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Gastrointestinal Impact of Flatulence-Causing Compounds in Foods: A Scientometric Study

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***Abstract*- Flatulence, or the passing of gas, can be caused by various factors, including the consumption of foods that contain hydrogen sulfide. When these foods are digested, they can release hydrogen sulfide gas, accumulating in the intestines and releasing flatulence. The present study aimed to give a scientometric overview of publications on flatulence regarding productive sources/journals, top active authors, foremost affiliations, prominent countries, and most used author's keywords. In all, 4752 articles were downloaded from the Web of Science (WoS) database (2007-2021), consisting of journal articles, review articles, and the English language. Data analysis and network visualization maps were created using Micro Soft Excel, Biblioshiny, and VOS viewer. The results indicate that the most productive author was Germain DP contributed 53 papers with the highest received 4026 citations. The topmost journal contributions were Plos One with number 113. Findings revealed that the top two institutions were from Canada. It was revealed that the United States, and China were the second-ranked in document contributions related to flatulence research. Articles produced by single-country publications had a higher number of papers compared with papers produced by multiple-country publications. Clinical research is a crucial aspect of healthcare as it helps determine the safety and effectiveness of new medical interventions, which can be used to improve patient outcomes related to flatulence research.**

Keywords: **Flatulence, Healthcare, Medical Informatics, Clinical Research, VOS Viewer**

I. INTRODUCTION

Flatulence (from Latin, flatulentus, flatus - a blowing) is the accumulation of excess air or gas in the stomach or intestines. By nature, it is an intense personal embarrassment. The sensation of abdominal fullness, tightness, and gas movement in the abdomen is an extremely unpleasant condition (Kurbel et al., 2006). One of the most common complaints among patients is flatulence. Flatulence affects about 15-23 percent of Asians and 15-30 percent of Americans (Larijani et al., 2016).

Common symptoms are associated with flatulence, belching, borborygmus, abdominal distension, or a combination of these symptoms (Martínez-Villaluenga et al., 2008). The term flatus should be used for flatulence without bloating. Belching is the emptying of gas from the stomach to the mouth, and borborygmus is a roaring or gurgling sound caused by the propulsion of gas through the intestines (Veenstra et al., 2010). A common cause of illness in patients with functional bowel problems is excessive intestinal gas (Alamer et al., 2023). The main complaint among the gas-related symptoms is flatulence which is defined as an increase in the number of gas discharges into the anus (Azpiroz et al., 2014). In the intestinal system, nitrogen (N2), oxygen (O2), hydrogen (H2), carbon dioxide (CO2), and methane (CH4) are quantitatively significant gases. Over 99 percent of the gases in the human intestine are these odourless gases (Roudebush, 2001).

Eating fatty foods delays gastric emptying and can exacerbate the unpleasant symptoms associated with bloating (Bobir et al., 2024). Flatulence is caused by eating foods that the patient is allergic to. It's important to remember that some of the worst gas producers are foods that aren't notoriously indigestible, such as milk and eggs, which have a good reputation in the sickroom (Alvarez, 1942; Kurbel et al., 2006). In fact, any food can be the main cause, such as fruit (apricot, apple, and pear), legumes (chickpeas, peas, beans, nuts, and soybeans), and vegetables (onion, cabbage, eggplant, carrot, sprouts, and Brussels). Occasionally, certain drinks such as rum irritate a sensitive colon and cause bloating. There is some reducing intestinal gas, to reduce the amount of flatus. Don't up the dietary fibre content all at once. Cut back on milk if lactose sensitivity is an issue. Take into account over-the-counter medicines or charcoal products (Malathi et al., 2024).

In this research, the researchers have been used various metrics for the current study; h-index: An indicator that counts the number of publications in addition to the amount of citations each one has. If an author has n works that have been referenced at least n times, they have an h-index of n. g-index: A statistic that prioritizes highly-cited publications

over less-cited ones, therefore outperforming the h-index. It is the highest value that is consistent with an author obtaining at least g^2 citations in their top g publications. The m-index is the h-index normalized by the duration of time since the initial release. Comparing researchers at various career stages is useful. Citations: The total amount of citations the author's publications have received.

