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Scientometric study of Food Technology Research : Most influential scholarly publications in 2015 based on Web of Science

Étude scientométrique de la recherche sur les technologies alimentaires : les publications savantes les plus influentes en 2015 basées sur Web of Science

القياسات العلمية لأبحاث تكنولوجيا الأغذية : أكثر المنشورات العلمية تأثيرًا في عام 2015 استنادًا إلى شبكة العلوم

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Abstract : In this research paper, we are analyzing the hy-core of Food technology Thomson Reuters Web of Science indexed papers of -2015, using Bibliometric and Scientometric techniques in order to have an overview about the main journals, institutions, authors, topics and countries that mostly influence the Food technology research area nowadays. This study confirmes that the main papers that currently influence Food technology research are either new papers introducing innovative techniques and findings or old papers that are mainly cited because they are considered as fundamental in the field by the Food technology research communities. This paper also proves the major influence that prominent researchers have, along with specialized nationwide research institutes, as well as journals with high impact factors that publish papers about all the aspects of Food technology research, or about general topics related to food analysis and processing, such as of the United States specifically University of Massachusetts Amherst on Food technology research.

Keywords : Influential papers, Web of Science, Food technology, Research Influences.

Résumé : Dans ce travail, nous avons analysé le hy-core des documents indexés du Web of Science de Thomson Reuters sur la technologie alimentaire pour l'année 2015 en utilisant des techniques bibliométriques et scientométriques afin d'obtenir un aperçu des principales revues, institutions, auteurs, sujets et pays qui influencent ce domaine de recherche. Il en ressort que les principaux articles qui influencent actuellement la recherche en technologie alimentaire sont soit de nouveaux articles définissant des techniques et des résultats innovants, soit d'anciens articles principalement cités parce qu'ils sont considérés comme fondamentaux par les communautés de recherche en technologie alimentaire. Cette étude a également prouvé une influence actuelle majeure des anciens chercheurs hautement cités, des instituts de recherche spécialisés à l'échelle nationale, des revues à fort impact qui publient des articles sur tous les aspects de la recherche en technologies alimentaires, des sujets généraux liés à l'analyse et à la transformation des aliments, et la contribution des États-Unis en particulier l'Université du Massachusetts Amherst dans la recherche en technologie alimentaire.

Mots-clés : Articles influents, Web of Science, Technologie alimentaire, Influences de la recherche.

مستخلص : في هذه الورقة البحثية، قمنا بتحليل نواة hy-core الخاصة بتقنية الأغذية لعام 2015 حسب شبكة العلوم (بالإنجليزية : Web of Science) باستخدام تقنيات ببليومترية للحصول على نظرة عامة حول المجلات والمؤسسات والمؤلفين والموضوعات والبلدان الأكثر تأثيرًا في مجال بحوث تكنولوجيا الغذاء في الوقت الحاضر. تؤكد هذه الدراسة أن الأوراق الرئيسية التي تؤثر حاليًا على أبحاث تكنولوجيا الغذاء هي إما أوراق جديدة تحدد التقنيات والنتائج المبتكرة أو أوراق قديمة يتم الاستشهاد بها بشكل أساسي لأنها تعتبر أساسية في هذا المجال من قبل مجتمعات الباحثين في تكنولوجيا الغذاء. كما أثبتت سيطرة الباحثين القدامى ومعاهد البحوث الوطنية والمجلات عالية التأثير التي تنشر أبحاثا عامة حول تكنولوجيا الغذاء، الموضوعات العامة المتعلقة بتحليل الأغذية ومعالجتها، والولايات المتحدة على وجه التحديد جامعة ماساتشوستس أمهيرست على أبحاث تكنولوجيا الغذاء.

الكلمات المفتاحية : الأبحاث المؤثرة، شبكة العلوم، تكنولوجيا الغذاء، تأثيرات البحوث.

Introduction

Food Technology research is the one explicitly dealing with the creation, adjustment or application of Chemical or Engineering techniques to analyze, modify or generate food patterns (Moraru, Panchapakesan, Huang, Takhistov, Sean, & Kokini, 2003). It has become an important and influential field of research which can help ameliorate quality and easiness in production of foods and reducing their costs (Alston, Beddow, & Pardey, 2009; Fan & Pardey, 1997; Heaton, 2001; Thompson & Scoones, 2009). That is why the first trials to assess the output quality, the practical effect and the usefulness of food science and technology research were not recent as there is a work that was written in 1948 about the issue (Fisher & Yates, 1949). Nowadays, Food Technology Research Evaluation is still an ongoing research trend as 2.4% of the worldwide scientometric studies deal with Agricultural and Food Science (Gao, 2015). In fact, more interest is given to the evaluation of research productivity (Glänzel & Veugelers, 2006; Ravichandran & Vijayakumar, 2015; Van Raan & Van Leeuwen, 2002) as well as the theoretical and practical effect of Food Technology Research worldwide and even by region (Alfaraz & Calviño, 2004; Fan & Pardey, 1997; Poornima, Surulinathi, Amsaveni, & Vijayaragavan, 2011) or by journal (Gomathi, 2014; Vijay & Raghavan, 2007; Zan & Zan, 2014), to the detection of the significant trends (Ravichandran & Vijayakumar, 2015), to analyze the behavior of the editors of Food technology journals in accepting papers for publication (Amat, 2007) and of the behavior of Food technology researchers in citing papers (Braun, Glänzel, & Grupp,

1995; Ravichandran & Vijayakumar, 2015), choosing topics (Eriksson, 1997) and establishing international or interdisciplinary research collaborations (Liu, Guns, Wei, & Yin, 2013; Mazloumian, Helbing, Lozano, Light, & Börner, 2013; Ponds, Van Oort, & Frenken, 2007; Van Raan & Van Leeuwen, 2002; Vijay & Raghavan, 2007; Zhou, Zhong, & Yu, 2013) and detection of Food technology research topics in need of proliferation (Achanta & Okos, 1996; Calo-Mata, Arlindo, Boehme, de Miguel, Pascoal, & Barros-Velazquez, 2008; Van Raan & Van Leeuwen, 2002). Such works use basic Bibliometric and Scientometric Analysis methods as well as the analysis of word co-occurrence networks and citation networks to give a detailed overview about food technology research (Van Raan & Van Leeuwen, 2002; Zhou, Zhong, & Yu, 2013).

