

Technological Prospecction of Industrial Uses of Turmeric: evidence and trends in food and pharmaceuticals (2005-2025)

Prospecção Tecnológica dos Usos Industriais da Cúrcuma: evidências e tendências em alimentos e fármacos (2005-2025)

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Abstract

This article presents a technological foresight study on the industrial uses of turmeric (*Curcuma longa* L.), focusing on the food and pharmaceutical sectors, based on an analysis of patent filings between 2005 and 2025 from the Espacenet and INPI databases. A significant increase in the number of patents was observed over the past two decades, with emphasis on applications in subclasses A61K and A23L of the International Patent Classification. The formulations include therapeutic preparations, functional foods, beverages, cosmetics, oils, and bioactive packaging. China leads the number of filings, highlighting its strategic interest in the industrial development of the species. In Brazil, despite its agronomic potential and biodiversity, the technological exploitation of turmeric remains incipient. Trends indicate a growing emphasis on functionality, sustainability, and application in innovative niches such as nanotechnology, sports nutrition, and smart packaging. The results suggest promising opportunities for advancing a natural product-based bioeconomy.

Keywords: *Curcuma Longa*; Technological Prospecction; Bioeconomy.

Resumo

Este artigo apresenta um estudo de prospecção tecnológica sobre os usos industriais da cúrcuma (*Curcuma longa* L.) com foco nos setores alimentício e farmacêutico, a partir da análise de depósitos de patentes realizados entre 2005 e 2025 nas bases Espacenet e INPI. Observou-se um crescimento expressivo no número de patentes ao longo das últimas duas décadas, com destaque para aplicações nas subclasses A61K e A23L da Classificação Internacional de Patentes (CIP). As formulações abordadas envolvem preparações terapêuticas, alimentos funcionais, bebidas, cosméticos, óleos e embalagens bioativas. A China lidera os depósitos, evidenciando o interesse estratégico pelo desenvolvimento industrial da espécie. No Brasil, embora haja potencial agrônomo e biodiversidade, a exploração tecnológica da cúrcuma ainda é incipiente. As tendências indicam crescente valorização da funcionalidade, sustentabilidade e aplicação em nichos inovadores como nanotecnologia, nutrição esportiva e embalagens inteligentes. Os resultados sugerem oportunidades promissoras para o avanço da bioeconomia baseada em produtos naturais.

Palavras-chave: *Curcuma Longa*; Prospecção Tecnológica; Bioeconomia.

Technological Areas: Intellectual Property and Technological Innovation.



1 Introduction

Curcuma longa L., commonly known as turmeric, is a perennial herbaceous plant belonging to the Zingiberaceae family, widely recognized for its aromatic, coloring, and medicinal properties. Native to South Asia, its rhizomes have been used for more than six millennia in traditional Ayurvedic medicine and were subsequently introduced into various regions of the world, including Europe and, more recently, Brazil, where they became incorporated into dietary and phytotherapeutic practices (Cecílio Filho *et al.*, 2000; Marchi *et al.*, 2016; Naghetini, 2006).

The plant's primary bioactive compound is curcumin, an intensely yellow polyphenol that accounts for up to 77% of the curcuminoid fraction. In addition to curcumin, *C. longa* contains demethoxycurcumin, bisdemethoxycurcumin, and essential oils rich in sesquiterpenes such as ar-turmerone and zingiberene, which are responsible for many of its therapeutic and sensory properties (Dosoky; Setzer, 2018; Silva *et al.*, 2016). These compounds have demonstrated antioxidant, anti-inflammatory, antimicrobial, hypocholesterolemic, and immunomodulatory activities, which explains the growing interest in turmeric across multiple industrial sectors (Santos *et al.*, 2021; Rajasekaran, 2011; Wientarsih; Chakeredza; Meulen, 2002).

Although historically used as a spice and natural colorant, turmeric has attracted considerable attention from the pharmaceutical, cosmetic, and food industries over recent decades. This expansion of applications is associated with the increasing demand for natural, sustainable, and functional products, in line with global trends focused on health, well-being, and responsible consumption (Marchi *et al.*, 2016; Muniz *et al.*, 2013; Nguyen; Govindasamy; Mentreddy, 2024). The rise of functional foods and integrative medicine has further promoted the incorporation of plant-derived bioactive ingredients into innovative formulations, extending the scope of turmeric applications far beyond its traditional uses.