As far as the author is aware, no scientometric analysis of flatulence research has been done to examine the trajectory of the field's research and the ways in which authors, organizations, and countries collaborate. As a result, the current study seeks to address a research gap by examining collaborative networks through knowledge-mapping approaches. This study examines the conceptual and methodological basis of the bibliography in a descriptive, retrospective manner (Ramakrishnan et al., 2022; Neelima et al., 2024). By reviewing the scientometric studies on flatulence-causing compounds in foods that are indexed in the Web of Science database from 2007 to 2021, this study seeks to add to the pertinent body of knowledge. It appears significant because it makes an effort to supplement the few studies conducted by Bibliometrix R and VOS viewer. This analysis was done by WoS database, to give end users of the literature recommendations on which databases to search, and to suggest more titles to database providers.

We believe that the reader will have a deeper comprehension of the features of the tools and the current research endeavors. The goal of the current study was to provide a scientometric overview of flatulence articles to active journals, prominent authors, eminent institutions, top nations, and the most frequently used keywords. For these reasons, this study aims to: describe the stakeholders of flatulence-causing compounds in foods by providing examples taken from the literature; present the publication activity of these compounds in foods revealing their profile, growth, and where they are published; and provide information about recent applications and tools that have been analyzed in research papers.

Scientometrics is a statistical technique for assessing and analyzing different facets of the subject matter. Leading organizations, thriving sources, the busiest scholars, global cooperation, year wise growth in documents, and the most cited articles in the domain (Amees et al., 2020). This study aimed to gather and examine international academic articles on flatulence from 2007 to 2021. In this work, information gaps about flatulence research will be filled and scientometric indications for bibliographical data retrieved from the WoS database will be put forward. There were some attempts made to

1. What are the active authors in the domain of flatulence research?

2. What contributions have the top sources, organizations, and countries made to the field of flatulence research?

II. Materials And Methods

To carry out the present study is based on the scientific productions in Scientometrics as reflected in Social Science Citation Index (SSCI), Science Citation Index (SCI), and Arts and Humanities Citation Index (A&HCI) (Gaffar et al., 2020). The bibliographic data obtained from Thomson Reuters' Web of Science database core collection provided the data source for this study.

The search topic used the logical combination of search terms: ((TS = (((“flatulence”) OR (“alpha galactosidase”) OR (“gastrointestinal tract”) AND (“hydrogen sulfide”) AND (irritable bowel syndrome) AND (raffinose) OR (“stachyose”))) AND LANGUAGE: (English) AND DOCUMENT TYPES: (Article OR Review Article) Timespan: All years. Indexes: SCI-EXPANDED, SSCI. During the search, found 9180 documents. We refined by publication year, document type, and language type and finally got 4752 documents for study. The publication years (2007 to 2021), English language, Article OR Review Articles were chosen for the research work shows in Figure 1.

