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# Plasma applications for smart and sustainable agriculture

Virtual Mobility grant title:

**Atmospheric cold plasma technology application in food production: a bibliometric evaluation**

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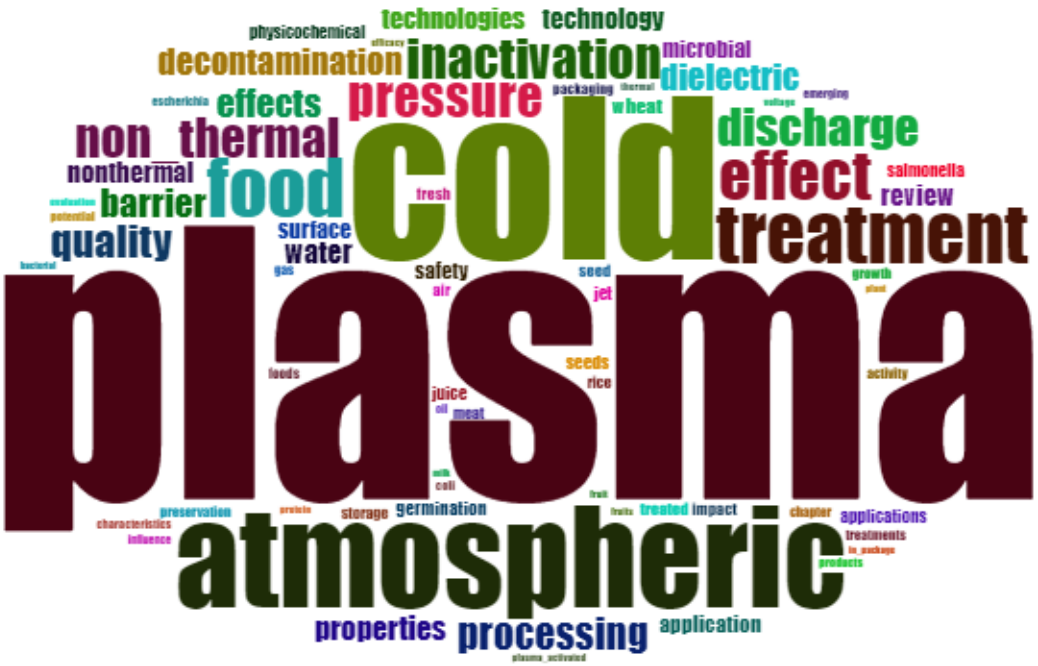

## Contents



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# Introduction

In general, the progress of science nowadays is reflected in the increased number of scientific publications as scientific publications are meant to record and disseminate scientific findings. Scientific output is increasing at a rapid pace and it is becoming increasingly infeasible to remain current with everything that is being published. Moreover, the emphasis on empirical contributions has resulted in voluminous and fragmented research streams (Briner & Denyer, 2012). This hampers the ability to accumulate knowledge and actively collect evidence through a set of previous research papers. All that leading to viewing data in isolation and that means one never can see the full picture.

Scholars' interest into cold plasma technology has dramatically grown in the last two decades, technology has emerged as a novel processing technology, with growing importance in food production and more and more application is researched every day. In this period, production of cold plasma technology literature has also seen exponential growth. There is also substantial number of publications that aim to review certain application of cold plasma technology, however, to the best of our knowledge, a bibliometric analysis of publication trends is missing.

A bibliometric review has the potential to introduce a systematic, transparent, and reproducible review process based on the statistical measurement of field, scientists, or scientific activity (Broadus, 1987). Unlike other techniques, bibliometrics approach provides more objective and reliable analyses. The overwhelming volume of new information, conceptual developments, and data are the milieu where bibliometrics becomes useful by providing a structured analysis to a large body of information, to infer trends over time, themes researched, identify shifts in the boundaries of the disciplines, to detect the most prolific scholars and institutions, and to present the "big picture" of extant research.

In this report, we analyze the evolution of the cold plasma technology literature based on the analysis of the content of the past 20 years of research, i.e. the time span from the year 2000 till the year 2021. Understanding deeply the conceptual structure of the field and its evolution has an added value for scholars. This is also important for reducing the gap of the entrance to new scholars that often consider performing a comprehensive review of prior research work to be a tedious task. Thus, results here presented will help to map the field and guide future research. These findings will be of twofold importance towards

the Action objectives. Firstly, through a better overview of the present state of the art, research coordination between all researchers/authors of future publications will be greatly facilitated. Secondly, a better overview of the most interesting published publications and their topic will provide needed input for coordinating future activities in the Action on the basis of comprehensive overlook of past explorations on the theme of cold plasma technology application in food production.

The further aim is to provide a bibliometric analysis related to sources, countries, affiliations, of the scientific activity related to the field. We also attempted to identify the most frequent and impactful journals, countries, institutions and authors.

The report is structured as follows. First, a brief overview of the bibliographic databases is provided. This is followed by a description of the methods employed in the study. Then we present the results of the analysis of the content and its evolution over time. In this section, we present also the most published authors and the most influential papers. Then we bring forward possible limitations of the report. Finally, in the conclusions, we discuss the future and provide some insights into the possible future development of the field.

## Bibliometric Methodology

In recent years, a growing attention has been devoted to the systematic study of the scientific literature dealing with a given domain of research, thanks to the availability of online databases together with the development of effective tools able to perform automatic analyses.

- Scientific literature is collected in bibliographic databases.
- A bibliographic database is a database of bibliographic records.
- Information related to a bibliographic record is named bibliographic metadata.
- Bibliographic metadata generally contains very rich subject description in the form of keywords, authors, titles, abstracts, sources, etc.
- Sources can be: journals, books, proceedings etc.

For this study, we chose to query Dimension database due some certain advantage of this database. Firstly, Dimensions is inclusive, it captures brooder list of sources and their research outputs, greatly increasing our analysis options. By December 2019, Dimensions contained more than 106 million publications – that's around 30% more than comparable databases. Secondly, access to databases for scientometric purposes is freely allowed, and

since the author did not have access to other databases that require subscription for access it was the only feasible option.

Alternative databases can be considered to retrieve bibliometric datasets, like Scopus, Google Scholar, Microsoft Academics, Crosreff and Web of Science but all of them have certain advantages and disadvantages just as Dimensions have. In a recent large-scale comparison of bibliographic data sources: Scopus, Web of Science, Dimensions, Crossref, and Microsoft Academic, Visser, Van Eck and Waltman (2021) discuss the strengths and weaknesses of the different data sources.

# Methods

## Selection strategy

We performed a computerized bibliometric analysis from the year 2000 to the 10th October of the year 2021. All of the bibliographic records dealing with cold plasma in food production, records were retrieved from the Dimensions database through its freely allowed open access (Herzog, Hook & Konkiel, 2020).

All data were extracted through a query. A combination of terms that identify the bibliometric records - scientific literature. A query was constructed of terms linked by Boolean operators to encompass all related bibliographic records but still provide adequate selectivity in data search and limit extraction to only records connected with our aim.

The following search fields were defined:

- Keywords
- Titles
- Abstracts

We chose to not limit what type of documents query returns. We chose to limit the language of the document to the English language only. For more comprehensive research, we added all terms that led to the improvement of search results. To identify all publications related to this field, we defined the following query:

> Plasma AND (cold OR nonthermal OR non-thermal OR atmospheric) AND (food OR cereals OR fruits OR dairy OR beverages OR milk OR meat OR egg OR beans OR fish OR insects OR oils OR packaging OR nuts OR rice OR wheat OR maize OR oat OR barley OR corn OR quinoa OR sorghum OR juice)

Querying Dimensions database returned 2953 records. The information about the retrieved record by Dimensions was exported into Microsoft Excel 2017. Then, several preprocessing methods were applied to improve the quality of the retrieved data:

- Detection of duplicate records
- Spellings checks of an authors names
- Screening of records for relevance

Relevance of records was assessed on the basis of several requirements and all records were manually checked for compliance. A record was deemed relevant if relevance requirements were satisfied. Requirements were defined to include a record in further analysis on the basis that a record is explicitly focused on the application of cold plasma in food production when it deals with at least one of the following topics:

- Effect of treatment of food characteristics (chemical, physical, sensory etc.).
- Effects of treatment on microorganism decontamination in food matrix.
- Effects of treatment on preparation of samples for further analysis.
- Effect of treatment on packaging materials properties tested on food.
- Effect of treatment on chemical decontamination of food samples.

Similarly, requirements to exclude records from the further analysis were defined on the basis that a record is not explicitly focused on the application of cold plasma in food production, its scope is broader:

- Literature review of several technologies, e.g. on all non-thermal technologies
- Application of cold plasma in analytic techniques
- Record is without overleap with Food Sciences categories, e.g. Physics, Materials, Medicine, Microbiology, Non-Food Biotechnologies.

