

# The Emerging Scope of Nutraceutical Research: A Bibliometric Analysis

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## Abstract

*Purpose:* The Present study sought to locate and examine referenced works on the subject of “Nutraceuticals and functional foods”.

*Methodology:* Data for bibliometrics is extracted by exploring the Scopus database. From 2000 to 2022, the top 100 relevant papers were collected.

*Findings:* International Journal of Biological Molecules (173) published most of the papers, followed by the Canadian Journal of Agricultural Economics (73). Nutraceuticals/ functional food is a multi-disciplinary field. Seven journals out of 100 focused on economics. Nutraceutical functional, functional foods (Centre for Nutrition and Biotechnology, CSIR-Central Leather Research Institute. The largest origin regions were the United States and Europe. India, China, and the US are the top nutraceuticals and functional foods producers. The findings project that people are more intent to consume nutraceutical and functional foods worldwide as these products add on the diet by increasing the total dietary intake of a person.

*Research implications:* The countries with the potential can have a comparative advantage in trading in these products, the lag which makes it difficult is the lack of conceptual clarity about the identification of the products. If products are correctly listed and identified, it will offer an enormous opportunity for developing and developed countries to unleash their potential in a way that will benefit people throughout the world.

**Keywords** nutraceutical, trend analysis, bibliometric, functional food, Dietary foods.

**JEL classification** A10, I110

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## 1. Introduction

Numerous studies on “nutraceuticals and functional foods” have been conducted recently, particularly in light of the development of food chemistry and biochemistry, the underlying analytical techniques, and their clinical applicability. (Tarun Belwal, 2018; Miles C. Braithwaite, 2014; David Julian Mc Clements, 2015; Adriano Mollica, 2017; Atanas G. Atanasovab, Jan 2018; Birgit Waltenberger, 2016). Stephen De Felice, chairman, and founder of the Foundation for Innovation in Medicine coined the term "nutraceutical," which is defined as a food or component of food that has medical or health advantages, such as the prevention and treatment of disease. (WilfriedAndlauer, 2002; Brower, 1998). The term “Nutraceutical” can be explained as functional foods with nutritional or medicinal value. They are also called medicinal foods, designer foods, functional foods, phytochemicals, and nutritional supplements (Cencic A, 2010). Many different terms and meanings are used worldwide for nutraceuticals, leading to confusion. However, this term had no regulatory definition (Zeisel, 1999). Essentially nutraceuticals are products derived from foods source that provides additional health benefits in addition to their nutritional value.

According to AAFCO (AAFCO, 1996), ‘Nutraceutical refers to any non-toxic dietary component that has scientifically established health advantages, including the prevention and treatment of illness. Nutrient refers to a feed element in a form and at a level that will help, and maintain, the life of a human being or animal.

To distinguish nutraceuticals from other food is that the functional food aids in the treatment and/ or treatment of disease(s) or/and disorder (Kalra, 2003)<sup>4</sup>.

**Table I: Brief description and example of nutraceutical products**

Nutraceutical	Description	Example	Availability
Dietary supplement	A substance produced by isolation, or microbial culture purification that gives health benefits	Docosahexaenoic acid (DHA)	Over the counter
Functional food	A food engineered or supplemented to give improved nutritional value	Transgenic canola oil engineered for improved trans fatty acid content	Over the counter

<sup>4</sup> Refer, for example Kalra (2003)

Medical food	A food that has inherent or added medicinal properties	A banana containing a cholera vaccine	From a doctor only
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Source: Kalra, 2003

Although a more general connotation of “functional food” is the development of nutraceuticals and functional foods may be traced back to the late 1960s, when researchers discovered that ‘polyunsaturated fatty acids’ might regulate blood cholesterol levels, for example. (Ancel Keys, 1965; J.A. Weststrate, 2007). This area has grown recently because bioactive natural compounds, which are present in many natural foods have pharmacological effects, and effectively provide additional functionality for the foods, (Suleman S.Hussain, 2016) examines the possible pharmacological effects of active phytoconstituents originating from foods such as soybeans, grapes, tomatoes, and green tea.

