



Scientometric Analysis of Garlic Research Publications

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ABSTRACT

This papers discussion on Scientometric analysis of garlic research publications from 2002 to 2016, 2836 papers have been published in this research, the study reveals that year wise publications in garlic research have increasing from 4.76 percent to 7.48 percent, It reveals that in document types article has occupies first place meeting abstract second has place, review has third place, conference proceedings fourth place news item has fifth, letter has sixth, editorial material has seventh place, and so on in this research. Countries contributed United States of America (USA) has occupies first place, South Korea has second place, India has occupies third place, and so on. Totally 2228 institutions were contributed in garlic research during the study period. Moreover, 991 sources were contributed in this research. Authorship pattern found that, more than ninety three percent of collaborative authors were contributed in garlic research.

KEYWORDS : Garlic, Medicinal herb, Disease prevention, Cancer preventative.

INTRODUCTION

Garlic is a food and medicinal herb used throughout the world. Its unique sulfur chemistry includes numerous bioactive compounds that may benefit human health. Preclinical studies indicate that garlic compounds may prevent and inhibit cancer, reduce total and low-density lipoprotein cholesterol, inhibit platelet aggregation, and regulate glucose (Charron, C.S. Milner, and J.A. Novotny, J.A, 2016). As early as 1550 B.C.E., Egyptians had realized the benefits of garlic as a remedy for various diseases (El-Bayoumy et al. 2006). Garlic (*Allium sativum*) is widely used in the cuisine around the world as seasoning ingredient, mainly in Asia, Africa and Europe. Historically, garlic was used by the Egyptians in several therapeutic formulas (Block, 1985).

Recent years have seen an increasing emphasis on foods and food components in disease prevention. Garlic (*Allium sativum* L.), one of the best-researched herbal remedies, holds a unique position in history, traditionally employed to treat infection, colds, diabetes, heart disease, and a host of other disorders. Clinically, it has been evaluated for lowering blood pressure, cholesterol, and glucose concentration, as well as for the prevention of arteriosclerosis and cancer. Epidemiologically, garlic consumption inversely correlates with the risk of oral, stomach, esophageal, colon, and prostate cancers. In addition, the biological activities of garlic, including antibacterial, antithrombotic, antioxidant, immunomodulatory, and antidiabetic actions and modulation of drug metabolism, have been extensively investigated. Here, we briefly summarize the recent findings on garlic and its sulfur-containing compounds in preventing cardiovascular diseases and cancer, along with its modulation of drug-metabolizing enzymes and membrane transporter activities. Finally, garlic safety and drug interaction are discussed (Chia-Wen Tsai, et al., 2012). Cancer preventative properties of garlic have also been reported (Ejaz, Woong, & Ejaz, 2003). Epidemiologic studies have revealed the lower risk of stomach cancer in people with high garlic intake (Galeone et al., 2006). Recent research has shown that garlic has anticarcinogenic properties. Many epidemiological studies have supported the protective role of garlic and related species against the development of certain human cancers (Cai et al. 1994, 1995; Dietz et al. 2003, 2004).

OBJECTIVES

The following objectives of the present study are:
 To find out garlic research publications during the study period
 To find top twenty five countries contributed in garlic research
 To identify top twenty five sources published in garlic research
 To find out top twenty five institutions contributed in garlic research

MATERIALS AND METHODS

The data have been collected from the Web of Science database; the

study period is during from 2002 to 2016. The search string was used 'garlic' in the Title search box, field was used, and the time span field was select from 2002 to 2016. A total of 2836 records were retrieved, the data downloaded and analyzed as per objectives of the present study. Moreover, the Relative Growth Rate and Doubling time have used in this study.

Relative Growth Rate (RGT) and Doubling time (Dt)

The Relative Growth Rate is the number of publications/pages per unit of time. Hence, one year is taken as the unit of time. The mean relative growth rate R (1-2) over a specified period of interval can be calculated from the following equation suggested by Mahapatra (1985).

$$R(1-2) = \frac{W2 - W1}{T2 - T1}$$

Where,

R = Mean relative growth rate over the specify period of interval
 W1 = log W1 (Natural log of initial number of publications/ pages)
 W2 = log W2 (Natural log of initial number of publications/ pages)
 T2-T1 = Unit difference between the initial time and final time.

Therefore,

R (a) = relative growth rate per unit per of publication per unit of time (year)

R (p) = relative growth rate per unit per of pages per unit of time (year).

