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Bibliometric analysis of apitherapy in complementary medicine literature between 1980 and 2016

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ABSTRACT

Apitherapy is the medical use and the application of honey bee products and in recent years there has been a growing interest in studies of this field. We aimed to perform a bibliometric study in the apitherapy literature. We used Web of Science database in this study and our search retrieved a total of 6917 documents of which great majority (82.4%) was original articles. Brazil was found to ranked first on the publication number with 889 papers followed by the USA, China, Japan and Turkey. We measured a productivity score for each country and the most productive countries in apitherapy field were Switzerland (2.978), Croatia (2.074), and Bulgaria (1.840). Propolis was the most used keyword followed by bee venom, flavonoids, apis mellifera and apoptosis. A moderate correlation was detected between number of publications and GDP. To the best of our knowledge our study was the first in this area and we proposed that further studies should be supported in this field.

1. Introduction

Apitherapy, is the medicinal use of honey bee products including honey, pollen, propolis, royal jelly and bee venom [1]. Apitherapy can be used for both treatment and prevention of diseases. Bibliometrics is the statistical analysis of published literature in a certain field. In this study, we aimed to analyze apitherapy literature and performed a citation analysis of literature and ranked countries according to the productivity in apitherapy field. To the best of our knowledge, this study is the first to investigate scientometric features of apitherapy literature.

2. Methods

The data of this study were obtained by using the database of Thomson Reuters WoS (Thomson Reuters, New York, NY, USA). We used “honey”, “bee venom”, “royal jelly”, “propolis” and “apitherapy” keywords to search WoS database. We could reach back to 1975 in the database and included all documents produced between 1975 and 2016 to the study. We excluded all papers published in 2017. Documents from England, Wales, Scotland and Northern Ireland were united under the United Kingdom (UK) heading. Statistical analyses were performed with SPSS (Version 22.0, SPSS Inc., Chicago, IL, USA; licensed for Hitit University, Çorum, Turkey). We created infographics showing scientometric networks by using a freeware named *VOSviewer software tool* for constructing and visualizing bibliometric networks [2].

3. Results

3.1. Total number of published items

Our WoS database search retrieved a total of 6917 items from beginning of 1980 to the end of 2016. It was found that the great majority of the total apitherapy documents (82.45%) were original articles followed by meeting abstracts (7.08%) and reviews (5.29%) (Table 1). Brazil ranked first on the publication number with 889 items followed by the USA, China, Japan and Turkey (818, 572, 568 and 453 items, respectively) (Figs. 1 and 2).

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Table 1
Types of publications on apitherapy field[a].

Document type	Number[a]	%[a]
Original article	5703	82.45
Meeting abstract	490	7.08
Review	366	5.29
Proceedings Paper	209	3.02
Letter	100	1.45
Note	69	1.00
Editorial material	57	0.82
Correction	21	0.30
News Item	11	0.16
Other	8	0.12
Total	***6917***	***100***

[a] Total number may exceed 6917 and total percentages may exceed 100% because certain items were included in more than one category.

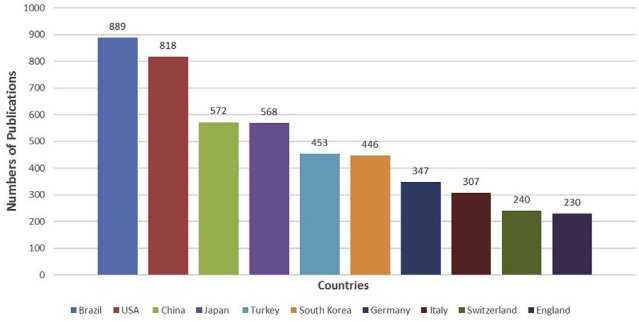

Fig. 1. Top ten countries publishing apitherapy publications by total number of items.

3.2. Productivity of the countries

We measured productivity scores of the countries published apitherapy documents by a simple formula (production numbers/population x 1,000,000) previously used in the literature and ranked the first 10 countries [3,4]. The most productive countries in apitherapy field were Switzerland (2.978), Croatia (2.074), Bulgaria (1.840) and Slovenia (1.456) (Fig. 3).