Many dimensions of bibliometric analysis range from illuminating the general picture of a specific study domain to examining journal editorial procedures (Yeung, 2017; Andy Wai Kan Yeung, A bibliometric review of research trends in neuroimaging, 2017). Selecting the top 100 important articles amid the large body of literature is a simple but crucial step to provide the foundation to explore newer research or as a reference for less experienced scholars to explore the domain. Such robust bibliometric analyses on the topic of functional food would help young scholars, and researchers to know the area of research more briefly. Therefore, it is important to do a bibliometric analysis for a better understanding of the publication and citation patterns of the area given the growing body of literature on the subject.

In the proposed investigation, we sought to find and evaluate the top articles on functional foods and nutraceuticals. Additionally, we wanted to focus on the relevant areas and well-known writers that contributed to these journals. Numerous studies have shown a significant correlation between stronger journal impact factors and higher citation counts (Michael Callahan & Weber, 2002; Fereshteh Didegah, 2013; Olalekan A. Uthman, 2013). As a result, we proposed that there was a direct link between the impact factor and the total/adjusted citation counts of the top publications.

The rest of the section is discussed as follows. Section II gives an overview of the data source. Section III highlights the result and discussion derived from the bibliometric analysis. Section

IV gives the concluding remarks for the bibliometric analysis for nutraceutical and functional foods.

## 2. Materials and Methods of study

### 2.1. Data collection

The data for Bibliometric analysis was gathered from Scopus, an Elsevier-hosted interdisciplinary database that is accessible online. In august 2022, we browsed through Scopus to identify publications that included the following string [All (“Nutraceuticals” and “functional foods”)]. This query searched for articles that had any of these words or phrases in the title, summary, or keywords.

By the number of citations, the papers were arranged in decreasing order. The titles and abstracts of the studies were reviewed by the authors to weed out those that did not pertain to nutraceuticals and functional foods. no restrictions were imposed on the included research model (in vivo vs. in vitro), paper type (research article, review, editorial, letter, etc.), or publishing language. The data was analysed using the R Studio (2022.07.2+576.exe) bibliometric analysis.

## 3. Results and Discussion

This paper focuses on the period 2000-2022. There were majorly cited documents (n = 13) and original articles (n = 44) among the top 100 nutraceutical and functional food publications, along with some conference presentations (n = 1) and book chapters (n = 38), and books (n=2). There were 100 papers written in English.

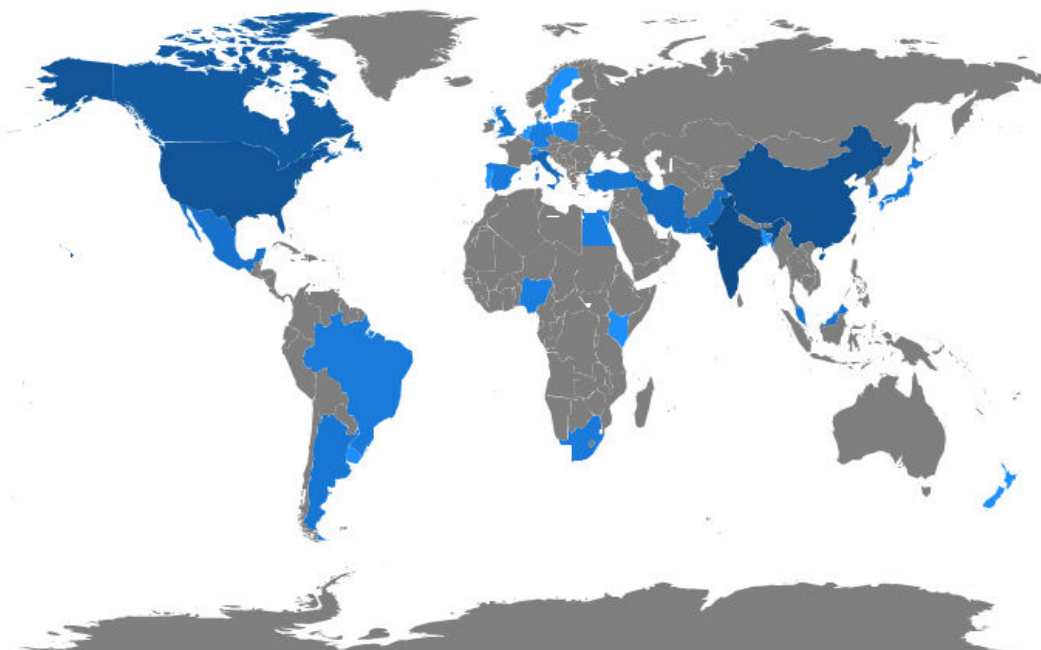
**Table II: Year-wise list of nos. of Country’s scientific production**

