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Stevia rebaudiana: A Bibliometric Analysis from 1966-2019

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Abstract

This study has been carried out to analyze research papers published on *Stevia rebaudiana* during 1966-2019 using a bibliometric approach. The data is mined from the Web of Science Core Collection, returning 1835 articles on the topic for analysis. The study documents most productive countries and authors delved into Stevia research. India appears to be the most productive country, followed by USA. The top-cited articles, top-organizations and funding agencies, and journals with most publications on subject are also identified. The analysis shows an increasing trend for research on *Stevia* during recent years with an Annual Percentage Growth Rate of 1.29 and the number jumped from only 03 publications in 1966-1971 to 1000 in 2014-2019. Pakistan has a comparable global share of 2.84% on Stevia research but further attention on research is needed in this field apprehending the commercial and health potential of this plant and considering the status of Pakistan as an agrarian country.

Introduction

Researchers have conducted bibliometric studies on a number of plants having medicinal and economic potential such as *Curcuma longa* [1], *Ocimum sanctum* [2], *Glycyrrhiza glabra* [3], *Nigella sativa* [4], *Aloe vera* [5] and *Azadirachta indica* [6]. However, no particular studies on bibliometric analysis of Stevia research are available, despite the significance attached to this plant as a no calorie sweetener grown commercially in many parts of the world and also for its potential as beneficial medication as remedy for many chronic diseases e.g Arterial hypertension [7]

Stevia (*Stevia rebaudiana* Bertoni, Asteraceae) is a native plant of Paraguay and is a small perennial plant [8]. It is widely grown commercially and used in many parts of the world including Central America, Paraguay, Brazil, Japan, Korea, Thailand, India and China as sweetener [9-11]. This plant has a potential future and has been proven to be better than most of other high-potency sweeteners in its sensory and functional properties. Stevia has become a major sugar alternate globally in growing food market [12]. In many countries, Stevia and its metabolites have been making market as substitutes for sugar in foods, beverages and medicines [12-15]. It is a point of concern that Stevia is not reportedly grown commercially in Pakistan despite of all its importance.

A number of studies have reported various health benefits of *Stevia* as therapeutic agent and an efficient medication for curing chronic diseases [16]. *Stevia* leaves are used broadly as antiviral, antimicrobial and antifungal agents [17-19]. The medical applications of *Stevia* are reported to be effective as anti-hypertensive and several studies are documented in a review paper [20]. Stevia is also reported as having properties as anti-hyperglycemic [21], hepatoprotective [22, 23], anti-inflammatory, anti-diarrheal and diuretic [10, 24, 25], and anti-tumor [19]. Stevia is also known to be effective against human rotavirus activities, is anti-HIV and possess immunomodulatory effects [16, 26, 27].

A report on Stevia by Expert Market Research (EMR) forecasted that the global stevia market will attain a production value of nearly USD 520.32 million in 2020 with a further growth at a CAGR of 8.4% during the forecast period (2021-2026). It is projected in the report that the global production value of stevia will expectedly reach USD 844.20 million by 2026 [28]. Europe is stipulated to account for more than half of the revenue shares in the stevia market by the end of 2029. The largest market for Stevia is Asia Pacific. Collaborations between researchers and relevant stakeholders in broad research communities are explored through bibliometric studies. Realizing the colossal benefits of Stevia, rigorous efforts toward improving knowledge, management, and commercialization of Stevia research is necessitated. Therefore, it is an imperative need to document status of research on Stevia. It will also facilitate planning and policy making. Thus, the aim of the present study was bibliometric analysis of the global scientific production, and help researchers understand the characteristics of research done on Stevia and reference an important and interesting field of research in future to set direction and quantum of research in this regard especially for agrarian economies to reap full benefits of the commercialization potential of this plant.