At the same time, advances in biotechnology and nanotechnology have facilitated the development of optimized formulations capable of overcoming limitations such as the low bioavailability of curcumin. Strategies including microencapsulation, micellar systems, phospholipid complexation, and controlled-release delivery systems have demonstrated effectiveness in enhancing the therapeutic potential of turmeric, thereby supporting its application in pharmaceutical, food, and cosmetic products (Dulbecco; Savarino, 2013; Silva *et al.*, 2016).

The dynamism observed in applied research has been accompanied by a significant increase in the number of patent filings involving *C. longa*. Countries such as China, Japan, South Korea, and the United States, although not all major agricultural producers of the plant, stand out as

leaders in turmeric-based innovations. India, in addition to being the world's largest producer, has institutionalized the promotion of turmeric through the establishment of the National Turmeric Board, aimed at fostering research, certification, and exports of the species (IBEF, 2023; Tian *et al.*, 2025).

In Brazil, production remains relatively modest, although the potential for expansion is considerable. The inclusion of turmeric in the National List of Medicinal Plants of Interest to the Brazilian Unified Health System (ReniSUS) highlights its recognition as a strategic resource for the development of public policies related to health and biodiversity (Brazil, 2020). States such as Goiás, Espírito Santo, and São Paulo have established production systems, and studies indicate both technical and economic feasibility for expanding the national production chain (Milhomem; Teixeira, 2007).

Nevertheless, Brazil's technological engagement in this field remains limited, particularly with regard to the development of innovative formulations and patent registrations. This gap may be attributed to structural barriers such as weak integration between academia and industry, limited incentives for intellectual property protection, and insufficient processing infrastructure (Guimarães; Evaristo; Ghesti, 2021). Therefore, investment in strategies that promote innovation, value addition, and international competitiveness is essential.

Patent document analysis has emerged as a strategic tool for understanding the technological development stage of a given asset. Through the International Patent Classification (IPC) system, it is possible to identify the most dynamic industrial sectors, the most recurrent formulation types, and the countries with the highest inventive activity (WIPO, 2025a; EPO, 2025). Classes A23 (foods), A61 (medical and cosmetic preparations), and C11 (chemical products) account for the majority of patent records associated with turmeric, highlighting its technological versatility.

Despite the extensive body of available information, studies that systematically examine the industrial applications of turmeric through patent analysis remain scarce. This gap limits the ability to anticipate technological trends, support strategic planning, and formulate public policies aimed at enhancing biodiversity-based innovation. The present study seeks to address this deficiency through a prospective approach based on the analysis of patents filed between 2005 and 2025 in the Espacenet and INPI databases.

The objective of this study is to provide a systematic overview of the industrial applications of turmeric, with particular emphasis on its use in the food and pharmaceutical sectors. The investigation aims to identify the most active countries and institutions, the most promising technological fields, and strategic opportunities for Brazil, thereby

contributing to the strengthening of sustainable production chains driven by innovation and national biodiversity.

2 Methodology

This is an exploratory study employing both quantitative and qualitative approaches, grounded in technological prospecting through patent analysis. This methodological choice is based on the relevance of patent documents as indicators of inventive activity and technological innovation, as they directly reflect the research and development efforts of institutions, companies, and countries in strategic fields (Guimarães; Evaristo; Ghesti, 2021).

Data collection was conducted in April 2025 using two specialized databases: Espacenet, maintained by the European Patent Office (EPO), and the search portal of the Brazilian National Institute of Industrial Property (INPI). The Espacenet database provides access to more than 150 million patent documents from various countries, whereas INPI contains patent applications filed within Brazilian territory. Both platforms were selected because of their broad coverage, accessibility, and compatibility with refined search strategies.

The initial stage of the study consisted of defining the keywords and search criteria. First, the term “turmeric” was searched across all text fields in the Espacenet database in order to capture the largest possible number of documents mentioning the plant. Subsequently, the search was restricted to the title and abstract fields to identify documents whose technological focus was specifically centered on turmeric. This strategy enabled the identification of the most relevant records while excluding superficial or secondary mentions.

