



Innovation, research and development on the passion fruit peel flour: bibliometric approach

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Abstract

The passion fruit peel flour, retrieved from the drying and milling of fruit-processing residues, is rich in fibers. In fact, it is an important food source, featuring many benefits for the human organism. Current study forwards a scientific and technological evaluation of the passion fruit peel flour development through bibliometric indicators. Data from scientific production were collected from Web of Science database and patent search was performed at different databases USPTO, WIPO, EPO and INPI. Bibliometric analysis addresses key sections focused on articles and patent applications, authors and inventors, relevant areas of interest, institutions and countries. The analysis of citations and analysis of social networks were also used as complementary indicators. The scientific and technological production of the passion fruit peel flour has occurred mostly in Brazil, particularly at universities. Since production is still fledgling, greater investments are required to improve Science, Technology & Innovation (ST&I) indicators in the field.

Keywords: waste; bibliometric analysis; food technology; agroindustrial; passion fruit peel.

Practical Application: The Association between patent and scientific literature will allow the emergence of innovative technologies.

1 Introduction

The passion fruit (*Passiflora edulis*), native to Brazil, is produced throughout the country due to its many qualities (Silva et al., 2014). The culture is mainly concentrated in northeastern Brazil, especially in the state of Bahia, featuring almost half of Brazilian production (Lima et al., 2017). Its high economic and commercial value derives from its medicinal, food, ornamental and nutritional capacities. The fruit is generally used to make juice and nectar, although their processing results in several industrial wastes, such as peels and seeds (Coelho et al., 2017).

The passion fruit peel is rich in bioactive compounds with nutritional and therapeutic value. In fact, it is the source of minerals and vitamins (Zeraik et al., 2010), phenolic compounds with antioxidant and anti-inflammatory activities, carotenoids (Zeraik et al., 2012; Rotili et al., 2013) and fibers (Cazarin et al., 2014). Further, flour from the peel has anti-diabetic and anti-obesity qualities due to a pectin-rich byproduct (Janebro et al., 2008).

In the wake of such importance, several efforts in Research, Development and Innovation (RD&I) are being taken to reprocess the passion fruit peel for the production of flour and its applications. It is expected that RD&I efforts produce a greater number of scientific articles and patents and thus a source of bibliometric studies.

Bibliometric indicators have been frequently employed to analyze scientific and technological production in different fields of knowledge (Dias & Mendes, 2018; Costa et al., 2018; Soosaraei et al., 2018; Anwar et al., 2018). Zanini et al. (2012)

indicate bibliometrics as an important method in the classification, mapping and systematization of pathways by Science, Technology and Innovation (ST&I). Further, they contribute towards the establishment of new policies for ST&I development and provide reliable elements for decision-taking.

Current analysis provides a scientific and technological evaluation for the development of the flour from the passion fruit peel through bibliometric indicators. The results of the research are presented considering three bibliometric measures that together allowed a more consolidated analysis of the data: (i) a survey of the scientific and technological activities related to passion fruit peel flour, (ii) citation analysis of patent and publications and (iii) study of scientific and technological collaborations networks about the subject.

2 Materials and methods

Bibliometric indicators and an analysis of social network were employed to evaluate the analysis of scientific and technological production on the passion fruit peel flour. Procedures and search strategies, indicators and variables will be described below.

Web of Science (WoS) of Clarivate Analytics was the database used in scientific prospection. Choice was based on its reliability, especially its indexation of documents from several fields of knowledge, especially the food segment (the focus of current study), and due to its adaptability for bibliometric studies.

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Keywords *flour*, *passion fruit* and *Passiflora edulis* were employed to identify scientific papers on the passion fruit peel flour, with a filter comprising the title and the abstract of the document at “Advanced search”.

