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Research Article

An Overview of Scientific Publication of the Chamomile (*Matricaria chamomilla*) Research: A Bibliometric Analysis

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ABSTRACT

Objectives: Chamomile (*Matricaria chamomilla*) has been used orally and in topical applications in traditional medicine for centuries for different conditions, including gastrointestinal, liver and respiratory problems, common cold, neuropsychiatric, pain, infections and skin, eye and mouth disorder. The objective of the present bibliometric analysis was to capture the characteristics of research publications on chamomile. **Materials and Methods:** The research population consisted of all English documents published and indexed in MEDLINE, Web of Science, Biosis and Scopus databases until the middle of 2021 about chamomile excluding letters, notes, editorials, short surveys, conference abstracts and books. The data were collected in this study using a multi-stage and combined search strategy. The retrieved records were saved as plain text, tab-delimited and RIS formats. After data storage, the related files were integrated and saved as one file for later use. Bibliometrics R Tools was used for data analysis and drawing scientific maps. **Results:** Total of 1860 publications were published by 6834 authors across 865 sources from 1980 to 2021. Since the beginning of 2006, there has been a sharp in the volume of publications on this topic. The Journal of Ethnopharmacology published the largest number of publications. The most productive country included Iran. Shiraz University had the most organizational affiliation in articles related to chamomile. **Conclusion:** The present study provides the characteristics of the literature on chamomile that allows an understanding of the past, present and future of research in this area. It is a useful evidence-based framework to base future research actions and academic directions.

Keywords: Bibliometric analysis, Chamomile, Scientometrics, Biblioshiny, *Matricaria recutita*, *Matricaria chamomilla*.

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INTRODUCTION

Nowadays, medicinal plants are being studied in order to develop new compounds for use in pharmacology, nutraceuticals, food supplements, folk medicine etc., Medicinal plants have been used as safe, cost-effective and easy-to-access therapeutic agents from ancient time. Also, it has been shown that the adverse effects of herbal drugs are relatively less than alternative synthetic ones when they are used properly. Therefore, in recent years, herbal remedies have been noticed and used alongside synthetic drugs for the treatment of several diseases.[1,2]

One of the most common herbs used for medicinal purposes is chamomile, whose standardized tea, aqueous or hydroalcoholic extracts and essential oils are prepared from dried flowers of the Matricaria species and are used orally or externally.[3] Moreover, the pharmacopoeia of 26 countries included chamomile as a therapeutic agent and its role as a pharmaceutical agent cannot be ignored.[4]

Matricaria chamomilla, which belongs to the Asteraceae family and is known by the English name German chamomile, has been used as an herbal medication since ancient times. It is still popular today and will probably continue to be used in the future,

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as it contains various bioactive phytochemicals with therapeutic effects. Approximately 120 secondary metabolites have been identified in chamomile essential oil and extract, including 28 terpenoids and 36 flavonoids, which are the most important products of this plant.[5]

In general, the most important terpenoid compounds of chamomile essential oil are bisabolol and its oxides A and B, bisabolone oxide A, chamazulene and farnesene. On the other hand, chamomile extracts were dominated by phenolic compounds, including phenolic acids, flavonoids and coumarins. Among the flavonoids, apigenin is the most promising compound.[4]

Chamomile is an annual herb that grows on all soil types and is native to northern and western Asia, the Mediterranean, Southern Africa and southern and Eastern Europe. It is now widely distributed all around the world.[6]

Chamomile has been used as a cure for gastrointestinal disorders, the common cold, liver disorders and neuropsychiatric and respiratory problems from ancient times. Moreover, this plant is effective for the treatment of pain, infections and skin, eye and mouth disorders externally.[7]

In a review article Hajizadeh *et al.* (2020)[8] showed that chamomile is effective for the treatment of diabetes mellitus. Their findings extend the novel functions of chamomile in the improvement of glycemic and lipid profiles and oxidative stress indicators in diabetic cases. Moreover, chamomile is used to relieve Post-Menopausal Syndrome (PMS) because of its therapeutic properties, such as anti-inflammatory, anti-spasmodic and anti-anxiety effects.[9] Also, Chamomile can improve cardiovascular conditions, stimulate the immune system and provide some protection against cancer due to its anti-oxidants properties.[10] In a review article, Bayliak *et al.* (2021)[11] showed that chamomile is enriched in flavonoid contents and it can be utilized to treat obesity and related metabolic disorders. Previous results showed that therapeutic effects of chamomile were associated with modulation of signaling pathways involving the AMP-activated protein kinase, NF-κB, Nrf2 and PPARγ transcription factors.[12]

One of the most widely used methods for analyzing the structure of knowledge in various fields and drawing conceptual maps is co-word analysis. As a graphical modeling method that uses ideas related to relational analysis, co-word analysis can describe the content of documents by examining and analyzing the

