

REVIEW

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A comprehensive bibliometric analysis of *Catha edulis* (Vahl) Endli (Khat) research (1961–2021)

Siddig Ibrahim Abdelwahab* and Manal Mohamed Elhassan Taha Mohamed

Abstract

Background: The use of Khat (*Catha edulis*) causes health, psychological, and socioeconomic burdens, and many scientific studies have been conducted on this abused plant. A careful review using bibliometric methods is required to increase the usefulness of this research and contribute to curbing the Khat problem. The main objective of this study is to evaluate the intellectual structure, diffusion of knowledge, emerging literature, and impact of collaboration in Khat research using bibliometric analysis.

Main body: The Scopus database was used to extract scientific papers published from 1961 to 2021 and search for titles and abstracts published in English. The VOSviewer software and MS Excel were used for citation, co-citation, and co-authorship analyses. Bibliographic coupling was calculated using the fractional counting method. There were 996 papers published in 60 years, 159 researchers, and 80 countries that met the criteria for inclusion. The top publishing countries, in order, are Ethiopia, the USA, Saudi Arabia, the UK, and Yemen. The USA provided the most prominent financial support for Khat's research. 32.1% of research is in the medical field, with eleven more diverse research fields. The top-publishing researcher with the highest total link strength is Mustafa al'Absi from Minnesota Medical School, USA. A bibliometric mapping of citations revealed 113 articles with more than 50 citations, diffused across various research areas. The Journal of Ethnopharmacology is the top-cited source. Ethiopia is the most collaborative country. Molecular mechanisms of Khat toxicity on gene and protein levels are emerging. A network visualization map of terms' occurrence in titles and abstracts resulted in four research themes.

Conclusion: The current study encourages researchers from various fields to inaugurate new platforms and direct the research toward evidence-based cessation programs.

Keywords: *Cathe edulis*, Bibliometric analysis, Knowledge structure, Intellectual dynamics, Scopus database, VIOS viewer

Background

Catha edulis is a perennial herbaceous plant of the Celastraceae family. It is referred to locally by various names, including Khat, Qat, and Gat in Yemen, Qaat and Jaad in Somalia; and Chat in Ethiopia (Al Moaleem et al. 2017; Alhazmi et al. 2020; Taha et al. 2014). For

eight centuries, the inhabitants of East Africa and the Arabian Peninsula have chewed Khat (*C. edulis*). This plant's natural habitat is Ethiopia's Hararghe Zone. Countries like Uganda, Ethiopia, Kenya, Yemen, and Djibouti where it is widely used have legalized its cultivation, sale, and chewing. Over 20 million abusers are thought to exist today, including both male and female adults, as well as college and middle school pupils. Khat is classified as a narcotic in Saudi Arabia, and its distribution is forbidden, as it is in other Western nations (Alsanosy et al. 2020; Alvi et al. 2014; Mahfouz et al.

*Correspondence: sadiqa@jazanu.edu.sa; siddigroa@yahoo.com

Medical Research Centre, Jazan University, P.O. Box 46852, Jazan, Jazan Region, Saudi Arabia

2013). The fresh leaves of this plant are chewed by those who use it for a delightful and energizing impact. It is chewed alone or in combination with cigars and alcohol. Due to the migration of indigenous people from Yemen, Somalia, Eritrea, and Saudi Arabia, Khat chewing is widespread even in the USA and Europe. Alkaloids, cathine, and cathinone are the principal active compounds in *C. edulis*, and they are responsible for the biochemical and clinical effects (Hoffman and Al'Absi 2010). It has been discovered that cathinone stimulates the release of dopamine and inhibits the absorption of epinephrine, norepinephrine, and serotonin in the central nervous system. All of these neurotransmitters are monoamines and have the overall structure of an aromatic ring with an amine group connected by a pair of carbon atoms (Ahmed 2019).

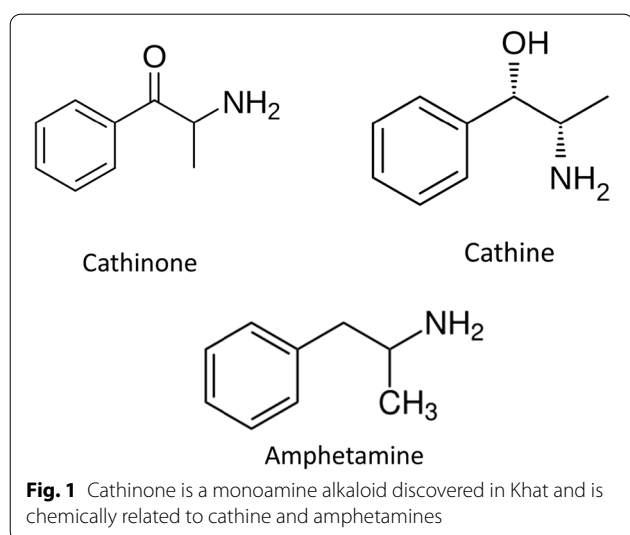
Khat intake is related to several health risks. According to the literature, it affects every human organ system and has negative consequences. Euphoria and moderate excitation are produced in the central nervous system, progressively replaced by mild dysphoria, anxiety, sleeplessness, and anorexia. Cathinone, which has a very similar structure to amphetamine, a well-known psychostimulant (Fig. 1), is thought to be responsible for the CNS effects of Khat. Khat intake has also been linked to hyperactivity and logorrhea. In several case reports, Khat use has been observed to cause schizophreniform psychosis and paranoid psychosis, along with other mental diseases. Khat was reported to cause acute myocardial infarction, coronary heart failure, and ischemic disorders in the cardiovascular system. According to one study, Khat users had higher systolic blood pressure due to the adrenoceptor's stimulant action in the heart. In the gastrointestinal tract,

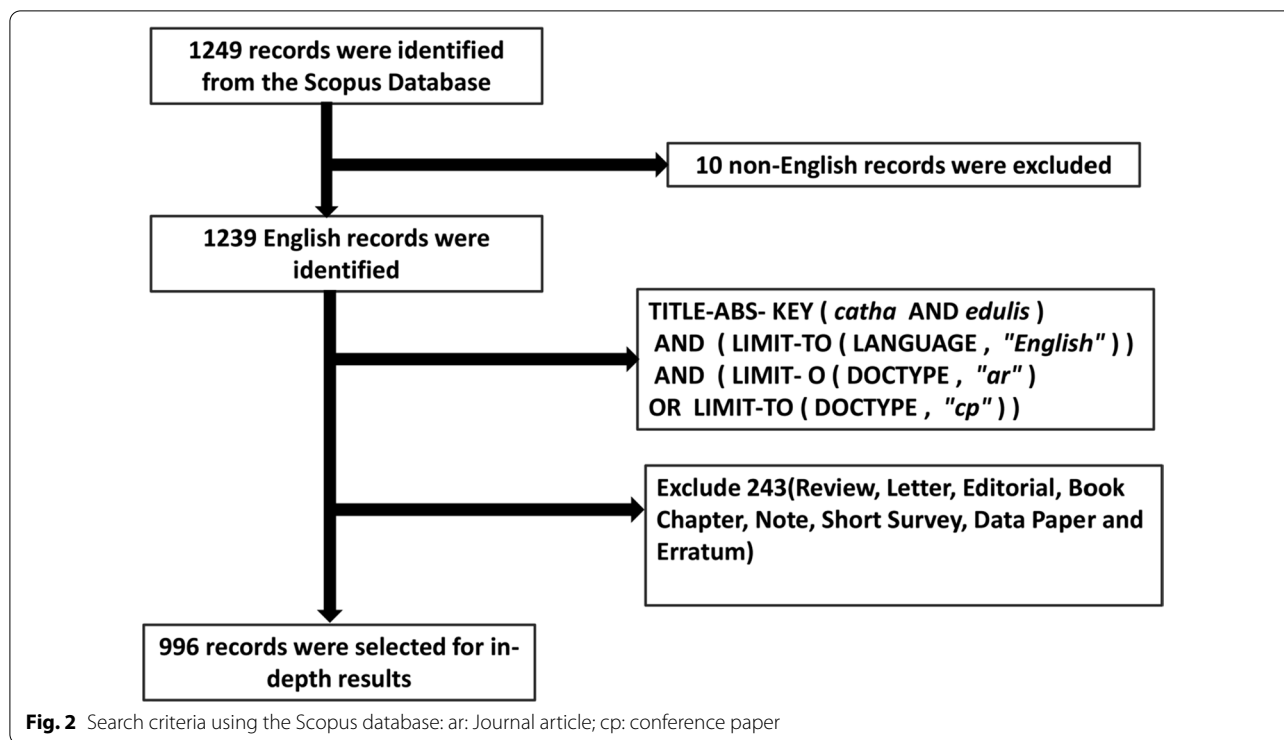
Khat had stomatitis, esophagitis, and gastritis. Apart from that, anorexia and constipation are common among heavy Khat users (Al-Zubairi et al. 2003; El-Setouhy et al. 2013; Hakami et al. 2021).