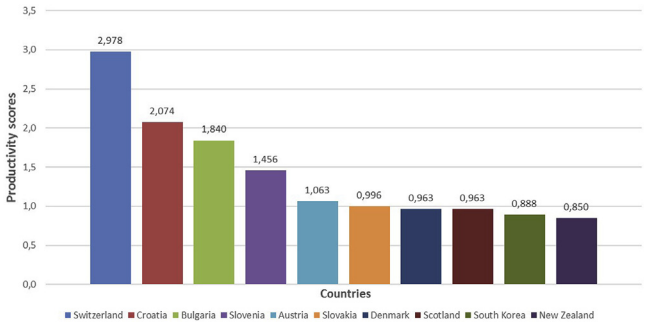

Fig. 3. Top ten countries in productivity of apitherapy literature.

We performed correlation analyses between number of publications and developmental indices of the 60 countries including gross domestic product (GDP), human development index (HDI), number of internet users (IU), percentage of individuals using the Internet according to total population of a country (PIUI), purchasing power parity (PPP) and English proficiency index (EF). GDP includes all final goods and services produced in a country. We detected a moderate correlation with number of publications and GDP. HDI is a combined measure of income, education and life expectancy indices of a country. Only a little correlation was found between number of publications and HDI of the countries. Low correlation with IU and little correlation with PIUI were noted. PPP is a basic index of the economic well-being of a country. No correlation was detected between number of publications and GDP per hour worked (Table 2).

3.3. Journals, publications, organizations and authors

Pharmacology, biochemistry and molecular biology were detected to be most published research areas (1355, 1031 and 1006 items, respectively) (Table 3). Vassya Bankova was found as the most published author in the apitherapy field with 83 records (Table 4). "*Propolis: recent advances in chemistry and plant origin*" published in the journal *Apidologie* in 2000 was most cited article Bankova with 464 citations (average citations: 26.61 per year) in

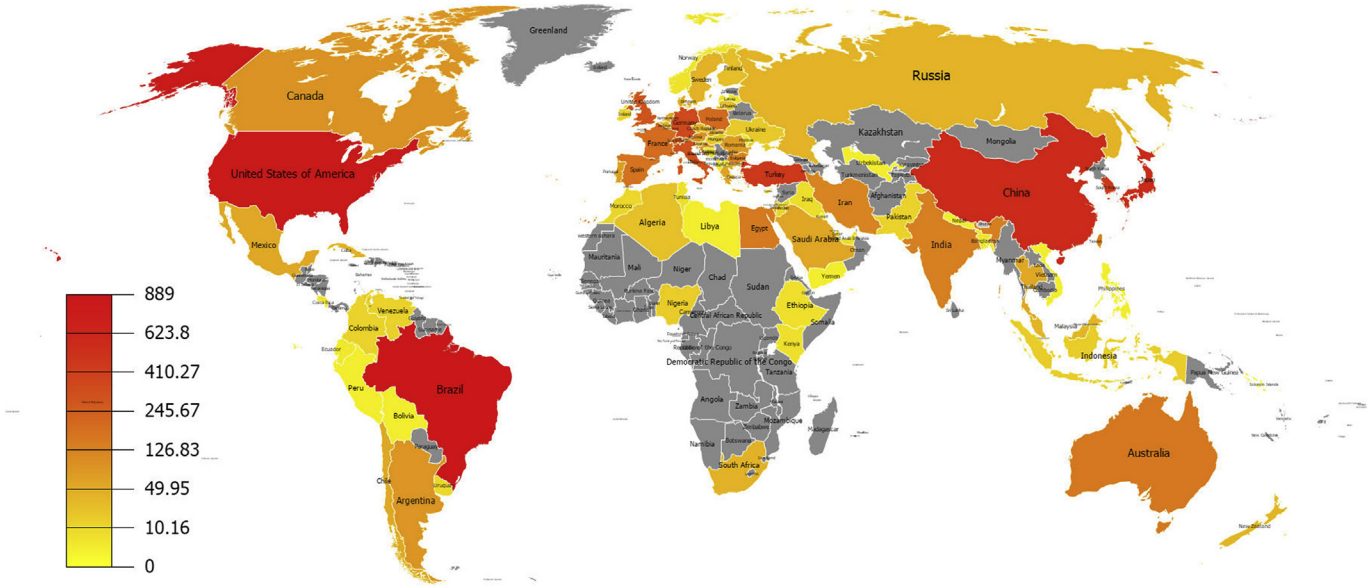

Fig. 2. Total apitherapy publication density of world countries.