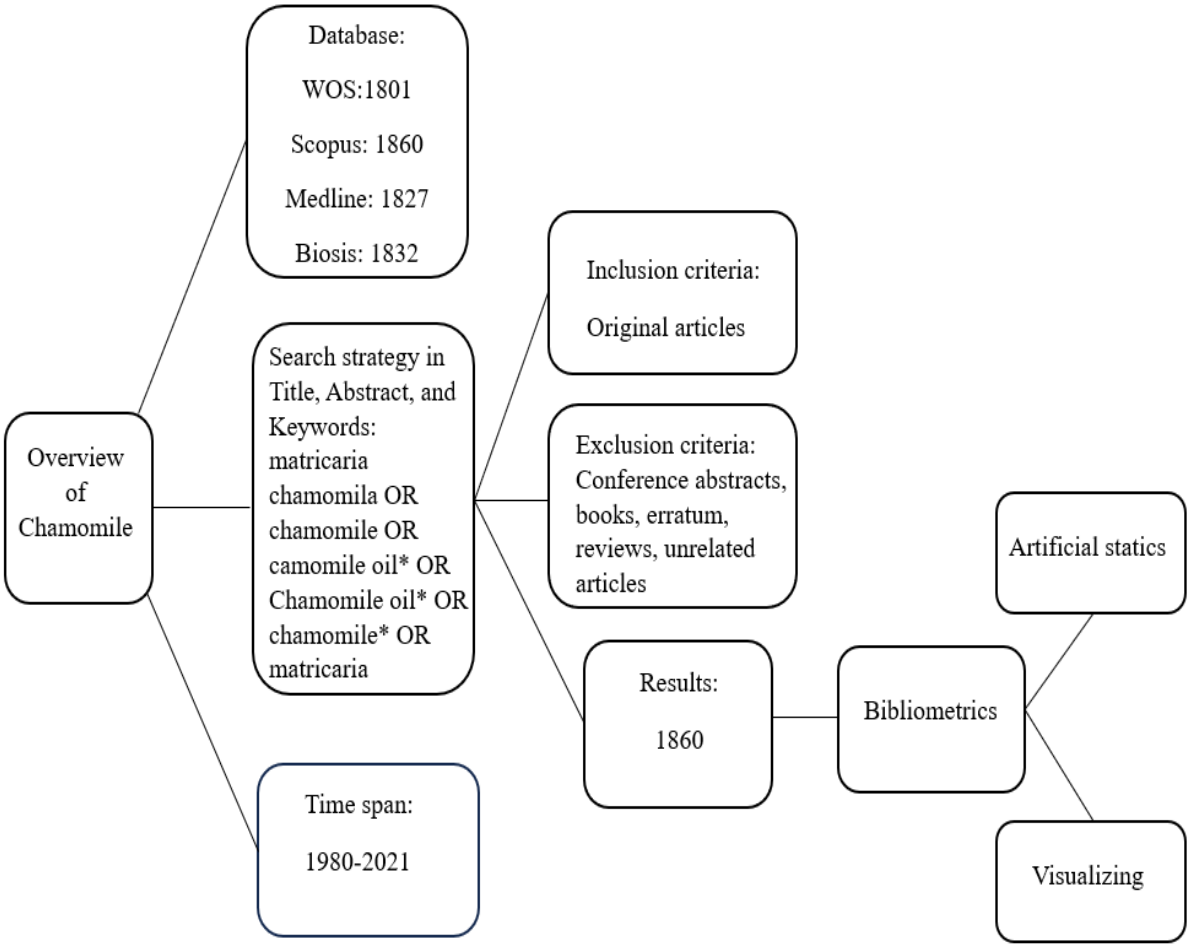

Figure 1: Flowchart of overview of chamomile.

keywords of articles published in a research field and directly provide a picture of the real content of the subjects in that field.[13] By measuring the relationship between these co-occurrences, the conceptual layout of a domain is illustrated. Conceptually, co-word analysis is an effective way to discover the connections between research domains and shows these important links that may be difficult to discover otherwise.[14] Besides, using this method, emerging subjects and the most widely used methods in each field of research can be identified to draw a clear path for future research.[15]

Because no bibliometric analysis of the chamomile research literature has been conducted to date, the objective of the present study is to capture the characteristics of research publications on this topic and to the best of our knowledge; our study was the first to perform a bibliometric evaluation of chamomile.

MATERIALS AND METHODS

The present study was conducted using co-word analysis. Co-word analysis is a quantitative approach to detecting the knowledge structure and has been used by various studies in the past decades as a powerful tool for knowledge discovery.

The research population consisted of all English documents published and indexed in MEDLINE, Web of Science, Biosis and Scopus databases from the first until the middle of 2021 about chamomile excluding letters, notes, editorials, short surveys, conference abstracts and books. The data were collected in this study using a multi-stage and combined search strategy. The retrieved records were saved as plain text, tab-delimited and RIS formats. After data collection, the related files were integrated and saved as one file for next use. Bibliometrics R Tool was used for data analysis and drawing scientific maps.

A multi-stage and combined search strategy was used to retrieve related data in each database according to the available capabilities and fields and the possibility of using different operators. To retrieve related records using a comprehensive retrieval process and after specifying synonyms, we searched titles, abstracts and keywords (author keywords and specific keywords) using operators. After the implementation of the search strategy, conference abstracts, books, erratum, reviews and unrelated articles were filtered. The flowchart of chamomile overview was shown in Figure 1.