A more targeted approach was then applied by combining the term “turmeric” with the subclasses of Class A23 of the International Patent Classification (IPC), which encompasses technologies related to food products and beverages. The time frame considered was from 2005 to 2025 (with 2025 representing an incomplete year at the time of publication), a period selected because it covers two decades marked by the expansion of research on natural ingredients, advances in nanotechnology, increasing demand for functional products, and the implementation of innovation policies on a global scale.

A similar strategy was adopted for the INPI database. Searches were conducted using the term “turmeric” in the title and abstract fields, and all available records filed between 2005 and 2025 were collected. This approach enabled a comparative analysis between the Brazilian scenario and the international landscape identified through the Espacenet database.

The analysis of the collected data encompassed the following aspects: the temporal evolution of patent filings, the leading applicant countries, the distribution of documents across IPC classes and subclasses, the identification of the main applicants (companies, universities, and research centers), and the categorization of the technologies described according to their industrial application, including food, pharmaceutical, cosmetic, and other sectors. Particular attention was given to Brazilian patent documents in order to understand the profile of domestic innovations and identify specific patterns.

In addition to the descriptive analysis, a qualitative interpretation of the data was carried out through the examination of patent abstracts and classifications, with the aim of identifying emerging technological trends, synergies with other fields of knowledge, and opportunities for the application of turmeric in innovative market niches. This critical assessment made it possible to understand the maturity level of the technologies, the challenges associated with their application, and the competitive advantages of the formulations.

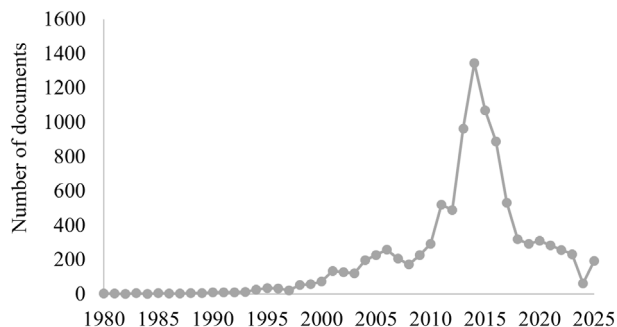
The data were organized into spreadsheets and graphical representations to facilitate trend visualization and support analytical interpretation. The interpretation of the results was based on the theoretical framework of the technological prospecting literature (Guimarães; Evaristo; Ghesti, 2021) and on technological innovation life cycle models (Andersen, 2000).

3 Results and Discussion

Analysis of the data extracted from the Espacenet database revealed approximately 9,901 patent documents containing direct references to “turmeric” in the title or abstract fields. When the term was searched throughout the full text of patent documents, the number exceeded 25,000 records, reflecting the extensive presence of the genus *Curcuma* in technological innovations. The annual evolution of patent filings shows a marked increase beginning in the 1990s, reaching a peak in 2013 with 1,343 documents, followed by a gradual decline from 2015 onward, culminating in only three records in 2024 (Figure 1).

This pattern follows the classical S-curve model, which describes the life cycle of technological innovation (Andersen, 2000). The period between 2005 and 2015 concentrated the highest volume of innovations, particularly those related to functional foods and phytotherapeutic products. The subsequent decline in patent filings may be attributed to the consolidation of key technologies and the need for new approaches capable of overcoming the limitations of conventional formulations, as well as the time required for patent examination and publication processes. Furthermore, a trend toward increasing specialization

Figure 1 – Annual evolution of granted patents related to turmeric according to the Espacenet database



Source: Prepared by the authors

can be observed, with patents becoming more complex and strategically oriented within the current technological landscape.