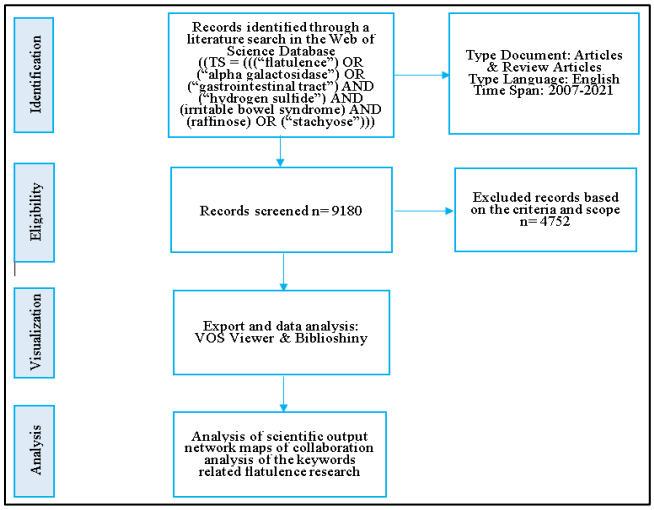

Fig. 1 Flow Diagram for Flatulence Research

The exported data to Biblioshiny (Hossain & Batcha, 2021) and Microsoft Excel included sources by year, research areas, active authors, influence organizations, and countries. Also, we used the mapping science through the VOS viewer tool for creating the network visualization maps (Rahaman et al., 2020).

III. Results

Active Authors

Table I lists authors who have published at least 20 papers. A total of 21119 authors contributed to 4752 publications, authors of single-authored documents (115), authors of multi-authored documents, (21004), single-author collaborated on 123 documents, documents per author 0.225, authors per document 4.44, and co-authors per document 6.52 were identified in the field of flatulence research during 2007 to 2021. Professor Germain DP (Salford Royal NHS in the UK)

was the most prolific author, publishing 53 papers, which have received 4026 citations, 31 h-index, and 53 g-index from papers in the WoS database. Wanner C (Würzburg University in Germany) was the next most cited author, publishing 48 papers, 2745 citations, 28 h-index, and 48 g-index received related to flatulence research. Professor Schiffmann R (Monash University) published 41 papers, which received a combined 2147 citations.

TABLE I TOP 10 ACTIVE AUTHORS BASED ON PUBLICATION ON FLATULENCE

Rank	Author/Year	Documents	h-index	g-index	m-index	Citations
1	Germain DP, 2007	53	31	53	1.938	4026
2	Wanner C, 2008	48	28	48	1.867	2745
3	Schiffmann R, 2007	41	23	41	1.438	2174
4	Sakuraba H, 2007	34	16	25	1	681
5	Warnock DG, 2007	34	25	34	1.563	2492
6	Desnick RJ, 2007	33	22	33	1.375	2695
7	Hollak CEM, 2007	32	21	32	1.313	1618
8	Linthorst GE, 2007	30	23	30	1.438	2572
9	Oliveira JP, 2007	26	19	26	1.267	1567
10	Ortiz A, 2008	26	22	26	1.467	1799

Figure 2 illustrates author collaboration among the most active authors. Thus, the total authors or items were selected as 50 out of 4752 authors, and the minimum number of citations of the records of 50. Through the VOS viewer software tool identified 439 total links, which fell into 4 clusters. Germain DP (2007), Banikazemi (2007), Aerts (2008), and Zarate (2008) were authors who demonstrated strong collaboration. Authors with similar circle colors form a cluster, indicating that they work closely together. The authors' more significant impact on flatulence study is shown by the higher size of the name and circle.

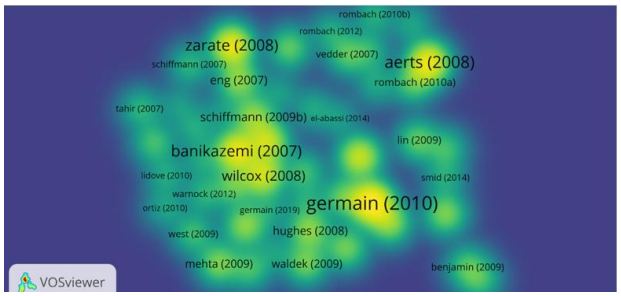

Fig. 2 Citations Density Visualization of Documents in Flatulence

Top 20 Prolific Sources

A large number of the 816 publications (17.17%) were issued in the twenty sources shown in Figure 3. Various studies emphasize importance of conducting research in any research area that includes scholarly journals. This information can help scientists in their seek for information resources, as well as readers, identify which sources are acceptable for sharing flatulence research. It was found that the journal of Plos One (113) was the greatest contribution, followed by Molecular Genetics and Metabolism (91), and Journal of Biological Chemistry, and Journal of Inherited Metabolic Disease with 53, respectively, articles published. Glycobiology has the fewest papers among the top twenty journals covering flatulence research.