Year	Country	No. of articles	Year	Country	No. of articles
2022	India	87	2022	Argentina	5
2022	China	65	2022	UK	5
2022	USA	49	2022	Turkey	5
2022	Canada	32	2022	Brazil	4
2022	Italy	16	2022	Japan	4
2022	Korea	12	2022	South Africa	4

2022	Iran	11	2022	Spain	4
2022	Pakistan	9	2022	Egypt	3
2022	Mexico	7	2022	Nigeria	3
2022	Malaysia	6	2022	Germany	3

Source: Authors’ own calculation Source: Authors’ own based on bibliometric analysis

**Map 1: Country’s Scientific production**

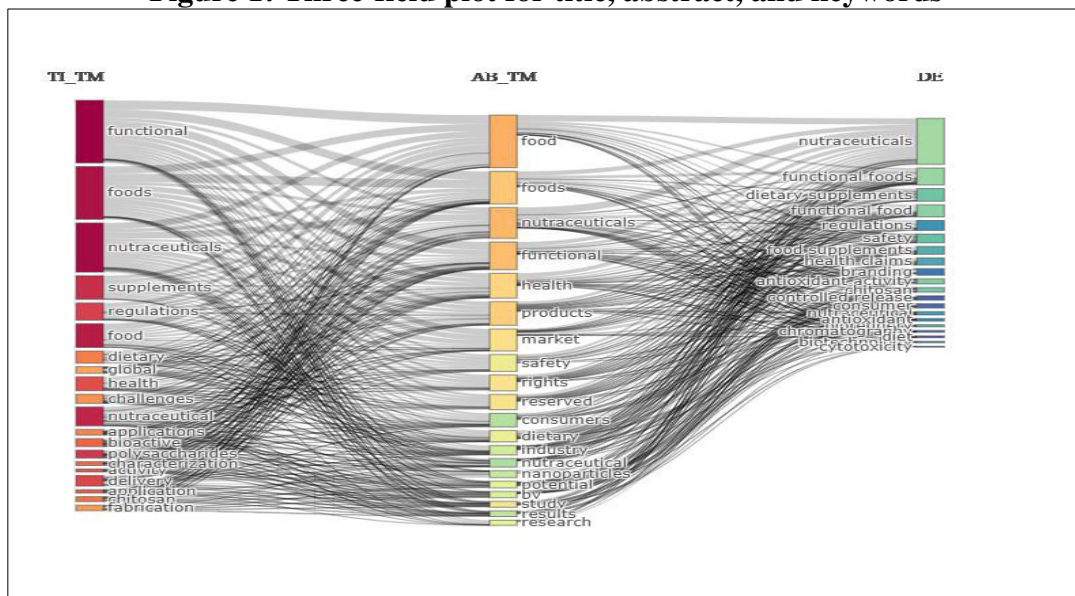


Note: \* - for illustration purpose only and not for a physical map  
 Source: Authors’ own based on bibliometric analysis