For treatments, we accepted the application of atmospheric cold plasma in all its forms onto samples as well as the application of cold plasma for producing plasma-activated water that is then used to treat samples.

### Data loading and converting

Starting from our final collection, which contained 1146 bibliographic records after completed preprocessing, we loaded the data (i.e., the selected records matching the inclusion criteria, including all their metadata) and converted it into R data frame using bibliometrix (Aria and Cuccurullo 2017) since it contains a more extensive set of techniques and it is suitable for practitioners through Biblioshiny (Moral-Muñoz et al. 2020).

## Analyses and results

### General Information

Main information about the collection is presented in Table 1. There were 336 different sources that published at least one document about cold plasma in food production. Looking at the authorship pattern, the 1146 documents were written by 3084 scholars, affiliated to the 699 institutions, with an average value of 0,372 documents per author. The 4,1% of these documents were written by a single author. Preliminary considerations can be made by taking into account the authors per document ratio, the coauthors per document ratio, and the collaboration index. From the authors per document value, it is possible to state that a document of our collection was written on average by 2,69 authors. This ratio evaluates the extent to which scholars publish single-authored or co-authored publications, and it can be also seen as a proxy for the average size of research teams. However, publications with a large number of authors can increase this metric substantially. For this reason, we can also look at the coauthors per document ratio, considering the number of times an author appeared in the collection. In the analyzed period, we observed on average 5,05 authors per document. From both, these two measures emerge hence an average number of authors for each document is between 2 and 5 authors.

The divergence in the results is related to the different ways used to count authors. If, for example, an author has written three different publications, the author will be counted only once in the authors per document ratio but the author will be counted three times in the coauthors per document ratio. Because of the complex nature of interactions that take place among authors over a period of time, the precise nature and magnitude of collaboration cannot be easily determined from these metrics. In order to overcome this problem, the collaboration index can be considered. Where collaboration index is the ratio of the total number of authors of multi-authored documents and the total number of

multi-authored documents. In our collection, we observed a collaboration index of 2,78 substantially confirming the results obtained from the other author-level metrics. In total, there are 28220 referenced cited by documents in our collection, while average citations per year per document indicate that an average document will wait a year to receive 4,328 citations.

**Table 1.** Main information about the collection

| Description | Results |
|---|---|
| **MAIN INFORMATION ABOUT DATA** | |
| Timespan | 2000 - 2021 |
| Sources (Journals, Books, etc.) | 336 |
| Documents | 1146 |
| Average years from publication | 2,86 |
| Average citations per documents | 21,77 |
| Average citations per year per doc | 4,328 |
| References | 28220 |
| **AUTHORS** | |
| Authors | 3084 |
| Author Appearances | 5782 |
| Authors of single-authored documents | 34 |
| Authors of multi-authored documents | 3050 |
| **AUTHORS COLLABORATION** | |
| Single-authored documents | 48 |
| Documents per Author | 0,372 |
| Authors per Document | 2,69 |
| Co-Authors per Documents | 5,05 |
| Collaboration Index | 2,78 |

A preliminary analysis showed that the research on cold plasma for food applications is dramatically intensifying, especially in the last few years. The average years from the publication of a document in our collection is 2,86 signaling that the majority of documents has been written recently, growth average rate, in timespan 2000 - 2020 was 30,91% and we chose to exclude the year 2021 from this calculation since there is still

more publication to be made by the end of the year. Figure 1 shows the year-wise distribution of the 1146 documents published during 2000 – 2021. timespan.

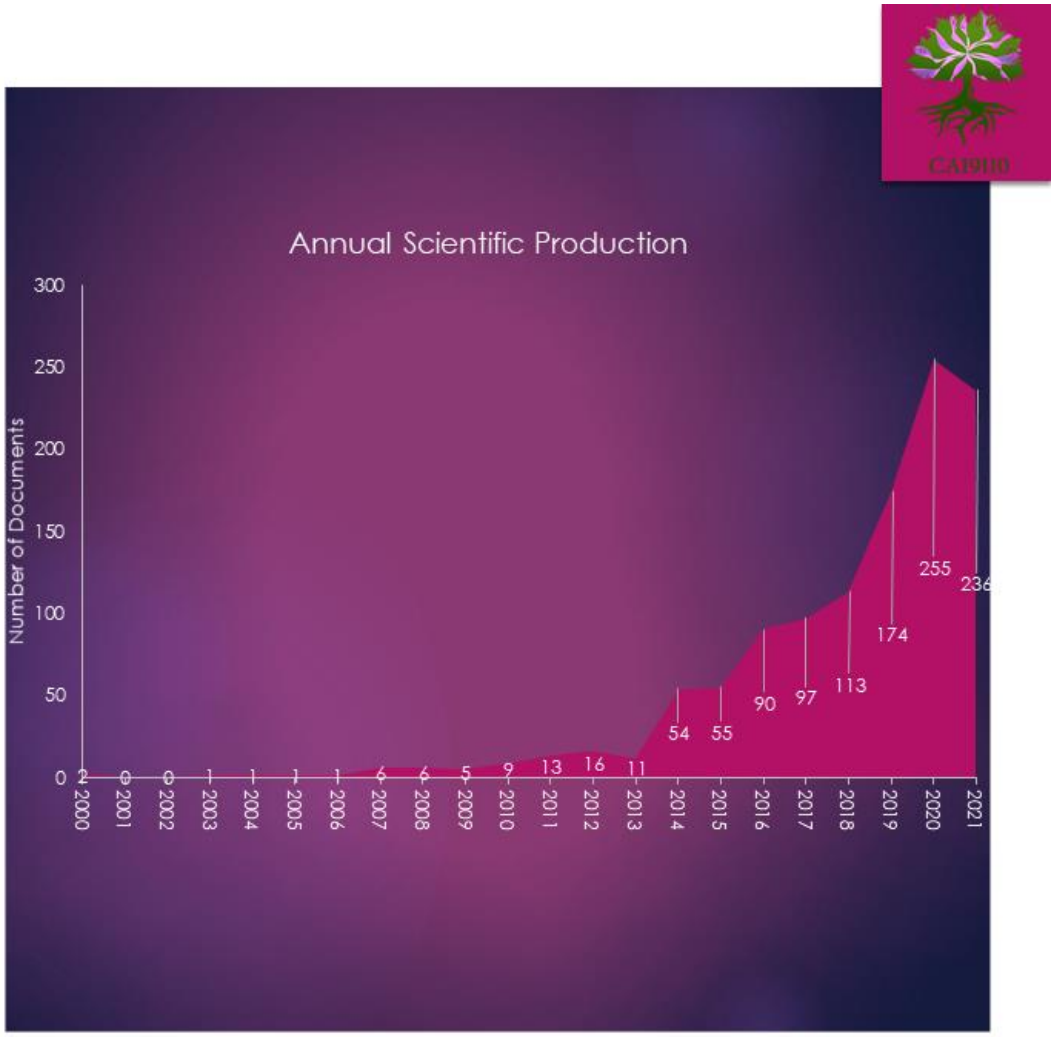


**Figure 1.** Year-wise distribution of scientific production in 2000 – 2021 timespan.

In the mid of the two-thousands, the annual volume of documents increased, with an average production equal to 4,5 documents per year. In the last decade, starting from 2011, the number of publications grew up, reaching 255 documents in the year 2020 and in the first 10 months of the year 2021, on the 10th October there were 236 documents published, suggesting that the total number of documents in this year could exceed that of the former year. Two main factors explain this growth. Firstly, the overall number of researchers has increased exponentially, boosting also the number of submissions to the sources, e.g. journals. Secondly, the development is fueled by the search for new technologies that provide minimally processed food products to consumers.

## Highly contributive sources and documents

Several sources played a key role in publishing on the application of cold plasma in food production. In Figure 2 the ten most relevant sources are listed and sorted considering publication number.