Search for patents occurred at different databases to have an overall vision of the development of the passion fruit peel flour. Research for patents was undertaken by using the keywords *flour*, *passion fruit* and *Passiflora edulis*, with filter on title and/or abstract of documents at United States Patent and Trademark Office (USPTO), European Patent Office (EPO – Espacenet) and World Intellectual Property Organization (WIPO – Patentscope) bases. A research for patents was also undertaken at the Brazilian National Institute of Industrial Property (INPI), with keywords in Portuguese. In January 2017, the search retrieved a total of 58 patent applications and 36 articles, where part of the documents (7 patents and 26 publications) were classified as passion fruit peel flour research. The updated data in July 2019 spot a total of 194 patent applications and 54 articles, and only 10 and 42 documents respectively classified as studies on the subject.

It should be underscored that all articles and patents were analyzed one by one to identify the documents focusing on the theme of current study. Choice criterion was taken into account for articles and patents on the passion fruit peel flour in the description of the selected document.

After document filtering, data were organized, analyzed and presented by BibExcel (v. 2014), Microsoft Excel (v. 2010), Ucinet 6.599 version (Borgatti et al., 2002), and Netdraw 2.157 version (Borgatti, 2002) were employed for the analysis of social networks and for the production of maps.

Procedures in data analysis were:

- Productivity scale, aiming at registering scientific and technological development on the passion fruit peel flour and to identify its main features;
- Impact scale, employed to examine the visibility of studies, authors, institutions and areas of interest in the scientific and technological community;
- Analysis of social networks to explore authors’ and inventors’ institutional partnership.

Each indicator took into account a series of variables for the analyses of scientific and technological production of flour from the passion fruit peel.

A co-relationship test was taken to foreground productivity measurements and to verify the co-relationship between the year and the number of publications and deposits.

3 Results and discussion

3.1 Technological production from the passion fruit peel flour

Technological prospection in Brazilian (INPI), US (USPTO), European (EPO) and World Intellectual Property Organization (WIPO) patent bases shows a low number of technologies (10 patent applications) related to passion fruit peel flour.

Initial search results (keywords: *flour*, *passion fruit* and *Passiflora edulis*) in databases provided from INPI (7),

WIPO (84) and EPO (103) resulting 194 patent applications. No patent registration occurred for the passion fruit peel flour in USPTO base.

Patents were then analyzed: only 12 documents complied with the aim of current research, distributed for INPI (6), WIPO (2) and EPO (4), as Figure 1 shows.

The Brazilian database had the greatest number of patents related to passion fruit peel flour, with applications occurring between 2003 and 2016. The first invention patent application related to the passion fruit peel flour occurred in 2003 (PI 0304911-6, tagged “Farinha da Casca de Maracujá”), featuring the production process. The patent was rejected since it did not comply with Art. 33 of the Industrial Property Law (LPI) (Brasil, 1996).

Since patent applications at WIPO and EPO databases occurred between 2014 and 2016, the technology implied is a recent theme within the study of technological development. The same patent applications were published at WIPO and EPO databases.

Co-relationship test demonstrated lack of relationship between year and the number of patent applications on the subject. No forecasts may be made with regard to patent registration related to flour of the passion fruit peel.

Figure 2 shows countries of patents and codes from the International Patent Classification (IPC) related to the passion fruit peel flour. Patenting technologies on the passion fruit peel flour occurs in Brazil and in China, world leaders in RD&I in the fields of agriculture and food production (Grueber & Studt, 2010).

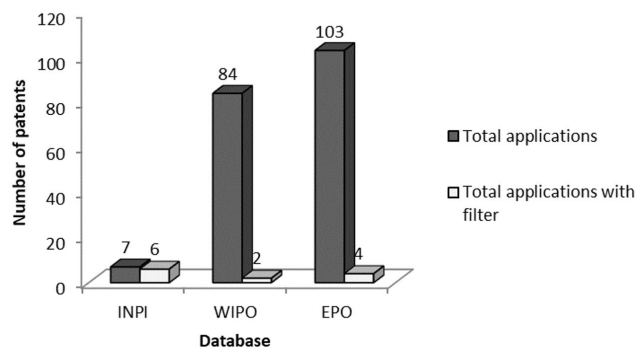


Figure 1. Total patent applications on passion fruit peel flour per database.