In the present study, we retrieve a list of the WoS papers that had most influenced the ones published in the year of 2015 to give an overview about the current situation and main influences of Food Technology Research and to verify if the analysis of the metadata of the yearly highly cited papers of a topic gives an idea about the individuals, journals, institutions, topics, and countries that influence the most that field with the same accuracy as the one of the analysis of the metadata of all the papers about that field of interest.

Methods

Using Thomson Reuters Web of Science Database and Website (Thomson Reuters, 2016), all the Literature about Food Science in all the WoS collections (348838 scholarly publications having *Food Science and Technology* as their research area in WoS database) is gathered and their citation reports are exported as XLS files. The papers are then classified according to their number of WoS received citations in 2015 using Microsoft Office Excel 2007 (Microsoft Corporation, 2007) and the works that are not related to food technology research are then manually eliminated. The process of elimination of scholarly publications not relevant for food technology research is mainly based on the screening of the titles, abstracts and keywords of the initial Web of Science search query results to find terms that are not linked to food technology such as “nutrition” and “diet”.

Analyzing all the papers requires advanced computer definitions including important computer memory and high CPU capacities (Grivel, Polanco, & Kaplan, 1997). That is why the analysis has been limited to a significant number of papers that can provide a broad outline of Food technology field. So far, research fronts of a given research field, defined

as the papers that have the best weights in the citation network of the field, have been used to give an overview about that research area (Bornmann & Marx, 2012). However, this method is not practical for a huge number of papers as it requires the processing of the references of all the set of analyzed publications before restricting the bibliometric study to obtained research fronts. Nowadays, it has been proved that the Hirsch core of a scientist (Cabrerizo, Alonso, Herrera-Viedma, & Herrera, 2010; Glänzel, 2008; Hirsch, 2005) or a topic (Banks, 2006) can reflect the characteristics of all the set of the papers from which it has been derived because the papers of the Hirsch core are generally highly cited and consequently they are very likely to be cited in the other works of their original set. By definition, the Hirsch core of a set of publications is the series of papers that have each received a number of citations superior or equal to the h-index (Definition 1) of the original set of papers (Glänzel, 2008; Hirsch 2005). Similarly, the h_y-core (Definition 2) of a set of papers can represent the current trends of that set of papers.

Definition 1: *The h-index is defined as h such that h of the papers of the original set have each received h citations or more and that the other papers of the original set have each received h citations or less* (Hirsch, 2005).

Definition 2: *The h_y-core is the set of papers having a number of received citations in year y that is superior or equal to the h_y-index or the yearly h-index (Definition 3)* (Cabrerizo, Alonso, Herrera-Viedma, & Herrera, 2010; Sidiropoulos, Katsaros, & Manolopoulos, 2007).

Definition 3: *The yearly h-index is defined as h_y such that h_y of the papers of the original set have each h_y or more citations received in year y and also the other papers of the original set have each h_y or less citations received in year y* (Sidiropoulos, Katsaros, & Manolopoulos, 2007).

As the number of the received citations of these h_y-core papers in a given year y is significant and the number of papers issued in the same year y for a topic is limited, the papers of the h_y-core would be cited in quite all the works of the year y and would consequently represent the research trends and influences of the field of the initial set of papers in the year y. The use of the h_y-index as a threshold number of citations for the papers to be considered is a better choice for our case as the determination of the h_y-index does not require the computation of the overall number of citations received by all the analyzed set of papers or of the number of the scholarly publications initially included in the

assessed set by contrast to characteristic scores and scales (Bornmann, Adam, & Fred, 2017).

Therefore, the h_y-index of the WoS-indexed Food technology related papers for the year 2015 has been calculated (Definition 3) after sorting in descending order the assessed scholarly publications according to their number of received citations in 2015. This can be easily done using "Create Citation Report" button in Web of Science interface after eliminating non-cited publications. As shown in Definition 2, the h_y-core papers are simply the papers that have the best number of received citations in the year *y* and can be easily picked from the processed list that was used for the computation of the h_y-index without having to study the citation distribution of the initially considered set. That is why the h_y-core of the Food Technology papers has been considered to study the current influences in Food Chemistry research.

The data about each research paper including titles, authors, author affiliations, journals, and years of publication have been retrieved using Thomson Reuters Web of Science website as a plain text. To study the influence of authors, countries, names, journals and papers in Food technology research in 2015, Web of Science interface has been used to retrieve the lists of the most published authors, countries, institutions and journals in the set from the obtained plain text (Thomson Reuters, 2012). Then, we will use VOSViewer to visualize the citation network and the keyword co-occurrence network of the set of influential papers to further understand food technology area. VOSViewer is a science mapping tool that is used to visualize scholarly networks from network data, plain text or APIs. These networks can be country-level, organization-level, source-level, author-level, publication-level or keyword-level ones and can show a variety of scientometric links: citation, co-citation, co-authorship, co-occurrence, and bibliographic coupling (Van Eck & Waltman, 2010). Created by Van Eck and Waltman in 2010 (Van Eck & Waltman, 2010), the software has proved to be efficient in such retrievals in studying other scientific fields such as Citizen Science (Kullenberg & Kasperowski, 2016), Science Education (Zohar & Barzilai, 2013), and Innovation (Merigó, Cancino, Coronado, & Urbano, 2016). For the keyword co-occurrence network, we will be based on WoS-generated keywords of the influential works (Fig. 1, so-called *KeyWords Plus*) as this type of metadata does not assign different names to similar concepts unlike author keywords (Guo, Weingart, & Börner, 2011; Thomson Reuters, 2016) and significantly reflects the topics of publications with an excellent accuracy just like titles and abstracts (Pollack & Adler, 2015; Whittaker, 1989).