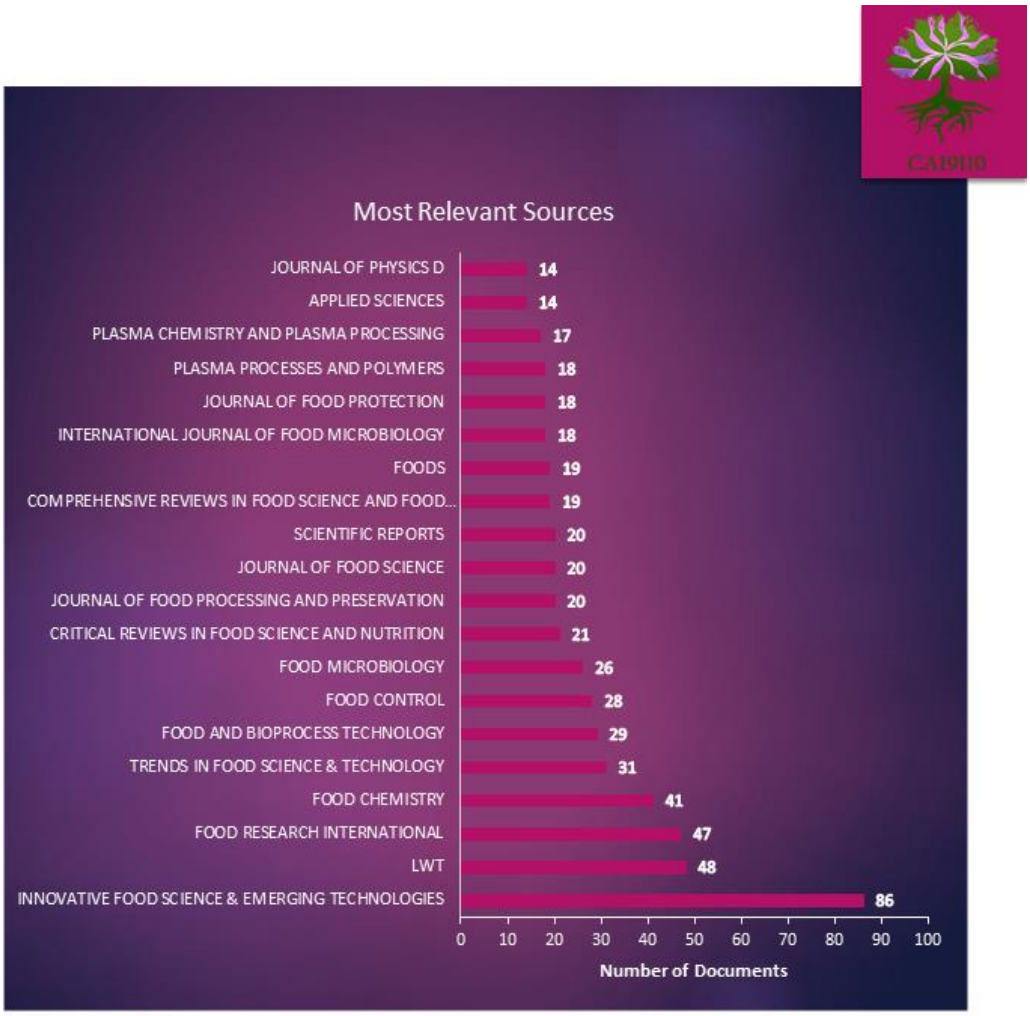


**Figure 2.** Highly contributive sources.

The most productive source for article publication was the "Innovative Food Science & Emerging Technologies" with 86 (7,50%) articles published in the 2000-2021 period, followed by "LWT". The majority of all the journals (n=20) belong to the field of Food Sciences, whereas the field of plasma is represented with 3 journals and only two multidisciplinary journals are on the list. Journals involved in publishing publications on the theme of cold plasma technology application in food production are well-established venues for publishing in food sciences, hence with adequate bibliometric indicators and professional prestige, indicating that the topic of cold plasma in food production is of

interest for editors and that research field is certainly one of the "hot" topics in development. In Figure 3, source growth during the last twenty years confirms that the previous statement is adequate.

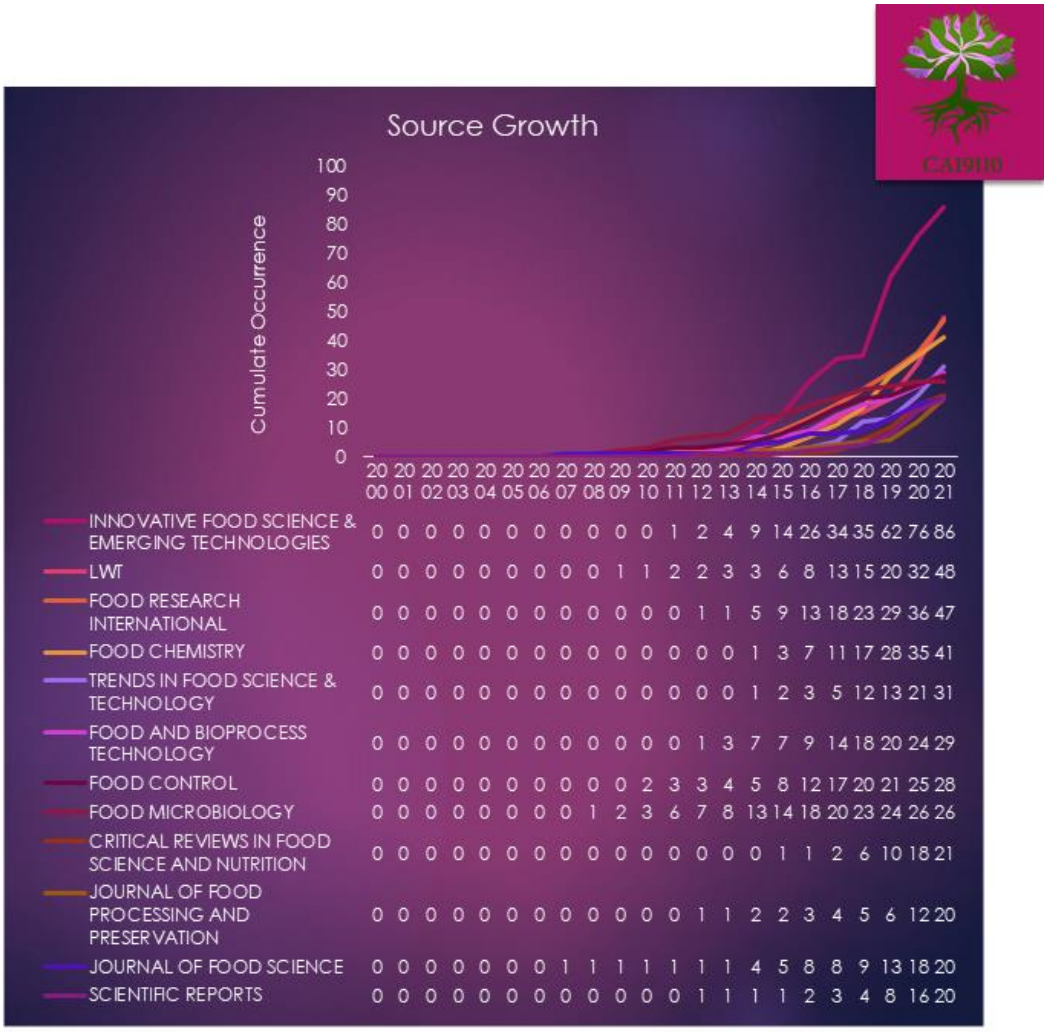


**Figure 3.** Year-wise distribution of scientific production in highly contributive sources.

From Figure 3 it can be seen that the majority of publications have been made in the last five years, which is to be expected due to the previously described year-wise distribution of scientific production. Source impact, shown as a number of citations that documents of a source have received from other documents in our collection is shown in Figure 4.