Bibliometric analysis is a widely used and rigorous technique for examining and interpreting vast amounts of scientific data. It helps us to grasp the evolutionary intricacies of a certain topic while also offering light on its burgeoning areas (Donthu et al. 2021). Scholars utilize bibliometric analysis for a number of purposes, including identifying developing trends in article and journal performance, cooperation patterns, and research elements, as well as examining the intellectual structure of a certain area in the existing research (Baker et al. 2020; Liu et al. 2015). There are not many bibliometric studies on Khat research. Such studies should be conducted periodically to know the research trends, developments, and strengths. So far, there are only two studies (Ye et al. 2021; Zyoud 2015). The first study was in 2014 (Zyoud 2015), while the second study was limited to journals indexed in ISI (Ye et al. 2021). Modern research has to be carried out over a longer time frame and using a larger and more detailed database. The main goals of this bibliometric study were to look at the intellectual structure, diffusion of knowledge, emerging literature, and impact of collaboration in *C. edulis* research, all of which were retrieved from the Scopus database (1961–2021). It is believed that this study's findings will help enhance the quality of future Khat studies. This research could be used as a starting point for policies on Khat at the national and international levels.

Data collection and analysis

The relevant papers were extracted using the Scopus database. Scopus was chosen because it has a larger number of indexed articles and includes all journals in Medline (Hill 2009). A similar search on *C. edulis* was conducted on Medline and yielded 799 articles. Additionally, Scopus indexes journals in the health, social, physical, and life sciences (Vera-Baceta et al. 2019). This enhances the likelihood of obtaining all relevant papers. Scopus's advanced search tool enables the creation of search strategies using an infinite number of phrases and a variety of Boolean operators. Finally, Scopus has several analytical features that enable data to be exported from Scopus and analyzed in Microsoft Excel using different file formats (Thor et al. 2016). The search strategy used in this study is shown in Fig. 2. The search technique was applied, and the returned data was saved as a CSV (comma-separated values) file in Microsoft Excel. The data exported included each document's title/abstract, author(s) name(s), country and institutional affiliation of the author(s), funding agencies, subject, author





keywords, yearly number of publications, citations, and journal titles. The search approach was restricted to the beginning of 1961 and ended on December 31, 2021. There were no further papers provided. Papers published in 2022 were not included to maintain yearly consistency. As a result, books and book chapters have been omitted. There were language restrictions imposed as the papers were extracted in English only. Two alternative approaches were used to verify the search strategy. First, an independent reviewer confirmed that the top 30 cited publications did not include any false-positive outcomes. Second, the top ten active journals that published the retrieved papers were all related to the area. Data on yearly growth, productivity, and citation analysis were displayed in linear graphics or tabular format based on information generated by Microsoft Excel. On the other hand, data on common author keywords, frequent phrases in titles and abstracts, cross-country cooperation, and author research networks were visualized using the VOSviewer (Van Eck and Waltman 2013). Nodes in VOSviewer maps vary in color and size. A node's size is related to its frequency of occurrence. The node's color shows its connection to other nodes with similar hues. International collaboration was analyzed using the fractional counting method (Sood et al. 2021) on VOSviewer.

Overview of *C. edulis* research (1961–2021)

One thousand two hundred forty-nine records were extracted from the Scopus database. An article, review, letter, conference paper, editorial, book chapter, note, short survey, and data paper, are different documents. Table 1 shows that 78.51% of the records are the journal's original research articles. Conference papers represent 1.44%. Nine hundred ninety-six papers were used in this bibliometric analysis after excluding non-English papers. We have used only journal's articles and conference papers. The progress on published articles per year is shown in Fig. 3. The increase in the

Table 1 Types of documents extracted from the Scopus database regardless of their types and languages

Document type	Percentage
Article	78.51
Review	11.82
Letter	3.57
Conference Paper	1.41
Editorial	1.26
Book chapter	1.12
Note	1.12
Short survey	1.04
Data paper	0.07
Total	100.00

Documents by year

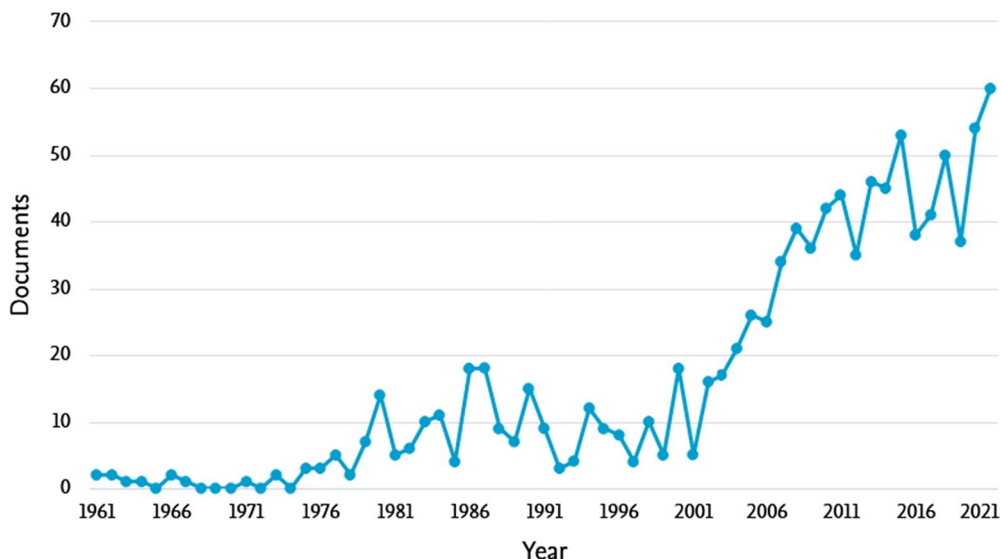


Fig. 3 Progress of research on *C. edulis* as per the number of published articles (1961–2021)

number of articles is fluctuating. In these sixty years of Khat research, papers are increasing. These scientific papers have been published by 159 researchers. Medicine, Pharmacology, Toxicology, and Pharmaceutics, Biochemistry, Genetics and Molecular Biology, Agricultural and Biological Sciences, Social Sciences, and

Environmental Sciences are the major research areas conducted on Khat. Studies conducted in medicine as per the Scopus classification of subjects' represent 32.1% of subjects' (Fig. 4). Eighty countries are involved in Khat research. The top publishing countries are Ethiopia, the USA, Saudi Arabia, the UK, and Yemen, with