Fig. 1 : Sample keywords assigned to a publication on Web of Science

Results and Discussion

The obtained set of WoS influential papers about Food technology research in 2015 involves 46 papers (Appendix A). All of them were written in English and included in Web of Science Core Collection. This language bias is explained by the lack of coverage of the scientfic literature written in languages other than English in WoS databases (Mongeon & Paul-Hus, 2016).

As shown in Fig. 2, most of the papers are unsurprisingly published after 2006 and evocating new and breakthrough findings in Food technology research. However, there are some papers that are still highly cited in 2015 even if there are considerably old. This is mainly explained by the fact that these papers, or rather Citation Classics, have added a fundamental theory in the field of Food technology (Abt, 1998; Garfield, 1986).

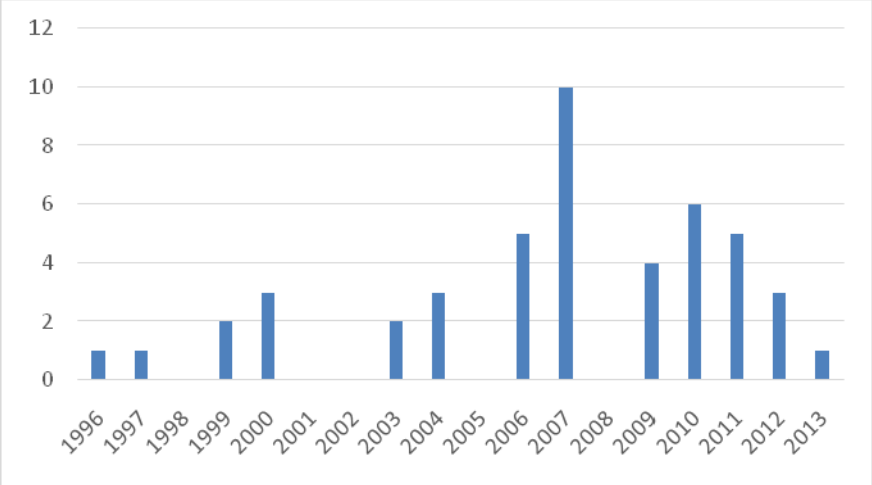

Fig. 2 : Repartition of the papers according to years of publication

In fact, these papers have even been references for some of the more recent highly cited papers in 2015 as shown in Fig. 3. Examples of these

papers are Piyasena (2003) and Gouin (2004). Such papers can remain highly cited even after decades of their creation (Abt, 1998).

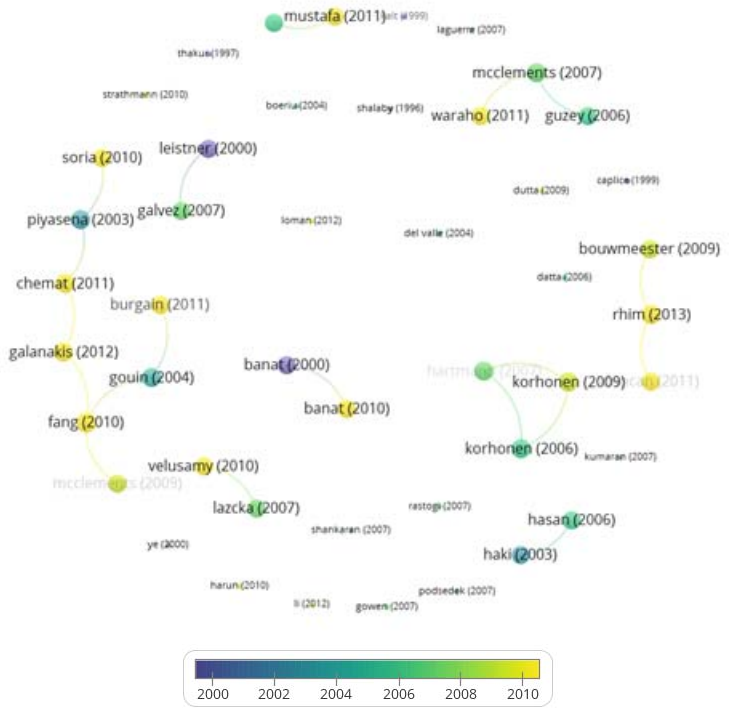

Fig. 3 : Year-aware visualization of the citation network of the 46 influential papers (Software : VOSViewer)

As the types of the 46 documents are retrieved, it is seen that 30 of the papers are reviews (65.2%), 16 are articles (34.8%) and 7 are proceedings papers that are published later in scholarly journals (15.2%). This is mainly explained by the important tendency of the scientists to cite the works of synthesis that review and evaluate the main research works about Food Technology as they involve all the recent advances in the field (Bornmann & Daniel, 2008; Case & Higgins, 2000).