The corresponding Doubling time for publications and pages can be calculated by using the following formula:

$$\text{Doubling time (Dt)} = \frac{0.693}{R}$$

Therefore,

$$\text{Doubling time for publications Dt (a)} = \frac{0.693}{R(a)}$$

ANALYSIS AND INTERPRETATIONS

Table 1 year wise garlic research publications

Sl. No	Publication Years	No. of Records	Percentages
1	2002	135	4.76
2	2003	129	4.55
3	2004	129	4.55
4	2005	159	5.61
5	2006	199	7.02
6	2007	197	6.95

7	2008	174	6.14
8	2009	200	7.05
9	2010	214	7.55
10	2011	263	9.27
11	2012	209	7.37
12	2013	199	7.02
13	2014	208	7.33
14	2015	209	7.37
15	2016	212	7.48
	Total	2836	100.00

Table 1 shows that, year wise publications in garlic research, totally 2836 papers published in garlic research during the study period. Among the fifteen years in 2011 have published more number of papers, 2010 has occupies second place with 214 papers, in the year 2016 has third place with 212, followed by 2012 and 2015 has 209 papers respectively, 2014 has 208 papers, in 2009 has published 200 papers, 2006 and 2013 has 199 respectively papers, 2007 has 197 papers, in 2008 has 174 papers, in 2005 has 159 papers, in 2002 has 135 papers, in 2003 and 2004 each has 129 papers published in garlic research respectively.

Table 2 Relative Growth Rate and Doubling Time of garlic research publications

Sl. No	Years	No. of Records	Cumulative	W1	W2	R (a)	Mean R (a)	Doubling time Dt (a)	Mean Doubling time Dt (a)
1	2002	135	135		4.9		0.43		1.76
2	2003	129	264	4.9	5.57	0.67		1.03	
3	2004	129	393	5.57	5.97	0.4		1.73	
4	2005	159	552	5.97	6.31	0.34		2.04	
5	2006	199	751	6.31	6.62	0.31		2.24	
6	2007	197	948	6.62	6.85	0.23	0.17	3.01	4.07
7	2008	174	1122	6.85	7.02	0.17		4.08	
8	2009	200	1322	7.02	7.18	0.16		4.33	
9	2010	214	1536	7.18	7.33	0.15		4.62	
10	2011	263	1799	7.33	7.49	0.16		4.33	
11	2012	209	2008	7.49	7.6	0.11	0.92	6.30	19.07
12	2013	199	2207	7.6	7.69	0.09		7.70	
13	2014	208	2415	7.69	7.78	0.09		7.70	
14	2015	209	2624	7.78	7.79	0.01		69.30	
15	2016	212	2836	7.79	7.95	0.16		4.33	
	Total	2836					0.5		10.41

Table 2 shows that, Relative Growth Rate and Doubling time of garlic research publications during the study period, Relative Growth Rate mean value is 0.5. In 1996, the garlic research publication was 135; gradually the research publications were rise up to 212 in the year 2016, Doubling time mean value is 10.41.

Table 3 language wise garlic research output

Sl. No	Languages	No. of Records	Percentages
1	English	2728	96.19
2	Portuguese	41	1.45
3	Korean	22	0.78
4	Spanish	20	0.71
5	Chinese	6	0.21
6	Japanese	4	0.14
7	French	4	0.14
8	Russian	3	0.11
9	German	3	0.11
10	Polish	2	0.07
11	Turkish	1	0.04
12	Italian	1	0.04
13	Czech	1	0.04
	Total	2836	100.00

Table 3 shows that, language wise garlic research publications during the study period, among the 2836 papers, 96.19 percent of papers have published in English language, Portuguese language has occupies second place with 1.45 percent of papers, in Korean language 0.78 percent of papers published, in Spanish has 0.71 percent of papers, in Chinese have published 0.21 percent of papers, Japanese and French each has 0.14 percent of papers respectively, Russian, German each has 0.11 percent of papers respectively, in Polish language have published 0. 7 percent of papers, Turkish, Italian and Czech each languages have published only 0.04 percent of papers during the study period.