Documents by subject area

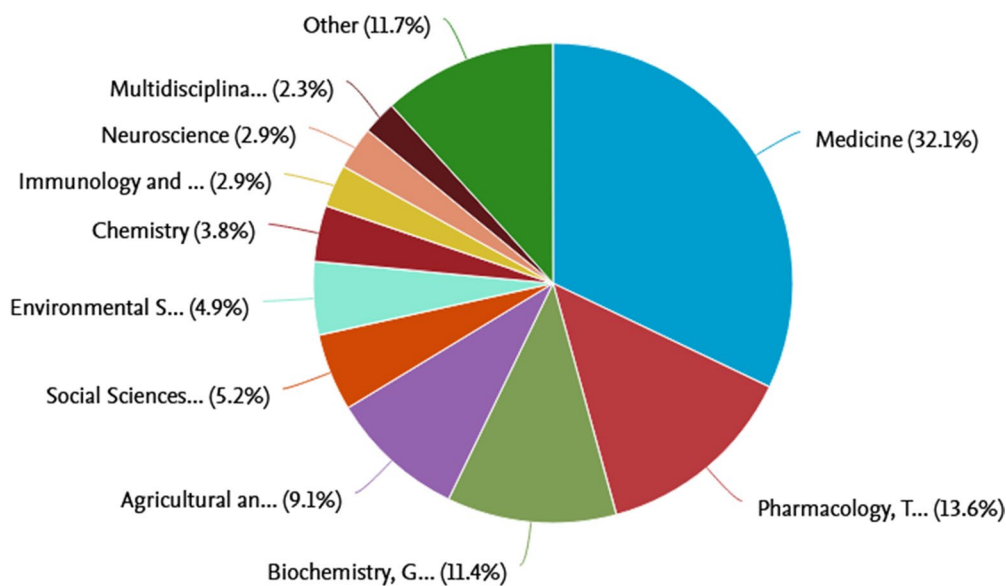
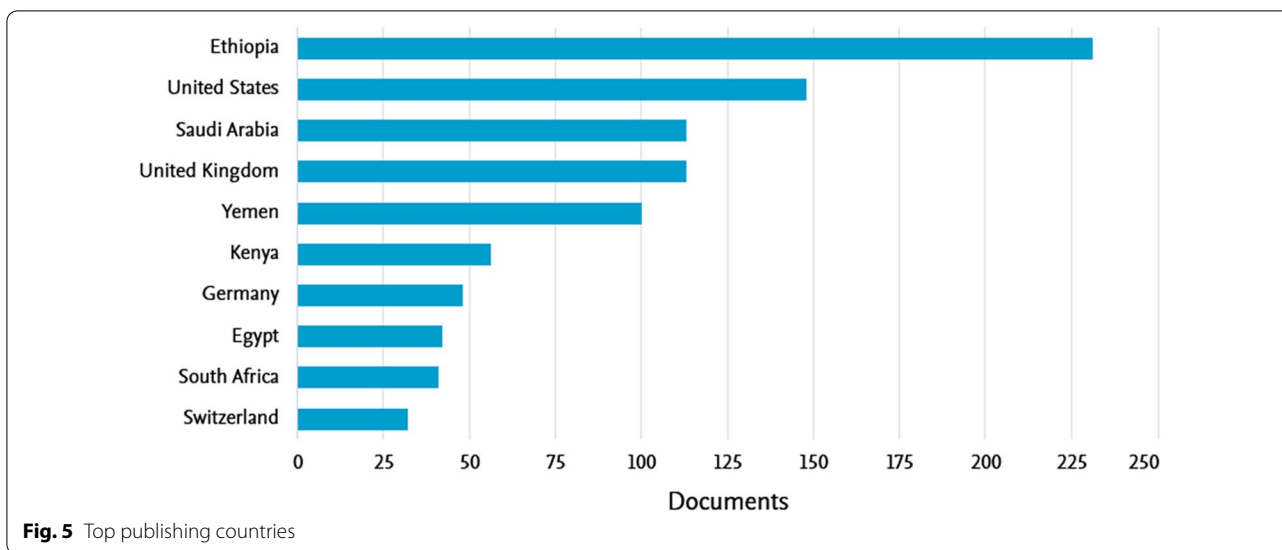


Fig. 4 Different areas of research on *C. edulis* as per Scopus classification

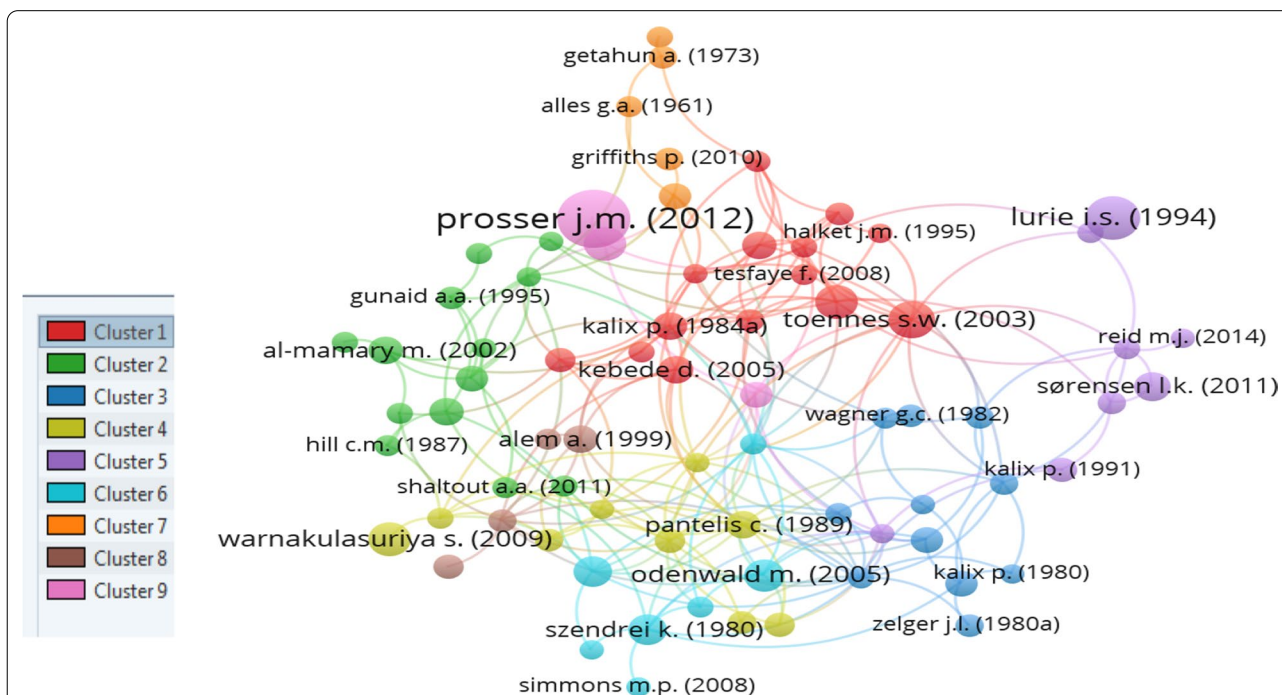


231, 148, 113, and 100 articles, respectively (Fig. 5). Four funding agencies from the USA have funded about 99 research papers. Specifically, they are the National Institute on Drug Abuse (31), the National Institutes of Health (31), the U.S. Department of Health and Human Services (19), and the Fogarty International Center (18). Addis Ababa University funded 18 research papers. Jazan University (KSA), Jimma University (Ethiopia),

and the U.K. Research and Innovation have also given a lot of funding to Khat research.

Citations of documents, authors, journals, institutions and countries

VOSviewer software was used to construct and visualize bibliometric networks. Figure 6 shows the mapping of 113 articles with 50 citations. Seventy-four of these



articles were connected, creating nine clusters and 211 links. Nodes and links connected by curved lines form clusters. Cluster 1 (red) consists of 14 documents. The top-cited article in this cluster is authored by Stefan W. Toennes and his research group, with 187 citations. Thirteen documents formed the second cluster (green), with Al-Mamary (2002) being the most-cited one (Al-Mamary et al. 2002). Clusters 3, 4, 5, 6, 7, 8, and 9 consist of 11, 9, 8, 7, 5, 4, and 3. Table 2 shows the top-cited journals with the number of articles published on *C. edulis*. Twenty-three journals showed citations of more than 5. These journals were categorized into five clusters, each with 101 links and 355 total link strength. The first cluster consists of journals that fall under medicine and public health research. Agroforestry and botany research journals represent the second cluster. Biomedical research journals came in the third cluster. At the same time, journals associated with substance abuse and drug dependence gathered together in the fourth cluster. The Journal of Ethnopharmacology occurred in the fifth cluster.