Out of the total selected documents, India has 87 authors on scientific production and from which only 3 were economics related viz. (A road map to enter Indian nutraceuticals and health supplements business, Regulations on nutraceuticals, functional foods, and dietary supplements in India, Nutraceutical and functional food regulations in India) as mentioned in table II and along with it represented in the map 1, dark blue highlighted area is majorly involved to light blue least highlighted once. And the grey-marked areas are not engaged. Projecting the potential mutual gains India can have with the ‘Look East Policy in the case of India. With the increase in Globalization and economic development, people are becoming more aware of

herbal product use. According to the world health organization<sup>5</sup>, about 80% of the world’s population is inclined to use herbal medicines for primary health care. The terms “functional foods” and “nutraceuticals” are arising from the advantages of meals that go beyond those related to necessary nutrients. The nutraceutical industry has three main segments: herbal/natural products, dietary supplements, and functional foods. The nutraceutical market, the market of Ayurveda, and other medicinal products have been categorized under the “Fast Moving Consumer Goods” (FMCG). The global market for nutraceuticals is very large, and although the developing country’s market of nutraceuticals is at the infant stage, it is growing geometrically. Asian countries have an ancient patrimony of traditional medicines including Ayurveda, Siddha, and Unani. Even a huge demand can be seen for nutraceuticals within the middle class in developing economies. Considering India’s population which has doubled and today is the fastest growing portion of the population about 600 million population belong to the middle-class providing potential for trade. India has the potential to become a global trader because of its patrimony in traditional medicines. Followed by China and USA at 65 and 49 respectively.

Figure 1: Three-field plot for title, abstract, and keywords



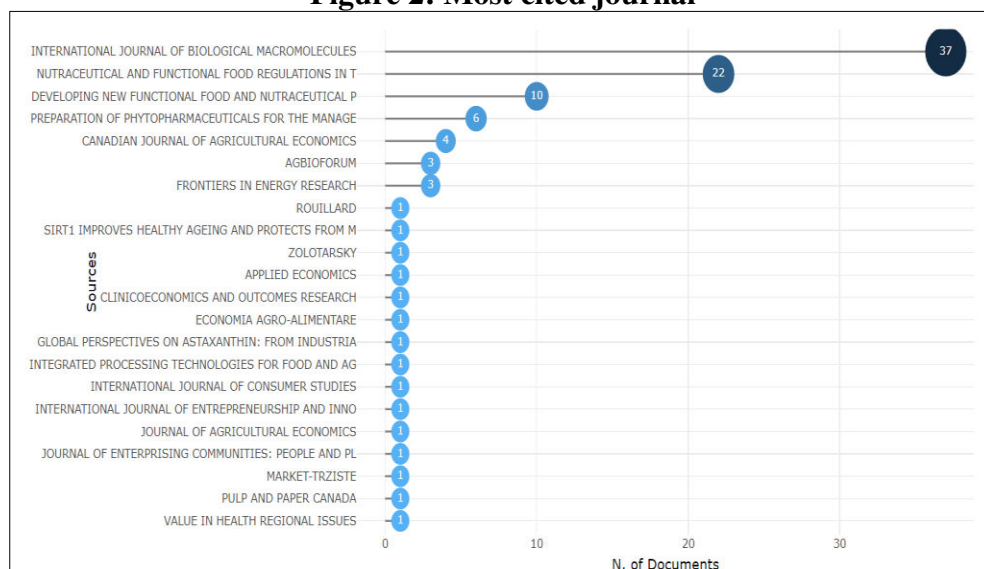
Source: Authors’ own based on bibliometric analysis

<sup>5</sup> Refer, For example World health Organisation



Figure 1 shows the three-field plot showing the Hierarchical relationship between the title on the left-hand side middle field indicating the abstract and the right-hand side taking keywords used by the author. Visualizing terms in title, abstract, and keywords.