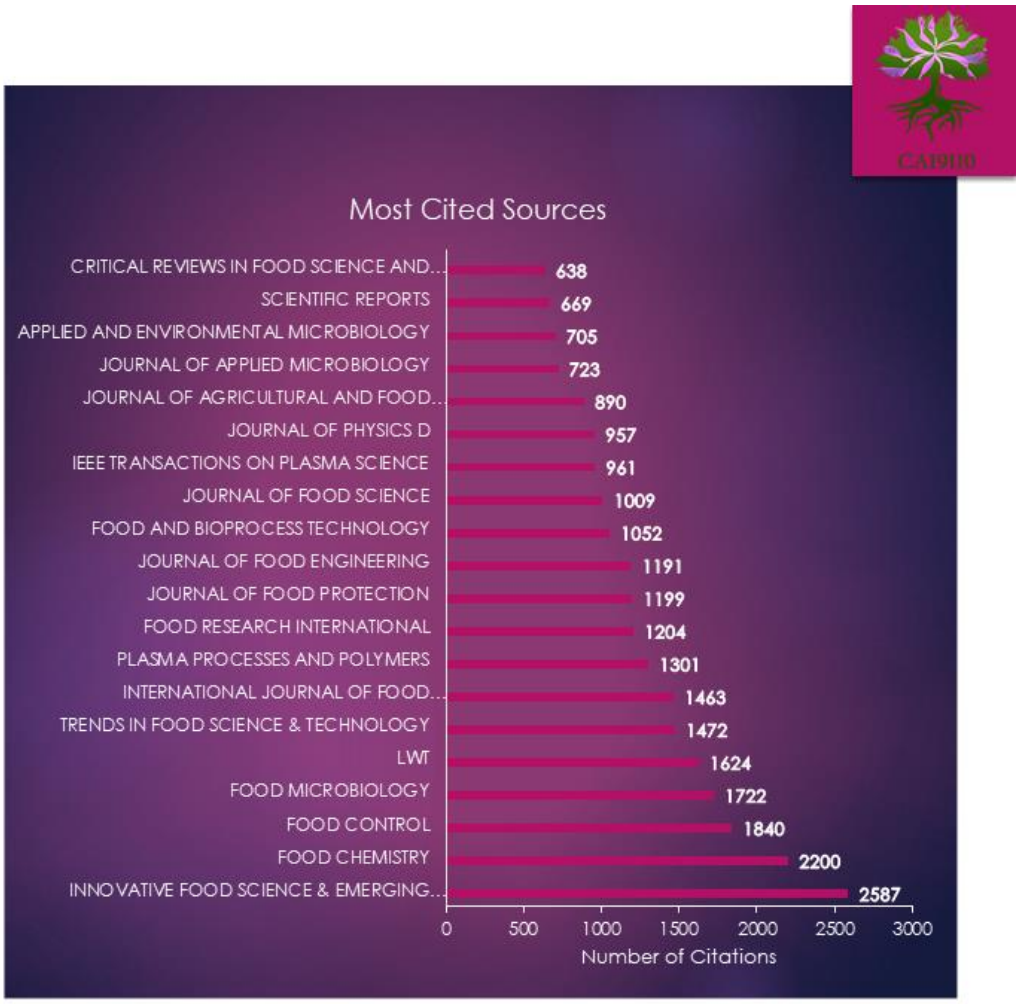


**Figure 4.** Source impact, expressed as a number of citations.

Interestingly, the least cited journal in the references of all 1146 included documents is journal specialized for review articles with 638 citations, while the most cited source was the "Innovative Food Science & Emerging Technologies" with 2587 citations followed by "Food Chemistry" and "Food Control" and "Food Microbiology". Also, when comparing figure 3 and figure 4, one can notice that the citation pattern does not reflect the publication pattern. Hence, some of the most contributive publication sources, such as "Journal of Food Processing and Preservation", "Comprehensive Reviews in Food Science and Food Safety", "Foods", "Plasma Chemistry and Plasma Processing" and "Applied Sciences" are not in the list of sources with the most citations. On other hand, there are sources that reflect just the opposite. These sources are cited and included in the list of sources with the most citations but have published less and are not in the list of the highly contributive publishing sources. In this group of sources, one can find "Journal of

Food Engineering", "IEEE Transactions on Plasma Science"," Journal of Agricultural and Food Chemistry", Journal of Applied Microbiology" and "Applied and Environmental Microbiology".

Finally, core sources of the field can be classified in clusters through Bradford's Law that states:

> ''If scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups or zones containing the same articles as the nucleus, when the number of periodicals in the nucleus and succeeding zones will be as 1: n: $n^2$, where 'n' is a multiplier."

On Figure 5 is presented classification of all sources in accordance with the Bradford's Law.

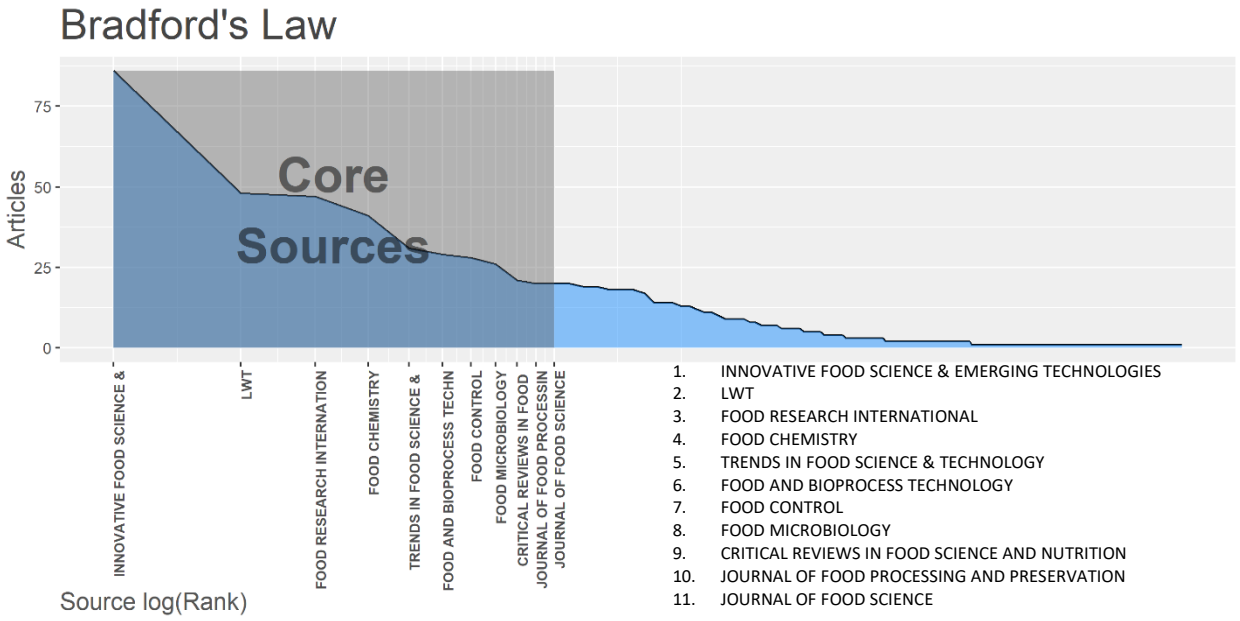


**Figure 5.** Core sources.

It can be seen that 11 journals are classified as core sources of the field, while 35 sources are classified in the second zone, all remaining belonging to the third cluster, having little influence on the research field. Also, all journals of the core zone are of a broader food sciences scope, leaving a question open, should there be a more specialized journal, focus only on the application of cold plasma on foods. In Figure 6 most contributing documents are presented, the contribution is measured in the form of citations and documents are

ranked by the number of total citations they had received. In total, from all analyzed documents in our collection, 56 documents had 100 or more citations. The most impactful document in the collection, or in other words, the most contributing document for the development of the field was an article by Misra et al (2011) in the journal Food Engineering Reviews. This article received 353 citations by 10th October of 2021 and is closely followed by another review article published by Niemira (2011) the same year in the Annual Review of Food Science and Technology.

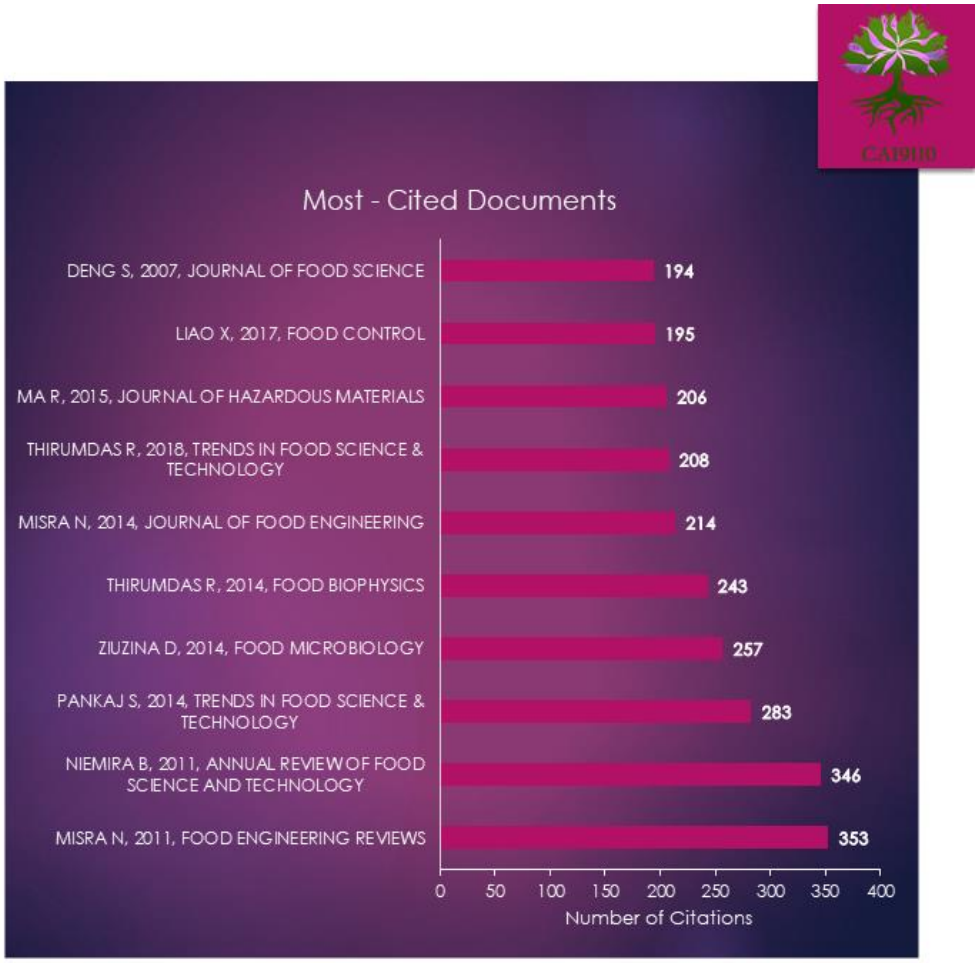


**Figure 6.** Most cited documents.

## Authors' productivity

In Figure 7. authors productivity can be shown through Lotka's Law. In total, there was 3084 unique authors. In accordance with Lotka's Law, 71,1% of authors authored just one document, 13,3% of authors authored 2 documents, 6,7 authored 3 documents, 3% authored 4 documents, 1,6 % authored 5 document end etc. In general, it is possible to