The bibliometric analysis was conducted using Bibliometrics R Tool.[16] The bibliometric data were analyzed using the Bibliometrics Biblioshiny R-package software (https://bibliometrix. org/Biblioshiny.html).[17]

This analysis was conducted to visualize, identify and describe the data to achieve the following goals:

- Determining the annual scientific production in this field based on the year of publication.
- Determining the core journals in the field.
- Determining authors and affiliations contributing to this research field.
- Determining countries active in this research field.
- Determining keywords, topics and themes in this field.

RESULTS

General Information on the Retrieved Documents

A total of 1860 articles were analyzed. Annexure 1 shows the descriptive statistics of the articles published about chamomile from 1980 to 2021.

This descriptive analysis revealed that 4360 keywords plus and 5076 author keywords were reported in journals. Besides, these articles were written by 6834 authors, with 90 articles being

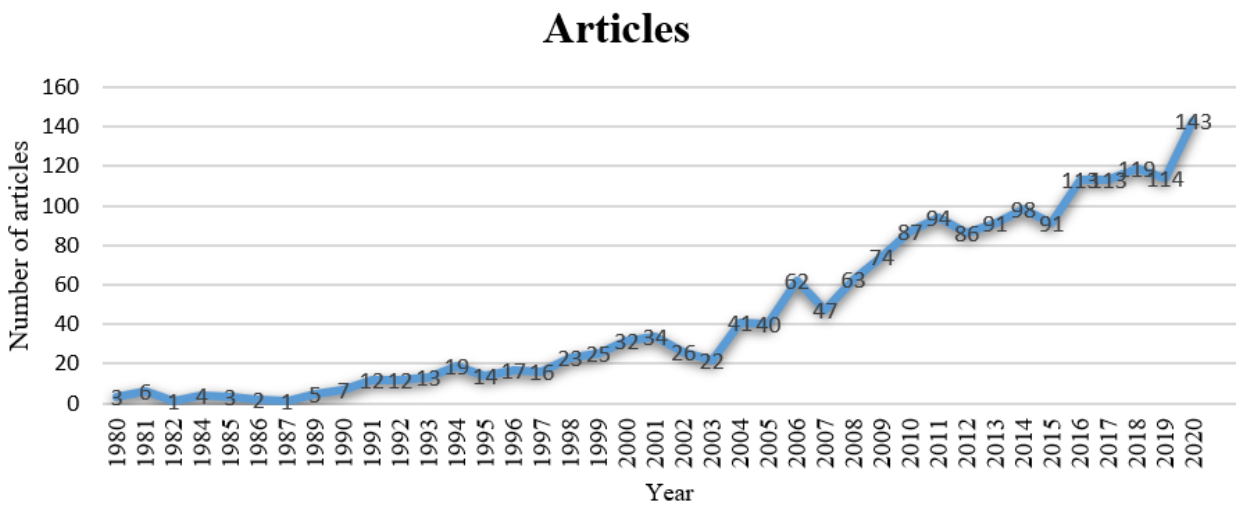

Figure 2: Overall publication performance in chamomile research from 1980 to 2020, presented as a total number of publications per year.

prepared by single authors. The co-authorship rate was reported as 3.82. Author per documents was reported as 3.67, indicating that almost four authors were involved in writing a paper.

The general information in retrieved published documents related to chamomile and the complete information about all the document types retrieved for each database are mentioned in Annexure 1.

Overall Publication Performance

Figure 2 shows the annual scientific production of chamomile. A total of 1860 articles were published about the chamomile plant in 40 years, of which 1742 were research articles. From 1980 to 2002, the published articles underwent an upward trend followed by a downward trend in 2003. In 2006, there was an increase in the number of published articles, indicating increased attention to this plant. In total, the number of publications before 2006 was low and this number increased significantly since 2011. Data analysis also indicated that the largest number of articles were published in 2020, indicating increased attention to chamomile and the upward trend of studies addressing medicinal plants in recent years.

Top University, Country and Keyword-plus Relations

The relations between universities, countries and keywords were visualized using the Three Fields Plot (TFP). In this instance, the significant features were represented in the diagram by rectangles with different colors. The height of the rectangles in the diagram of the TFP depended on the rate or value of the summation of the relations arising between the component of the rectangle represents (university, keywords and countries) and the diagram of other elements. The more relations the component or element had, the higher the rectangle represented it. Figure 3 shows the TFP analysis of publications on chamomile centered on relations between the universities, keywords and countries. The diagram demonstrated the relations between top universities, keywords and countries in publications on chamomile and its related studies.

The data also indicated that Iran contributed to most of the affiliations and subjects. Besides, Brazil and the United States had the highest contributions in terms of subjects and affiliations and are ranked second and third, respectively. Shiraz University had the greatest number of affiliations in articles related to chamomile. This confirms that this university published the greatest number of articles in this field. One possible reason is that chamomile is native to Fars Province (Shiraz) resulting in more studies on this plant.

Core Journals in the Field of Chamomile

We used source impact and Bradford law to show the original and influential journals publishing articles on chamomile. Table 1 presents the ranking of the top ten journals based on the H, M and G index, the Total number of Citations (TC), the number of publications (NP) and the year of publication (PY_start).