Table 4 document types in garlic research publications

Sl. No	Document types	No. of Records	Percentages
1	Article	2154	75.95
2	Meeting abstract	343	12.09
3	Review	83	2.93
4	Proceedings paper	81	2.86
5	News item	53	1.87
6	Letter	42	1.48
7	Editorial material	36	1.27
8	Book review	18	0.63
9	Correction	16	0.56
10	Poetry	7	0.25
11	Retracted publication	1	0.04
12	Reprint	1	0.04
13	Book chapter	1	0.04
	Total	2836	100.00

Table 4 indicates that, document types in garlic research publications, thirteen document types were published 2836 papers in this research during the study period. Among the thirteen documents article has occupies predominate place with 75.95 percent, meeting abstract second has place with 12.09 percent, review has third place with 2.93 percent, followed by conference proceedings paper has 2.86 percent, news item has 1.83 percent, letter has 1.48 percent, editorial material has 1.27 percent, book review has 0.63 percent, correction has 0.56 percent, poetry has 0.25 percent, retracted publication, reprint and book chapter each has 0.04 percent respectively.

Table 5 top twenty five countries contributed in garlic research

Sl. No.	Countries/Territories	No. of records	% of 2836
1	United States of America (USA)	461	16.26
2	South Korea	315	11.11
3	India	268	9.45
4	Peoples Republic China	264	9.31
5	Iran	163	5.75
6	Japan	148	5.22
7	Turkey	97	3.42
8	Brazil	95	3.35
9	Spain	90	3.17
10	Germany	86	3.03
11	England	76	2.68
12	Egypt	75	2.65
13	Mexico	63	2.22
14	Italy	61	2.15
15	Poland	57	2.01
16	Canada	57	2.01
17	France	56	1.98
18	Argentina	56	1.98
19	Taiwan	55	1.94
20	Tunisia	46	1.62
21	Nigeria	40	1.41
22	Israel	40	1.41

23	Saudi Arabia	37	1.31
24	Australia	34	1.20
25	Pakistan	33	1.16

Table 5 shows that, top twenty five countries contributed in garlic research, totally 92 countries have published 2836 papers in garlic research during the study period, among the 92 countries only top twenty five countries listed contributed in garlic research, those countries are United States of America (USA) has occupies first place with 16.26 percent of papers, South Korea has second place with 11.11 percent of papers, India has occupies third place with 9.45 percent of papers, followed by Peoples Republic China has fourth place with 9.31 percent, Iran has fifth place with 5.75 percent, Japan has sixth place with 5.22 percent, Turkey has seventh place with 3.42 percent, Brazil has eighth place with 3.35 percent, Spain has ninth place with 3.17 percent, Germany has tenth place with 3.03 percent, England has eleventh place with 2.68 percent, Egypt has twelfth place with 2.65 percent, Mexico has thirteenth place with 2.22 percent, Italy has fourteenth place with 2.15 percent, Poland has fifteenth place with 2.01 percent, Canada has sixteenth place with 2.01 percent, France has seventeenth place with 1.98 percent, Argentina has eighteenth place with 1.98 percent, Taiwan has nineteenth place with 1.94 percent, Tunisia has twentieth place with 1.62 percent, Nigeria has twenty first place with 1.41 percent, Israel has twenty second place with 1.41 percent, Saudi Arabia has twenty third place with 1.31 percent, Australia has twenty fourth place with 1.20 percent, Pakistan has twenty fifth place with 1.16 percent. Moreover remaining 67 countries were contributed 2.71 percent of papers in this research during the study period.

Table 6 top twenty five institutions contributed in garlic research

Sl. No.	Institutions	No. of records	% of 2836
1	Council of Scientific Industrial Research (CSIR) India	52	1.83
2	United States Department of Agriculture (USDA)	51	1.80
3	University of California System	50	1.76
4	Wakunaga Pharmaceut CO. LTD.,	36	1.27
5	Seoul National University	35	1.23
6	Consejo Nacional de Investigaciones Cientificas Y Tecnicas (CONICET)	32	1.13
7	Northwest A F University China	29	1.02
8	Islamic Azad University	29	1.02
9	Consejo Superior De Investigaciones Cientificas (CSIC)	28	0.99
10	University of California Los Angeles	27	0.95
11	Kyungpook National University	26	0.92
12	Pennsylvania Commonwealth System of Higher Education (PCSHE)	25	0.88
13	Hebrew University of Jerusalem	25	0.88
14	Empresa Brasileira De Pesquisa Agropecuaria Embrapa	25	0.88
15	Chung Shan Medical University	25	0.88
16	China Agricultural University	25	0.88
17	Ankara University	24	0.85
18	Sejong University	23	0.81
19	Pusan National University	23	0.81
20	Universidad Nacional Autonoma de Mexico	22	0.78
21	Kuwait University	22	0.78
22	University of Wisconsin System	19	0.67
23	Pusan National University Hospital	19	0.67
24	Dankook University	19	0.67
25	Chungnam National University	19	0.67
	2203 Institutions	2126	74.96
	Total	2836	100.00