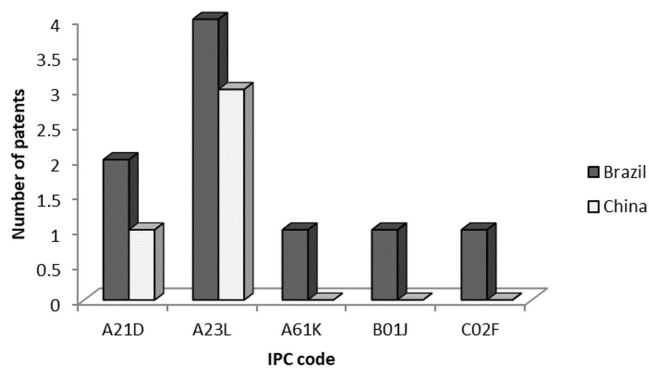


Figure 2. Distribution codes of the International Patent Classification of patents related to the passion fruit peel flour, per country.

In the case of IPC, the analyses revealed that code A23L (Food, food products and non-alcohol beverages: preparation, treatment and conservation) has been the focus of protection by Brazil (67%) and China (75%), followed by A21D (Treatment of flour or dough). China forwarded patents on the passion fruit peel flour only in areas of human needs, especially in the field of food production. On the other hand, Brazil diversified work on technologies in areas of human needs (66%), processing and transport (17%) and chemistry and metallurgy (17%).

Figure 3 demonstrates that the passion fruit peel flour may be employed for different aims. Documents show that patent applications related to the passion fruit peel flour involve the production of new types of food (60%), such as pastry, pasta, bread, porridge and cereal candies. These new products include the flour of the passion fruit peel as their main component.

Three patent deposits deal with processes for the production of the passion fruit peel flour developed by Brazilian inventors. The flour from the peel of *Passiflora edulis* has been specifically used in medicine to decrease carbohydrate rates in the body.

In Brazil, patent applicants on the *Passiflora edulis* peel flour are universities and individual persons. This is different from the Chinese context where the main applicants are private enterprises and public institutions.

Brazil has developed an innovation system greatly based on government resources, resulting in a great number of patent applications in different fields of knowledge undertaken by public institutions (Brasil, 2017; Instituto Nacional de Propriedade Industrial, 2017). On the other hand, China has a great number of innovations undertaken by industries (Lei et al., 2011), similar to that in developed countries in which the private sector ranks first with great technological capacity in the national innovation system.

3.2 Analysis of patents' citations

Patent citations represent knowledge flow and have been widely employed as indicators to measure the diffusion and relevance of technological knowledge by evaluating patent impact and quality (Chen, 2017).

No-charge patents, as is the Brazilian case of industrial property (INPI), Espacenet (EPO) and Patentscope (WIPO) do not provide tools to calculate the number of citations. This fact makes unfeasible the impact on technological production of the flour of the passion fruit peel on other research works. However, Espacenet bases already provide a catalogue of references quoted in the documents on patents.

Most patent applications (60%) fail to give any reference to other documents. These reports do not take into account the legal provisions in the field of Intellectual Property which regulate the need to mention the technical status, or rather, the previous technological knowledge used by the inventor to develop new technologies. The above may give a rather shallow technical status to the report.

Other documents provide an average of seven references per patent. References in the patents' description space are characterized as fruit preparation processes or flour preparation processes (20%), but mostly (80%) as new food products, comprising bread, bio-bread, cereal candies, biscuits, porridge,

fruit cakes and food products for people suffering from diabetes. These types of food and processes are the technical basis of technological production on the passion fruit peel flour.

3.3 Technological cooperation network

According to Sternitzke et al. (2008), the analysis of social network helps in the field of patents' bibliometric analyses, with several tools that visualize, analyze and interpret agents-institutions relationships within certain technological fields. Consequently, the technological cooperation network on the passion fruit peel flour is chiefly intra-institutional, or rather, the network agents establish partnerships with other researchers from the same institution. Further, joint ventures are established by postgraduate students, with fragile bonds. In fact, postgraduate researchers transit students within the academia, after which they frequently take on non-academic jobs (Meadows, 1999). On the other hand, joint ventures have stimulated an increase in scientific and technological production in different fields of knowledge.