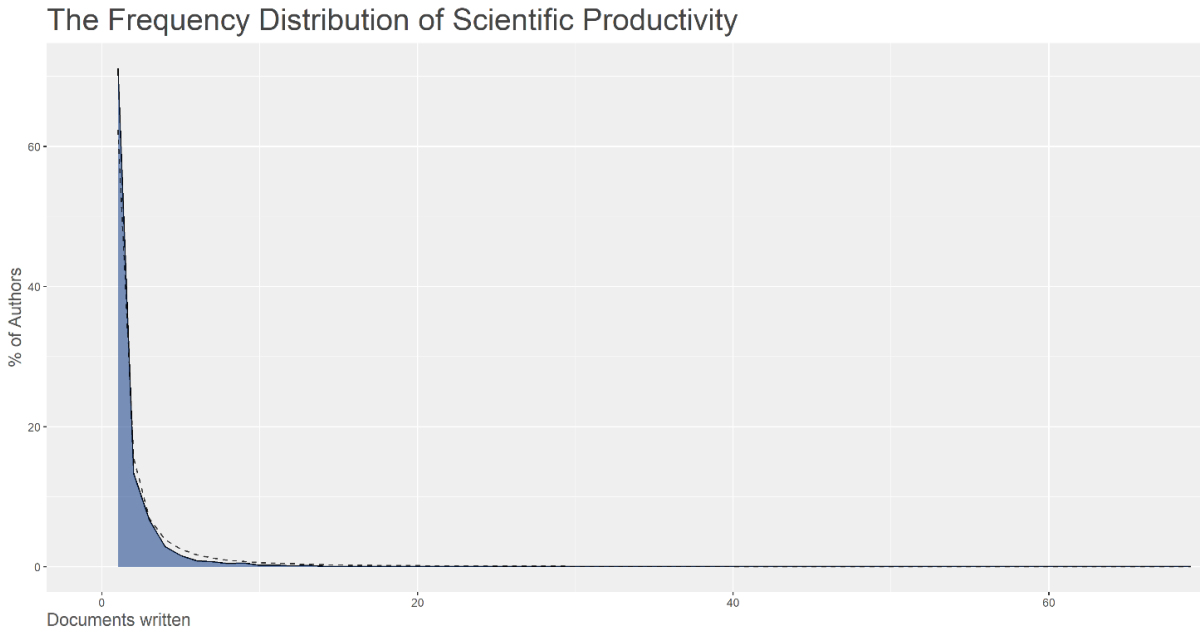


**Figure 7.** Authors productivity.

observe in Figure 8 that all the top authors wrote at least twenty articles during the analyzed period. The most productive author was Cullen with 69 publications, followed by Bourke with 51 publications and Keener with 47 publications. In order to identify the most productive authors on the basis of their actual contribution, the fractionalized frequency of publications has also been reported. Fractional counting considers the number of publications with respect to the number of authors, removing evident disproportions in authors 'contributions in single or multi-authored publications and hence providing an adjusted number of publications per author (Vavryčuk 2018). If we consider the fractionalized frequency of publications, the first author is now Misra with a value of 12,81, followed by Cullen (12,28) and Keener (11,55).

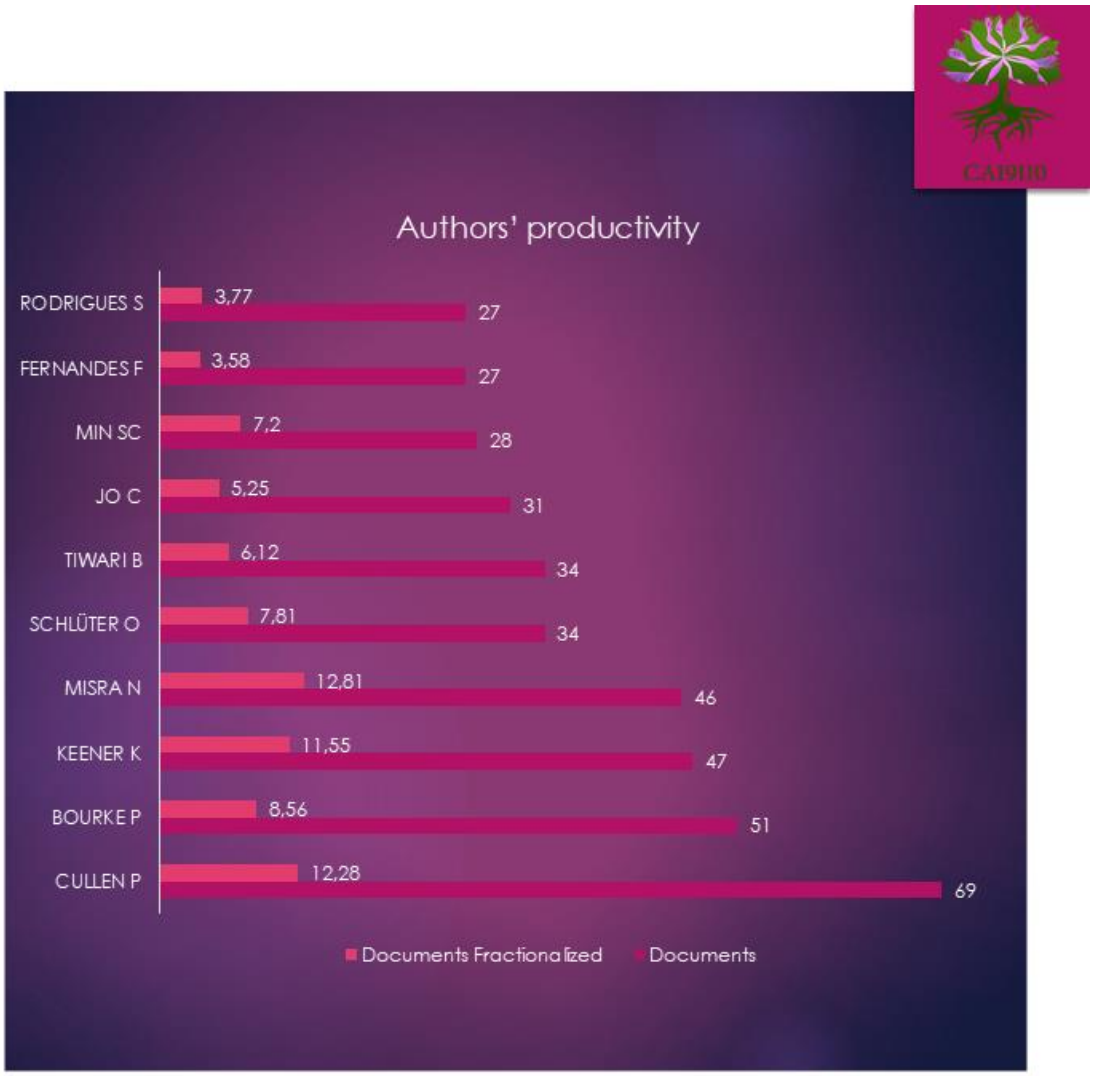


**Figure 8.** Most productive authors.

To further analyze authors and the development of the field, a timeline of the top ten authors over time (2000 – 2021) is shown in Figure 9. It can be noticed that the intensive development of the field starts around 2009 with the first documents authored by Keener, Schlüter and Jo, research activity then further intensified around 2011 when Cullen, Misra and Tiwary join and start producing their research outputs. Finally, the third wave of expansion starts in 2013 and lasts till 2015 with the joining of other authors. Publication outputs explode in 2014 and stay relatively stable over the years for all authors.