Networks of cited authors having five or more citations are shown in Fig. 7. Sixty-four authors with citations totaling more than five were mapped. The number of

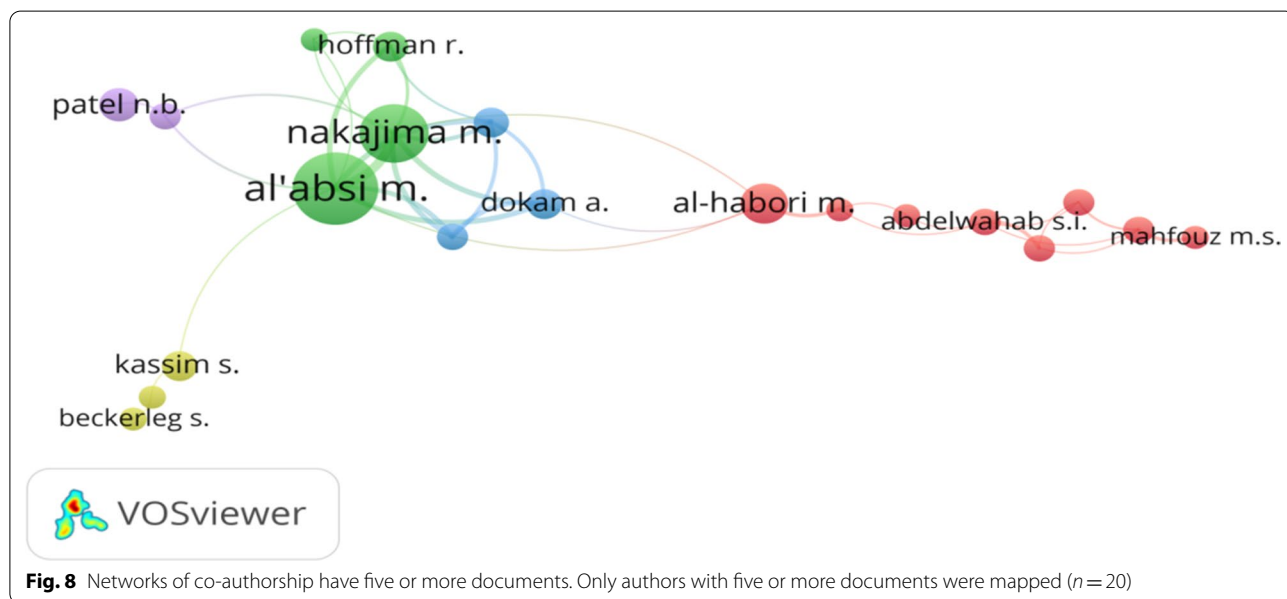
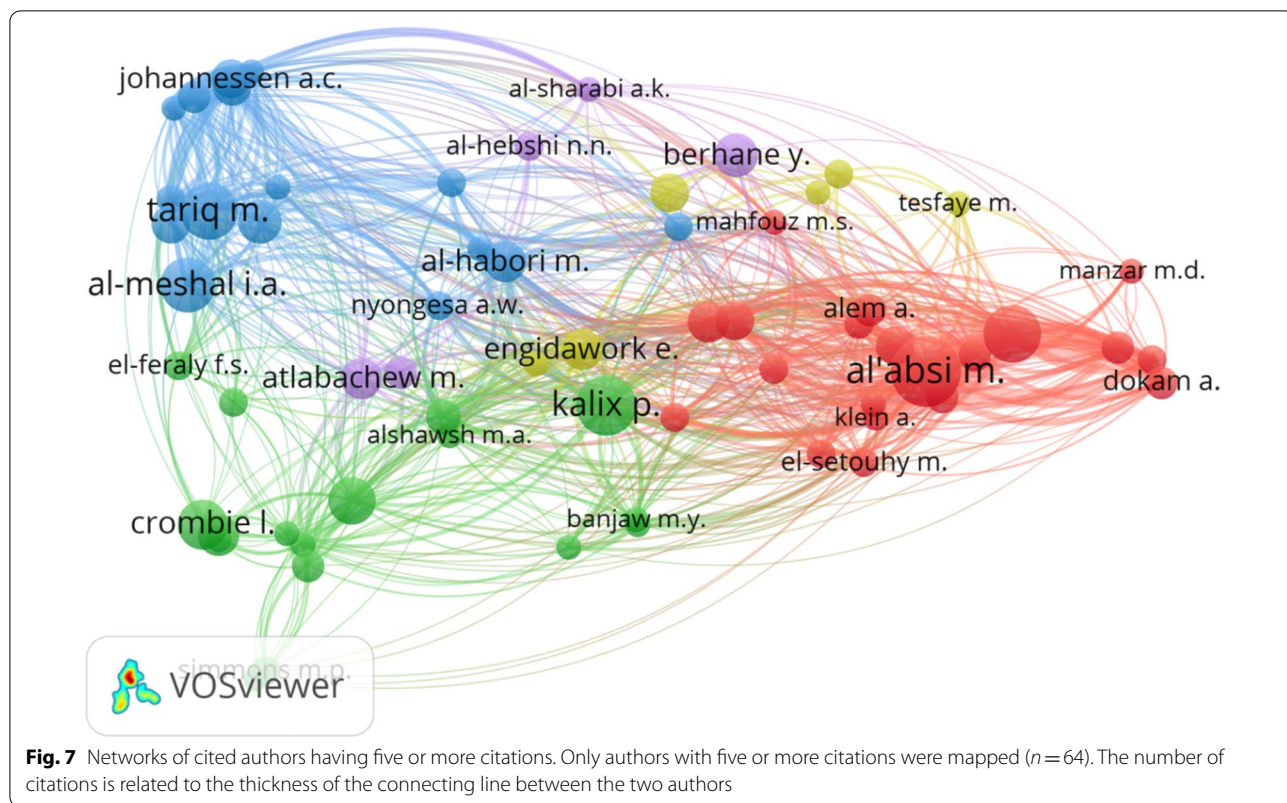
citations is related to the thickness of the connecting line between the two authors. Nodes represent the total link strength of the authors. Authors were assembled into five clusters with 777 links and a total link strength of 2711. The top-cited author is Brenneisen, R., affiliated with the Institute of Pharmacy, University of Berne, Switzerland. The top-publishing researcher with the highest total link strength is al'Absi M. from Minnesota Medical School, USA. The London School of Hygiene and Tropical Medicine in the UK, Makerere University in Uganda, the University of Sana'a in Yemen, the Ethiopian Public Health Association in Ethiopia, Vivo International in Italy, and the University of Nairobi in Kenya are cited the most.

Impact of international collaboration

National and international collaboration can be comprehended through the analysis of co-authorship in the VOSviewer software. As for researchers, we find that 3004 have participated in publishing on *C. edulis*. 477 of them participated in scientific articles with two authors, while 197 participated in scientific papers with three authors. According to VOSviewer mapping, only twenty researchers with five documents are connected (Fig. 8),

Table 2 Top-cited journals with the number of articles published on *C. edulis*

Source	Documents	Citations	Total Link Strength
Journal of Ethnopharmacology	57	1900	155
Remote Sensing of Environment	5	468	0
PLOS One	25	453	37
East African Medical Journal	20	425	80
Bulletin on Narcotics	11	410	31
Forensic Science International	15	375	34
Drug and Alcohol Dependence	6	260	31
BMC Public Health	6	253	32
Saudi Medical Journal	10	239	39
Journal of Pharmacy and Pharmacology	6	224	17
Ethiopian Medical Journal	6	223	49
Agroforestry Systems	6	175	2
Pharmacology, Biochemistry and Behavior	6	157	6
Journal of the Chemical Society, Perkin Transactions 1	7	152	3
Journal of Psychoactive Drugs	7	136	69
Economic Botany	5	120	11
Biomed Research International	13	119	43
African Health Sciences	5	114	4
BMC Psychiatry	7	69	19
Journal of Substance Use	6	60	16
BMJ Open	7	37	17
BMC Research Notes	5	36	6
International Journal Of Environmental Research and Public Health	5	34	7
Research Communications in Substances of Abuse	5	30	2



with 36 links and 113 total link strength. A geographical pattern of these co-authorships was noticed. Cluster 1 (red) included authors from Saudi Arabia as well as two Yemeni scholars (Al Habori M. and Al-Mamary M.) and one Malaysian scholar (Al Shawish, M. A.). Abdelwahab