With identification of the leading authors, it is clear that David Julian McClements from University of Massachusetts Amherst (United States) is the most influential author of the set with 4 publications followed by Eric Andrew Decker from University of Massachusetts Amherst with 3 publications and Ibrahim M Banat from University of Ulster (United Kingdom), Hannu Korhonen from MTT Agrifood Research Finland (Finland) and Jochen Weiss from University of

Massachusetts Amherst with 2 publications. This fact is confirmed when calculating their h-indices using Google Scholar as it is seen that h>=55 proving that these scientists are in the main reference scientists in this field of research. It is clear that the works of these scientists had even ameliorated the influence of their institutions on the field as they are among the eight best published institutions in the set of 46 papers as shown in Bold in Table 1. The advantage of the University of Massachusetts Amherst is mainly explained by the fruitful collaboration between McClements, Decker and Weiss (McClements, Decker, Park, & Weiss, 2009). In fact, it has been confirmed in many studies that multi-authored papers can have more effect than papers written by a single author mainly when all the collaborating authors are important scientists (Hirsch, 2010; Oromaner, 1975; Tscharntke, Hochberg, Rand, Resh, & Krauss, 2007; Van Hooydonk, 1997).

Table 1 : Repartition of the papers according to their issuing institutions

Institution	Country	Papers
University of Massachusetts Amherst	United States	4
Consejo Superior de Investigaciones Cientificas CSIC	Spain	3
Agriculture Agri Food Canada	Canada	2
Council of Scientific Industrial Research CSIR	India	2
Institut National de la Recherche Agronomique	France	2
Monash University	Australia	2
MTT AgriFood Research Finland	Finland	2
University of Ulster	United Kingdom	2

Quite all the remaining institutions are national research institutes or structure about Food technology as shown in Italics in Table 1 and this is evident as such institutions are co-editing all the Food Technology papers of the country they exist in (Picard, Darmon, & Pradoura, 1990).

When seeing the list of most published countries, it is clear that the countries of the eight ranked institutions are featured as shown in Bold in Table 2.

Table 2 : Repartition of the papers according to their issuing countries

Country	Papers
United States	11
Germany	5
Spain	5
United Kingdom	4
India	4
Australia	3
France	3
Ireland	3
Finland	2
Netherlands	2
Canada	2

The existence of other countries in the ranking and by that their influence in Food Technology research is mainly explained by the existence of nationwide leading food science research institutes that monitor and adjust the quality of Food technology research in these countries (Lafferty, Commins, & Walsh, 1999; Picard, Darmon, & Pradoura, 1990) or by the involvement of these countries in these influential papers through international collaborations (Aksnes, 2003; Zhou, Zhong, & Yu, 2013). In fact, both facts are common in the publication of highly cited papers (Aksnes, 2003; Picard, Darmon, & Pradoura, 1990). The existence of these countries can also be explained by their history and weight in Food technology research. In fact, all the countries showed in the Table are cited in previous studies as the most productive and cited countries as well as the oldest ones in Food technology research (Braun, Glänzel, & Grupp, 1995; Fisher & Yates, 1949; Scimago Lab, 2015; Surwase, Mohan, Kademani, & Bhanumurthy, 2014; Van Raan & Van Leeuwen, 2002).

As for the most influential journals in 2015, they are the main specialized journals having an IF>=2.4 that publish original researches contributing to the advancement of all aspects of Food Technology as shown in Table 3. Journals like Meat Science that are contributing to a particular aspect of Food technology do not exist even if they have important Impact Factors (Thomson Reuters, 2015).

Table 3 : Repartition of the papers according to their issuing journals

Journal	Papers	2014 Impact Factor (Thomson Reuters, 2015)
TRENDS IN FOOD SCIENCE AND TECHNOLOGY	6	4.651
INTERNATIONAL JOURNAL OF FOOD MICROBIOLOGY	4	3.082
CRITICAL REVIEWS IN FOOD SCIENCE AND NUTRITION	3	5.176
APPLIED MICROBIOLOGY AND BIOTECHNOLOGY	2	3.337
FOOD CHEMISTRY	2	3.391
LWT FOOD SCIENCE AND TECHNOLOGY	2	2.416

This is evident because a research about Meat Technology can only be used in researches about that particular field of Food technology. However, general developments and amelioration of techniques in Food technology can be used in all aspects of Food technology including Meat Research (Bornmann & Daniel, 2008). This is confirmed when seeing the "KeyWords Plus" keyword co-occurrence network of the 46 analyzed publications as shown in Fig. 4. Effectively, the figure does not reveal types of food and businesses such as "meat", "milk" or "dairy". Fig. 4 rather shows that the topics of the influential publications are general ones with various applications: positive and negative effects of food-borne bacteria and Enzymes on Food composition and health metabolisms (e.g. lactic acid bacteria, *Listeria monocytogenes*, and 0157-h7 Escherichia Coli), mechanisms of food interactions with gut bacteria and other patterns (e.g. bioactive films), the use of the isolated molecules behind positive food patterns such as the elimination of the harmful bacteria effects and the amelioration of health benefits and taste, patterns in foods (e.g. antioxidant activity, antimicrobial activity, and food packaging), the development of engineering techniques to eliminate harmful molecules or bacteria from food products and consequently to ameliorate food patterns (e.g. ultrasound and accelerated solvent acceleration), and the amelioration of the efficiency of traditional and old techniques of food processing (e.g. in-water emulsions). This finding seems to reproduce previous findings about the main topics of food

technology research in many regions such as India (Poornima, Surulinathi, Amsaveni, & Vijayaragavan, 2011) and Latin America (Alfaraz & Calviño, 2004).