Table 6 shows that, top twenty five institutions contributed in garlic research, totally 2228 institutions were published garlic research during the study period, top twenty five institutions are listed in this table, among those 'Council of Scientific Industrial Research (CSIR) India' has occupies first place with 52 papers, United States Department of Agriculture (USDA), has second place with 51 papers, University of California System, has third place with 50 papers, Wakunaga Pharmaceut CO. LTD., has fourth place with 36 papers, Seoul National University has fifth place with 35 papers, Consejo Nacional de Investigaciones Cientificas Y Tecnicas (CONICET) has sixth place with 32 papers, Northwest A F University China, and Islamic Azad University has seventh and eighth place respectively, Consejo Superior De Investigaciones Cientificas (CSIC) has ninth place with 28 papers, University of California Los Angeles has tenth place with 27 papers, Kyungpook National University has eleventh place with 26 papers, Pennsylvania Commonwealth System of Higher Education (PCSHE), Hebrew University of Jerusalem, Empresa Brasileira De Pesquisa Agropecuaria Embrapa, Chung Shan Medical University, and China Agricultural University has twelfth, thirteenth, fourteenth, fifteenth and sixteenth place respectively, Ankara University has seventeenth place, Sejong University, and Pusan National University has eighteenth and nineteenth place respectively, Universidad Nacional Autonoma de Mexico, Kuwait University has twentieth and twenty first place respectively, University of Wisconsin System, Pusan National University Hospital, Dankook University, Chungnam National University has twenty second, twenty third, twenty fourth and twenty fifth place respectively with 19 papers, remaining 2203 institutions were contributed are less than 19 papers in this research during the study period.

Table 7 top twenty five authors contributed in garlic research

Sl. No.	Authors	No. of Records	% of 2836
1	Ide, N	27	0.952
2	Cheng, Z H	24	0.846
3	Kyung, K H	22	0.776
4	Ali, M	21	0.74
5	Thomson, M	19	0.67
6	Meng, H W	19	0.67
7	Kim, I H	19	0.67
8	Pedraza-Chaverri, J	17	0.599
9	Morihara, N	15	0.529
10	Limam, F	15	0.529
11	Durak, I	15	0.529
12	Conci, V C	15	0.529
13	Budoff, M	15	0.529
14	Asdaq, S M B	15	0.529
15	Lee, S	14	0.494
16	Choi, YW	14	0.494
17	Weiss, N	13	0.458
18	Nagini, S	13	0.458
19	Kim, J S	13	0.458
20	Kim, H J	13	0.458
21	Kim, H H	13	0.458
22	Inamdar, M N	13	0.458
23	Flores, F	13	0.458
24	Auger, J	13	0.458
25	Zeng, T	12	0.423

Table 7 shows that, top twenty five authors contributed in garlic research, totally 8130 authors were contributing in garlic research. Among top twenty five authors listed Ide, N has contributed more number of papers with first place, Cheng, Z H has second place with 24 contributions, Kyung, K H has third place with 22 contributions, Ali, M has fourth place with 21 papers, 19 papers published by Thomson, M, Meng, H W, and Kim, I H has occupies fifth, sixth, and seventh place respectively, Pedraza-Chaverri, J has eighth place with 17 papers, 15 papers contributed by Morihara, N, Limam, F, Durak, I, Conci, V C, Budoff, M, Asdaq, S M B, has occupies ninth, tenth,

eleventh, twelfth, thirteenth, and fourteenth, place occupies respectively, fifteenth and sixteenth place has occupies with Lee, S and Choi, YW respectively, Weiss, N, Nagini, S, Kim, J S, Kim, H J, Kim, H H Inamdar, M N, Flores, F and Auger, J has occupies seventeenth, eighteenth, nineteenth, twentieth, twenty first, twenty second twenty third and twenty fourth place respectively, Zeng, T has occupies twenty fifth place with 12 papers contributed, moreover remaining 8105 authors were contributed less than 12 papers.

Table 8 authorship pattern in garlic research

Sl. No.	Authorship pattern	Total	Percentages
1	Single	194	6.84
2	Double	409	14.42
3	Three	520	18.34
4	Four	541	19.08
5	Five	399	14.07
6	Six and above	773	27.26
	Total	2836	100.00

Table 8 shows that, authorship pattern in garlic research papers published during the study period, among 2836 papers Six and above authors were published 27.26 papers, Four authors were published 19.08 percent of papers, three authors were published 18.34 percent, Double authors were published 14.42 percent of papers, Five authors were published 14.07 percent of papers, and Single authors were published 6.84 percent of papers. Among the 2836 papers in garlic research, 93.16 percent of authors were published collaborative authors.