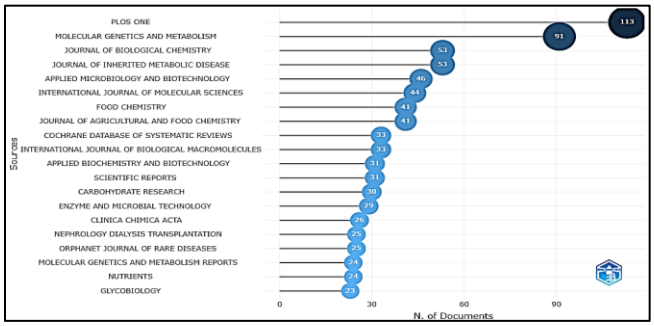

Fig. 3 Top 20 Leading Sources Flatulence Research

Top Ten Leading Organizations

The top ten most productive organizations on flatulence. The University of Amsterdam (94) ranked first followed by Charles University with 84 papers and the University of Naples Federico II with 83 papers. The most published papers originated from (The University of British Columbia and the University of Toronto) organizations in Canada. University of Amsterdam (2382) from the Netherlands ranked first in the terms of citations received followed by the University of Naples Federico II with 1782 citations (Italy) and Charles University (Prague) with 1761 citations.

The most influential papers that have been published in the WoS journals were analyzed using the VOS Viewer between 2007 and 2021 as shown in Figure 4. Visualization of among organizations with minimum productivity of 50 citations of documents. A total of 10 papers from 223 articles met the minimum threshold. The shape of the circle given to a country shows the extent of working together for that organization, whilst the length of the line linking two organizations represents the extent of collaboration between those organizations (Hu et al., 2014). The map includes 50 organizations in five clusters using the VOS viewer tool. Strong cooperation was found between the following pairs of organizations such as the University of Amsterdam, Charles University, and the University of Naples Federico II.

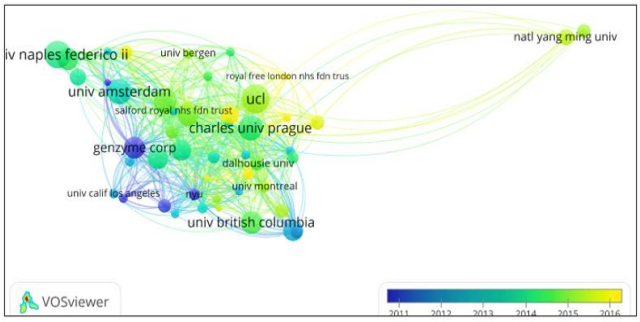

Fig. 4 Co-authorship Network Visualization Map Organizations on Flatulence Research

Co-occurrences in Flatulence Research

The study on flatulence employed 10,224 author keywords; however, only 183 of these terms were utilized ten times or more as shown in Figure 5. As a result, 6 clusters with 353 links and TLS of 1811 were found in the VOS viewer software. The keywords "fabry disease" used 665 times each followed by "alpha-galactosidase" 300 times and "enzyme replacement" 192 times, "therapy" 156 times, and "alpha-galactosidase a" 132 times were found in the area of flatulence research.

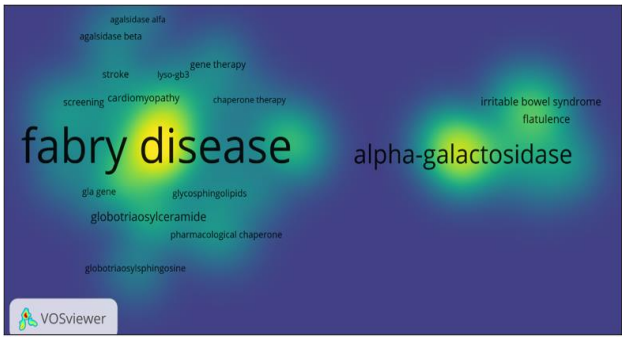

Fig. 5 Author Keywords Visualization in Flatulence Research

Top Ten Leading Countries

Table II depicts the list of the top 10 productive countries related to flatulence publications. The documents retrieved were written by authors from 93 different countries. The United States was the most influential in the number of records with 719 papers, followed by R. China with 648 papers, and Japan with 336 papers.