Methods

Literature Search strategy and selection criteria

A comprehensive search was conducted on Web of Science, Core Collection, hosted by Clarivate Analytics on January 15, 2020. The search was done using the keywords "Stevia" or "Stevia rebaudiana". The search was limited to time period (1966-2019), and documents types (article, review, meeting abstract, letter, proceedings paper, note and editorial material). Articles were evaluated for several attributes including authorship, citation characteristics including cites per document, total times cited, , most frequently cited articles, year of research publication, the country of origin of the article, name of journal, and document type of the article. Articles were downloaded in the BibTeX file format. The retrieved data was analyzed for bibliometric indicators using Rstudio v.3.6.2 software with bibliometrix R-package [29]. Data were imported into RStudio and converted to a bibliographic data frame and normalized for duplicate filing.

Discussion

The present study appraised the global research on *Stevia rebaudiana* Bertoni starting from the first available paper in 1966 and stretched over fifty-four-year period till 2019, returning 1835 papers in the field from the Web of Science.

Characteristics of Retrieved Publications

The distribution of document types identified by Web of Science was analyzed. The publications were identified into 09 document types during the study period. Most of the bibliometric studies indicate that research articles are the most frequently employed document types, while English as the most used language [30, 31, 32]. Our study also come across research articles (1,498) as the most frequent document type accounting for 81.64% of all publications, followed by proceedings papers (96; 5.23%), meeting abstracts (90; 4.91%) and reviews (87; 4.74%). The remaining document types have less significance as also in other studies. Papers were published in 13 different languages of which 93.46% of all these articles were published in English. Spanish is the second most used language by Stevia researchers for communicating their findings (2.56%) although this share is quite low in comparison to English. Language wise share of published article is given in Figure 1. The top 10 Web of Science categories are presented in Table 1. Food Science Technology was the leading category (n=488 records), followed by Plant Sciences (n=372 records), and Biochemistry Molecular Biology (n=191).

Annual distribution of publications and citations

The Annual Percentage Growth Rate of Stevia publications is 1.29. The total number of publications on Stevia did not go beyond single digits per year over first

one and half decades (1966-1983) with most of the years bearing no output on Stevia. However, a stead-fast increase in publications was observed over subsequent years. For further analysis the data is divided into 09 cohorts of six years each. As shown in Figure 2, the retrieved data indicate an exponential growth in the published articles over years, but the focus shifted to research on Stevia in the last decade and the number of researches showed an increase from just 6.87% in 2002-2007 to 23.62% in 2008-2013. As compared to this 23.62%, the number of publications almost doubled to 54.56% in the last cohort. This trend is like several bibliometric studies on various plants of medicinal importance [35, 6]. This may be attributed to growing awareness about health as well as on exploration of research having an economic potential.

The retrieved documents were published in 736 peer-reviewed journals. These publications were cited 25,118 times, with average citations per item 13.7 times. The overall h-index was 67. The average total citations of articles published on Stevia oscillated over the years and peaked in the cohort 2002-2007 (average = 37.94). Generally, an inverse relationship was observed in the average total number of citations per year, for 2014-2019 the average was 5.74 (Figure 2).

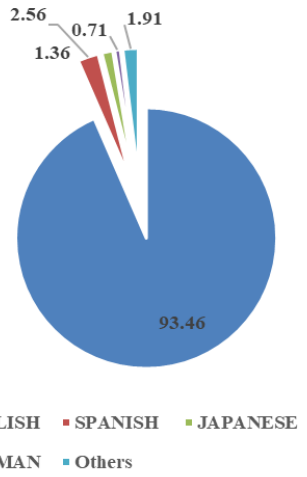

Figure 1: Comparative share of articles published in different languages on stevia from 1966 to 2019.

Ranking	Web of Science categories	Record	Percentage
1	Food Science Technology	488	26.59
2	Plant Sciences	372	20.27
3	Biochemistry Molecular Biology	191	10.41
4	Pharmacology Pharmacy	184	10.03
5	Chemistry Medicinal	151	8.23
6	Chemistry Applied	143	7.80
7	Nutrition Dietetics	131	7.12
8	Agronomy	119	6.45
9	Chemistry Multidisciplinary	95	5.18
10	Biotechnology Applied Microbiology	92	5.01

Table 1: The top 10 Web of Science categories of the published studies on stevia.