Figure 2: Most cited journal



Source: Authors’ own based on bibliometric analysis

Figure 2 represents the International Journal of Biological Macromolecules as most cited (37 times) followed by Nutraceutical and Functional Food Regulations (22 times) and the least cited were Pulp and paper Canada and Value in Health Issues. **Table III: Bradford Law**

Sr.no	SOURCE	Rank	Freq	Cumulative Frequency
1	International journal of biological macromolecules	1	37	37
2	“Nutraceutical and functional food regulations in the united states and around the world”	2	22	59
3	Developing new functional food and nutraceutical products	3	10	69
4	“Preparation of phytopharmaceuticals for the management of disorders: the development of nutraceuticals and traditional medicine”	4	6	75
5	Canadian journal of agricultural economics	5	4	79
6	Agbioforum	6	3	82
7	Frontiers in energy research	7	3	85
8	Economics	8	1	86

9	Clinic economics and outcomes research	9	1	87
10	Economia agro-alimentare	10	1	88
11	“Global perspectives on astaxanthin: from industrial production to food, health, and pharmaceutical applications”	11	1	89
12	Integrated processing technologies for food and agricultural by-products	12	1	90
13	International journal of consumer studies	13	1	91
14	International journal of entrepreneurship and innovation management	14	1	92
15	Journal of agricultural economics	15	1	93
16	Journal of enterprising communities: people and places in the global economy	16	1	94
17	Market-trziste	17	1	95
18	Pulp and paper Canada	18	1	96
19	Value in health regional issues	19	1	97

Source: Authors’ own based on bibliometric analysis

With the journal aligned by the sequence of decreasing articles, table III shows Bradford's law describing the dispersion of citations for a certain subject or field. It is also used to find the most highly cited journals within the field of nutraceutical and functional foods (Brandford’s Law of Scattering, 1948). International journal of biological macromolecules ranks first followed by Nutraceutical and functional food regulations in the United States and around the world, Developing new functional food and nutraceutical products and Creation of nutraceuticals and conventional medicine in the preparation of phytopharmaceuticals for the management of illnesses.

**Table IV: Most Relevant authors (globally cited)**

Authors	Articles
Cranfield J	3
Henson S	3
Mcclements DJ	3
Shao A	3
Chahar D	2



Chen X	2
Chong LK	2
Downs BW	2
Egbuna C	2
Herath D	2
Keservani RK	2

Source: Authors' own based on bibliometric analysis

Table IV shows the 11 most relevant authors globally. Mentioning Cranfiled J and Henson S followed by McClements DJ are the most relevant authors who are being cited globally.

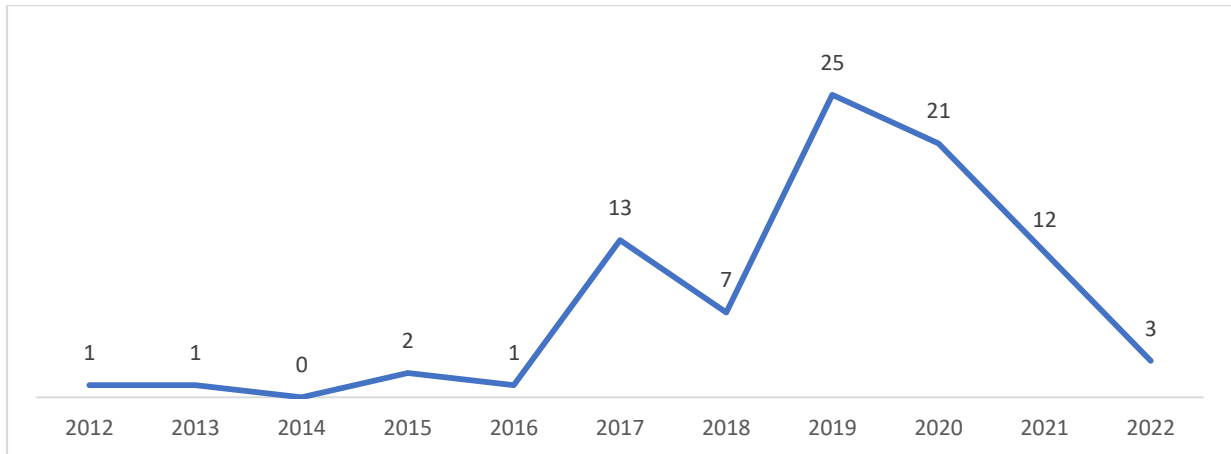
**Table V: Most Productive authors (Locally cited)**

Author	Local Citations
Apoorva A	5
Dasgupta S	5
Dhara S	5
Padmavati M	5
Rameshbabu AP	5
Akil E	1
Alfano V	1
Amaral PFF	1
Aruoma OI	1
Bahorun T	1
Burn P	1

Source: Authors' own based on bibliometric analysis

Table V shows the 11 most productive authors with their local Apoorva, Dashgupta, Dhara, and Padmavati are the most cited local authors.