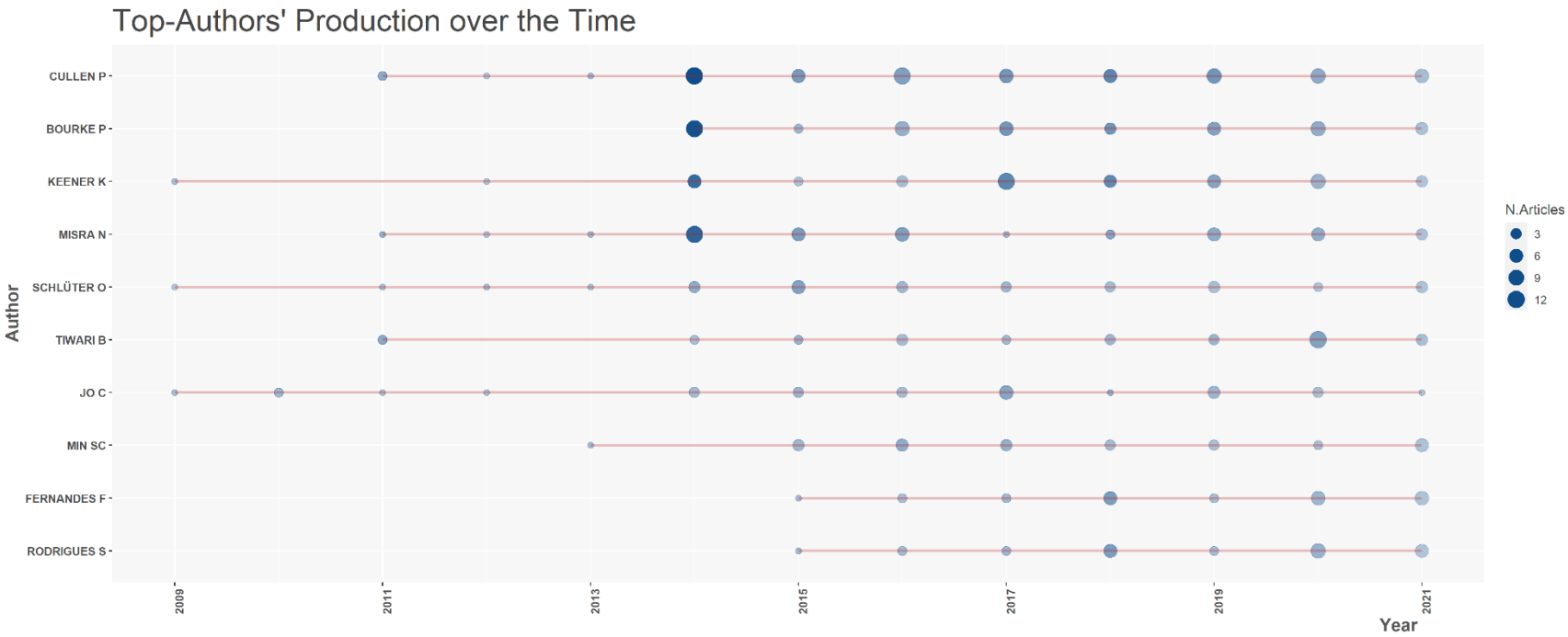


**Figure 9.** Timeline of the top ten authors over time (2000 – 2021).

## Countries and institutions productivity

The ten most active countries are listed and sorted considering both publications and citations. It is necessary to notice that with the country we referred to the author's affiliation country was at the time of publication. Moreover, only the countries of the corresponding author were considered in the following. The ten most active countries are presented in Figure 10 and most cited in Figure 11.

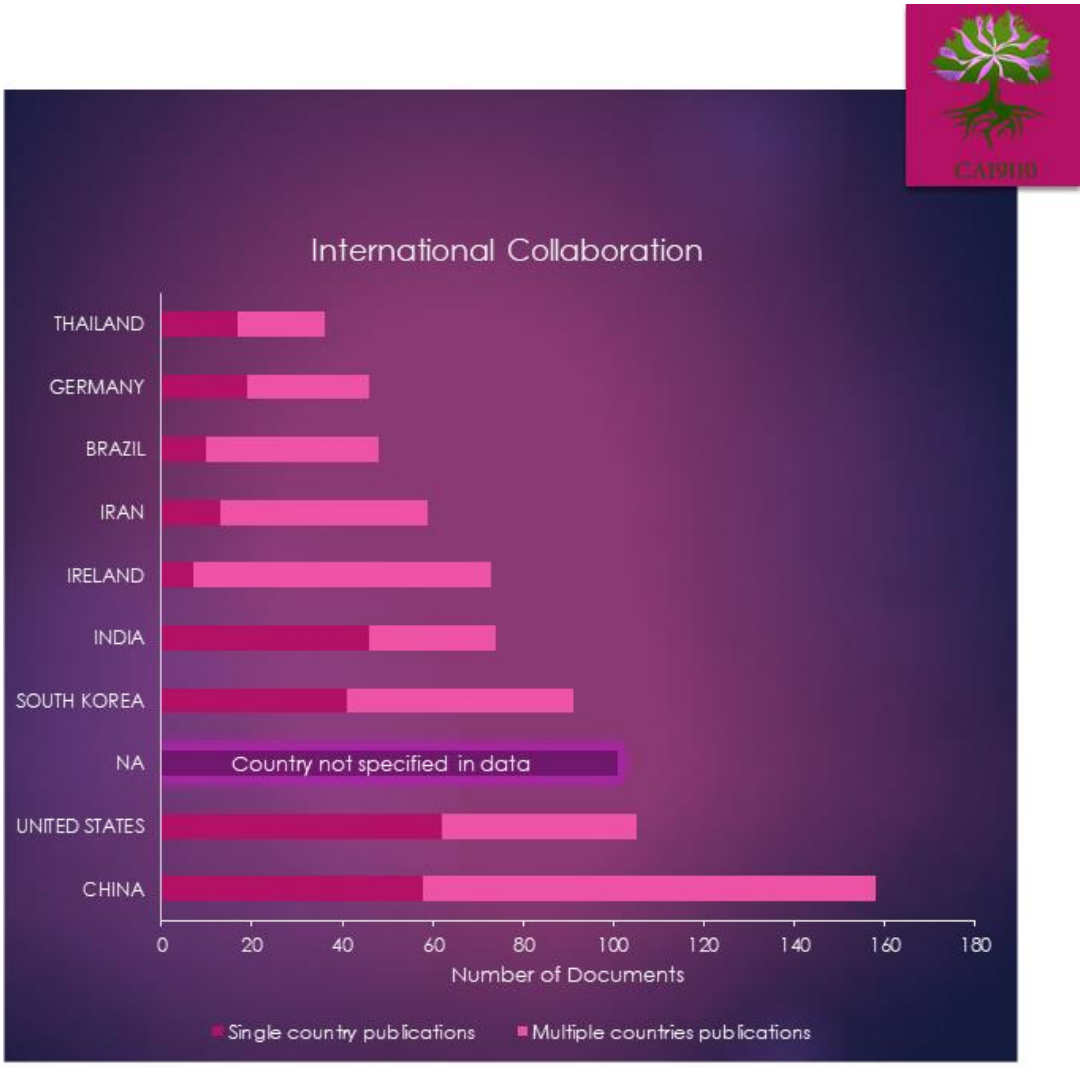


**Figure 10.** Top 10–Most productive countries (based on first author's affiliation). SCP - single country publications; MCP - multiple countries publications.


**Figure 11.** Top 10–Most cited countries (based on first author's affiliation).

China was the leading country, the first in terms of the total number of publications and second in the ranking of the total number of citations. If we consider the number of published documents, China was followed by the USA and South Korea for the publications, but on the side of citations, described ranking stays in place from after second place, China is in the second place, the USA and South Korea are following. Ireland takes the first rank for the citations. Hence, these performances clearly indicate that ranking in terms of scientific production or citations may be related to countries' populations but is not strictly determinate and that other factors also play a considerable role in the rankings. Indeed, the same can be noticed with other two European countries which publish less but are cited more than other countries, Germany and United Kingdom.

It is important to underline that scholars do not work in isolation, since they are members of a worldwide community of researchers working together to provide new insights and inspiration for new researchers to work on the same or related fields. International co-authored publications are frequently used as a measure to obtain a comprehensive picture of international collaborative works. Co-authorship is a final result of different scientific exchanges that facilitate the acquisition of science undertaken within a community of facts and ideas. Figure 10 allows verifying the propensity of each country to collaborate with others. In particular, it provides detail on the international collaboration by considering the number of documents produced by authors from the same country as metric for the intra-country collaboration (single country publications, SCP) and the number of documents produced by authors from different countries as metric for the inter-country collaboration (multiple countries publications, MCP). We observed that all the leading countries, except the USA, showed a higher MCP, with respect to the corresponding SCP, revealing that there was a greater propensity in collaborating with other countries. An in-depth analysis focused on institutions offers other interesting cues on the history and the evolution of the field. Figure 12 shows the top ten most productive institutions. As above, we referred to the institution each author was affiliated with at the time of publication.