3.4 Scientific production on the passion fruit peel flour

Figure 4 provides results of yearly scientific production on the passion fruit peel flour. There were several fluctuations in the publication of articles on the theme throughout the years, with 42 articles between 2007 and 2019. The collected database

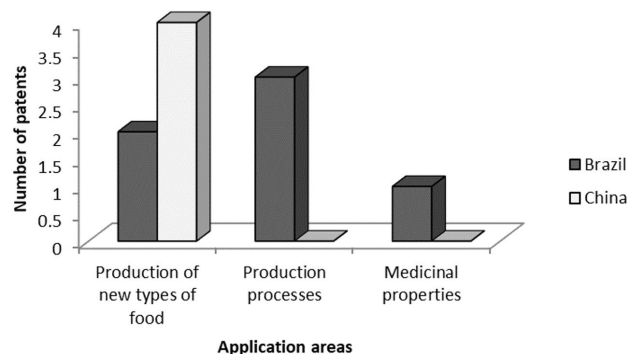


Figure 3. Distribution areas in the application of technologies on the passion fruit peel flour.

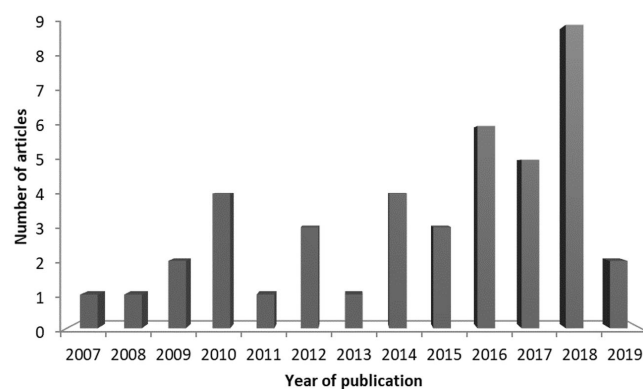


Figure 4. Yearly evolution of scientific publications on the passion fruit peel flour indexes in *Web of Science*.

found contributions from 6 countries in research on passion fruit peel flour. Brazil produced almost all articles (98%) and had the some partnership of countries like the USA, France, Spain and Canada. India, second in the ranking, presented one article on the topic.

Hypothesis test revealed that there is a co-relationship between year and scientific production, with a co-relation coefficient at 66.4%, indicating that 33.6% variation is not explained by adjustment. Further, scientific production on the flour of the passion fruit peel averaged a yearly 22.1% geometric growth, or rather, a good indicator for such a recently developed theme.

Table 1 shows the main scientific journals with papers on flour of the passion fruit peel, Impact Factor (IF) during the last five years, quartile, and journal status. Quartile gives rates according to a set of observations, in increasing order, dividing the distribution in four equal parts. The first quartile (Q1) is defined as the middle number (25%-75%) between the smallest number and the median of the set (Q2) or 50%-50%. The third quartile (Q3) is the middle value (75%-25%) between Q2 (median) and the highest value of the set.

Papers about passion fruit peel flour were distributed among 31 journals, mainly international ones (77.4%). Most journals (33.3%) hail from the Food Science and Technology area, followed by Nutrition and Dietetics and Agriculture with 11.9% each. Most journals were classified at the fourth quartile of the category (Q4), perhaps due to low impact factor by journals of their sub-areas.

Researches about passion fruit peel flour are more frequent in the field of Food Science & Technology, where studies assess the various properties and benefits present in flour, evidencing its potential as a functional food. Pharmacology & Pharmacy and Nutrition & Dietetics fields also have great relevance on the studies on the passion fruit peel flour, since the fruit has nutraceutical properties with nutritional and therapeutic aspects.

Despite these contributions, some studies evaluate the harmful aspect of the use of passion fruit peel flour for human health due to the increase in cyanogenic compounds, but is a little exploited issue (Nascimento, 2016). Medeiros et al. (2009), evaluating the clinical toxicology of the use of the passion fruit flour in healthy volunteers by the use of 10 g of the product three times a day for eight weeks, revealed, after completion of physical examinations and laboratory, no signs of toxicity in

various organs and systems, indicating that the product may be used as food with ownership of health.