Table 2
Correlations between total number of publications and developmental indices of the countries.

	Population number	Productivity	GDP (PPP) per hour worked	GDP (PPP) per capita	GDP	IU	PIUI	HDI	EF
Apitherapy, Bee venom, Propolis, Royal jelly	***r*=0.475**[a] ***p*<0.001**	***r*=0.565**[a] ***p*<0.001**	$p = 0.215$	***r*=0.371**[a] ***p*=0.001**	***r*=0.753**[a] ***p*<0.001**	***r*=0.576**[a] ***p*<0.001**	***r*=0.283**[a] ***p*<0.010**	***r* = 0.438**[a] ***p*<0.001**	$p = 0.089$

GDP = gross domestic product; HDI = human development index; IU= Internet users; PIUI = percentage of individuals using the Internet (according to total population of a country); PPP = purchasing power parity; EF = English proficiency index.
[a] Statistically significant ($0.00 < r < 0.25$: little if any correlation; $0.26 < r < 0.49$: low correlation; $0.50 < r < 0.69$: moderate correlation; $0.70 < r < 0.89$: high correlation; $0.90 < r < 1.00$: very high correlation).

Table 3
The first 10 research areas by publications in apitherapy.

Research areas	Number of publications	%
Pharmacology Pharmacy	1355	19.59
Chemistry/Biochemistry	1031	14.91
Molecular Biology	1006	14.54
Immunology	752	10.87
Food Science Technology	663	9.58
Allergy	634	9.17
Integrative Complementary Medicine	465	6.72
Entomology	363	5.25
Plant Sciences	341	4.93
Toxicology	333	4.81

Table 4
The first ten authors by record count in apitherapy.

Authors	Record Count	%
Bankova V	83	1.20
Chen J	66	0.95
Sforcin JM	63	0.91
Akdis CA	60	0.87
Rosalen PL	60	0.87
Blaser K	59	0.85
Silici S	50	0.72
Marcucci MC	49	0.71
Lee JH	46	0.67
Park KK, Ikegaki M, Bastos JK, Akdis M	45	0.65

WoS database [5]. The first 10 journals according to the number of published documents covered only 14.1% of the literature with 971 documents (Table 5). A review written by Havsteen published in 2002 was most cited article in the apitherapy literature with 1113 citations [6] (Table 6).

University of São Paulo in Brazil published highest number of apitherapy publications with 273 documents and covered 3.94% of the total literature. Three of the top publishing institutions were also in Brazil. Although Bulgaria was not in the first ten publishing countries it had two organizations in top ten publishing organizations list. Japan, Turkey, Germany, Italy and England had no top ten publishing organization although they were in the first ten countries in apitherapy literature (Table 7).

3.4. Progression of apitherapy literature

A significant correlation was noted between the year and cumulative number of apitherapy publications (Fig. 4). Total number of apitherapy documents was highest in 2014 and over 500 per year in the last four years (Fig. 5). Citations were found to be increased progressively and higher than 12,000 items per year in the last three years (Fig. 6).

3.5. Co-authorship network for countries

We created a co-authorship network for countries by using WoS database. This network showed both productivity power of the countries by the point size and connections between countries including authors publishing together. For instance, Brazil had the highest number of publications with the biggest point size and it connected with the same-color countries such as Spain, Mexico, Argentina and Cuba. Authors in the countries with the same color were publish together and they were co-authors of the publications (Fig. 7).