In the time frame analyzed, the Journal of Ethnopharmacology had the highest publication output (*n*=38), followed by food chemistry (n =32), phytomedicine (*n*=25) and phytochemistry research (*n*=23). The most cited journals were Food Chemistry (*n*=2885), Journal of Ethnopharmacology (*n*=2114), Journal of

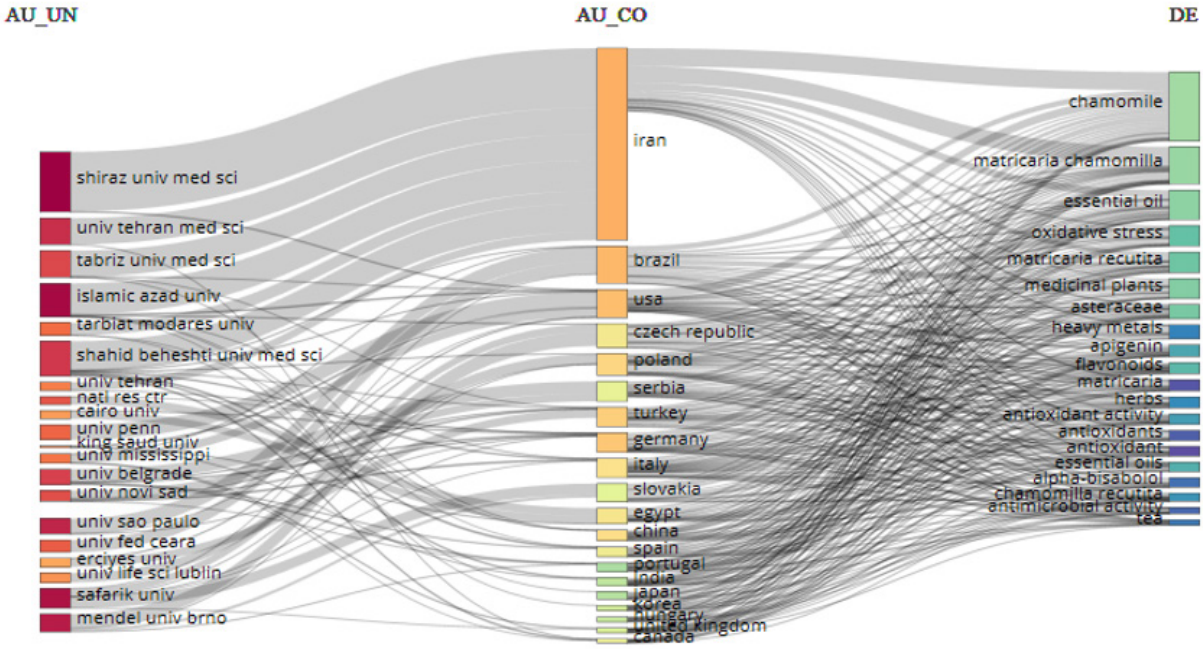

Figure 3: Relations between keywords (right), countries (middle) and affiliations (left) for research in chamomile literature.

Table 1: Source impact of the top ten journals publishing on chamomile.

Journal	H_index	G_index	M_index	TC	NP	PY_start
Food Chemistry.	24	32	1.043478	2885	32	1999
Journal of Ethnopharmacology.	22	38	0.594595	2114	38	1985
Journal of Agricultural and Food Chemistry.	16	18	0.571429	1190	18	1994
Phytomedicine.	16	25	0.727273	965	25	2000
Phytotherapy Research.	16	23	0.666667	736	23	1998
Industrial Crops and Products.	14	22	1.166667	655	22	2010
Journal of Chromatography A.	12	16	0.48	596	16	1997
Weed Research.	12	14	0.387097	351	14	1991
Planta Medica.	11	17	0.268293	713	17	1981
Weed Science.	11	13	0.34375	353	13	1990

H_index: The number of articles from that journal that have at least the same number of cited and referenced articles, **G_index:** Give more weight to highly-cited journals, **M_index:** Takes into account years since the first publication and is more relevant to an earlier career journal than the H-index, **TC:** Times cited, **NP:** Number of publications, **PY_start:** Year start.

Agricultural and Food Chemistry (*n*=1190) and phytomedicine (*n*=965). Food Chemistry (H=24) had the highest H index, following by Journal of Ethnopharmacology (H=22).

Journals ranking according to Bradford's law in the field of chamomile

According to Bradford's law, journals are divided into three zones. Zone 1 shows the core journals as the most important journals in this field. An analysis of journals publishing articles on chamomile showed that 48 journals are classified in Zone 1 and the remaining journals fall under Zones 2 and 3. Table 2 shows the top ten journals classified in Zone 1 according to Bradford's law and to avoid the length of the table, other journals were not mentioned in the manuscript.

The most important Zone 1 journals in the field of chamomile publications were the Journal of Ethnopharmacology (35), Food Chemistry (32), Journal of Essential Oil-Bearing Plants (25) and Phytomedicine (24), respectively.

Most prolific authors and authors' impact

We used the H, G and M index to show the main and influential authors in the published articles on chamomile. Table 3 shows the ranking of the top ten contributing authors.