Highly cited articles

The top 10 highly cited articles are shown in Table 2. The article by Geuns JM., entitled "Stevioside", achieved the highest number of citations (n = 307). The article discussed in detail literature on Stevia and occurrence, biosynthetic pathway and toxicological aspects of its natural sweeteners. Of the top 10 highly cited articles, the topics ranged from natural sweet molecules and health benefits of Stevia.

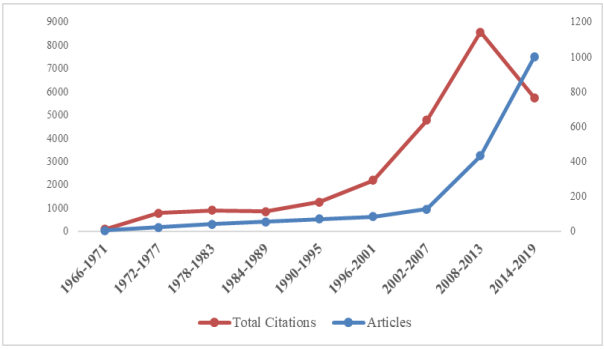

Figure 2: Quantitative growth of global publications and total number of citations on stevia.

Distribution of Authors and Author Collaborations

Analysis of the data showed that a total of 5347 researchers have played a role in the publication of 1835 articles. 110 single-authored documents were contributed by 87 researchers. 5260 researchers contributed multi-authored documents, with an average of 4.44 co-authors per document. Collaboration Index is calculated as 3.05. The authorship pattern is presented in Table 3. The ratio of the fraction of multi-authored articles in which a researcher appears as the first author was calculated to find the Dominance Factor. Our study revealed that maximum articles were contributed by multi- authors. Chaturvedula, VSP has the highest dominance factor (0.632) followed by Roman, LU (0.588). Our study, indicative of the high occurrence of multiple authorships, is consistent with findings of other bibliometric studies [33-35]. Amongst researchers "Jan M. C. Geuns" is considered the most active in the field, by contribution of 34 articles to global literature. "Pedro Joseph Nathan" is in second place, with 32 articles while "Indra Prakash" held third place with 28 articles. Among the most relevant researchers, Pakistani researcher Ahmad Nisar, contributed 17 articles in the field, and ranked sixth in global Stevia contribution. Details are presented in Table 4. There is no refute on research productivity as an asset of a researcher but more important than this is the impact of the research that is reflected by the number of citations accumulated.

Among such measures of the productivity and impact of a researcher, *h*-index and g-index are most important that are designed to indicate the cumulative effect of research output, and the number of citations. As shown in Table 4, "Jan M. C. Geuns" not only contributed the highest number of research articles on Stevia but also these articles have highest *h*-index and g-index amongst all Stevia researchers. "Osamu Tanaka" with an H-index of 14 follows and is ranked second.

Paper	Total Citations	Average Citations per Year
"Geuns JM. Stevioside. Phytochemistry. 2003;64(5):913-921."	307	17.06
"Puri, M.; Sharma, D.; Barrow, C.J. Enzyme-assisted extraction of bioactives from plants. Trends Biotechnol. 2012, 30, 37–44."	233	25.89
"Lemus-Mondaca, R.A., Vega-Gálvez, A., Zura-Bravo, L., & Ah-Hen, K.S. (2012). Stevia rebaudianaBertoni, source of a high-potency natural sweetener: A comprehensive review on the biochemical, nutritional and functional aspects. Food chemistry, 132 3, 1121-1132."	226	25.11
"Bouvier, F., Suire, C., Mutterer, J. and Camara, B. (2003b) Oxidative remodeling of chromoplast carotenoids: identification of the carotenoid dioxygenase CsCCD and CsZCD genes involved in Crocus secondary metabolite biogenesis. Plant Cell. 15. 47-62"	207	11.50
"Chatsudthipong V, Muanprasat CH (2009) Stevioside and related compounds: therapeutic benefits beyond sweetness. PharmacolTher 121:41–54"	201	16.75
"Gregersen S, Jeppesen PB, Holst JJ, Hermansen K (2004) Antihyperglycemic effects of stevioside in type 2 diabetic subjects. Metabolism 53:73–76"	189	11.12
"J. E. Brandle, A. N. Starratt, M. Gijzen. Stevia rebaudiana: Its agricultural, biological, and chemical properties. Canadian Journal of Plant Science, 1998, 78:527-536, https://doi.org/10.4141/P97-114"	181	7.87
"Anton SD, Martin CK, Han H, et al. Effects of stevia, aspartame and sucrose on food intake, satiety and postprandial glucose and insulin levels. Appetite. 2010; 55:37-43."	164	14.91
"K. Yamasaki, H. Kohda, T. Kobayashi, R. Kasai, O. Tanaka. Structures of stevia diterpene-glucosides: Application of 13C NMR. Tetrahedron Lett., 13 (1976), pp. 1005-1008"	164	3.64
"P. B. Jeppesen, S. Gregersen, C. R. Poulsen, and K. Hermansen, "Stevioside acts directly on pancreatic β cells to secrete insulin: actions independent of cyclic adenosine monophosphate and adenosine triphosphate-sensitive K+-channel activity," Metabolism, vol. 49, no. 2, pp. 208–214, 2000."	161	7.67