3.6. Keyword analysis

Propolis was the most used keyword followed by bee venom, flavonoids, apis mellifera, apoptosis, caffeic acid phenethyl ester and melittin. We created a network and connections map using most used keywords according to the keyword frequency (Fig. 8). Keywords associated with each other located closely in the same color. For instance, bee venom, melittin, inflammation, acupuncture, pain, hyperalgesia and rheumatoid arthritis were related keywords and bee venom was most used among them (Fig. 8).

Table 5
The first 10 journal source according to the number of published documents.

Journal Name	Number of publications	%
Evidence Based Complementary and Alternative Medicine	157	2.27
Journal of Allergy and Clinical Immunology	123	1.79
Allergy	113	1.63
Journal of Agricultural and Food Chemistry	98	1.42
Journal of Ethnopharmacology	91	1.32
American Bee Journal	83	1.20
Food Chemistry	79	1.14
Journal of Apicultural Research	78	1.13
Clinical and Experimental Allergy	76	1.10
PLoS ONE	73	1.06

Table 6
The 10 most cited manuscripts in the apitherapy literature.

Article	Author	Journal Name/Published	Total Citation	Average Citations per Year
The biochemistry and medical significance of the flavonoids	Havsteen, BH	Pharmacology & Therapeutics	1113	69.56
Antimicrobial activity of flavonoids	Cushnie, TPT and Lamb AJ	International Journal of Antimicrobial Agents	1027	79.00
A metagenomic survey of microbes in honey bee colony collapse disorder	Cox-Foster, Diana L.; Conlan, Sean; Holmes, Edward C.; et al.	Science	782	71.09
Caffeic acid phenethyl ester is a potent and specific inhibitor of activation of nuclear transcription factor NF-kappa B	Natarajan, K; Singh, S; Burke, TR; et al.	Proceedings Of The National Academy Of Sciences Of The United States Of America	761	34.59
Estimation of total flavonoid content in propolis by two complementary colorimetric methods	Chang, CC; Yang, MH; Wen, HM; et al.	Journal Of Food And Drug Analysis	745	46.56
Review of the biological properties and toxicity of bee propolis (propolis)	Burdock, GA	Food And Chemical Toxicology	673	33.65
Role of interleukin 10 in specific immunotherapy	Akdis, CA; Blesken, T; Akdis, M; et al.	Journal Of Clinical Investigation	655	32.75
IL-10 and TGF-beta cooperate in the regulatory T cell response to mucosal allergens in normal immunity and specific immunotherapy	Jutel, M; Akdis, M; Budak, F; et al.	European Journal Of Immunology	534	35.60
Propolis - chemical-composition, biological properties and therapeutic activity	Marcucci, MC	Apidologie	527	22.91
Non-cyclooxygenase-derived prostanoids (f2-isoprostanes) are formed insitu on phospholipids	Morrow, JD; Awad, JA; boss, HJ; et al.	Proceedings Of The National Academy Of Sciences Of The United States Of America	523	20.12

Table 7
The first ten institutions by number of publications in apitherapy.

Organizations	Document number	%
University of São Paulo (Brazil)	273	3.94
São Paulo State University (Brazil	152	2.21
University of Campinas (Brazil)	139	2.01
Bulgarian Academy of Sciences (Bulgaria)	118	1.70
Kyung Hee University (South Korea)	117	1.69
University of Sofia (Bulgaria)	113	1.63
Swiss Institute of Allergy Asthma Research (Switzerland)	93	1.34
University of Zagreb (Croatia)	84	1.21
Fourth Military Medical University (China)	72	1.04

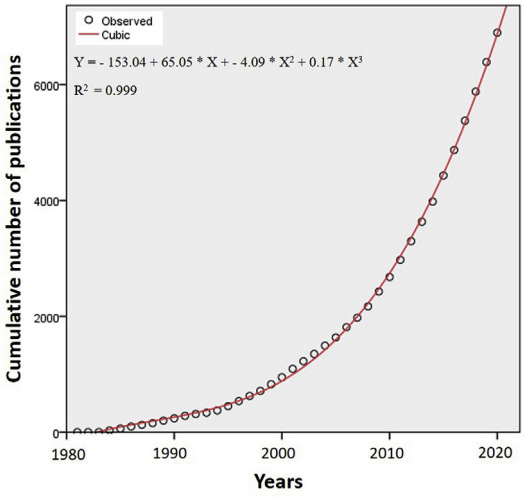

Fig. 4. Cumulative number of apitherapy publications by year.