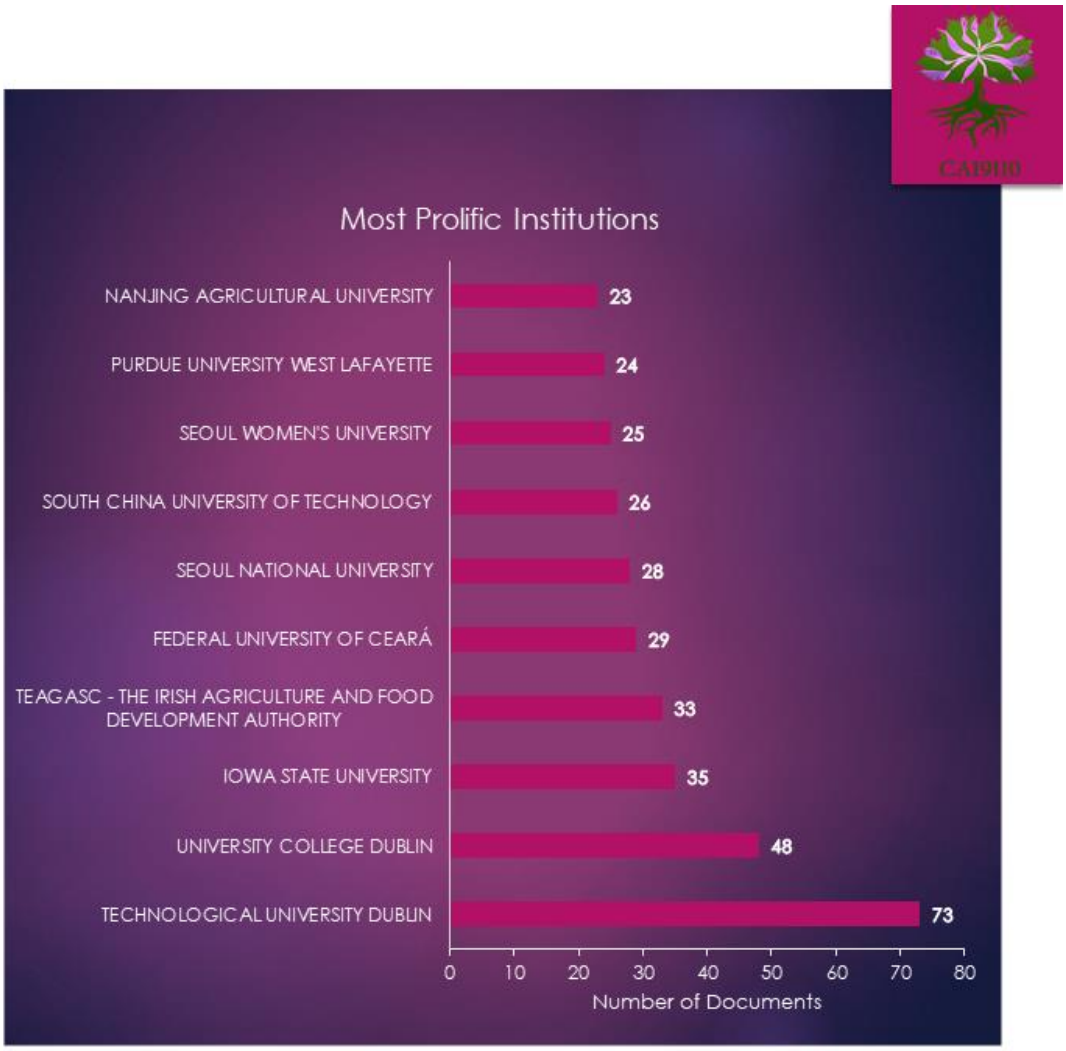


**Figure 12.** Top 10–Most productive institutions (based on first author's affiliation).

As well as Ireland was the most productive country in the citation in ranking, so are Ireland institutions in the top ten most productive institutions and are positioned in the first, second, and third places of the ranking.

## Co-word analysis

In this section, we focused our attention on the conceptual structure of publications. Identifying the conceptual structure could also be useful for studying the research topic evolution over time (Dumont Oliveira 2018). This analysis allows finding subgroups of strongly linked terms, where each subgroup corresponds to a centre of interest or to a given research theme/topic of the analyzed collection. Once the analysis is carried on, it is possible to plot the results in a so called strategic or thematic diagram (Cobo et al. 2011), according to the Callon centrality and Callon density of each cluster/theme. Callon

centrality can be read as the importance of the topic in the whole collection, while Callon density can be read as a measure of the topic's development. The graphical representation allows defining four typologies of themes (Cahlik 2000), depending on the quadrant in which they are plotted:

- Themes in the upper-right quadrant are known as the motor themes, characterized by high centrality and high density, meaning that they are developed and important for the research field;
- Themes in the lower-right quadrant are known as basic and transversal themes, characterized by high centrality and low density, meaning that these themes are important for a domain and they concern general topics transversal to the different research areas of the field;
- Themes in the lower-left quadrant are known as emerging or declining themes, with low centrality and low density, meaning that are weakly developed and marginal;
- Themes in the upper-left quadrant are known as the high developed and isolated themes, with well-developed internal links (high density) but unimportant external links (low centrality), meaning that they are of limited importance for the field.

The aim of the co-word analysis was to draw the conceptual structure, presented in Figure 13 of cold plasma applications in food production framework using a word co-occurrence network to map and cluster terms extracted from keywords in our bibliographic collection. A minimum threshold of 5 occurrences was imposed to filter only the most frequent keywords. Each theme is labeled with the corresponding most frequent keywords. The readability of the representations is enhanced by proportionally dimension each topic/theme with the total occurrences of the keywords that compose it.

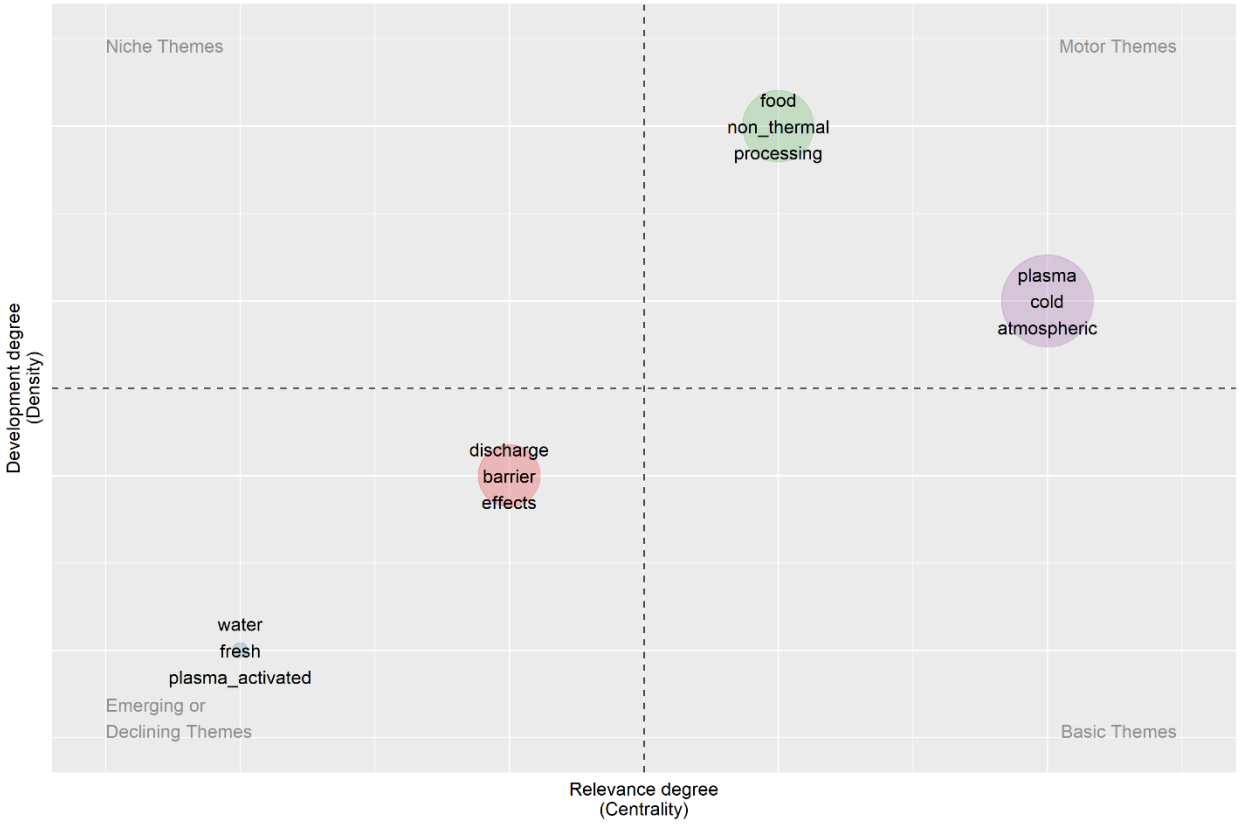


**Figure 13.** Thematic diagram of cold plasma in food production.

Four main topics emerged. According to the strategic diagram, nonthermal processing of food and cold atmospheric plasma was the motor theme of the field. In the lower-left quadrant, the keyword of water, fresh and activated appears indicating that the topic of plasma-activated water is emerging topics, in the same quadrat but more transversal, keyword of discharge and barrier effect is located, confirming predominate use of dielectric barrier discharge technique for excitation of cold plasma. There are no basic themes, themes that are well established and important for a domain and they concern general topics of cold plasma application in food production. The thematic diagram can also be presented in the form of a network diagram where keywords are presented as individual nodes and group into main topics in which their use is predominant. The size of each keyword node is proportional to the frequency of its use. This form of presentation is shown in Figure 14.