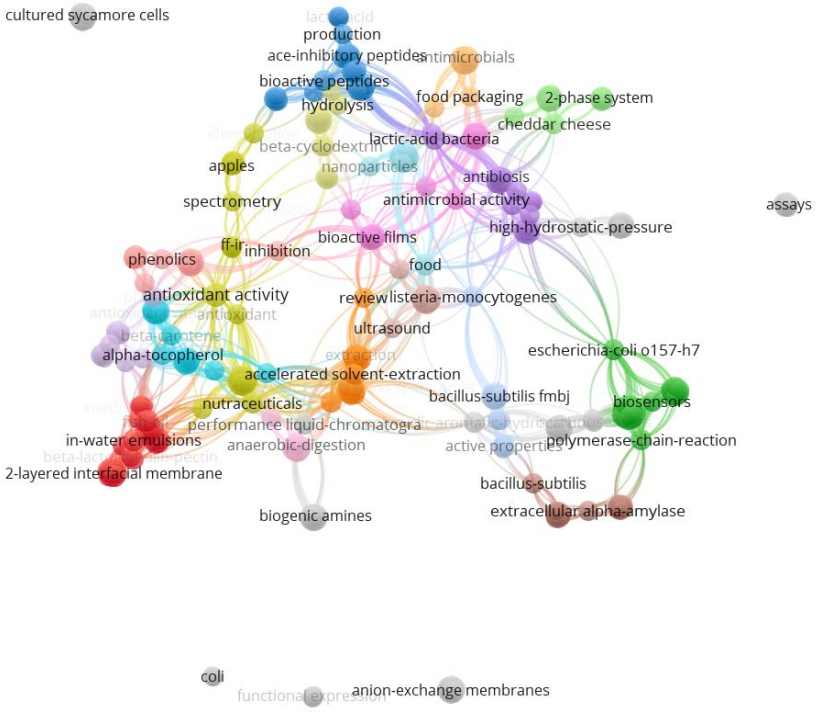

Fig. 4 : "KeyWords Plus" Keyword co-occurrence network of the analyzed scholarly publications (Software: VOSViewer, Node weight: Occurrences)

Conclusion

The present study provides a snapshot of bibliometric and scientometric methods to examine the current influences of the research driven by Food Technology specialists. Totally 46 documents have been selected as the most pioneer ones. The institutions, journals, scientists, topics and countries which were the main sources of influential contributions have been recognized using bibliometric methods. However, this research has been faced with some limitations which can also provide future research for other scholars. Firstly, our method has just been applied on WoS core collection dataset. The future research can be applied on other well-known datasets such as Scopus. Also, secondly, the future scholars can integrate Scopus and WoS databases to compare

the results with current study. The obtained results of the paper will especially be of interest to Food Technology research community how research into Food Technology field is transforming and for food industry professionals to figure out their international research outreaches, while it is also worthwhile to mention that the methods that has been used in this paper will be of attentiveness to the scientometric scholars.

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References

- Abt H. A., (1998). Why some papers have long citation lifetimes. *Nature*, vol. 395, pp. 756-757.

- Achanta S., ; Okos M. R., (1996). Predicting the quality of dehydrated foods and biopolymers—research needs and opportunities. *Drying Technology*, vol. 14, nº 6, pp. 1329-1368.

- Aksnes D. W., (2003). Characteristics of highly cited papers. *Research Evaluation*, vol. 12, nº 3, pp. 159-170.

- Alfaraz P. ; Calviño, A., (2004). Bibliometric study on food science and technology: Scientific production in Iberian-American countries (1991-2000). *Scientometrics*, vol. 61, nº 1, pp. 89-102.

- Alston J. M. ; Beddow J. M. ; Pardey, P. G., (2009). Agricultural research, productivity, and food prices in the long run. *Science*, vol. 325, nº 5945, pp. 1209-1210.

- Amat C., (2007). Editorial and publication delay of papers submitted to 14 selected Food Research journals. Influence of online posting. *Scientometrics*, vol. 74, nº 3, pp. 379-389.

- Banks M. G., (2006). An extension of the Hirsch index: Indexing scientific topics and compounds. *Scientometrics*, vol. 69, nº 1, pp. 161-168.

- Bornmann L. ; Adam, Y. Y. ; Fred Y. Y., (2017). Sequence analysis of annually normalized citation counts: an empirical analysis based on the characteristic scores and scales (CSS) method. *Scientometrics*, vol. 113, nº 3, pp. 1665-1680.

- Bornmann L. ; Daniel H. D., (2008). What do citation counts measure? A review of studies on citing behavior. *Journal of Documentation*, vol. 64, nº 1, pp. 45-80.

- Bornmann L. ; Marx, W., (2012). HistCite analysis of papers constituting the h index research front. *Journal of Informetrics*, vol. 6, nº 2, pp. 285-288.

- Braun T. ; Glänzel W. ; Grupp H., (1995). The scientometric weight of 50 nations in 27 science areas, 1989–1993. Part II. Life sciences. *Scientometrics*, vol. 34, nº 2, pp. 207-237.

- Cabrerizo F. J. ; Alonso S. ; Herrera-Viedma E. ; Herrera F., (2010). q2-Index: Quantitative and qualitative evaluation based on the number and impact of papers in the Hirsch core. *Journal of Informetrics*, vol. 4, nº 1, pp. 23-28.

- Calo-Mata P. ; Arlindo S. ; Boehme K. ; de Miguel T. ; Pascoal A. ; Barros-Velazquez J., (2008). Current applications and future trends of lactic acid bacteria and their bacteriocins for the biopreservation of aquatic food products. *Food and Bioprocess Technology*, vol. 1, nº 1, pp. 43-63.

- Case D. O. ; Higgins G. M., (2000). How can we investigate citation behavior? A study of reasons for citing literature in communication. *Journal of the American Society for Information Science*, vol. 51, nº 7, pp. 635-645.

- Eriksson E. D., (1997). Topics in Food Science and Nutrition March 1997: 65-75. *Nutrition reviews*, vol. 55, nº 3, pp. 65.

- Fan S. ; Pardey P. G., (1997). Research, productivity, and output growth in Chinese agriculture. *Journal of Development Economics*, vol. 53, nº 1, pp. 115-137.

- Fisher R. A. ; Yates F., (1949). *Statistical tables for biological, agricultural and medical research* (3 ed.).

- Gao S., (2015). Towards a frontier of spatial scientometric studies by SONG Gao with Martin Vesely as coordinator. *ACM SIGWEB Newsletter (Spring)*, vol. 5.