Table 2: Top 10 most cited global research on Stevia from 1966-2019.

Author	Dominance Factor (DF)	Total Articles	Single-Authored	Multi-Authored	First Authored	Rank by Articles	Rank by DF
Venkata Sai P Chaturvedula	0.632	19	0	19	12	5	1
Luisa U Roman	0.588	17	0	17	10	6	2
Indra Prakash	0.464	28	0	28	13	3	3
Ahmad Nisar	0.381	21	0	21	8	4	4
Jan M. C. Geuns	0.258	34	3	31	8	1	5
Danial Kahrizi	0.143	14	0	14	2	10	6
Cerda-Garcia-Rojas CM	0.133	15	0	15	2	8	7
Luciana G Angelini	0.067	15	0	15	1	9	8
Osamu Tanaka	0.063	16	0	16	1	7	9
Pedro Joseph Nathan	0.063	32	0	32	1	2	10

Table 3: Aauthorship pattern of stevia articles.

Author Name	Country	Articles	Percentage	Citations	*h*-index	*g-index*
Jan M. C. Geuns	Belgium	34	1.9	1046	15	32
Pedro Joseph Nathan	Mexico	32	1.7	185	8	13
Indra Prakash	USA	28	1.5	512	13	22
Helena Maria André Bolini	Brazil	27	1.5	226	8	15
Venkata Sai Prakash Chaturvedula	USA	20	1.1	355	12	18
Ahmad Nisar	Pakistan	17	0.9	214	11	14
Juan D. Hernandez	Mexico	17	0.9	179	8	12
Luisa U Roman	Mexico	17	0.9	179	8	12
Osamu Tanaka	Japan	17	0.9	754	14	17
Luciana G Angelini	Italy	15	0.8	157	7	12

Table 4: Ten most productive researchers in the field of stevia based on number of articles published.

Journal	Articles Published	% Contribution	Total Citations	Impact Factor	*h*-index	*g-index*
Phytochemistry	63	3.43	1521	2.905	18	36
Food Chemistry	48	2.62	996	5.399	18	30
Journal of Agricultural and Food Chemistry	32	1.74	1192	3.571	20	32
Journal of Natural Products	28	1.53	532	4.257	12	22
Planta Medica	28	1.53	343	2.746	10	18
Food and Chemical Toxicology	23	1.25	887	3.775	15	23
Sugar Tech	23	1.25	110	1.024	6	9
Industrial Crops and Products	20	1.09	183	4.191	8	13
Cellular and Molecular Biology	16	0.87	79	1.463	6	8
Natural Product Communications	16	0.87	117	0.554	5	10

Table 5: List of ten most frequently used journals by Stevia researchers.

Funding Agencies	Number of Papers	Percentage of Total
National Natural Science Foundation of China	51	2.779
National Council for Scientific and Technological Development CNPq (Brazil)	46	2.507
CAPES-Coordination for the Improvement of Higher Education Personnel (Brazil)	32	1.744
Council of Scientific Industrial Research CSIR India	30	1.635
Consejo Nacional de Ciencia Y Tecnologia Conacyt (Mexico)	25	1.362
European Union	21	1.144
Ministry of Education Culture Sports Science and Technology Japan MEXT	21	1.144
University Grants Commission India	19	1.035
Department of Science Technology India	15	0.817
National Institutes of Health NIH USA	15	0.817

Table 6: Top ten funding agencies in terms of stevia research.