S.I. had the highest link strength in this cluster. The second group (Green) included international cooperation between al’Absi, M., Hoffman, R., and Nakajima, M., from the USA, and Tesfaye, M., from Ethiopia. al’Absi M. had the highest total link strength in the second

cluster. Dokam, A., and Alsoofi, M., from Taiz University in Yemen, and Khalil N.S., from Sana'a University, had a research collaboration (Cluster 3). Kassim, S., Beckerleg, S. (UK), and Klein, A. (Belgium) collaborated as shown in cluster four (Fig. 8). A national research team from Kenya formed the fifth cluster (purple). Figure 9. shows the collaboration among organizations based on co-authorship analysis. The University of Minnesota, Sana'a University, Jazan University, Taiz University, Addis Continental Institute of Public Health, and Colorado State University had the highest total link strength. The macrolevel of collaboration between countries is shown in Fig. 8 and Table 3. Eight clusters were extracted using VOSviewer software from 38 countries, with 176 links and 512 total link strength. The top collaborative countries are Ethiopia, the USA, Yemen, Saudi Arabia, and the United Kingdom, with total link strengths of 134, 117, 113, 94, and 73, respectively. These five countries were the leaders in their respective clusters. Ethiopia, Australia, France, the Netherlands, Spain, and Belgium were the members of cluster 4 (Fig. 10). The Arabian countries and Malaysia fell into the same cluster (green).

Keywords' co-occurrence: important topics and major research themes

The author and indexed keywords were 2144 and 8058, respectively. Figure 11 shows the co-occurrence analysis of author keywords (important topics). In this figure, the overlay visualizations show the developments over time for these research topics. It shows a co-occurrence

analysis of author keywords with a minimum occurrence of five. Important keywords (topics) on the map included cathinone, Ethiopia, cathine, Yemen, Khat chewing, amphetamine, substance use, alcohol, tobacco, Kenya, dopamine, norephedrine, and apoptosis. By mapping all keywords, the major research themes of Khat's research were obtained. A visualization map of terms in titles and abstracts with a minimum occurrence of five was mapped, resulting in four clusters (research themes) (Fig. 12). The clusters are shown in Table 4.

Co-citation and bibliographic coupling

Figure 13 shows a co-citation analysis of journals with at least 40 citations ($n = 55$). The node size shows the number of times a journal was mentioned by another journal with a similar node color. The discipline(s) underpinning *C. edulis*' study fields are represented by the topic area(s) of the journals with the biggest node size. Traditional knowledge of drug misuse (Journal of ethnopharmacology, addiction), phytochemistry and biological activities (Phytochemistry, Forensic Science International), and clinical and public research (East African Medical Journal, BMC Public Health, Plos One, Lancet) were used to construct the knowledge structure for Khat in the present study. VOSviewer can be used to construct bibliographic coupling networks of researchers ($n = 67$). Figure 14 depicts a representation in which each circle represents a researcher. Large circles represent researchers with many publications. Small circles represent researchers with few

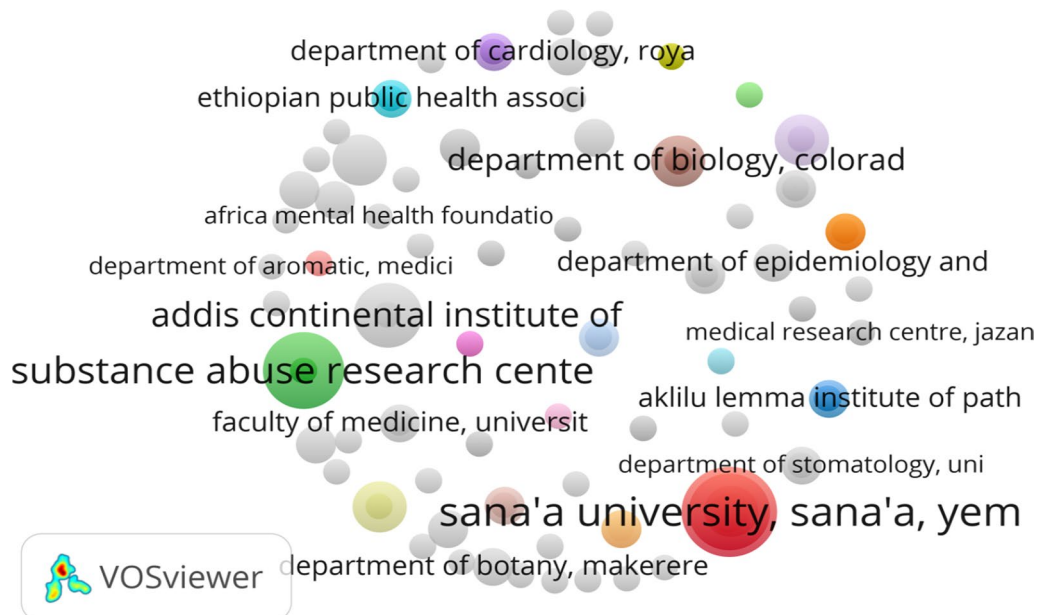


Fig. 9 Mapping of organizations according to co-authorship

Table 3 Countries with a minimum of five documents

Country	Documents	Citations	Total Link Strength	Citation Average
Ethiopia	231	3174	134	13.74
United States	148	4061	117	27.44
Yemen	101	1855	113	18.37
Saudi Arabia	112	1269	94	11.33
United Kingdom	113	3274	73	28.97
Germany	48	1441	46	30.02
Egypt	42	467	44	11.12
Qatar	9	187	35	20.78
Kenya	56	812	28	14.5
South Africa	41	771	27	18.8
United Arab Emirates	7	176	24	25.14
Netherlands	28	886	23	31.64
Oman	6	139	23	23.17
Sweden	26	621	21	23.88
Austria	7	289	16	41.29
Malaysia	19	238	16	12.53
India	20	304	15	15.2
Norway	24	565	14	23.54
Australia	20	520	13	26
Canada	16	737	13	46.06
France	15	563	12	37.53
Italy	22	541	12	24.59
Nigeria	7	55	12	7.86
Spain	11	225	12	20.45
Japan	13	223	11	17.15
Tanzania	7	56	11	8
Uganda	11	440	11	40
Belgium	11	140	9	12.73
Sudan	7	76	9	10.86
Somalia	8	148	8	18.5
Switzerland	32	1233	7	38.53
China	17	157	5	9.24
Denmark	9	265	4	29.44
Israel	13	320	4	24.62
Brazil	10	324	3	32.4
Hungary	7	273	3	39
Iran	10	34	1	3.4
South Korea	6	144	1	24