Table 9 top twenty five sources contributed in garlic research

Sl. No.	Source Titles	No. of Records	% of 2836
1	Journal of Agricultural and Food Chemistry	70	2.47
2	Journal of Nutrition	65	2.29
3	Faseb Journal	64	2.26
4	Plant Disease	43	1.52
5	Food Science and Biotechnology	36	1.27
6	Food Chemistry	34	1.20
7	Journal of Medicinal Food	33	1.16
8	Phytotherapy Research	31	1.09
9	Hortscience	30	1.06
10	Food and Chemical Toxicology	29	1.02
11	Journal of Food Science	25	0.88
12	Journal of Dairy Science	22	0.78
13	Planta Medica	21	0.74
14	Scientia Horticulturae	18	0.63
15	European Food Research and Technology	18	0.63
16	Abstracts of Papers of the American Chemical Society	18	0.63
17	Life Sciences	17	0.60
18	Korean Journal of Horticultural Science Technology	17	0.60
19	Journal of the Science of Food and Agriculture	17	0.60
20	Journal of Food Science and Technology Mysore	17	0.60
21	Plos One	15	0.53
22	Journal of Food Engineering	15	0.53
23	Poultry Science	14	0.49
24	Molecular Nutrition Food Research	14	0.49
25	European Journal of Plant Pathology	14	0.49
	966 sources	2139	75.42
	Total	2836	100.00

Table 9 shows that, top twenty five sources contributed in garlic research during the study period, totally 991 sources were contributed in this research, among the top twenty five sources 'Journal of Agricultural and Food Chemistry' has occupies first

position with 70 papers, 'Journal of Nutrition' has second place with 65 papers, 'Faseb Journal' has third place with 64 papers, 'Plant Disease' has fourth place with 43 papers, 'Food Science and Biotechnology' has fifth place with 36 papers, 'Food Chemistry' has sixth place with 34 papers, 'Journal of Medicinal Food' has seventh place with 33 papers, 'Phytotherapy Research' has eighth place with 31 papers, 'Hortscience' has ninth place with 30 papers, 'Food and Chemical Toxicology' has tenth place with 29 papers, 'Journal of Food Science' has eleventh place with 25 papers, 'Journal of Dairy Science' has twelfth place with 22 papers, 'Planta Medica' has thirteenth place with 21 papers, 'Scientia Horticulturae', 'European Food Research and Technology', and 'Abstracts of Papers of the American Chemical Society' has fourteenth, fifteenth and sixteenth place respectively, 'Life Sciences', 'Korean Journal of Horticultural Science Technology', 'Journal of the Science of Food and Agriculture', 'Journal of Food Science and Technology Mysore', has seventeenth, eighteenth, nineteenth, and twentieth place respectively. Moreover, 'Plos One', and 'Journal of Food Engineering' has twenty first and twenty second place respectively, 'Poultry Science' 'Molecular Nutrition Food Research' and 'European Journal of Plant Pathology' has twenty third, twenty fourth and twenty fifth place respectively, remaining 966 sources were contributed are less than 14 papers in this research during the study period.

CONCLUSION

Conclude for this study, totally 2836 papers published in garlic research during the study period, year wise garlic research publications shows an increasing trend, majority of papers were published in English language, followed on Portuguese, Korean, Spanish, Chinese, Japanese and French, Russian, German, Polish, Turkish, Italian and Czech languages have published least number of papers in this research. totally 92 countries were contributed in this research during the study period, United States of America (USA) has occupies first place, South Korea has second place, India has occupies third place, Peoples Republic China has fourth place, Iran has fifth place, Japan has sixth place, remaining countries are contributed less than 100 papers. totally 2228 institutions were contributed in garlic research during the study period, among those institutions 'Council of Scientific Industrial Research (CSIR) India' has occupies first place, United States Department of Agriculture (USDA), has second place, University of California System, has third place, and remaining intuitions were contributed less than 50 papers published. Totally 8130 authors were contributing in garlic research, Ide, N has contributed more number of papers with first place, Cheng, Z H has second place, Kyung, K H has third place, Ali, M has fourth place and remaining authors were contributed less than 20 papers. Collaborative authors were highly contributed compare with single author publication.

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