**Figure 3: Annual Scientific Production (in numbers)**



Source: Authors' own based on bibliometric analysis

Figure 3 shows that there is considerable growth in the literature after the year 2017, before that there is very negligible work on Nutraceuticals and functional food. The highest growth was observed in the year 2019 when 25 article/research papers were published followed by 2020 (21), 2017(13), and year 2021 (12). Till September 2021, three articles have been published in the field of Nutraceutical and functional food. In the last few years, scientific production shows an increasing trend that can be concluded by the bibliometric analysis.

**Figure 4: Top 100 main terminologies**



shows collaboration with Canada, Mexico, the USA, etc. the most contributing regions in nutraceutical research are America and Europe. China is in mostly collaboration with south Asian countries like Bangladesh, Iran, Japan, etc. UK and Switzerland are in collaboration with Belgium and with each other.

## Conclusion

Bibliometric analysis is an important tool for gathering information by applying a unique set of techniques i.e. bibliography, etc. for monitoring the trend and management of literature systematically. The examination of the structures of scientific research, evaluation of research activities, and the management of scientific information is all employed by bibliometric tools. To study the characteristics and behavior of recorded knowledge are performed by tools of bibliometric. Numerous statistical techniques are used to investigate authorship, citation and publishing patterns, relationships among scientific communities and domains, and the organizational structure of certain subjects. In this respect, bibliometrics is particularly significant for researchers, decision-makers, and researchers who wish to follow the trends in a particular topic in course of their study.

Qualitative and quantitative analysis is provided by our bibliometric analysis. Additionally, it is important to promote bibliometric studies that assess how well a nation is doing in a specific area of study. Bibliometrics research can be used to generate information on national science policy. It is anticipated that this field of research would attract the attention of an increasing number of researchers.

According to the World health organization<sup>6</sup>, about 80% of the world's population is inclined to use herbal medicines for primary health care. The terms "functional foods" and "nutraceuticals" are emerging out of benefits from foods that go beyond those attributable to essential nutrients. The nutraceutical industry has three main segments: herbal/ natural products, dietary supplements, and functional foods. The nutraceutical market, the market of Ayurveda, and other medicinal products have been categorized under the "Fast Moving Consumer Goods" (FMCG).

Developing countries have the potential to trade in nutraceutical and functional foods. As they have a comparative advantage in the trade of nutraceuticals and functional foods. Most Asian

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<sup>6</sup> Refer, For example World health Organisation

countries catch hold of the bud. As only a few countries are able to identify and list the nutraceutical and functional foods, the HS code marking through which the products are traded must be identified these products and evaluation of the regulatory procedure for trade, Intellectual property, branding, trademark, regulations/norms/ licensing, can make the process accomplished at national and International Levels.

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**Appendix Table I: Collaboration of research between the countries**

From	To	From	To
Argentina	Uruguay	India	USA
Bangladesh	Singapore	Iran	Poland
Bangladesh	Sweden	Iran	Turkey
Canada	New Zealand	Italy	United Kingdom
China	Bangladesh	Mexico	Germany
China	Iran	Netherlands	Portugal
China	Japan	Pakistan	Nigeria
China	Kenya	Singapore	Sweden
China	Singapore	Switzerland	Belgium



China	Sweden	Turkey	Poland
China	USA	United Kingdom	Belgium
India	Canada	United Kingdom	Brazil
India	Mexico	United Kingdom	Switzerland
India	Nigeria	USA	Canada
India	United Kingdom		

Source: Authors' own based on bibliometric analysis