Analysis of co-authorship of most papers on the passion fruit peel flour (61.9%) forwards between four and six authors; 33.3% of article were co-authored by six authors. Maximum number of co-authors was 12 authors per article and minimum 2 authors per article. In other words, collaboration is a hallmark in all publications on the theme.

Two hundred and twelve researchers produced 42 articles focusing passion fruit peel flour between 2007 and 2019. However, most authors (90.6%) published only one article and 0.47% published five. The above analysis corroborates studies by Ho (2008), Dabi et al. (2016) and Hoppen & Vanz (2016), who insist that a small number of researchers publish more papers, whereas most write only one.

One should underscore that a researcher from the Food Engineering Department at the University of Campinas (UNICAMP) is the author of most articles published on the theme. In fact, he developed studies on the properties about passion fruit peel flour and its effects on the body.

3.5 Analysis of citations in published papers

Citation analysis has been employed as a supplementary index to determine the impact of scientific studies about passion fruit peel flour and to identify studies, researchers and the most renowned institutions dealing with the theme. Figure 5 shows total citations and their respective aggregated value during the 2008 - 2019 period.

Scientific production on the passion fruit peel flour featured 254 citations retrieved from different scientific materials, averaging 6.05 citations per article and 21.17 citations per year. There was a significant increase in the number of citations as from 2012, with the greatest number (57) during 2018.

One should bear in mind that several papers on the passion fruit peel flour (52.4%) were published from 2016, causing a decrease within the total number of citations. This is due to the fact that these papers have still not produced any citations. However, an increase in the number of citations is expected in the coming years, with greater visibility on the theme.

Table 1. Main scientific journals with publications on the flour of the passion fruit peel (2007-2019).

Journal	NP	IF	Quartile	Rank of journal
Revista Brasileira de Farmacognosia	5	1.983	Q3; Q4	Pharmacology & Pharmacy; Chemistry, Medicinal
Ciência Rural	3	0.663	Q4	Agronomy
Food Science and Technology (Campinas)	2	0.69	Q4	Food Science & Technology
LWT - Food Science and Technology	2	4.0	Q1	Food Science & Technology
Journal of Food Science and Technology-Mysore	2	2.391	Q2	Food Science & Technology
Food Chemistry	2	5.488	Q1; Q1; Q1;	Food Science & Technology Nutrition & Dietetics Chemistry, Applied

Note: NP: number of publications, IF: impact factor during the last five years according to Journal Citation Reports 2019.

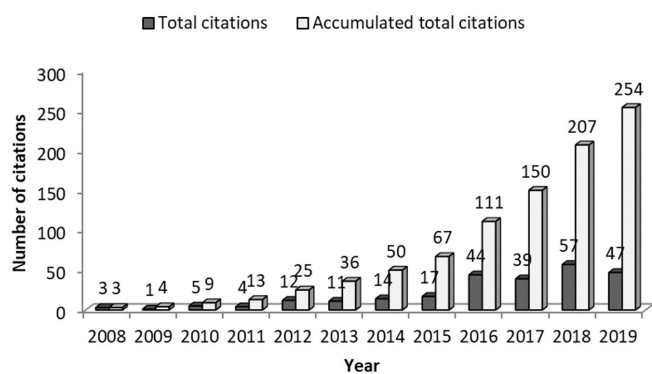


Figure 5. Total citations per year in publications on the passion fruit peel flour (2008 - 2019).

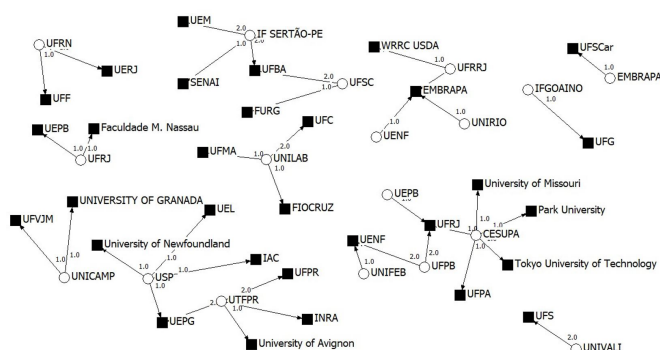


Figure 6. Scientific institutional network of papers on the passion fruit peel flour (2007 - 2019).