Journals

A list of top 10 journals in the field of Stevia research is shown in Table 5. The top 10 journals included 16% of the total number of publications (n = 297, 16.19%). "Journal of Agricultural and Food Chemistry" is the journal with the highest *h*-index (=20) in this list while Phytochemistry has the highest g-index (=36) showing most cumulative citations. "Food Chemistry" has the highest impact factor (IF= 5.399) as per latest Journal Citation Report, followed by "Journal of Natural Products" and "Industrial Crops and Products " come next with impact factors 4.257 and 4.191 respectively.

Geographical Distribution of Stevia Studies

Most of the published research on Stevia is from Indian researchers (10.18%). The top 20 countries in terms of research output in the field of Stevia research are shown in Figure 3. As it is clear from Figure 3, in terms of geographical distribution, India is ahead of all the other countries. This is not in agreement with most of other bibliometric studies in different fields that confirm USA as the global research leader regarding the quality and quantity of published publications [36, 37]. Our data revealed that India has not only contributed the highest number of publications but is the country that has added maximum single country publications (ratio of Single country publications: Multiple country publications= 0.0539). Figure 4 presents the comparison of single country publications to multiple country publications based on the share of the corresponding author. For example, the total number of papers from India is 380. The corresponding authors for 204 papers are from India either in multiple country or single country publications (Single country publications = 193; Multiple country publications= 11).

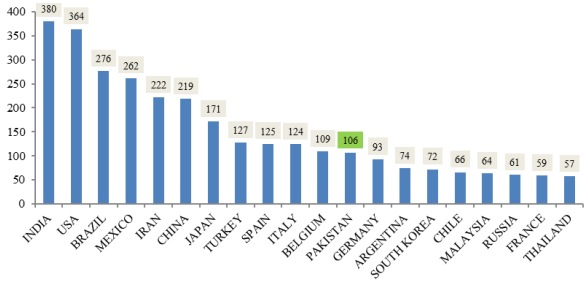

Figure 3: Most productive countries in terms of stevia research.

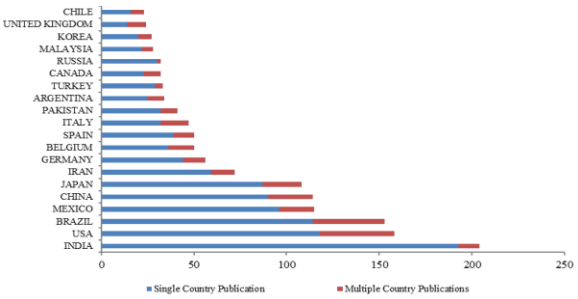

Figure 4: Comparison of single country publications to multiple country publications based on corresponding author's country.

Funding Sources

Table 6 shows information about top funding agencies in Stevia research. Highest number of studies in the said field were funded by the National Natural Science Foundation of China (n=51), National Council for Scientific and Technological Development (CNPq) (n=46) and CAPES, Coordination for the Improvement of Higher Education Personnel (n=32) both from Brazil. India has also provided funding for *Stevia* research through different sources resulting in a considerable share in global publications.

Co-occurrence of keywords

The density visualization map of co-occurrence of all keywords is given in Figure 5. The density of a term reflects the number of related keywords in various documents in which both were found. The distance between two terms offers an approximate indication of the relatedness of the terms. The relatedness of terms was determined based on co-occurrences. The minimum number of occurrences of a keyword was 10. Of the total 6179 keywords, only 231 keywords meet the threshold. The most frequent keyword was "stevioside" with 473 occurrences and a total link strength of 2349, followed by "Stevia rebaudiana" (occurrences=346, total link strength=1653), and "stevia" (occurrences=291, total link strength=1151). The word art of Stevia was created based on keywords in top 100 publications.