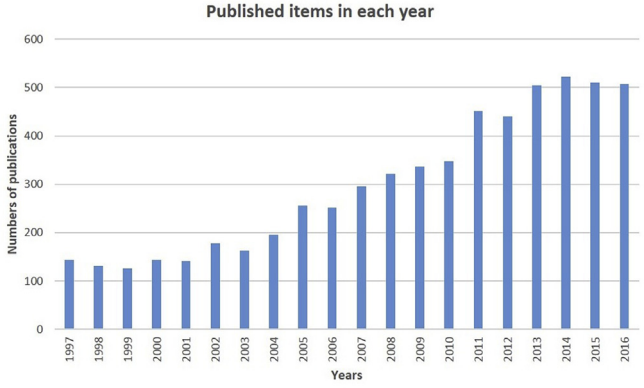

Fig. 5. Published apitherapy documents by year.

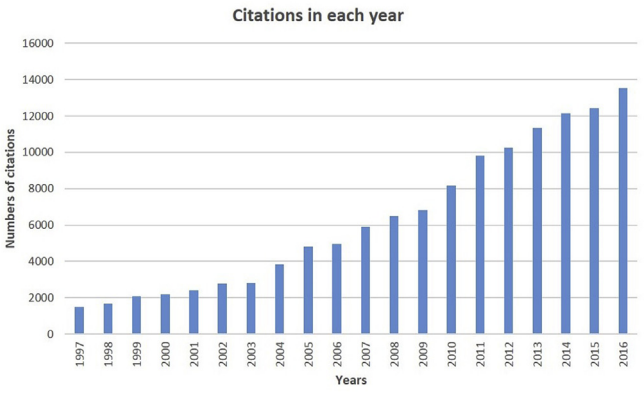

Fig. 6. Citations in apitherapy field by year.

4. Discussion

Bibliometrics is a novel scientific area providing statistical analysis of academic literature and describing publication and citation trends and patterns in a certain field [7]. In 1896, Campbell carried out the first bibliometric study using statistical analyses for studying subject scattering in publications [8]. Pritchard proposed the term "bibliometrics" to replace a confusing and little used term of "statistical bibliography" in 1969 [9]. Bibliometrics uses statistical and mathematical methods to measure contributions of researchers,