Papers with the highest averages of citations/year were published between 2011 and 2018. The paper with the greatest number of citations (48) was published in the scientific journal *Food Research International* in 2012. The institution with most citations (papers) is UNICAMP. It should be noted that the most cited papers had, on average, 5.8 authors per article.

3.6 Scientific cooperation network

The Scientific Cooperation Network is a team of researchers, research groups and institutions striving to produce new knowledge. The scientific network has been studied to analyze the dynamics of joint ventures in certain fields of knowledge and explore the relationship among agents. The most popular agents or institutions are thus indicated through indexes of centrality (Costa et al., 2013; Hoppen & Vanz, 2016).

Figure 6 shows the network of institutional collaboration of publication on the passion fruit peel flour. Current network comprised 48 institutions distributed into 8 sub-groups, with three isolated agents. White round knots indicate the institutions of papers authors, while black square knots were institutions of papers co-authors and lines represent links between institutions (vertexes).

Papers focusing passion fruit peel flour average 1.36 institutions per paper, with a standard deviation of 1.53. Analysis of co-authorship of papers revealed a dominance of intra-institution collaboration, with a representation at 60%.

Ter Wal & Boschma (2009) argue that, within the context of network formation, organizations tend to form bonds with other institutions in the same region, or rather, the network agents do not necessarily connect with the most central agents but with those geographically closest. Geographical localization is an important factor for partnership and joint venture. Perhaps this is why there is a heavy presence of intra-institutional relationships within the scientific network on publications on the passion fruit peel flour.

There was a fledging international collaboration in 11.9% of papers. In fact, relationships were characterized by ventures between Brazilian institutions with universities and research institutions in France (4.76%), Spain (2.38%), US (2.38%) and Canada (2.38%).

4 Conclusions

Main aspects related to scientific and technological production (S&T) on the passion fruit peel flour were forwarded by bibliometric indexes. S&T production on passion fruit peel flour is still fledging and mainly concentrated in Brazil where the fruit is native. Significant asymmetries could be detected. Technological production does not keep up pace with the rhythm of scientific development, with no communication between the fields, albeit with converging factors (patent country/publication country; IPC and publication field).

The technological production of the passion fruit peel flour showed insignificant when compared to other fields of technological knowledge. Cooperation network is shallow and particularly intra-institutional. In other words, it has few joint ventures and authors seem to not take into account the possibility of partnership with other institutions. On the other hand, produced technologies bring forth important contributions, with trends in the production of new types of healthier food and in the sustainable collaboration through the reuse of organic/industrial wastes, such as fruit peels.

In the case of scientific production, the papers analyzed underscore several capacities on the use of passion fruit peel flour (source of fibers, rich in bioactive compounds with antioxidant and phenolic capacity and anti-obesity and anti-diabetic properties) proved by several tests to assess their effects on the organism.

Scientific production underscores the technological properties of the passion fruit flour and presents greater dynamism on results of patents. The scientific network has actually established inter-institutional ventures expecting an increase in the number of papers and patents, with great improvement in ST&I indexes in the field.