TABLE II TOP TEN LEADING COUNTRY

Rank	Country	Articles	Citation	SCP	MCP
1	USA	719	27703	537	182
2	R. China	648	9048	552	96
3	Japan	363	6181	307	56
4	Italy	242	5276	180	62
5	Germany	232	5662	159	73
6	India	223	5826	207	16
7	Korea	207	3253	181	26
8	United Kingdom	195	8784	119	76
9	Spain	174	4820	121	53
10	Brazil	160	3147	126	34

*SCP- Single Country Publication, MCP- Multiple Country Publications

The USA comes in first place after China and Japan among the top-producing nations, which were ranked according to the quantity of citations on paper. Out of all the countries with the highest activity, publications from Brazil and Korea received the fewest citations. Articles produced by SCP had a higher number of papers compared with papers produced by MCP (Nita, 2019). Based on SCP, the United States, and China were the most influential in terms of SCP and MCP in the field of flatulence research.

IV. Discussion

An incorrect eating technique is one of the most common causes of flatulence. Several different processes may mediate the emergence of gas-related symptoms. As scientifically proven in the lab, diet affects the volume of gas produced by colonic fermentation, the volume evacuated, the number of evacuations, and the sensation of flatulence (Kellow et al., 2006). However, some individuals who complain of flatulence have a more significant frequency of gas evacuations but do not expel larger amounts of gas than healthy subjects on the same diet, indicating that gas volume is not the only factor in flatulence.

Several clinical trials have consistently demonstrated that acupuncture relieves fatigue and decreases diarrhoe (Dean-Clower et al., 2010). These positive effects of acupuncture on fatigue and diarrhoea are confirmed by our bibliometric analysis of a much larger cohort of patients. It is noteworthy to highlight that while earlier studies have demonstrated a considerable reduction in depression symptoms (Coggrave et al., 2014), acupuncture did not alleviate symptoms of depression (Lämås et al., 2009). The variability of outcomes reported in these articles, as well as the likelihood of distinct depression symptoms in various cancer types, may be at least partially to blame for this gap. Yet, additional research has also demonstrated that massage reduces the intensity of gastrointestinal symptoms (Ciardulli et al., 2018).

In this paper, a scientometric analysis was used with a detailed qualitative explanation. A total of 4752 documents were chosen from 2007 to 2021 from the WoS on flatulence research. This study's goal was to conduct a quantitative examination of the most prestigious publications, keywords, co-authorship analysis, affiliations, and countries in the research of flatulence. In this study, VOS viewer was used for visualization of the network map of organizations and occurrence keywords. The study's evidence-based approach was successful in answering the research questions. The findings of the study Germain DP was the most prolific author. The most prolific university in the field of flatulence research was the University of Amsterdam. Based on journals, Plos One was the most prolific source in the field. The top-producing countries were stratified by the number of citations on paper, the USA ranks first after China and Japan. From a practical aspect, this research will help scholars to get benefits from the most active authors, sources, organizations, and regions/countries related to flatulence.

V. Conclusion

In conclusion, from a useful perspective, this study will help researchers to get benefits from the most prominent authors, sources, organizations, and regions/countries related to flatulence. This research has some limitations, the information is initially obtained from the WoS. Additional data will be collected for future research by combining information from various databases for quantitative and qualitative studies from Scopus, Dimension, Google Scholar etc. Second, only journal publications and review articles

were the focus of this investigation. The study only focused on journal articles are written in the English language in the domain of flatulence academic research.

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