Total link strength describes the strength of co-authorship

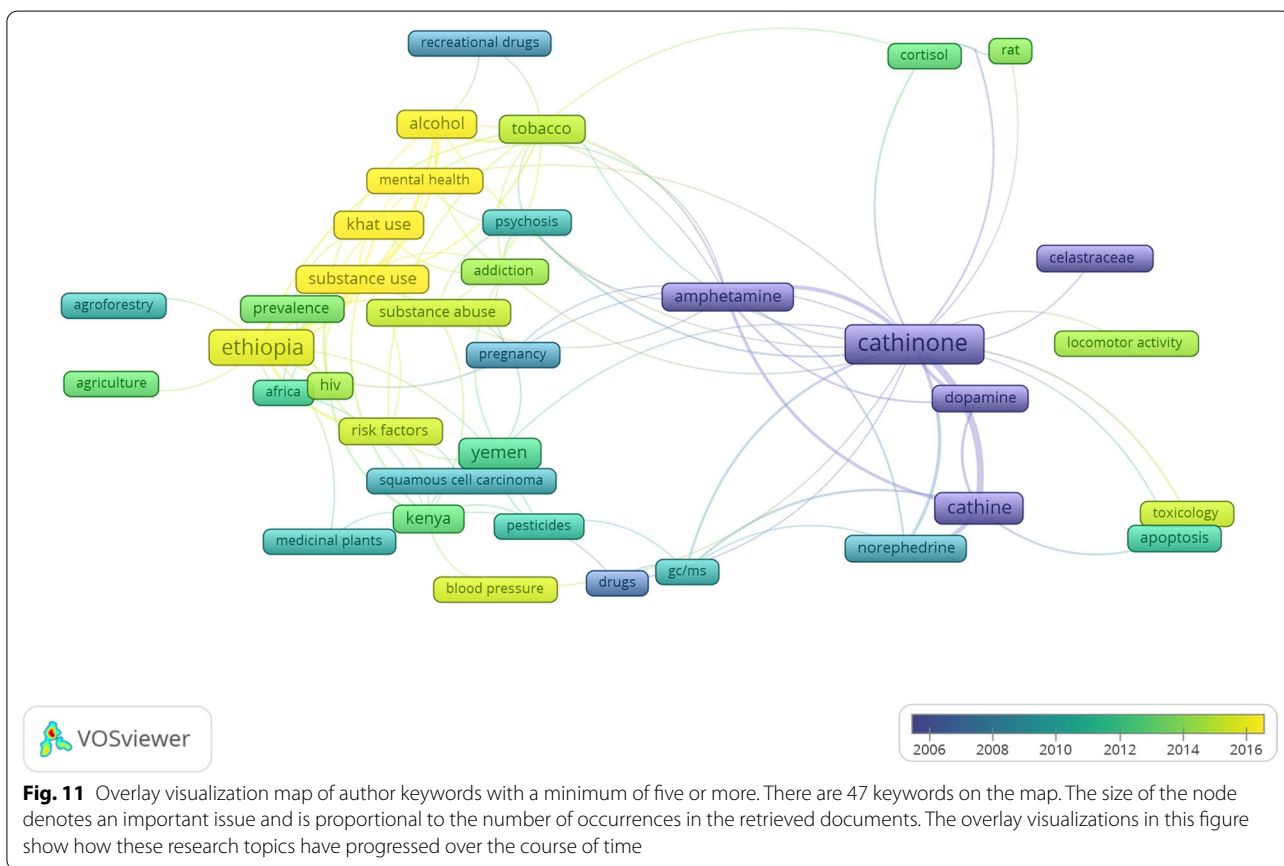
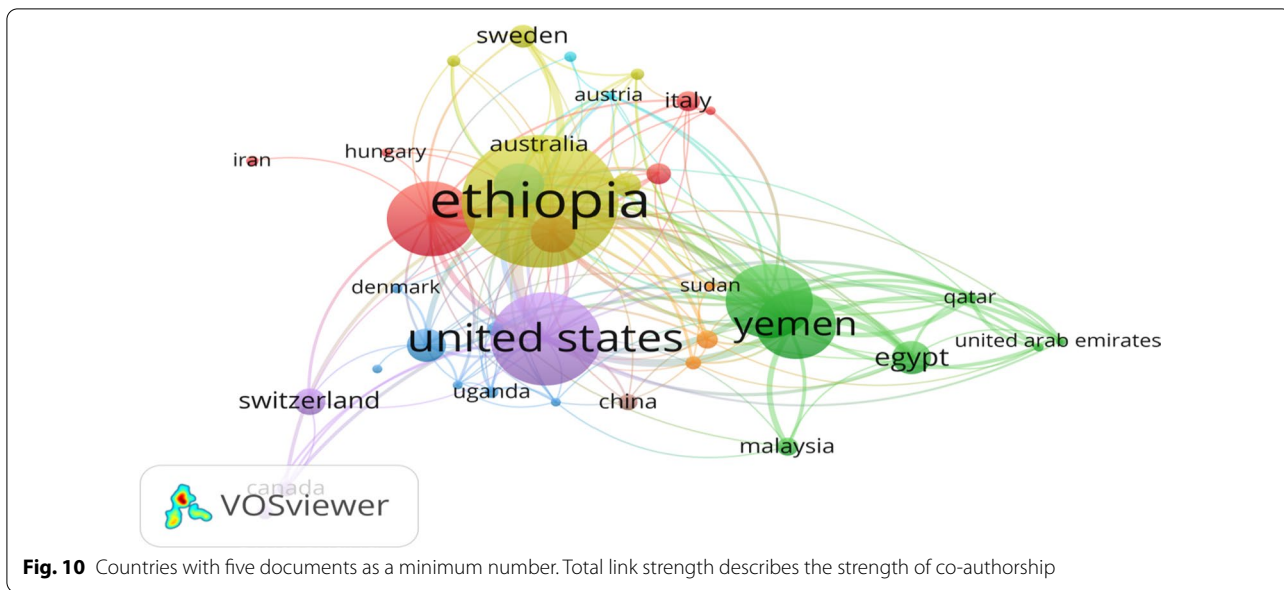
publications. The minimum number of publications in this analysis is five. In general, the closer two scholars are positioned in the visualization, the stronger their bibliographic link is. In other words, researchers who are near each other are more likely to mention the same publications, but researchers who are far apart are less likely to cite the same articles. The colors signify groups

of researchers who are closely tied to one another. There are ten clusters with 1718 links and a total link strength of 5152.16.