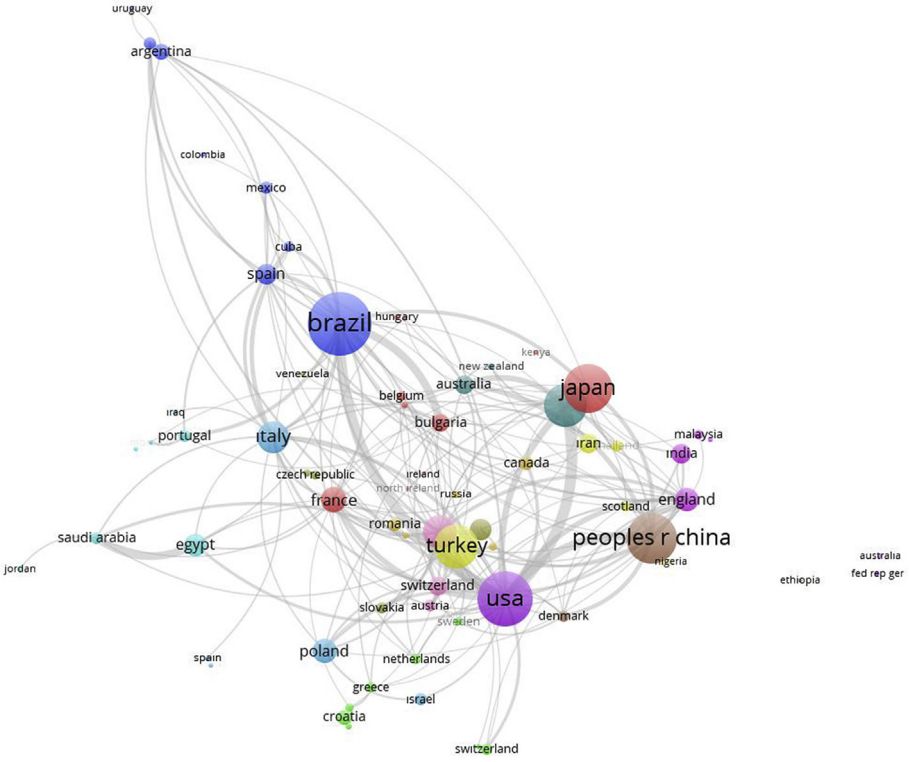

Fig. 7. Co-authorship network in apitherapy field.