- Garfield E., (1986). Do Nobel-Prize Winners Write Citation-classics. *Current Contents*, vol. 23, pp. 38.

- Glänzel W., (2008). What are your best papers? *ISSI Newsletter*, vol. 4, nº 4, pp. 64-67.

- Glänzel W. ; Veugelers R., (2006). Science for wine: A bibliometric assessment of wine and grape research for wine-producing and consuming countries. *American journal of enology and viticulture*, vol. 57, nº 1, pp. 23-32.

- Gomathi P., (2014). Scientometric Dimensions of Food Science and Technology Research from 2007 to 2012. *International Journal of Pharmaceutical & Biological Archive*, vol. 5, nº 2.

- Grivel L. ; Polanco X. ; Kaplan A., (1997). A computer system for big scientometrics at the age of the World Wide Web. *Scientometrics*, vol. 40, nº 3, pp. 493-506.

- Guo H. ; Weingart S. ; Börner K., (2011). Mixed-indicators model for identifying emerging research areas. *Scientometrics*, vol. 89, nº 1, pp. 421-435.

- Heaton S., (2001). *Organic farming, food quality and human health*. Soil Association.

- Hirsch J. E., (2010). An index to quantify an individual's scientific research output that takes into account the effect of multiple coauthorship?. *Scientometrics*, vol. 85, nº 3, pp. 741-754.

- Hirsch J. E., (2005). An index to quantify an individual's scientific research output. *Proceedings of the National academy of Sciences of the United States of America*, vol. 102, nº 46, pp. 16569-16572.

- Kullenberg C. ; Kasperowski D., (2016). What is citizen science?–A scientometric meta-analysis. *PloS one*, vol. 11, nº 1, pp. e0147152.

- Liu Y. ; Guns R. ; Wei W. ; Yin J., (2013). Genetically Modified Food research in China: Interactions between authors from Social sciences and Natural sciences. *Proceedings of the 14th International Society of Scientometrics and Informetrics Conference*, I, pp. 819-830. Vienna, Austria.

- Mazloumian A. ; Helbing D. ; Lozano S. ; Light R. P. ; Börner K., (2013). Global multilevel analysis of the 'Scientific Food Web'. *Scientific reports*, vol. 3, nº 1167.

- McClements D. J. ; Decker E. A. ; Park Y. ; Weiss J., (2009). Structural design principles for delivery of bioactive components in nutraceuticals and functional foods. *Critical Reviews in Food Science and Nutrition*, vol. 49, nº 6, pp. 577-606.

- Merigó J. M. ; Cancino C. A. ; Coronado F. ; Urbano D., (2016). Academic research in innovation: a country analysis. *Scientometrics*, vol. 108, nº 2, pp. 559-593.

- Microsoft Corporation., (2007). *Microsoft Office Excel 2007*.

- Mongeon P. ; Paul-Hus A., (2016). The journal coverage of Web of Science and Scopus: a comparative analysis. *Scientometrics*, vol. 106, nº 1, pp. 213-228.

- Moraru C. I. ; Panchapakesan C. P. ; Huang Q. ; Takhistov P. ; Sean L. ; Kokini J. L., (2003). Nanotechnology: a new frontier in food science. *Food Technology*, vol. 57, nº 12, pp. 24-29.

- Oromaner M., (1975). Collaboration and impact: the career of multi-authored publications. *Social Science Information*, vol. 14, nº 1, pp. 147-155.

- Picard J. F. ; Darmon G. ; Pradoura E., (1990). *La république des savants: La recherche française et le CNRS*. Flammarion.

- Pollack J. ; Adler D., (2015). Emergent trends and passing fads in project management research: A scientometric analysis of changes in the field. *International Journal of Project Management*, vol. 33, nº 1, pp. 236-248.

- Ponds R. ; Van Oort F. ; Frenken K., (2007). The geographical and institutional proximity of research collaboration. *Papers in regional science*, vol. 86, nº 3, pp. 423-443.

- Poornima A. ; Surulinathi M. ; Amsaveni N. ; Vijayaragavan M., (2011). Mapping the Indian research productivity of food science and technology: A scientometric analysis. *Food Biology*, vol. 1, nº 1, pp. 36-41.

- Ravichandran P. ; Vijayakumar P., (2015). Food Chemistry: A Bibliometric Analysis of Publications Output during 2004–2013. *Indian Journal of Science*, vol. 21, nº 72, pp. 231-240.

- Scimago Lab., (2015). *Country Rankings in Food Science*. Retrieved from SJR: http://www.scimagojr.com/countryrank.php?area=0&category=1106&region=all&year=all&o rder=it&min=0&min_type=it

- Sidiropoulos A. ; Katsaros D. ; Manolopoulos Y., (2007). Generalized Hirsch h-index for disclosing latent facts in citation networks. *Scientometrics*, vol. 72, nº 2, pp. 253-280.

- Surwase G. ; Mohan L. ; Kademani B. S. ; Bhanumurthy K., (2014). Research Trends on Food Preservation: A Scientometric Analysis. *DESIDOC Journal of Library & Information Technology*, vol. 34, nº 3.

- Thompson J. ; Scoones I., (2009). Addressing the dynamics of agri-food systems: an emerging agenda for social science research. Environmental science & policy, vol. 12, nº 4, pp. 386397.

- Thomson Reuters, (2012). *HistCite*.

- Thomson Reuters, (2015). *Journal Citation Report*.

- Thomson Reuters, (2016). *Web of Science*.

- Tscharntke T. ; Hochberg M. E. ; Rand T. A. ; Resh V. H. ; Krauss J., (2007). Author sequence and credit for contributions in multiauthored publications. *PLoS Biology*, vol. 5, nº 1, pp. e18.