In the entire dataset of 6834 contributing authors, Kovacik J (Institute of Chemistry and Biochemistry, Faculty of Agronomy, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic) was ranked first in the number of published articles (*n*=51), followed by Klejdus B (Institute of Chemistry and Biochemistry, Faculty of Agronomy, Mendel University in Brno, Zemědělská 1, 613 00 Brno, Czech Republic) with 31 published articles. Moreover, Kovacik J had the highest H-, M- and G-index among contributing authors in chamomile publications.

Analysis of the most relevant affiliation In publications on chamomile

Table 4 shows the most relevant universities based on at least one author in each published document on chamomile studies. The results obtained from the analysis shows that the Shiraz University of Medical Sciences had the highest affiliation, followed by the Islamic Azad University, Safarik University and Mendel University in Brno.

Most cited chamomile papers

Of 1742 articles related to chamomile, the average number of citations per document was 21.48 and the average number of citations per year per document was 2.03. Table 5 demonstrates the top ten papers according to the total number of citations. The research article entitled "Screening of radical scavenging activity of some medicinal and aromatic plant extracts" published by Miliauskas G in the Journal of Food Chemistry in 2004 received the highest number of citations (*n*=1095). Results of this paper showed that ethyl acetate, acetone and methanol extracts of *Matricaria recutita* had antioxidant activity via DPPH assay. Also, most of the total phenolic contents of chamomile were flavonoids.[18] The research article entitled "Impedance measurements to study the antimicrobial activity of essential oils from *Lamiaceae* and *Compositae*" published by Marino M in the International Journal of Food Microbiology in 2001 ranks second with 438 total citations. They results showed that essential oil of chamomile had generally a bacteriostatic activity, but it had not showed bactericidal effects at tested concentration on gram positive and gram negative bacteria.[19] The research article entitled "Effect of oil extracted from some medicinal plants on different mycotoxigenic fungi" published by Soliman KM *et al.* in the food and chemical toxicology journal in 2002 ranks third with 342 total citations. Results of this research showed that chamomile oil at all tested concentrations were partially effective against the test toxigenic fungi such as *Aspergillus flavus, A. parasiticus,*

Table 2: The ten top journals rankings according to Bradford law.

Journals	Rank	Freq	cumFreq	Zone
Journal of Ethnopharmacology.	1	35	35	Zone 1
Food Chemistry.	2	32	67	Zone 1
Journal of Essential Oil-Bearing Plants.	3	25	92	Zone 1
Phytomedicine.	4	24	116	Zone 1
Phytotherapy Research.	5	24	140	Zone 1
Industrial Crops and Products.	6	22	162	Zone 1
Planta Medica.	7	21	183	Zone 1
Phytochemistry.	8	19	202	Zone 1
Journal of Agricultural and Food Chemistry.	9	18	220	Zone 1
Weed Science.	10	16	236	Zone 1

Freq: Frequency, **cumFreq:** Cumulative frequency.

Table 3: Top ten contributing authors in field of chamomile research.

Authors	Affiliation	Country	H_ index	G_ index	M_index	TC	NP	PY_ start
Kovacik Jozef	Šafárik University.	Slovak Republic	27	42	1.688	1887	51	2006
Klejdus Bořivoj	Mendel University of Agriculture and Forestry.	Czech Republic	20	31	1.333	1302	31	2007
Hedbavny Josef	Mendel University of Agriculture and Forestry.	Czech Republic	18	26	1.385	848	26	2009
Backor Martin	University of Pavol Jozef Šafárik.	Slovakia	15	17	0.938	984	17	2006
Ferreira Isabel C.F.R.	Instituto Politécnico de Bragança.	Portugal	13	14	1.083	645	14	2010
Repcak Miroslav	Šafárik University.	Slovak Republic	13	24	0.31	614	29	1980
Barros Lillian	Instituto Politécnico de Bragança.	Portugal	11	12	0.917	580	12	2010
Gruz Jiří	Palacký University and Institute of Experimental Botany ASCR.	Czech Republic	9	9	0.643	325	9	2008
Kelber Olaf	Phytomedicines Supply and Development Center.	Germany	9	9	0.5	282	9	2004
Szoke Éva B.			9	12	0.391	176	12	1999

H_index: The H-index identifies the highest number of an author's papers to have the same or higher number of citations, **G_index:** The G-index attempts to give more weight to highly-cited paper, **M_index:** The M-index takes into account years since the first publication and is more relevant to an earlier career researcher than the H-index, **TC:** Times cited, **NP:** Number of publications, **PY_start:** year start.

A. ochraceus and *Fusarium moniliforme*.[20] The publication entitled "Antibacterial Effects of the Essential Oils of Commonly Consumed Medicinal Herbs Using an*in vitro* Model" wrote by Sokovic M *et al*. In the Molecules journal ranked fourth with 321 total citations.[21] Also, the research published by Abdel-Gaber AM *et al*. in corrosion science journal entitled "Inhibitive action of some plant extracts on the corrosion of steel in acidic media" the same as previous publication had 321 total citations.[22]

Table 4: Most relevant authors affiliation in publications on chamomile.