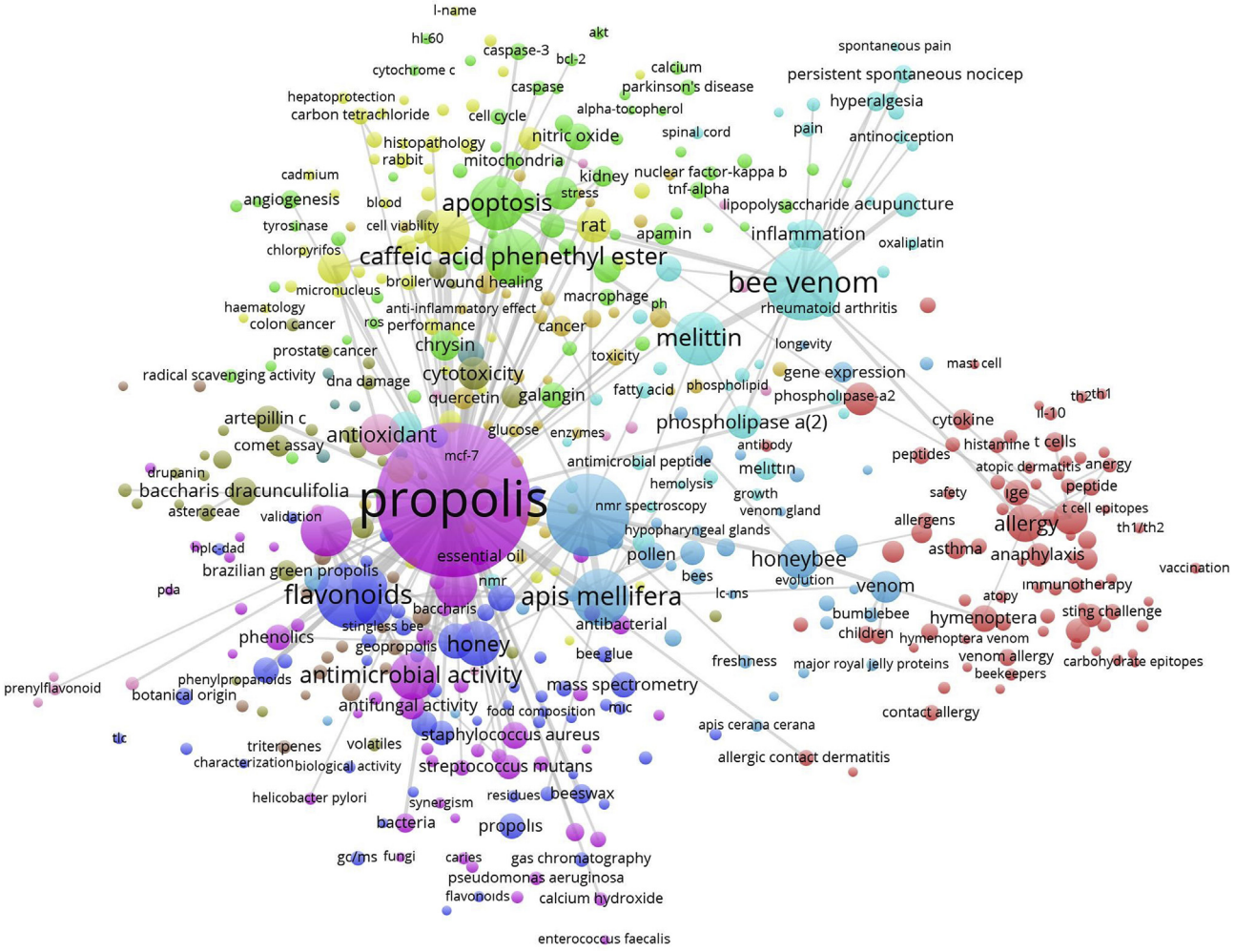

Fig. 8. Keyword network in apitherapy field.

foundations and countries to the literature. Although a few articles investigating of bibliometric analysis of alternative an complementary medicine have been published, to best of our knowledge our study was the first to perform a bibliometric evaluation of apitherapy literature [10–12]. Fu et al. performed a bibliometric analysis of alternative and complementary medicine literature using WoS database during 1980–2009 and detected 17,002 documents. Seventy percent of papers were original articles and the USA was found to be most productive country with 4117 documents followed China and India although Brazil ranked first in the Apitherapy literature as seen in our study. China Medical University located in Taiwan was found to be the most productive organization although three of the top publishing organizations were in Brazil in our study [12].

5. Conclusion

Although there has been a growing interest in apitherapy studies in recent years, the fact that our study was the first in the bibliometrics of apitherapy and that there was no other study to compare was indicative of the inadequacy of the statistical literature in this area. We found a moderate correlation with the number of publications and GDP. Researchers in low-income countries should to be supported and encouraged to carry out apitherapy studies.

References

[1] S. Trumbeckaite, J. Dauksiene, J. Bernatoniene, V. Janulis, Knowledge, attitudes, and usage of apitherapy for disease prevention and treatment among undergraduate pharmacy students in Lithuania, Evid. base Compl. Alternative Med. (2015), https://doi.org/10.1155/2015/172502.
[2] Vosviewer, VOSviewer - Visualizing Scientific Landscapes, 2017. http://www.vosviewer.com/. (Accessed 22 October 2017).
[3] E. Şenel, E. Demir, A global productivity and bibliometric analysis of telemedicine and teledermatology publication trends during 1980-2013, Dermatol. Sin. 33 (2015) 16–20.
[4] P.L. Moser, H. Hauffe, I.H. Lorenz, M. Hager, W. Tiefenthaler, H.M. Lorenz, G. Mikuz, P. Soegner, C. Kolbitsch, Publication output in telemedicine during the period January 1964 to July 2003, J. Telemed. Telecare 10 (2004) 72–77.
[5] V.S. Bankova, S.L.D.E. Castro, C M, Propolis: recent advances in chemistry and plant origin, Apidologie 31 (2000) 3–15.
[6] B.H. Havsteen, The biochemistry and medical significance of the flavonoids, Pharmacol. Ther. 96 (2002) 67–202.
[7] E. Şenel, E. Demir, A global productivity and bibliometric analysis of telemedicine and teledermatology publication trends during 1980-2013, Dermatol. Sin. (2015), https://doi.org/10.1016/j.dsi.2014.10.003.
[8] W.W. Hood, C.S. Wilson, The literature of bibliometrics, scientometrics, and informetrics, Budapest Sci 52 (2001) 291–314.
[9] A. Pritchard, Statistical bibliography or bibliometrics? J. Doc. 25 (1969) 348–349.
[10] L.S. Wieland, E. Manheimer, M. Sampson, et al., Bibliometric and content analysis of the Cochrane Complementary Medicine Field specialized register of controlled trials, Syst. Rev. 2 (2013) 51.
[11] A.J. Vickers, Bibliometric analysis of randomized trials in complementary medicine, Compl. Ther. Med. 6 (1998) 185–189.
[12] J.-Y. Fu, X. Zhang, Y.-H. Zhao, M.-H. Huang, D.-Z. Chen, Bibliometric analysis of complementary and alternative medicine research over three decades, Scientometrics 88 (2011) 617–626.