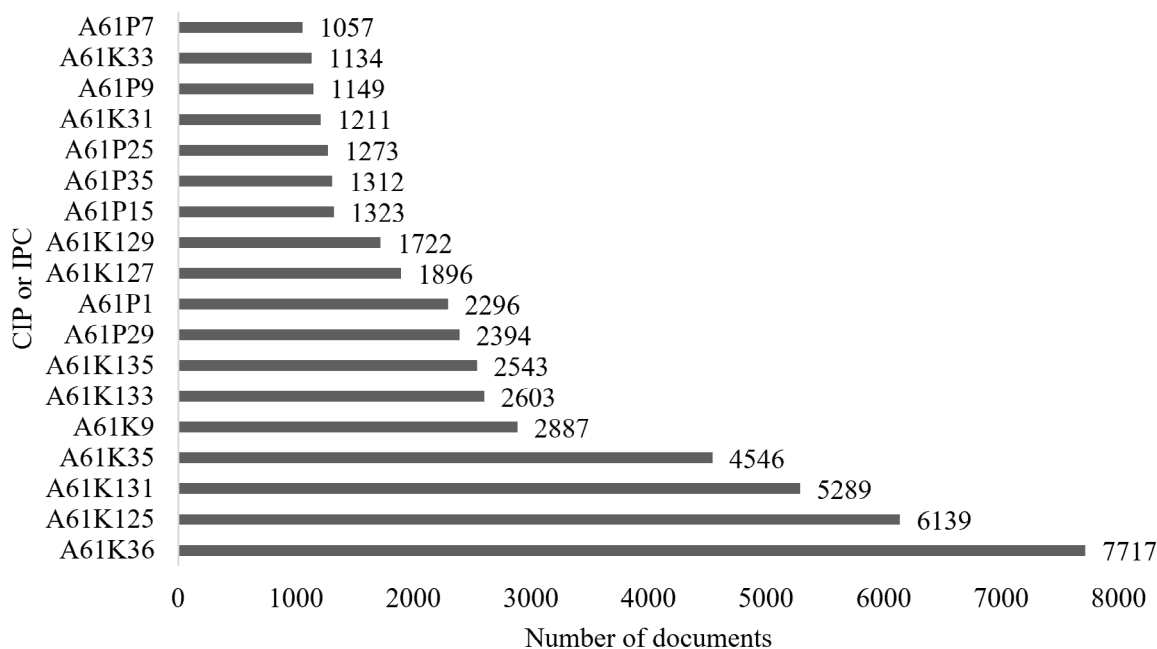
The classification of patent documents according to the International Patent Classification (IPC) system revealed the predominance of subclasses A61K and A61P, both associated with the pharmaceutical sector (Figure 2). Subclass A61K36, which encompasses medicinal preparations containing plant-derived extracts, accounted

for the largest share of the records. This trend reinforces the prominent role of *Curcuma longa* as a bioactive ingredient in formulations intended for the prevention and treatment of conditions such as chronic inflammation, metabolic disorders, and gastrointestinal diseases.

Several patents describe formulations combining turmeric with other bioactive compounds, including omega-3 fatty acids, vitamin C, resveratrol, and phenolic compounds, indicating a clear trend toward the development of multifunctional products. Applications were also identified in dermatological formulations for the treatment of acne, skin lightening, and wound healing, further expanding the scope of the plant’s industrial applications.

Class A61, which encompasses medicine and hygiene, accounted for the largest number of patent records, particularly through subclasses A61K and A61P. Subclass A61K36 concentrates phytotherapeutic formulations containing turmeric-derived bioactive compounds such as curcumin, bisdemethoxycurcumin, and essential oils. These formulations have been applied in the treatment of inflammatory conditions, neurodegenerative diseases, metabolic disorders, and oncological pathologies, employing technologies such as nanoencapsulation, lipid emulsions, liposomes, and phospholipid complexation to overcome the low oral bioavailability of curcumin (Dulbecco; Savarino, 2013).

Figure 2 – Main patent classifications related to turmeric identified in the Espacenet database



Source: Prepared by the authors

Notable examples include patent WO2019002173A1, which proposes a composition containing curcumin and resveratrol for the treatment of rheumatoid arthritis; CN109746365A, which describes curcumin nanoparticles with antitumor activity; and WO2019183736A1, focused on neuroprotection in Alzheimer’s disease. Other patents, such as WO2020179565A1, propose antiviral applications in oral sprays, whereas US20220064614A1 combines curcumin with coenzyme Q10 for the prevention of cardiovascular diseases. Subclass A61P, which covers specific therapeutic activities, further reinforces the role of turmeric in health promotion and wellness systems, extending beyond the direct treatment of diseases. Nutritional supplements, therapeutic cosmetics, and formulations combining turmeric with ginger, black pepper, and green tea are also frequently observed.

These findings confirm the positioning of *Curcuma longa* as a multifunctional raw material with high value for the pharmaceutical, nutraceutical, and cosmetic industries, highlighting its versatility and potential for integration into diverse health- and wellness-oriented technological platforms.