Affiliation	Numbers of articles
SHIRAZ University of Medical Sciences.	62
ISLAMIC AZAD University.	58
SAFARIK University.	56
MENDEL University of BRNO.	39
University of SAO PAULO.	35
University of TEHRAN Medical Sciences.	35
SHAHID BEHESHTI University of Medical Sciences.	34
University of BELGRADE.	34
TABRIZ University of Medical Sciences.	29
University of NOVI SAD.	24
NATL Research Center.	22
University of FED CEARA.	22
University of PENN.	22
TARBIAT MODARES University.	21
University of MISSISSIPPI.	20
University of TEHRAN.	19
KING SAUD University.	18
University of Life Science LUBLIN.	18
CAIRO University.	17
ERCIYES University.	16

Analysis of keywords

Frequently used words in the field of chamomile

The keywords are the high-level summarization and refinement of the article core and can represent its main content and the frequency of occurrence and co-occurrence can reflect themes focuses in a special field to some extent.

As shown in Table 6, the most common words are in four groups, including keyword plus, title, abstract and author's keyword, along with their co-occurrence. The most common co-occurrences in the following tables include L. (*n*=106), plants (*n*=104), extracts (*n*=89) and growth (*n*=89) in keyword plus; chamomile (*n*=225), *Matricaria chamomilla* (*n*=116), essential oil (*n*=98) and medicinal plants (*n*=82) in author's keywords. However, chamomile (*n*=475), Matricaria (*n*=384), *chamomilla* (*n*=275) and essential (*n*=214) were the most title keywords, chamomile (*n*=2309), plants (*n*=1263), study (*n*=1240) and oil (*n*=1085) were the most frequent abstract keywords. Chamomile was the most frequent keyword in author's, title and abstract keywords. We identified keywords with a high frequency, which can be used to predict research areas attracting an extraordinary degree of attention.

Conceptual structure map

Multiple Correspondence Analysis (MCA) is a regularly used sociological method. In this approach, extensive data with multiple variables are compressed into a low-dimensional space to create an intuitive two-dimensional (or three-dimensional) graph. This graph illustrates the similarity between the keywords by utilizing plane distance. The keywords that have attracted attention in recent years are near the center point. By contrast, the closer the keywords are to the edge, the narrower the study theme, or transferred to other themes.[23]

The conceptual structure map of chamomile (Figure 4) was plotted based on the authors' keywords and showed two clusters

Table 5: Most globally cited documents on chamomile.

Paper	Total citations	Total citation per Year	Normalized total citation
Miliauskas G, 2004, FOOD CHEM	1095	60.8333	16.385
MARINO M, 2001, INT J FOOD MICROBIOL	438	20.8571	9.708
Soliman KM, 2002, FOOD CHEM TOXICOL	342	17.1	9.6338
Sokovic M, 2010, MOLECULES	321	26.75	10.3779
Abdel-Gaber AM, 2006, CORROS SCI	321	20.0625	8.1969
Hurrell RF, 1999, BRIT J NUTR	277	12.0435	6.8294
Kultur S, 2007, J ETHNOPHARMACOL	262	17.4667	6.6419
Srivastava JK, 2010, MOL MED REP	253	21.0833	8.1795
Viola H, 1995, PLANTA MED	235	8.7037	6.3514
Budzinski JW, 2000, PHYTOMEDICINE	233	10.5909	4.0043

Table 6: Most frequent words in keyword plus, author's keyword, title keyword and abstract keyword.

Keyword plus	Oc	Author's keywords	Oc	Title keywords	Oc	Abstract keyword	Oc
L.	106	Chamomile	225	Chamomile	475	Chamomile	2309
Plants	104	Matricaria chamomilla	116	Matricaria	384	Plants	1263
Extracts	89	Essential oil	98	Chamomilla	275	Oil	1085
Antioxidant	86	Medicinal plants	82	Essential	214	Plant	1064
Chamomile	80	Asteraceae	59	Plants	191	Matricaria	940
Essential oil	75	Matricaria recutita	58	Oil	167	Activity	919
Flavonoids	64	Oxidative stress	58	Recutita	140	Essential	885
Phenolic-compounds	58	Flavonoids	45	Herbal	138	Extracts	825
Oxidative stress	55	Apigenin	41	Medicinal	133	Chamomilla	720
Matricaria-chamomilla	50	Antioxidant activity	39	Extracts	126	Extract	710
Constituents	49	Heavy metals	34	Oils	108	Herbal	675
Chemical-composition	47	Alpha-bisabolol	29	Evaluation	92	Treatment	651
Antioxidant activity	44	Antimicrobial activity	28	Antioxidant	84	Content	594
Apigenin	44	Antioxidants	28	Analysis	80	Medicinal	591

Oc: Occurrence.

