austria.
2. The most significant trend is the exponential growth in the number of patent applications in China. This phenomenon is driven by targeted state policy aimed at developing the domestic dairy market and China's transformation from a net importer into one of the world leaders in the production and consumption of dairy products.
3. Patent activity in China is characterized by a dual structure: on one hand, there are large national dairy processing enterprises and universities, and on the other, leading international corporations that often prefer to patent their developments specifically in the Chinese market, indicating its strategic importance. A significant portion of Chinese applicants are large dairy processing enterprises, indicating a high degree of research commercialization and an intention to implement patented innovations into real production.
4. Countries with historically established cheesemaking traditions (such as France, Switzerland, Italy) demonstrate relatively low patent activity, which can be explained by their use of other mechanisms for protecting intellectual property (know-how, geographical indications) and licensing business models.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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