- Van Eck N. ; Waltman L., (2010). Software survey: VOSviewer, a computer program for bibliometric mapping. *Scientometrics*, vol. 84, nº 2, pp. 523-538.

- Van Hooydonk G., (1997). Fractional counting of multiauthored publications: Consequences for the impact of authors. *Journal of the American Society for Information Science*, vol. 48, nº 10, pp. 944-945.

- Van Raan A. F. ; Van Leeuwen T. N., (2002). Assessment of the scientific basis of interdisciplinary, applied research: application of bibliometric methods in nutrition and food research. *Research Policy*, vol. 31, nº 4, pp. 611-632.

- Vijay K. R. ; Raghavan I., (2007). Journal of Food Science and Technology: a bibliometric study. *Annals of Library and Information Studies*, vol. 54, nº 4, pp. 207.

- Whittaker J., (1989). Creativity and conformity in science: Titles, keywords and co-word analysis. *Social Studies of Science*, 19 (3), 473-496. vol. 19, nº 3, pp. 473-496.

- Zan B. U. ; Zan N., (2014). A Collaboration Analysis Study of Food Chemistry Journal. *International Journal of Engineering and Innovative Technology*, vol. 4, nº 1.

- Zhou P. ; Zhong, Y. ; Yu M., (2013). A bibliometric investigation on China–UK collaboration in food and agriculture. *Scientometrics*, vol. 97, nº 2, pp. 267-285.

- Zohar A. ; Barzilai S., (2013). A review of research on metacognition in science education: Current and future directions. *Studies in Science education*, vol. 49, nº 2, pp. 121-169.

Appendix A: The list of WoS influential papers in 2015

Title	Authors	Source Title	Publication Year	2015 Citations
Cyclodextrins and their uses: a review	Del Valle, EMM	PROCESS BIOCHEMISTRY	2004	141
Performance comparison of benchtop high-throughput sequencing platforms	Loman, Nicholas J.; Misra, Raju V.; Dallman, Timothy J.; Constantinidou, Chrystala; Gharbia, Saheer E.; Wain, John; Pallen, Mark J.	NATURE BIOTECHNOLOGY	2012	121
Applications of ultrasound in food technology: Processing, preservation and extraction	Chemat, Farid; Zill-e-Huma; Khan, Muhammed Kamran	ULTRASONICS SONOCHEMISTRY	2011	113
Industrial applications of microbial lipases	Hasan, Fariha; Shah, Aamer Ali; Hameed, Abdul	ENZYME AND MICROBIAL TECHNOLOGY	2006	103
Applications of nanotechnology in food packaging and food safety: Barrier materials, antimicrobials and sensors	Duncan, Timothy V.	JOURNAL OF COLLOID AND INTERFACE SCIENCE	2011	86
Bio-nanocomposites for food packaging applications	Rhim, Jong-Whan; Park, Hwan-Man; Ha, Chang-Sik	PROGRESS IN POLYMER SCIENCE	2013	81
An overview of foodborne pathogen detection: In the	Velusamy, Vijayalakshmi; Arshak, Khalil; Korostynska,	BIOTECHNOLOGY ADVANCES	2010	79

perspective of biosensors	Olga; Oliwa, Kamila; Adley, Catherine			
Bioactive peptides: Production and functionality	Korhonen, H; Pihlanto, A	INTERNATIONAL DAIRY JOURNAL	2006	76
Perspectives for chitosan based antimicrobial films in food applications	Dutta, P. K.; Tripathi, Shipra; Mehrotra, G. K.; Dutta, Joydeep	FOOD CHEMISTRY	2009	76
Hyperspectral imaging - an emerging process analytical tool for food quality and safety control	Gowen, A. A.; O'Donnell, C. P.; Cullen, P. J.; Downey, G.; Frias, J. M.	TRENDS IN FOOD SCIENCE & TECHNOLOGY	2007	75
Microbial biosurfactants production, applications and future potential	Banat, Ibrahim M.; Franzetti, Andrea; Gandolfi, Isabella; Bestetti, Giuseppina; Martinotti, Maria G.; Fracchia, Letizia; Smyth, Thomas J.; Marchant, Roger	APPLIED MICROBIOLOGY AND BIOTECHNOLOGY	2010	73
Bacteriocin-based strategies for food biopreservation	Galvez, Antonio; Abriouel, Hikmate; Lopez, Rosario Lucas; Ben Omar, Nabil	INTERNATIONAL JOURNAL OF FOOD MICROBIOLOGY	2007	71
Pathogen detection: A perspective of traditional methods and biosensors	Lazcka, Olivier; Del Campo, F. Javier; Munoz, F. Xavier	BIOSENSORS & BIOELECTRONICS	2007	69

Engineering the provitamin A (betacarotene) biosynthetic pathway into (carotenoid-free) rice endosperm	Ye, XD; Al-Babili, S; Kloti, A; Zhang, J; Lucca, P; Beyer, P; Potrykus, I	SCIENCE	2000	67
Food-derived peptides with biological activity: from research to food applications	Hartmann, Rainer; Meisel, Hans	CURRENT OPINION IN BIOTECHNOLOGY	2007	62
Formation, stability and properties of multilayer emulsions for application in the food industry	Guzey, Demet; McClements, D. Julian	ADVANCES IN COLLOID AND INTERFACE SCIENCE	2006	62
Potential commercial applications of microbial surfactants	Banat, IM; Makkar, RS; Cameotra, SS	APPLIED MICROBIOLOGY AND BIOTECHNOLOGY	2000	59
Sub- and supercritical fluid extraction of functional ingredients from different natural sources: Plants, food-byproducts, algae and microalgae - A review	Herrero, M; Cifuentes, A; Ibanez, E	FOOD CHEMISTRY	2006	59
A perspective on paper-based microfluidics: Current status and future trends	Li, Xu; Ballerini, David R.; Shen, Wei	BIOMICROFLUIDICS	2012	59