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References

- Anwar, S., Abdullah, F. M., Alkahtani, M. S., Ahmad, S., & Alatefi, M. (2018). Bibliometric analysis of abrasive water jet machining research. *Journal of King Saud University Engineering and Science*, 31(3), 262-270. <http://dx.doi.org/10.1016/j.jksues.2018.02.002>.
- Borgatti, S. P. (2002). *Netdraw network visualization*. Harvard: Analytic Technologies.
- Borgatti, S. P., Everett, M. G., & Freeman, L. C. (2002). *Ucinet for windows: software for social network analysis*. Harvard: Analytic Technologies.
- Brasil. (1996, Maio 14). Lei n. 9.279, de 14 de maio de 1996. Regula os direitos e obrigações relativos à propriedade industrial. *Diário Oficial da União*, Brasília, Poder Executivo.
- Brasil. (2017). *Indicadores de recursos aplicados: indicadores consolidados*. Brasília: Ministério de Ciência, Tecnologia, Inovação & Comunicações. Retrieved from <http://www.mct.gov.br/index.php/content/view/2068.html>
- Cazarin, C. B. B., Silva, J. K., Colomeu, T. C., Zollner, R. L., & Maróstica Junior, M. R. (2014). Capacidade antioxidante e composição química da casca de maracujá (*Passiflora edulis*). *Ciência Rural*, 44(9), 1692-1698. <http://dx.doi.org/10.1590/0103-8478cr20131437>.
- Chen, L. (2017). Do patent citations indicate knowledge linkage? The evidence from text similarities between patents and their citations. *Journal of Informetrics*, 11(1), 63-79. <http://dx.doi.org/10.1016/j.joi.2016.04.018>.
- Coelho, E. M., Gomes, R. G., Machado, B. A. S., Oliveira, R. S., Lima, M. S., Azêvedo, L. C., & Guez, M. A. U. (2017). Passion fruit peel flour—Technological properties and application in food products. *Food Hydrocolloids*, 62, 158-164. <http://dx.doi.org/10.1016/j.foodhyd.2016.07.027>.
- Costa, B. M. G., Florencio, M. N. S., & Oliveira Junior, A. M. (2018). Analysis of technological production in biotechnology in northeast Brazil. *World Patent Information*, 52, 42-49. <http://dx.doi.org/10.1016/j.wpi.2018.01.006>.
- Costa, B. M. G., Pedro, E. S., & Macedo, G. R. (2013). Scientific collaboration in biotechnology: the case of the northeast region in Brazil. *Scientometrics*, 95(2), 571-592. <http://dx.doi.org/10.1007/s11192-012-0924-1>.
- Dabi, Y., Darrigues, L., Katsahian, S., Azoulay, D., Antonio, M., & Lazzati, A. (2016). Publication trends in bariatric surgery: a bibliometric study. *Obesity Surgery*, 26(11), 2691-2699. <http://dx.doi.org/10.1007/s11695-016-2160-x>. PMID:27052317.
- Dias, C., & Mendes, L. (2018). Protected Designation of Origin (PDO), Protected Geographical Indication (PGI) and Traditional Speciality Guaranteed (TSG): a bibliometric analysis. *Food Research International*, 103, 492-508. <http://dx.doi.org/10.1016/j.foodres.2017.09.059>. PMID:29389640.
- Grueber, M., & Studt, T. (2010). Battelle global funding forecast. *R & D Magazine*, 52(7), 33-64.
- Ho, Y. S. (2008). Bibliometric analysis of biosorption technology in water treatment research from 1991 to 2004. *International Journal of Environment and Pollution*, 34(1-4), 1-13. <http://dx.doi.org/10.1504/IJEP.2008.020778>.
- Hoppen, N. H. F., & Vanz, S. A. (2016). Neurosciences in Brazil: a bibliometric study of main characteristics, collaboration and citations. *Scientometrics*, 109(1), 121-141. <http://dx.doi.org/10.1007/s11192-016-1919-0>.
- Instituto Nacional de Propriedade Industrial. (2017). *Estatísticas gerais de propriedade industrial*. Rio de Janeiro: INPI. Retrieved from <http://www.inpi.gov.br/sobre/estatisticas>