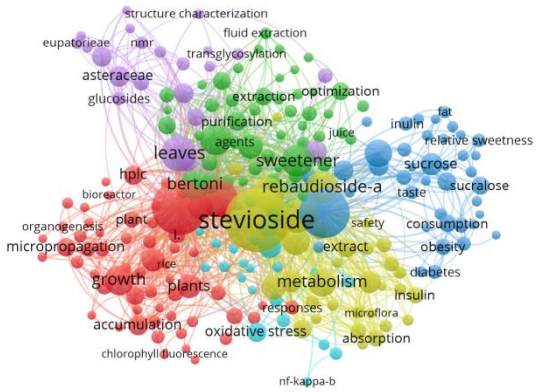

Figure 5: Co-occurrence and keywords.

Bibliometric visualizations

Maximum number of countries per document was set at 25. Minimum number of documents per country was set at 10. Of the 92 countries, 38 meet the thresholds. Number of countries selected for visualization was 25. Figure 6 shows that USA was the leading county (documents=240, citations=3422, total link strength=85), followed by Spain (documents=76, citations=1006, total link strength=47), and Brazil (documents=147, citations=2041, total link strength=35). Pakistan has total link strength of 13 with 47 documents and 374 citations. The present bibliometric study presents an in-depth review of global research on *Stevia* showing greater research output from countries India, USA, Brazil, Mexico and Iran. The publication trend on Stevia research kept increasing in a linear manner and is

reflective of the potential growth of Stevia research in the future. The findings confirm that the literature on Stevia plant is of interdisciplinary nature. There is a focus in research on identifying active components of Stevia for various purposes, especially in Food Science Technology, Plant Sciences and Biochemistry Molecular Biology. Maximum research output is the result of team effort that has been increasing over time. A limited trend of collaboration with developing countries exhibited by technologically advanced and developed countries and low productivity in developing countries in Stevia research is evident from the results. Pakistan has a good global share in literature on Stevia but keeping in consideration the economic potential of this crop, much more research is expected. We expect that future studies should continue to explore maximum medicinal potential of Stevia and develop new ways of its commercial cultivation as an alternate sugar crop.

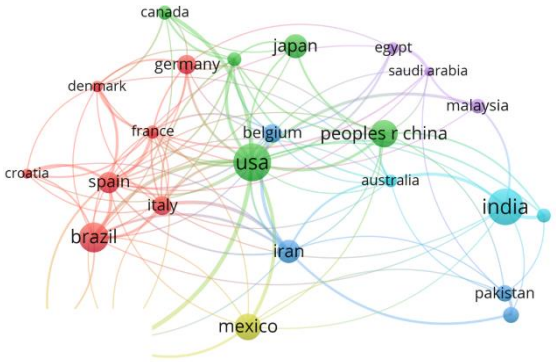

Figure 6: Bibliometric visualization of co-authorship and countries. The size of node represents the number of publications, and the thickness of line represents the degree of cooperation (mutual publications) between countries.

Conclusion

The analysis shows an increasing trend for research on *Stevia* during recent years with an Annual Percentage Growth Rate of 1.29 and the number jumped from only 03 publications in 1966-1971 to 1000 in 2014-2019. Pakistan has a comparable global share of 2.84% on Stevia research but further attention on research is needed in this field apprehending the commercial and health potential of this plant and considering the status of Pakistan as an agrarian country.

Author Contributions

Both authors have equally contributed to the manuscript. Saima Nasir analyzed the data, wrote and edited the manuscript. Jamila Ahmad retrieved and analyzed data from Web of Science and formatted the manuscript.

Competing Interest

The authors certify that they have no conflict of interest to declare in the subject matter or materials discussed in this manuscript.