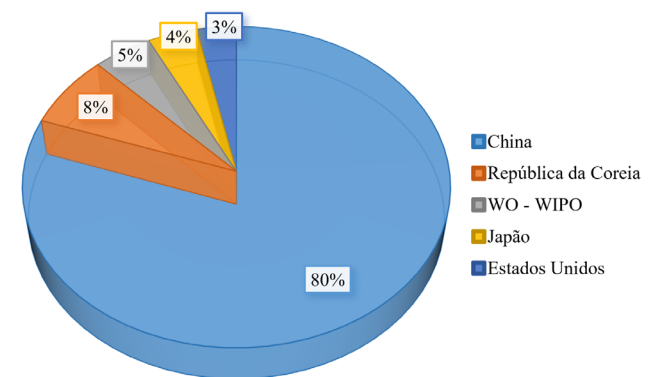
In the food sector, Class A23 accounted for 1,327 patent documents, of which 924 were filed between 2005 and 2025. Subclass A23L, which encompasses functional foods and non-alcoholic beverages, led with more than one thousand records, demonstrating that turmeric has been widely incorporated as a functional ingredient. Subclasses A23F (coffee and tea products), A23G (confectionery), A23D (edible fats and oils), A23C (dairy products), and A23B (food preservation) also showed significant activity, underscoring the versatility of turmeric as a food ingredient.

Patents such as CN105341769A described sashimi products enriched with turmeric and ingredients derived from traditional Chinese medicine, whereas PH22020050606U1 presented a functional tea formulated from turmeric rhizome residues and pandan leaves. Patent KR101859552B1 disclosed a fermented milk formulation containing turmeric designed to support immune system function, while PH22019050320U1 described a functional ice cream incorporating curcumin and stevia. In addition, patents related to bread products, protein snacks, energy bars, nutritional supplements, and fermented seasonings were identified, all emphasizing ingredient functionality and the health-promoting appeal of the final products.

The diversity of these formulations highlights not only the versatility of turmeric as an ingredient in processed foods but also its alignment with market trends that favor natural, health-promoting products with scientifically validated functional properties. Turmeric has also been explored as an antimicrobial and antioxidant agent in food packaging materials and biodegradable films, extending its applications beyond the food product itself.

From an international perspective, the analysis of patent filings identified China as the leading country in turmeric-related patent registrations, followed by South Korea, Japan, and the United States (Figure 3). China’s prominence, despite not being among the world’s major agricultural producers of the plant, is associated with its capacity to transform traditional knowledge into technological innovation through public policies that promote intellectual property protection and support a domestic industry focused on the utilization of natural ingredients in cosmetics, functional foods, and phytotherapeutic products. Its proactive technological protection policies, combined with substantial investments in biotechnology, have enabled China to convert a globally available biological resource into a strategic market asset.

Figure 3 – Number of patent records by national and international patent office (WIPO)



Source: Prepared by the authors

South Korea and Japan have likewise invested heavily in the development of sophisticated formulations that combine turmeric with advanced bioactive delivery technologies. The United States, although largely dependent on imported raw materials, has concentrated its efforts on the standardization, clinical validation, and regulatory approval of natural products, targeting consumers who seek natural, safe, and scientifically supported health solutions.

In Brazil, 29 records were identified in the Espacenet database and 16 in the INPI database between 2005 and 2025 (Figure 4). National patents are concentrated primarily in Classes A61K and A23, and although the number of filings remains modest by international standards, several innovative initiatives highlight the country’s potential. Patents such as BR1020230226779, which describes a turmeric-enriched dulce de leche product, and BR1020200111540A2, related to a functional sweetener formulated with spices, illustrate the creative capacity of Brazilian inventors.

Figure 4 – Image captured from the INPI webpage showing the results of the applied search

Search criteria:
 All records containing the word "Curcuma" in the title.
 Results: A total of 16 patent applications matched the search criteria. Displaying page 1 of 1.