- Janebro, D. I., Queiroz, M. D. S. R. D., Ramos, A. T., Sabaa-Srur, A. U., Cunha, M. A. L. D., & Diniz, M. F. F. M. (2008). Efeito da farinha da casca do maracujá-amarelo (*Passiflora edulis* f. *flavicarpa* Deg.) nos níveis glicêmicos e lipídicos de pacientes diabéticos tipo 2. *Revista Brasileira de Farmacognosia*, 18(Suppl.), 724-732. <http://dx.doi.org/10.1590/S0102-695X2008000500016>.
- Lei, X. P., Zhao, Z. Y., Zhang, X., Chen, D. Z., Huang, M. H., & Zhao, Y. H. (2011). The inventive activities and collaboration pattern of university–industry–government in China based on patent analysis. *Scientometrics*, 90(1), 231-251. <http://dx.doi.org/10.1007/s11192-011-0510-y>.
- Lima, L. K. S., Soares, T. L., Souza, E. H., Jesus, O. N., & Girardi, E. A. (2017). Initial vegetative growth and graft region anatomy of yellow passion fruit on *Passiflora* spp. rootstocks. *Scientia Horticulturae*, 215, 134-141. <http://dx.doi.org/10.1016/j.scienta.2016.12.001>.
- Meadows, A. J. (1999). *A comunicação científica*. Brasília: Briquet de Lemos.
- Medeiros, J. S., Diniz, M. F. F. M., Srur, A. U. O. S., Pessoa, M. B., Cardoso, M. A. A., & Carvalho, D. F. (2009). Ensaios toxicológicos clínicos da casca do maracujá-amarelo (*Passiflora edulis*, f. *flavicarpa*), como alimento com propriedade de saúde. *Revista Brasileira de Farmacognosia*, 19(2), 394-399. <http://dx.doi.org/10.1590/S0102-695X2009000300010>.
- Nascimento, E. M. G. C. (2016). *Estudo dos Cianogênicos em Casca de Maracujá através de bioensaio e quantificação de amostras por processos térmicos diferentes* (Tese de doutorado). Universidade Federal do Rio de Janeiro, Seropédica.
- Rotili, M. C. C., Coutro, S., Celant, V. M., Vorpapel, J. A., Barp, F. K., Salibe, A. B., & Braga, G. C. (2013). Composição, atividade antioxidante e qualidade do maracujá-amarelo durante armazenamento. *Semina: Ciências Agrárias*, 34(1), 227-240. <http://dx.doi.org/10.5433/1679-0359.2013v34n1p227>.
- Silva, J. K., Cazarin, C. B. B., Bogusz Junior, S., Augusto, F., & Maróstica Junior, M. R. (2014). Passion fruit (*Passiflora edulis*) peel increases colonic production of short-chain fatty acids in Wistar rats. *Lebensmittel-Wissenschaft + Technologie*, 59(2), 1252-1257. <http://dx.doi.org/10.1016/j.lwt.2014.05.030>.
- Soosaraei, M., Khasseh, A. A., Fakhari, M., & Hezarjaribi, H. Z. (2018). A decade bibliometric analysis of global research on leishmaniasis in Web of Science database. *Annals of Medicine and Surgery* (2012), 26, 30-37. <http://dx.doi.org/10.1016/j.amsu.2017.12.014>. PMID:29387384.
- Sternitzke, C., Bartkowski, A., & Schramm, R. (2008). Visualizing patent statistics by means of social network analysis tools. *World Patent Information*, 30(2), 115-131. <http://dx.doi.org/10.1016/j.wpi.2007.08.003>.
- Ter Wal, A. L., & Boschma, R. A. (2009). Applying social network analysis in economic geography: framing some key analytic issues. *The Annals of Regional Science*, 43(3), 739-756. <http://dx.doi.org/10.1007/s00168-008-0258-3>.
- Zanini, G. B., Pinto, M. D. S., & Filippim, E. S. (2012). Análise bibliométrica aplicada à gestão do conhecimento. *Conhecimento Interativo*, 6(2), 124-140.
- Zeraik, M. L., Pereira, C. A., Zuin, V. G., & Yariwake, J. H. (2010). Maracujá: um alimento funcional? *Revista Brasileira de Farmacognosia*, 20(3), 459-471. <http://dx.doi.org/10.1590/S0102-695X2010000300026>.
- Zeraik, M. L., Yariwake, J. H., Wauters, J. N., Tits, M., & Angenot, L. (2012). Analysis of passion fruit rinds (*Passiflora edulis*): isoorientin quantification by HPTLC and evaluation of antioxidant (radical scavenging) capacity. *Química Nova*, 35(3), 541-545. <http://dx.doi.org/10.1590/S0100-40422012000300019>.