References

1. Ahmed KKM, Gupta BM, Gupta R. Curcuma longa (Medicinal Plant) Research: A Scientometric Assessment of Global Publications Output during 1997-2016. Pharmacognosy Journal, (2018); 10(5): 998–1006.
2. Mushtaq R, Ali A. A Scientometric Glimpse of Tulsi Plant from 1989-2016. International Journal of Advance Research in Science and Engineering, (2018); 7(4): 1000-1010.
3. Gupta BM, Ahmed KKM, Gupta R. Glycyrrhiza glabra (Medicinal Plant) Research: A Scientometric Assessment of Global Publications Output during 1997-2016. Pharmacognosy Journal, (2018); 10(6): 1067-1075.
4. Gupta BM, Ahmed KKM. Research on Nigella sativa: A scientometric assessment of global publications' output during 1989-2018. International Journal of Pharmaceutical Investigation, (2018); 8(4): 173-181.
5. Gupta BM, Ahmed KKM, Dhawan SM, Gupta R. Aloe Vera (Medicinal Plant) Research: A Scientometric Assessment of Global Publications Output during 2007-16. Pharmacognosy Journal, (2018); 10(1): 1-8.
6. Singh N. Scientific Output on Azadirachta indica (Neem): A Bibliometric Study. SRELS Journal of Information Management, (2017); 53(6): 479-485.
7. Carrera-Lanestosa A, Moguel-Ordóñez Y, Segura-Campos M. Stevia rebaudiana Bertoni: A Natural Alternative for Treating Diseases Associated with Metabolic Syndrome. Journal of Medicinal Food. (2017); 20(10), 933–943.
8. Gasmalla, MAA, Yang R, Hua X. (2014); Stevia rebaudiana Bertoni: An alternative Sugar Replacer and Its Application in Food Industry. Food Engineering Reviews, 6(4): 150–162.
9. Mizutani K, Tanaka O. Use of Stevia rebaudiana sweeteners in Japan. Medicinal and Aromatic Plants, (2002); 19: 178-195.
10. Kim SY, Jo MJ, Hwangbo M, Back YD, Jeong TY, Cho IJ,Jee, SY. Anti-inflammatory Effect of Stevia Rebaudiana as a Results of NF-κB and MAPK Inhibition. The Journal of Korean Oriental Medical Ophthalmology and Otolaryngology and Dermatology, (2013); 26(3): 54–64.
11. Jaroslav P, Barbora H, Tulia H. Characterization ofStevia rebaudiana by comprehensive two-dimensionalliquidchromatography time-of-flight mass spectrometry. Journal of Chromatography, (2006); 1150: 85-92.
12. Samuel P, Ayoob KT, Magnuson BA, Wölwer-Rieck U, Jeppesen PB, Rogers PJ, Mathews R. Stevia Leaf to Stevia Sweetener: Exploring Its Science, Benefits, and Future Potential. The Journal of Nutrition, (2018); 148(7): 1186S–1205S.
13. Ashwell M. Stevia, Nature's Zero-Calorie Sustainable Sweetener. Nutrition Today, (2015); 50(3): 129–134.
14. Carakostas M, Curry L, Boileau A, Brusick D. Overview: The history, technical function and safety of rebaudioside A, a naturally occurring steviol glycoside, for use in food and beverages. Food and Chemical Toxicology, (2008); 46(7): S1-S10.
15. Prakash I, Dubois G, Clos J, Wilkens, K, Fosdick, L. Development of rebiana, a natural, non-caloric sweetener. Food and Chemical Toxicology, (2008); 46(7): S75-82.
16. Chatsudthipong V, Muanprasat C. Stevioside and related compounds: Therapeutic benefits beyond sweetness. Pharmacology & Therapeutics, (2009); 121(1): 41–54.
17. Kedik SA, Yartsev EI, Stanishevskaya IE. Antiviral activity of dried extract of Stevia. Pharmaceutical Chemistry Journal, (2009); 43: 198–199.
18. Silva PA, Oliveira DF, Prado NR, Carvalho DA, Carvalho GA.Evaluation of the antifungal activity by plant extracts against Colletotrichum gloeosporioides PENZ. Ciência e Agrotecnologia, (2008); 32:420–428.
19. Satishkumar J, Sarvanan MM, Seethalakshmi I. In-vitro antimicrobial and antitumor activities of Stevia rebaudiana (Asteraceae) leaf extracts. Tropical Journal of Pharmaceutical Research, (2008); 7:1143–1149.
20. Misra H, Mehta D, Mehta K, Jain C. Antihypertensive (Blood Pressure Lowering) effects of Stevioside, from Stevia rebaudianaBertoni, on rats, dogs and humans – A short review. Indian Journal of Drugs, (2015); 3(4): 102-108.
21. Ahmad U, Ahmad RS. Anti-diabetic property of aqueous extract of Stevia rebaudiana Bertoni leaves in Streptozotocin-induced diabetes in albino rats. BMC complementary and alternative medicine, (2018); 18(1): 179.
22. Ramos-Tovar E, Hernández-Aquino E, Casas-Grajales S, Buendia-Montaño LD, Galindo-Gómez S, Camacho J, Muriel P. Stevia Prevents Acute and Chronic Liver Injury Induced by Carbon