Request	Deposit	Title	IPC
BR 10 2023 027211 8	22/12/2023	Nanostructured Cosmetic Compositions Containing Curcuma longa L. Extract for Aesthetic Procedures in the Control of Androgenetic Alopecia	A61K 8/9794
BR 10 2023 022677 9	30/10/2023	Spreadable Dulce de Leche Enriched with Turmeric (Curcuma longa L.) and Its Production Process	A23G 3/46
BR 10 2021 022178 0	04/11/2021	Production of a Polymeric Film Incorporated with Curcuma longa L. Essential Oil and Pectin Extract for the Manufacture of Active Packaging	C08J 5/18
BR 10 2021 013840 8	13/07/2021	Process for Obtaining Starch from Residues Generated During the Extraction of Colorants from Turmeric (Curcuma longa L.) and Annatto, Process for Producing Bioactive Plastic Films from These Starches and Their Blends with Chitosan, and Bioactive Plastic Films Based on Turmeric Starch and Its Blends	C08B 30/10
BR 13 2021 001944 0	02/02/2021	Latex-Based Biomembranes (Hevea brasiliensis) Containing Liposomes with Curcumin (Curcuma longa) and Papain (Carica papaya), and Their Use in Combination with LED Therapy for the Treatment of Chronic Ulcers and Diabetic Wounds	A61K 36/9066
BR 10 2020 021673 2	22/10/2020	Turmeric-Based Mouthwash and Its Use as a Photosensitizing Agent in Antimicrobial Photodynamic Therapy	A61K 8/9794
BR 10 2020 011154 0	03/06/2020	Turmeric-Based Sweetener with Spices	A23L 27/30
BR 10 2017 020466 9	25/09/2017	Biocellulose-Based Wound Dressing Containing Curcuma longa Extract for Therapeutic Applications in Individuals with Autism, Cancer, Neglected Diseases, and Psoriasis.	A61K 31/12
BR 11 2017 026422 6	10/06/2016	Use of a Combination of Extracts from Curcuma longa, Punica granatum, and Zingiber officinale for the Prevention and/or Treatment of Mucosal Lesions.	A61K 36/9066
BR 10 2014 009532 2	17/04/2014	Functional Food Composition, Manufacturing Process, and Use of Curcuma zerumbet Extract	A23C 9/127
BR 11 2013 023705 8	01/03/2012	Process for the Modification of Curcuma aromatica Essential Oil	A23L 27/12
PI 0804524-0	21/10/2008	Use of Curcuma longa Compounds in Hydrogels for Human and Veterinary Applications	A61K 47/36
PI 0801401-9	09/05/2008	Transdermal Turmeric Gel	A61K 47/36
PI 0709379-9	16/03/2007	Extracts and Methods Comprising Curcuma Species	A61K 36/906
PI 0303487-9	01/07/2003	Use of Cosmetic Hair Care Compositions Comprising a Blend of Saffron (Crocus sativus) and Turmeric (Curcuma longa) Extracts as a Shine Enhancer, Photoprotective Agent, and Tonalizer for Golden and/or Orange Shades (Yellow Blondes)	A61K 7/06
PI 9802521-0	06/08/1998	Process for Obtaining Curcuma longa Flour, a Mixture Based on Said Flour, Its Use in the Prevention, Elimination, and Treatment of Parasitic Infestations in Warm-Blooded Animals, and a Process for the Prevention, Elimination, and Treatment of Parasitic Infestations in Warm-Blooded Animals	A21D 2/36

Displaying page 1 of 1

Source: Prepared by the authors

Other initiatives involve the development of bioactive packaging materials incorporating turmeric essential oils, with potential antimicrobial and antioxidant applications. Despite these advances, turmeric remains underutilized in areas such as biodegradable materials, natural adhesives, nanocosmetics, and green chemistry, sectors in which Brazil could assume a leading role by leveraging its biodiversity and traditional knowledge. Stronger collaboration among universities, companies, and public policy initiatives, together with the reinforcement of local production clusters, could accelerate the transformation of turmeric into a strategic asset for the national bioeconomy.

Emerging technological trends associated with turmeric point toward highly promising directions, reflecting the growing demand for natural, functional, sustainable, and technologically advanced products. One of the most significant trends is the adoption of green extraction technologies for obtaining bioactive compounds, replacing organic solvents with more efficient and environmentally friendly processes such as supercritical fluid extraction,

ultrasound-assisted extraction, and pressurized fluid extraction. These approaches not only ensure higher extract purity and yield but also meet international regulatory requirements related to environmental sustainability.

Another recurring innovation identified in the analyzed patents is the use of controlled-release systems, particularly nanoencapsulation using biodegradable polymers, functionalized liposomes, and self-emulsifying delivery systems. These technologies are designed to optimize the absorption and efficacy of turmeric-derived compounds in pharmaceutical, nutraceutical, and cosmetic formulations.