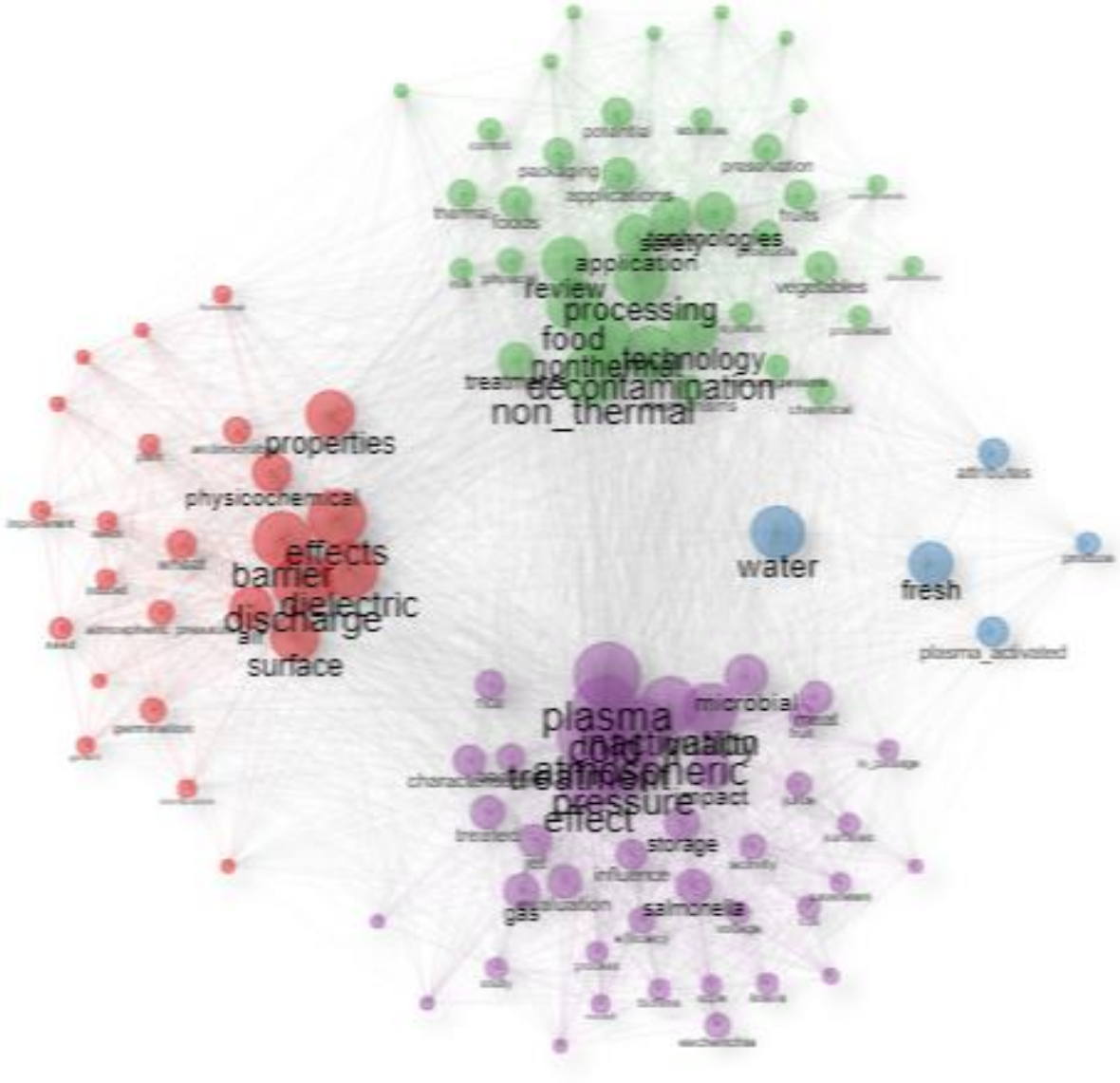


**Figure 14.** Network presentation of co-word analysis of cold plasma in food production.

## Limitations of Study

This study has several limitations mainly related to the instrument of bibliometric analysis per se. Indeed, there are always false positive and false negative results in any bibliometric research, because it is impossible to generate a perfect and all-encompassing research query. The citation analysis represents an objective and quantitative measure of the research but does not provide information about research quality or the influence on practice, although we may hypothesize that the more citations a document receives, the greater impact that document may have on the scientific community.

Considering all these limitations, the number of publications analyzed in this study might not exactly reflect the entire global research activity on cold plasma in food production, but the data presented likely provides significant insight into the evolving trends over the last two decades.

## Conclusions

This report aimed at presenting a systematic review of the documents published on the theme of cold plasma application in food production in the last 20 years through a bibliometric approach, tracing the evolution as well as of the research lines and trends in the field. The number of publications has shown a clear increasing trend in the past decade. A great extent of collaboration among different countries, authors and institutions is already established. Core sources as well as the most prolific authors are identified with the list of ten most impactful documents.

Science mapping is becoming an essential activity for scholars of all scientific disciplines. As the number of publications related to the application of cold plasma in food production, the task of accumulating knowledge becomes more complicated. The determination of the research-front of application of cold plasma in food production is important not only for the research but also for the policy-making and practice. And its adoption as a new technique by the food industry.

## References:


Aria, M., & Cuccurullo, C. (2017). bibliometrix: An R-tool for comprehensive science mapping analysis. *Journal of informetrics*, *11*(4), 959-975.

Briner, R. B., & Denyer, D. (2012). Systematic review and evidence synthesis as a practice and scholarship tool. *Handbook of evidence-based management: Companies, classrooms and research*, 112-129.

Broadus, R. N. (1987). Toward a definition of "bibliometrics". *Scientometrics*, *12*(5-6), 373-379.

Cahlik, T. (2000). Search for fundamental articles in economics. *Scientometrics*, *49*(3), 389-402.

Cobo, M. J., López-Herrera, A. G., Herrera-Viedma, E., & Herrera, F. (2011). An approach for detecting, quantifying, and visualizing the evolution of a research field: A practical application to the fuzzy sets theory field. *Journal of informetrics*, *5*(1), 146-166.

Moral Muñoz, J. A., Herrera Viedma, E., Santisteban Espejo, A., & Cobo, M. J. (2020). Software tools for conducting bibliometric analysis in science: An up-to-date review.

Oliveira, T. D. (2018, June). From Modelmania to Datanomics: The Top Journals and the Quest for Formalization. In *STOREP 2018-Whatever Has Happened to Political Economy?*.

Vavryčuk, V. (2018). Fair ranking of researchers and research teams. *PloS one*, *13*(4), e0195509.

Visser, M., van Eck, N. J., & Waltman, L. (2021). Large-scale comparison of bibliographic data sources: Scopus, Web of Science, Dimensions, Crossref, and Microsoft Academic. *Quantitative Science Studies*, *2*(1), 20-41.

Herzog, C., Hook, D., & Konkiel, S. (2020). Dimensions: Bringing down barriers between scientometricians and data. *Quantitative Science Studies*, *1*(1), 387-395.

# Appendix

**List of ten most cited documents:**

| Paper | DOI |
|---|---|
| MISRA N, 2011, FOOD ENGINEERING REVIEWS | 10.1007/S12393-011-9041-9 |
| NIEMIRA B, 2011, ANNUAL REVIEW OF FOOD SCIENCE AND TECHNOLOGY | 10.1146/ANNUREV-FOOD-022811-101132 |
| PANKAJ S, 2014, TRENDS IN FOOD SCIENCE & TECHNOLOGY | 10.1016/J.TIFS.2013.10.009 |
| ZIUZINA D, 2014, FOOD MICROBIOLOGY | 10.1016/J.FM.2014.02.007 |
| THIRUMDAS R, 2014, FOOD BIOPHYSICS | 10.1007/S11483-014-9382-Z |
| MISRA N, 2014, JOURNAL OF FOOD ENGINEERING | 10.1016/J.JFOODENG.2013.10.023 |
| THIRUMDAS R, 2018, TRENDS IN FOOD SCIENCE & TECHNOLOGY | 10.1016/J.TIFS.2018.05.007 |
| MA R, 2015, JOURNAL OF HAZARDOUS MATERIALS | 10.1016/J.JHAZMAT.2015.07.061 |
| LIAO X, 2017, FOOD CONTROL | 10.1016/J.FOODCONT.2016.12.021 |
| DENG S, 2007, JOURNAL OF FOOD SCIENCE | 10.1111/J.1750-3841.2007.00275.X |