Microencapsulation: industrial appraisal of existing technologies and trends	Gouin, S.	TRENDS IN FOOD SCIENCE & TECHNOLOGY	2004	57
Opportunities and challenges in high pressure processing of foods	Rastogi, N. K.; Raghavarao, K. S. M. S.; Balasubramaniam, V. M.; Niranjan, K.; Knorr, D.	CRITICAL REVIEWS IN FOOD SCIENCE AND NUTRITION	2007	57
Significance of biogenic amines to food safety and human health	Shalaby, A. R.	FOOD RESEARCH INTERNATIONAL	1996	55
Characterisation of structure-dependent functional properties of lignin with infrared spectroscopy	Boeriu, CG; Bravo, D; Gosselink, RJA; van Dam, JEG	INDUSTRIAL CROPS AND PRODUCTS	2004	55
Electrodialysis, a mature technology with a multitude of new applications	Strathmann, H.	DESALINATION	2010	55
Lactic acid: recent advances in products, processes and technologies - a review	Datta, Rathin; Henry, Michael	JOURNAL OF CHEMICAL TECHNOLOGY AND BIOTECHNOLOGY	2006	54
Structural Design Principles for Delivery of Bioactive Components in Nutraceuticals and Functional Foods	McClements, David Julian; Decker, Eric Andrew; Park, Yeonhwa; Weiss, Jochen	CRITICAL REVIEWS IN FOOD SCIENCE AND NUTRITION	2009	54

Chemistry and uses of pectin - A review	Thakur, BR; Singh, RK; Handa, AK	CRITICAL REVIEWS IN FOOD SCIENCE AND NUTRITION	1997	53
Inactivation of microbes using ultrasound: a review	Piyasena, P; Mohareb, E; McKellar, RC	INTERNATIONAL JOURNAL OF FOOD MICROBIOLOGY	2003	53
Recovery of high added-value components from food wastes: Conventional, emerging technologies and commercialized applications	Galanakis, Charis M.	TRENDS IN FOOD SCIENCE & TECHNOLOGY	2012	53
Bioprocess engineering of microalgae to produce a variety of consumer products	Harun, Razif; Singh, Manjinder; Forde, Gareth M.; Danquah, Michael K.	RENEWABLE & SUSTAINABLE ENERGY REVIEWS	2010	53
Developments in industrially important thermostable enzymes: a review	Haki, GD; Rakshit, SK	BIORESOURCE TECHNOLOGY	2003	52
Natural antioxidants and antioxidant capacity of Brassica vegetables: A review	Podsedek, Anna	LWT-FOOD SCIENCE AND TECHNOLOGY	2007	52
In vitro antioxidant activities of methanol extracts of five Phyllanthus species from India	Kumaran, A.; Karunakaran, R. Joel	LWT-FOOD SCIENCE AND TECHNOLOGY	2007	51

Milk-derived bioactive peptides: From science to applications	Korhonen, Hannu	JOURNAL OF FUNCTIONAL FOODS	2009	51
Antioxidant capacity, vitamin C, phenolics, and anthocyanins after fresh storage of small fruits	Kalt, W; Forney, CF; Martin, A; Prior, RL	JOURNAL OF AGRICULTURAL AND FOOD CHEMISTRY	1999	50
Encapsulation of polyphenols - a review	Fang, Zhongxiang; Bhandari, Bhesh	TRENDS IN FOOD SCIENCE & TECHNOLOGY	2010	50
Emulsion-based delivery systems for lipophilioc bioactive components	McClements, D. J.; Decker, E. A.; Weiss, J.	JOURNAL OF FOOD SCIENCE	2007	49
Basic aspects of food preservation by hurdle technology	Leistner, L	INTERNATIONAL JOURNAL OF FOOD MICROBIOLOGY	2000	48
Encapsulation of probiotic living cells: From laboratory scale to industrial applications	Burgain, J.; Gaiani, C.; Linder, M.; Scher, J.	JOURNAL OF FOOD ENGINEERING	2011	48
Evaluation of the ability of antioxidants to counteract lipid oxidation: Existing methods, new trends and challenges	Laguerre, M.; Lecomte, J.; Villeneuve, P.	PROGRESS IN LIPID RESEARCH	2007	47
Effect of ultrasound on the technological properties and bioactivity of food: a review	Soria, Ana Cristina; Villamiel, Mar	TRENDS IN FOOD SCIENCE & TECHNOLOGY	2010	46

Review of health safety aspects of nanotechnologies in food production	Bouwmeester, Hans; Dekkers, Susan; Noordam, Maryvon Y.; Hagens, Werner I.; Bulder, Astrid S.; de Heer, Cees; ten Voorde, Sandra E. C. G.; Wijnhoven, Susan W. P.; Marvin, Hans J. P.; Sips, Adrienne J. A. M.	REGULATORY TOXICOLOGY AND PHARMACOLOGY	2009	46
Pressurized liquid extraction as a green approach in food and herbal plants extraction: A review	Mustafa, Arwa; Turner, Charlotta	ANALYTICA CHIMICA ACTA	2011	45
Food fermentations: role of microorganisms in food production and preservation	Caplice, E; Fitzgerald, GF	INTERNATIONAL JOURNAL OF FOOD MICROBIOLOGY	1999	44
Recent advancements in surface plasmon resonance immunosensors for detection of small molecules of biomedical, food and environmental interest	Shankaran, Dhesingh Ravi; Gobi, K. Vengataj Alabathy; Miura, Norio	SENSORS AND ACTUATORS B - CHEMICAL	2007	44
Mechanisms of lipid oxidation in food dispersions	Waraho, Thaddao; McClements, D. Julian; Decker, Eric A.	TRENDS IN FOOD SCIENCE & TECHNOLOGY	2011	44