A further trend is the valorization of turmeric processing by-products, including pomace and rhizome residues, which are being utilized in the development of functional beverages, biodegradable packaging materials, and biofilms with antimicrobial and antioxidant properties. Such applications align with the principles of the circular economy, promoting sustainability and innovation through cost-effective resource utilization.

The targeting of specialized market segments, including older adults, vegans, athletes, and individuals with dietary restrictions, represents another well-established trend reflected in patents describing formulations tailored to these specific consumer groups. The combination of turmeric with ingredients such as ginseng, green tea, probiotics, and dietary fibers further demonstrates an ongoing search for synergistic effects capable of enhancing its therapeutic and preventive benefits.

Finally, the use of turmeric in therapeutic devices, smart cosmetics, and multiphase delivery systems represents an emerging frontier that integrates biotechnology, nanotechnology, and materials science. These developments further establish turmeric as a versatile and strategic resource with substantial value-added potential in the transition toward a bioeconomy driven by innovation and sustainability.

4 Final Considerations

The prospective analysis of the industrial applications of *Curcuma longa*, based on patent records filed between 2005 and 2025, demonstrates the broad and expanding use of this species across multiple industrial sectors, particularly within the pharmaceutical, food, and cosmetic industries. The predominance of documents classified under subclasses A61K and A61P confirms the relevance of curcuminoids in the development of therapeutic products, while the expansion of subclasses within Class A23 highlights the versatility of turmeric as a functional ingredient in innovative foods and beverages.

A temporal pattern characterized by growth, peak activity, and subsequent decline in patent filings was also observed, consistent with innovation life cycle models. This finding suggests that new technological frontiers must be explored to sustain the dynamism of the field. Recent trends point toward the incorporation of sustainable technologies, including green extraction processes, the utilization of by-products, and the development of biodegradable packaging materials, as well as the combination of turmeric with other bioactive ingredients. These advances indicate not only the maturity of certain turmeric applications but also the potential for technological reconfiguration based on emerging paradigms in green industry and preventive healthcare.

From a geographical perspective, the leadership of China, South Korea, Japan, and the United States reflects the interplay between industrial capacity, innovation-oriented public policies, and the valorization of natural ingredients. Although Brazil's performance remains modest, it demonstrates a promising foundation. The presence of national patent filings within the INPI database,

albeit limited in number, signals growing interest among entrepreneurs and research institutions in exploring turmeric as a strategic raw material for value-added formulations.

To translate this potential into tangible outcomes, it will be necessary to strengthen institutional Research, Development, and Innovation (R&D&I) frameworks through incentives for intellectual property protection, technical capacity building, and technology transfer. It is equally important to implement bioeconomy policies that connect native biodiversity to sustainable value chains while respecting traditional knowledge and fostering regional development.

In summary, turmeric stands out as a strategic resource for the development of innovative and health-promoting products. The technological prospecting panorama presented in this study reveals a promising field for future exploration, both in terms of industrial applications and sustainability, offering significant opportunities for the bioeconomy and for value creation based on biodiversity. The innovation trajectory of *Curcuma longa* may therefore contribute to the consolidation of new production models guided by principles of health, functionality, and socio-environmental responsibility.

5 Future Perspectives

Considering the identified landscape, future prospects for the industrial use of turmeric involve the diversification of applications beyond traditional sectors such as food and pharmaceuticals. Significant advances are expected in areas including nanotechnology, functional packaging, bioactive cosmetics, regenerative agriculture, and even environmental biotechnology. For instance, the antioxidant and antimicrobial properties of turmeric may be harnessed in biofilms with preservative functions, offering sustainable alternatives to synthetic additives.

In the healthcare sector, there is substantial potential for greater integration of curcuminoids with controlled drug delivery platforms, including liposomes, hydrogels, and nanoparticles. Likewise, the sports nutrition industry and the growing market for longevity-focused products may benefit from formulations combining turmeric with other bioactive compounds to enhance health-promoting effects.

For Brazil, strengthening local production chains, investing in bioprocessing technologies, and valuing traditional knowledge may represent a promising strategy for generating innovation with a strong territorial identity. The integration of public policies, research funding mechanisms, and incentives for intellectual property protection will be essential to transform turmeric into a driver of sustainable and technology-based development.

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