Discussion

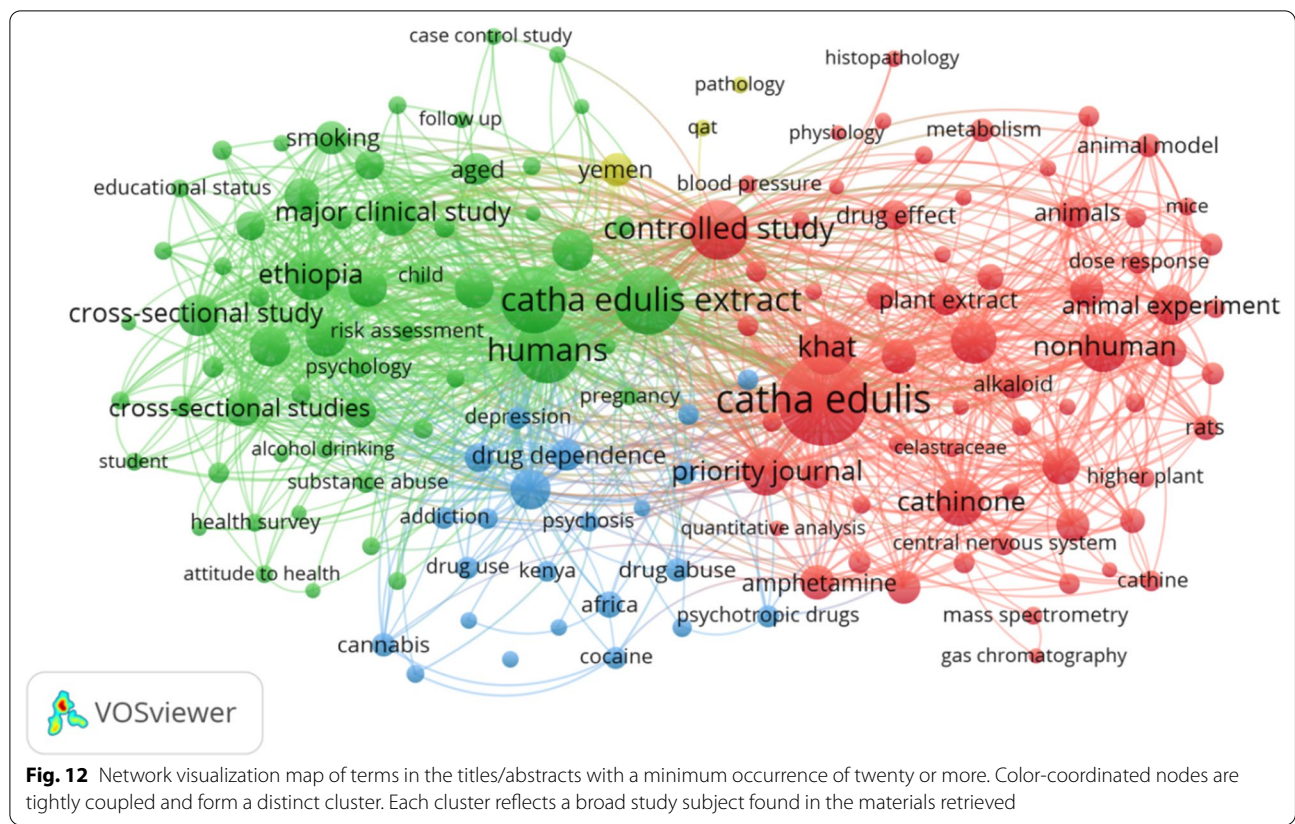
The current study provided a bibliometric overview of the intellectual structure, diffusion of knowledge, emerging literature, and impact of collaboration in *C. edulis* research. Research on Khat was thought to be uncommon prior to the year 2000 for several different reasons, the most significant of which is that Khat as a phenomenon is thought to be geographically limited in some countries, such as Yemen and Somalia, and the social acceptance of Khat chewing is very high. Until then, the adverse effects that Khat might have on a person's health, social life, or finances were not acknowledged. The lack of awareness programs and the scarcity of research capabilities at the universities of the Arab World and the Horn of Africa also affected the growth of Khat research. But there was a noticeable jump in the number of studies after 2001 (Fig. 1). This resulted from the emergence of Yemeni scholars such as Al Habori, M., Al-Mamary, M. A., and Al-Motarreb, A. (Al-Habori et al. 2002; Al-Mamary et al. 2002; Al-Motarreb et al. 2013; Al-Zubairi et al. 2003). Abdelwahab, S.I., and Alsanosy, R., from the Substances Research Center at Jazan University (Saudi Arabia), conducted various research projects on Khat (Abdelwahab et al. 2018, 2015; Alsanosy et al. 2020, 2013). Nakajima, M., and al'Absi, M., from the Khat Research Group at the University of Minnesota (USA), have published many papers (Al'Absi et al. 2013, 2014; Nakajima and Al'absi 2021; Nakajima et al. 2014). As for Ethiopia, the emergence of scholars such as Berhane, Y., Engidawork, E., and Atlabachew, M. in and after 2008 led to the growth of Khat research (Atlabachew et al. 2013; Bedada and Engidawork 2010; Kedir et al. 2013; Tesfaye et al. 2006). The United Kingdom was one of the first countries to engage in Khat research from 1961 until today. Four funding agencies from the USA and the U.K. Research and Innovation provided substantial funds for Khat research. Some Western countries are doing research on Khat because Arab and African immigrants told them about the problem and because it's easy to share information in the modern world.

The study of citations' numbers, patterns, and graphs in texts is known as "citation analysis" (White and McCain 1998). Citation analysis can be used to learn more about a topic or issue by finding the most important works in that area or on that issue. It can also be used to measure the impact of a work by finding out which other scholars were influenced by it (Liu and Hu 2021). It employs the directed graph of citations to expose document attributes. The most common goal would be to identify the



most crucial papers, researchers, and journals in the area (González-Valiente et al. 2019). VOSviewer software was used to construct and visualize bibliometric networks for

citation analysis. The citation map shown in Fig. 4 represents an excellent example of the diffused knowledge connected with Khat research. The top-cited document



was authored by Prosser and Nelson (2012). The article reviewed the toxicology of Bath salts (Prosser and Nelson 2012). Bath salts are synthetic cathinones that have recently been developed and are increasing in popularity as recreational drugs. Cathinone is a naturally occurring beta-ketone amphetamine analog discovered in the *C. edulis* plant's leaves. This compound's derivatives are synthetic cathinones (Cottencin et al. 2014; Karila et al. 2012). This proves the diffusion of knowledge related to Khat research into other fields. Table 2 shows the

top-cited journals with articles published on *C. edulis*. The top-cited journals were categorized into three clusters. Specifically, agroforestry and botany research journals; biomedical research journals; and substance abuse and drug dependence journals. The Journal of Ethnopharmacology is the most-cited and published journal. Articles published in this journal reported the effects of *C. edulis* on lactating women, heart rates, uteroplacental blood flow, electroencephalogram, adrenocortical functions, motor behaviors, free radical metabolism, plasma lipid peroxidation, testosterone, prolactin, luteinizing hormone, cortisol levels, sedation, sexual behavior, periodontal pathogens, cardiac biomarkers, and the malaria parasite (Admassie and Engidawork 2011; Al-Hebshi et al. 2010; Connor et al. 2002; Geisshüsler and Brenneisen 1987; Jansson et al. 1988; Kalix 1991; Krizevski et al. 2007; Murdoch et al. 2011; Nyongesa et al. 2008; Nyongesa et al. 2007; Oyungu et al. 2009; Stafford et al. 2005). Networks of cited authors having five or more citations are shown in Fig. 5. The most-cited author is Rudolf Brenneisen. The author with the highest number of papers and the strongest total link strength is al'Absi, M. al'Absi, M., and his team established the Khat Research Program (KRP). KRP is an interdisciplinary research and training program dedicated to *C. edulis* that has

Table 4 Keywords' co-occurrence and important topics and major research themes

Clusters No	Important topics and major research themes	Color of the cluster*
1	Phytochemistry, botany and pharmacology of Khat	Green
2	Addiction, concurrent use of other drugs, survey-based studies, sex difference	Red
3	Case reports, clinical studies, pathology	Blue
4	Case-control studies	Yellow

*The color of the clusters is based on the visualization performed using VOSviewer as depicted in Fig. 10

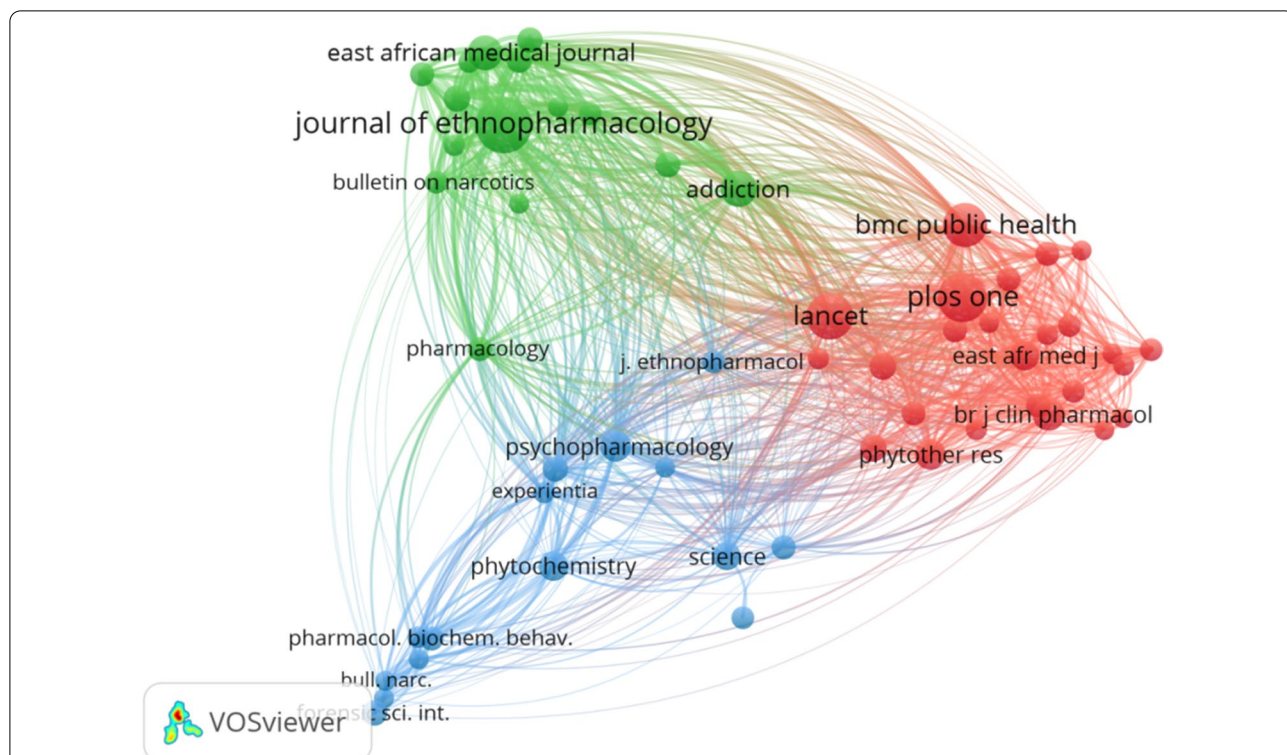


Fig. 13 A map depicting the results of a journal co-citation study ($n = 55$ journals). A big node reflects publications that are regularly co-cited by other journals of the same hue. The topics of the largest nodes are the fields of the documents that were found