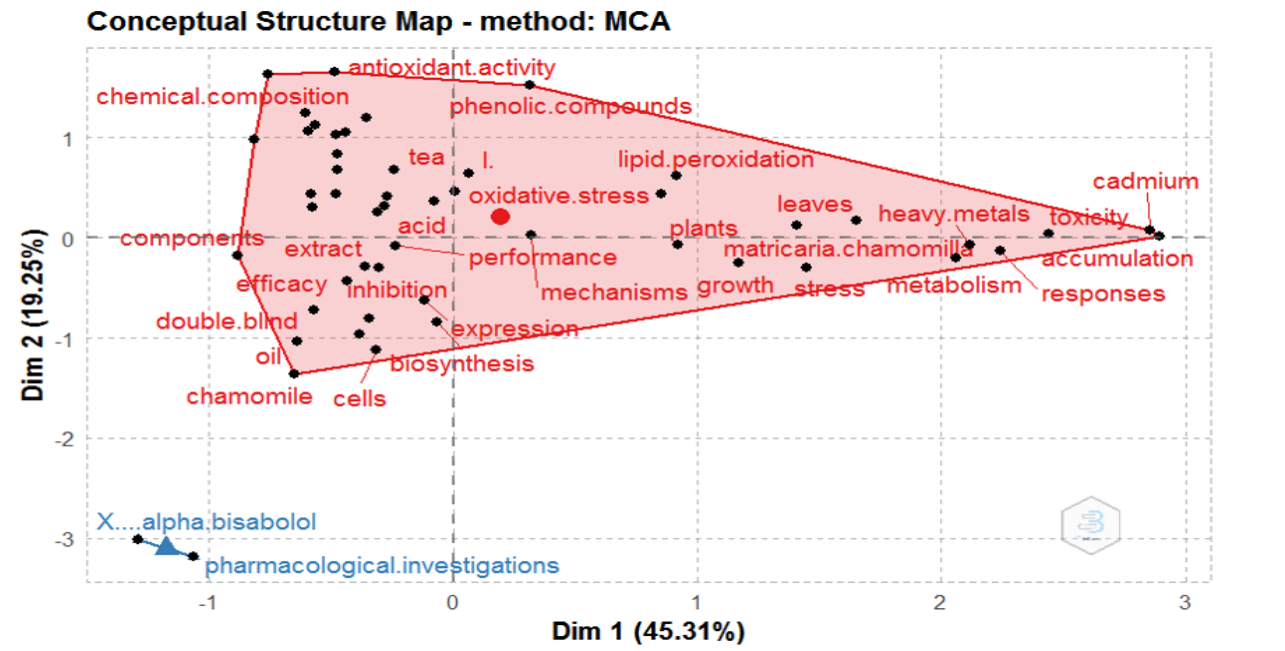

Figure 4: The conceptual structural map in published documents on chamomile studies.

in blue and red. The blue cluster shows the relation between alpha-bisabolol and pharmacological investigations.

Oxidative stress is mentioned at the center of the red cluster because most of the studies that have been done on the chamomile plant are related to the inhibition of oxidative stress. Furthermore, lipid peroxidation, L., mechanisms, inhibition, acid, tea and plants were close to the center point in the red cluster. However, antioxidant activity, chemical composition, components, chamomile, accumulation and cadmium were closer to the edge.

Thematic evolution map of chamomile publications

The thematic evolution map of chamomile literature in Figure 5 shows the historical development of this plant. Thematic evolution was carried out in two times intervals using Biblioshiny. Periods were selected based on the number of articles. As shown in Figure 2, in 2013, the number of articles reached the middle. In each

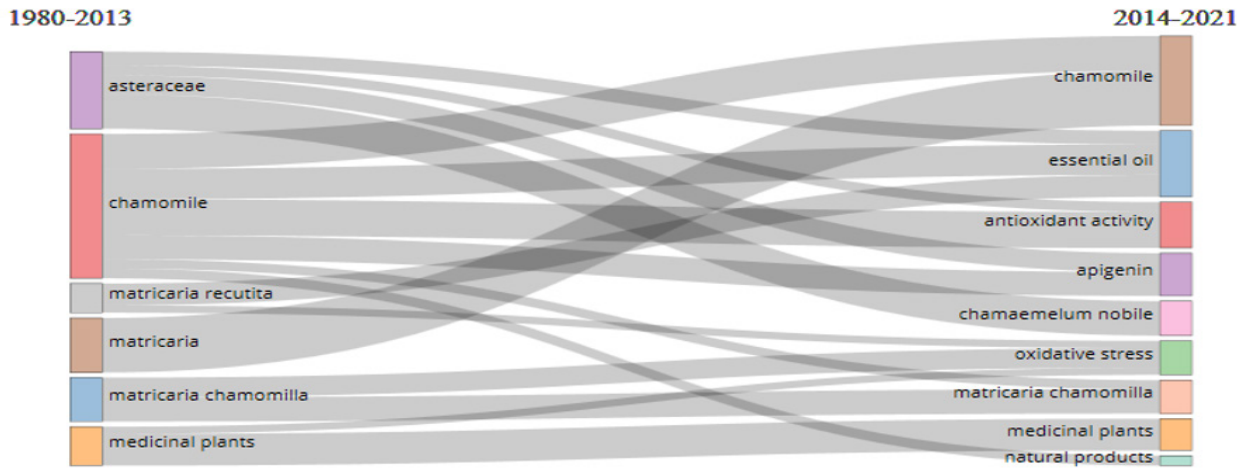

Figure 5: Thematic evolution map of chamomile publications based on authors keywords.

period the keywords are not the same, in a lexicographic sense or number. Then the Fuzzy Sets Theory (FST) terminology evolves through the time intervals using different keywords to identify the content of the documents. New topics with their related keywords appear and others disappear. Hence, there is a subset of keywords that remained unchanged during consecutive time intervals and a subset of keywords only used in some.[24] For example, the keywords chamomile, *Matricaria chamomilla* and medicinal plant appeared in both studied time intervals. In contrast, the keywords Asteraceae, Matricaria and *Matricaria recutita* only appeared in the first studied time intervals (1980-2013). The second period (2014 to 2021) reveals the articles published on chamomile, essential oil, antioxidant activity, apigenin, *Chamaemelum Nobile*, oxidative stresses, medicinal plants, natural products and *Matricaria chamomilla*. Moreover, the links show the relationship between the keywords in two-time frames and the thicker the lines, the greater the relationship between the two keywords.