Tetrachloride by Blocking Oxidative Stress through Nrf2 Upregulation. Oxidative Medicine and Cellular Longevity, (2018); 2018, 1–12.
23. Ramos-Tovar E, Muriel P. Stevia as a putative hepatoprotector", In Liver pathophysiology: therapies and antioxidants. (2017); 715-727. Elseveir/Academic Press, London, United Kingdom.
24. Lemus-Mondaca R, Vega-Gálvez A, Rojas P, Stucken K, Delporte C, Valenzuela-Barra G. et al. Antioxidant, antimicrobial and anti-inflammatory potential of Stevia rebaudiana leaves: effect of different drying methods. Journal of Applied Research on Medicinal and Aromatic Plants, (2018); 11: 37-46.
25. Takahashi K, Matsuda M, Ohashi K, Matsuda M, Ohashi K, Taniguchi K, Nakagomi O, Abe Y, Mori S, Sato N, Okutani K, Shigeta S. Analysis of anti-rotavirus activity of extract from Stevia rebaudiana. Antiviral Research, (2001); 49(1): 15-24.
26. Kumari N, Ranac R, Sharma Y, Kumar S. Extraction, Purification and Analysis of Sweet Compounds in Stevia rebaudianaBertoni using Chromatographic Techniques. Indian Journal of Pharmaceutical Sciences, (2017); 79(4): 617-624.
27. Mohan K, Robert J. Hepatoprotective effects of Stevia rebaudiana bertoni leaf extract in CCl4-induced liver injury in albino rats. Medicinal and Aromatic Plant Science and Biotechnology, (2009); 3:59–61.
28. Reports: Global Stevia Market Outlook, https://www.expertmarketresearch.com/reports/stevia-market, accessed on 18-12-2020
29. Aria M, Cuccurullo C. Bibliometrix: An R-tool for comprehensive science mapping analysis. Journal of Informetrics, (2017); 11(4): 959–975.
30. Hao DC, Yuan X, Di YH, Xiao PG. Global Himalaya plant research trend and performance in science citation index from 1998 to 2017. Pakistan Journal of Botany, (2019); 51(5): 1907-1916.
31. Nasir S, Ahmed J, Qadir J, Gilani AH. Mapping of plant science research productivity in Pakistan. Pakistan Journal of Botany, (2019); 51(4): 1531-1538.
32. Yeung A, Heinrich M, Atanasov AG. Ethnopharmacology-A Bibliometric Analysis of a Field of Research Meandering Between Medicine and Food Science? Frontiers in Pharmacology, (2018); 9:215.
33. Youngblood M, Lahti D. A bibliometric analysis of the interdisciplinary field of cultural evolution. Palgrave Communications, (2018); 4: 120-128.
34. Koseoglu MA. Growth and structure of authorship and co-authorship network in the strategic management realm: Evidence from the Strategic Management Journal. BRQ Business Research Quarterly, (2016); 19(3): 153–170.
35. Kumar S, Jan M. Mapping research collaborations in the business and management field in Malaysia, 1980–2010. Scientometrics, (2013); 97(3): 491–517.
36. Nasir S, Ahmed J, Asrar M, Gilani AH. A Bibliometric Analysis of Pharmacy/Pharmacology Research in Pakistan. International Journal of Pharmacology, (2015); 11(7): 766-772.
37. Zhang X, Estoque RC, Xie H, Murayama Y, Ranagalage M. Bibliometric analysis of highly cited articles on ecosystem services. PLoS One, (2019); 14(2): e0210707.