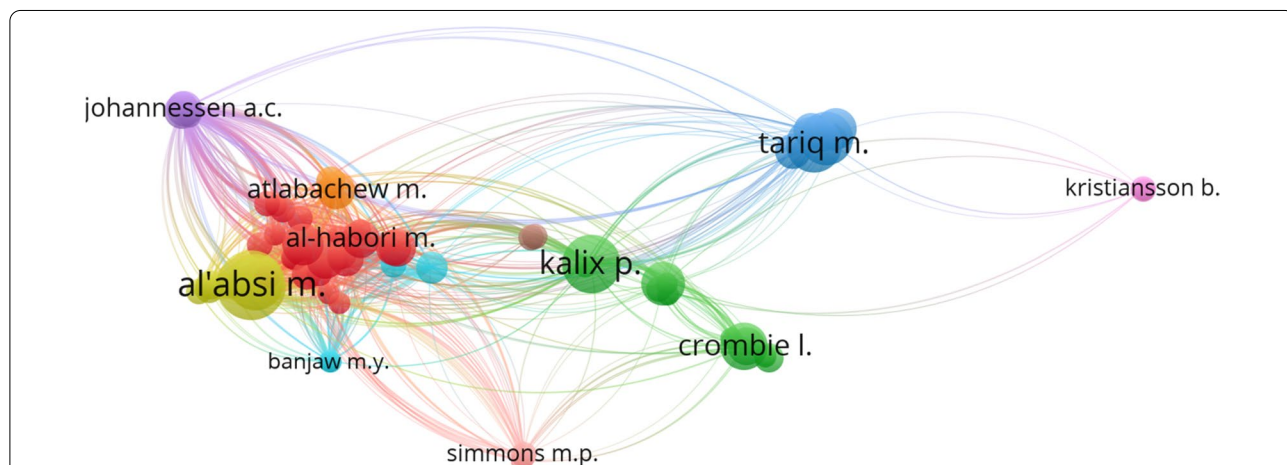


Fig. 14 VOSviewer visualization of a researcher's bibliographic coupling network

garnered significant support from a variety of US-based funding sources (Al'Absi et al. 2013; Bongard et al. 2011; Hoffman and Al'Absi 2010, 2013; Nakajima et al. 2012, 2013). al'Absi's research on Khat started in 2010, according to the Scopus database (Hoffman and Al'Absi 2010). The most prolific organizations are the London School of Hygiene and Tropical Medicine, followed by institutions

from all over the globe. The USA is the top-cited country, followed by the United Kingdom, Ethiopia, Yemen, Saudi Arabia, and Switzerland. The spread of citations in the West, the Middle East, the Far East, and Africa indicates the diffusion of knowledge. Knowledge diffusion can be thought of as the ways in which scientific publications are changed and used (Chen and Hicks 2004).

Text mining and co-word analysis were used to map the intellectual structure using co-occurrence (Chen and Hicks 2004; Chen et al. 2016). Many scholars have utilized co-word analysis to investigate conceptual work in many disciplines. Co-occurrence analysis of author keywords is used to define essential topics, while all keyword analysis is used for detecting major research themes. The network visualization map resulted in the research themes of Khat. This includes phytochemistry, botany, pharmacology, toxicology, pathology, case report studies, addiction, behavioral studies, case-control studies, and clinical studies. Important topics included cathinone, cathine, Khat chewing, amphetamine, substance use, alcohol and tobacco concurrent use, dopamine, norephedrine, and apoptosis.

The bibliographic coupling network is an excellent lens for examining how information is incorporated into a scientific endeavor. The bibliographic coupling network is built on common references between publications. It offers information on how writers utilize and establish relationships among the existing literature, providing deeper insights into scientific activity. It can be used to look at an article's place in the literature, figure out how big its research community is, and answer questions that haven't been answered (Biscaro and Giupponi 2014; Kessler 1963). The current study confirmed that the discipline(s) underpinning *C. edulis*' study fields are represented by the journals' topic area(s). Journals from various fields were used to disseminate Khat's research. The journals that were looked at had wide-ranging topics, such as traditional knowledge, phytochemistry and biological activities, clinical and public research, agricultural science, sociology, and psychiatry.

Conclusions

Khat leaves are chewed for their stimulating properties. Khat is an evergreen bush or tiny tree. The leaves are fragrant. The flavor is astringent and sweet. The seedless plant thrives in a wide range of temperatures and soils. Alkaloids, terpenoids, flavonoids, sterols, glycosides, tannins, amino acids, vitamins, and minerals are all present in Khat. The primary alkaloids structurally similar to amphetamine are phenylalkylamines and cathedulins. Khat has a substantial impact on human health. These include gastrointestinal problems such as constipation or urinary retention and acute cardiovascular effects such as hyperalertness and mental issues. Men's sexual potency is harmed by elevated blood pressure, tachycardia, sleeplessness, and anorexia (Krizevski et al. 2007; Patel 2019; Wabe 2011). With the magnitude of the social, economic, and health problems caused by Khat, there is an urgent need for many bibliometric

studies. These studies help decision-makers and researchers distinguish research trends and health decisions. This bibliometric study is broader in terms of time and uses a more significant number of scientific papers. Contrary to previous studies conducted in a few years with fewer scientific papers. Our study used 996 papers extracted from the Scopus database, while the last two studies used 514 and 651 papers, respectively. We studied it in more depth and came up with results that will contribute to the reconstruction of scientific research in Khat. Khat research has become a global spread in performance and scientific publication. But it focused on some of the countries that suffer from the burden of Khat addiction, such as Yemen, Saudi Arabia, Ethiopia, and Kenya. Some of the new scientific institutes have contributed well to the development of Khat research, especially in Saudi Arabia and the USA, which is evident after 2012. Research collaboration has also played a significant role in Khat research, with 80 countries contributing to this matter. Many scientific disciplines participated in Khat research, including agricultural, medical, engineering, social, chemistry, epidemiology, computer science, remote sensing, etc. Al-Absi M. is the most important researcher in Khat research. The analysis of citations and the occurrence of keywords confirmed the existence of many emerging studies and the spread of knowledge. The implications for the spread and use of bibliometric methods in Khat studies help researchers figure out how to make decisions, do scientific research, and save money and time.

Limitations

There are certain limitations to the present research. Even though the author tried his utmost to minimize this sort of inaccuracy, false-positive and false-negative outcomes are possible. Furthermore, the use of Scopus to retrieve documents may have resulted in the loss of certain papers published in non-English nations' natively unindexed journals.

Abbreviations

MS Excel: Microsoft excel; CSV: Comma-separated values; AR: Article; CP: Conference paper; KSA: Saudi Arabia.

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Author contributions

SIA planned the investigation, evaluated the findings, wrote the article, and oversaw the administrative aspects. MMET gathered the information and revised the text. Both authors have read and approved the manuscript.

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Availability of data and materials

The datasets used and/or analyzed during the current study available from the corresponding author on reasonable request.

Declarations**Ethics approval and consent to participate**

There is no form of human subject involved in this manuscript; therefore, ethics approval is not required.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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