DISCUSSION

The method of bibliometric analysis can be used to analyze a large amount of scientific data. With this method it is possible to get the evolutionary nuances of a particular subject while the emerging areas in that particular field are revealed to us.[25] If bibliometric studies are done well in a special field, it can create firm foundations for advancing that field in meaningful and new ways. Conducting bibliometric studies in a specific field allows the researcher to get an overview of the subject, find out the knowledge gaps and get ideas for future research.[26]

The objective of the present bibliometric analysis was to capture the characteristics of research publications on the topic of chamomile. The search conducted on Medline, Web of Science, Bioscience and Scopus yielded nearly 1900 research publications from 1980 to 2021, representing the first bibliometric analysis of chamomile literature to date to the author's knowledge.

Several scientometric studies have investigated the field of plants. For example, in the study of Aurang Zeb *et al.*,[27] the interaction between nanoparticles and plants has been investigated. The results of this study, which examined more than 900 scientific documents, will be advantageous for fully understanding the relevant research themes and the research trends of interaction of nano-plant.

In a previous paper the scientometric analysis was done to obtain knowledge mapping of *Coptis*. Overall, their results showed that the anti-oxidative stress, pharmacokinetics and Alzheimer's disease treatment of *Coptis* are new hotspots in this field and this data are beneficial for future research.[28]

The results of a bibliometric analysis on *Moringa oleifera* publications during 1935-2019 showed that there are more than 3000 publications in this field and the global annual average publications production on *M. oleifera* study registered 16.18% growth and averaged to 17.69 citations per document.[29] Also, similar research on *Celastrus paniculatus* during 2001 to 2018 showed that among 120 publications, annual output on research registered 16.55% and 85.71% growth during the last 18 years. The bibliometric analysis showed that more pharmacological study and other researches on the safety, bioavailability and pharmacokinetics are necessary in future.[30]

Moreover, similar studies have examined plants in terms of bibliometric studies, among which plants such as *Aloe vera*,[31] Panax species[32] and *rographis paniculate*,[33] *Withania somnifera*,[34] *Curcuma longa*,[35] *Nigella sativa*[36] and etc., can be mentioned.

In current study a total of 1860 articles were analyzed about chamomile that had been written by 6834 authors. Our results showed that 90 articles were prepared by a single author and almost about four authors were involved in writing a paper.

Chamomile is popular as a traditional medicinal plant in the prevention and healing of disease in the world for centuries.[37] Articles related to the chamomile have been of interest in most countries, but Shiraz University (Iran) has the greatest number of affiliations in articles and chamomile is native to this region. Besides, Brazil and the United States have the highest contributions in terms of subjects and affiliations and are ranked second and third, respectively.

The impact factor of a journal and the total number of journal or document citation are between the important criteria used to express the scientific impact of a publication. Also, the number of citations actually indicates the dissemination of its results and is used as a marker to measure the importance of that article in the special subject.[24,38] Therefore, the total number of citation of documents is mentioned in the current study to assess the paper's quality. From the analysis, we observed that most of the leading papers on chamomile and chamomile-related studies were published in high impact factor journals such as the ethnopharmacology (n=38), food chemistry (n=32) and phytomedicine (n=25). In the same manner, the topmost cited papers on chamomile studies were also published in high impact factor journals and the average citations per documents was 21.48 and average citations per year per doc was 2.03. The most cited paper on chamomile retrieved from the current analysis was the research article entitled "Screening of radical scavenging activity of some medicinal and aromatic plant extracts" published in Journal of Food Chemistry in 2004 with 1095 citations.[18]

"Chamomile" is the word that is most frequently used in author keywords, title and abstract and "L" in keywords plus which refers to Linn, the person naming the chamomile plant for first time.

In the entire dataset of 6834 contributing authors, Kovacik J, Klejdus B and Hedbavany J had a greater number of published articles on chamomile, respectively.

CONCLUSION

In conclusion, a comprehensive search was conducted for learning about the present status of chamomile research and predicting the further tendency of the scientific research of this plant. In recent years, many studies have addressed chamomile. Since the popularity of traditional medicine and the use of medicinal plants for treating diseases has increased, the use of optimal and efficient analytical approaches, such as scientometrics seems necessary. Besides, specifying countries, universities and authors with the most scientific contributions in studies on chamomile is of great importance. The present study showed the keywords most frequently used over the years and the connections between chamomile compounds and their therapeutic effects. A scientometric analysis of the articles published in this field reveals the shortcomings in the field and directions for future research.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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