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Prospecção tecnológica e científica da farinha do bagaço da cana-de-açúcar (*saccharum officinarum* l.)

Technological and scientific prospecting of sugar cane bagasse flour (*saccharum officinarum* l.)

Prospección tecnológica y científica de la harina de caña de azúcar (*saccharum officinarum* l.)

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Resumo

A farinha do bagaço da cana-de-açúcar (*Saccharum officinarum* L.) é um produto promissor e apresenta grande potencial de mercado com aplicação na alimentação humana. Com o auxílio da prospecção tecnológica e científica, é possível nortear e abranger a visão sobre as pesquisas a cerca da utilização desse material na área de ciência de alimentos. Com isso, objetivou-se investigar a existência do desenvolvimento de farinha obtida pelo bagaço da cana-de-açúcar em bases de dados tecnológicos e científicos. As bases patentárias analisadas foram o Instituto Nacional de Propriedade Industrial (INPI), *World Intellectual Property Organization* (WIPO), *United States Patent and Trademark Office* (USPTO) e no banco de dados *Espacenet Patent Search*. As plataformas científicas analisadas foram *Scientific Electronic Library Online* (SciELO), *Web of Science*, Pubmed e Portal Periódicos Capes. O Brasil apresentou avanço na produção intelectual nas bases patentárias, porém, não foi identificado nenhum registro tecnológico e/ou científico sobre a utilização da farinha para a alimentação humana no período analisado. A partir disso, faz-se necessário, então, a realização de pesquisas a cerca do potencial alimentício dessa farinha, principalmente no Brasil, uma vez que o país é considerado o maior produtor da cana-de-açúcar, tendo um vasto material a ser explorado, desenvolvendo uma funcionalidade na elaboração de novos produtos e aumentando a propriedade intelectual na área.

Palavras-chave: Farinha; Resíduos alimentares; *Saccharum officinarum*.

Abstract

Sugar cane bagasse flour (*Saccharum officinarum* L.) is a promising product and has great market potential with application in human food. With the help of technological and scientific prospecting, it is possible to guide and cover the view on research about the use of this material in the area of food science. With that, the objective was to investigate the existence of the development of sugarcane bagasse flour in technological and scientific databases. The patent bases analyzed were the National Institute of Industrial Property (NIIP), the World Intellectual Property Organization (WIPO), the United States Patent and Trademark Office (USPTO) and the Espacenet Patent Search database. The scientific platforms analyzed were Scientific Electronic Library Online (SciELO), Web of Science, Pubmed and Portal Periódicos Capes (Brazil). Brazil has made progress in intellectual production on patent bases, however, no technological and / or scientific record has been identified regarding the use of flour for human consumption in the analyzed period. From this, it is necessary, then, to carry out research on the food potential of this flour, mainly in Brazil, since the country is

considered the largest producer of sugarcane, having a vast material to be explored, developing functionality in the development of new products and increasing intellectual property in the area.

Keywords: Flour; Food residue; *Saccharum officinarum*.

Resumen

La harina de bagazo de caña de azúcar (Saccharum officinarum L.) es un producto prometedor y tiene un gran potencial de mercado con aplicación en alimentos para humanos. Con la ayuda de la prospección tecnológica y científica, es posible orientar y cubrir el punto de vista de la investigación sobre el uso de este material en el área de la ciencia de los alimentos. Con esto, el objetivo fue investigar la existencia del desarrollo de la harina obtenida por el bagazo de caña de azúcar en bases de datos tecnológicas y científicas. Las bases de patentes analizadas fueron el Instituto Nacional de Propiedad Industrial (INPI), la Organización Mundial de la Propiedad Intelectual (OMPI), la Oficina de Patentes y Marcas de los Estados Unidos (USPTO) y la base de datos Espacenet Patent Search. Las plataformas científicas analizadas fueron Scientific Electronic Library Online (SciELO), Web of Science, Pubmed y Portal Periódicos Capes. Brasil ha progresado en la producción intelectual sobre bases de patentes, sin embargo, no se han identificado registros tecnológicos y / o científicos con respecto al uso de harina para consumo humano en el período analizado. A partir de esto, es necesario, entonces, llevar a cabo una investigación sobre el potencial nutricional de esta harina, principalmente en Brasil, ya que el país es considerado el mayor productor de caña de azúcar, ya que tiene un vasto material para ser utilizado, explorado, desarrollando funcionalidades en el desarrollo de nuevos productos y aumentando la propiedad intelectual en el área.

Palabras clave: Harina; Residuo alimentar; *Saccharum officinarum*.

1. Introduction

Sugar cane is a perennial plant, belonging to the family of grasses (Poacea), of the genus *Saccharum* and with six species, the species *officinarum* being the most cultivated in tropical and subtropical countries. This species is a cane recognized as noble or tropical cane, characterized by its high sugar content, high size and thick juice (Aranha & Yahn, 1987, Marin & Nassif, 2013).

The sugar cane agro-industrial system is one of the most traditional in Brazil, where its cultivation has been reported since the time of its discovery, by the colonizers. The tropical climate and good conditions such as soil, relief and light in the country are ideal factors for its cultivation (Brazil, 2019).

Despite the great potential for using sugarcane, the sugar and alcohol sector achieved greater prominence based on the use of only one third of the energy potential: the juice, for the production of sugar, ethanol and derivatives. The threshold is in the use of the other two thirds of the plant - bagasse, a waste that is neglected in industries and with potential for great applicability to other areas (Santos et al., 2017).

Studies already point out alternative ways of using sugarcane bagasse for animal feed production, in the chemical industry, as an alternative material in civil construction and in the production of alcohol via bagasse (Cruz & Andrade, 2016, Filho & Martins, 2017, Mokomele et al., 2018, Protásio et al., 2015, Soares et al., 2017, Santos et al., 2014). The strong appeal of the applicability of sugarcane residue in several areas is due to the fact that this material has good characteristics of physical and chemical composition (Santos et al., 2017).

In this bias, the valorization of residues and agri-food by-products presents itself as an opportunity to increase human food by obtaining flour, adding more nutritional value to new products and generating a direct impact on the health of the population, on the environment and on the economy of industries that benefit from taking full advantage of this matter (Bressani et al., 2017, Gomes & Teixeira, 2017).

In that context, the objective of this research was to carry out a technological and scientific prospecting on the development of flour using sugarcane bagasse for human consumption, in order to map the research already developed on the subject and analyze participation countries in filing patent applications at national and international innovation and technology banks.

2. Materials and Methods

According to Pereira et al. (2018), a research is made to bring new knowledge for society. A Technological research involved searching for patent applications filed with the National Institute of Industrial Property of Brazil (NIIP or in Portuguese: Instituto Nacional de Propriedade Industrial – INPI), the World Intellectual Property Organization (WIPO), the United States Patent and Trademark Office (USPTO) and the Espacenet Patent Search database . The scientific search was developed by searching for articles published between

1945-2019 in the electronic databases Scientific Electronic Library Online (SciELO), Web of Science, PubMed and Portal Periódicos Capes.

The searches were carried out in march 2019 and the keywords were used as keywords: “sugar cane” or “sugar cane”, “flour” or “flour” and “bagasse” or “bagasse”, from isolated and / or combined, according to the use of the boolean operators “OR” and “AND”.

Terms in English were used for international bases, while the terms in Portuguese were used to search for documents on a national basis, being considered valid the documents that presented these terms in the title and/or abstract.

For the analysis of patent applications and scientific search, the area of concentration, the year and the country of deposit or publication of the article were considered. Such criteria were established in order to refine the research.

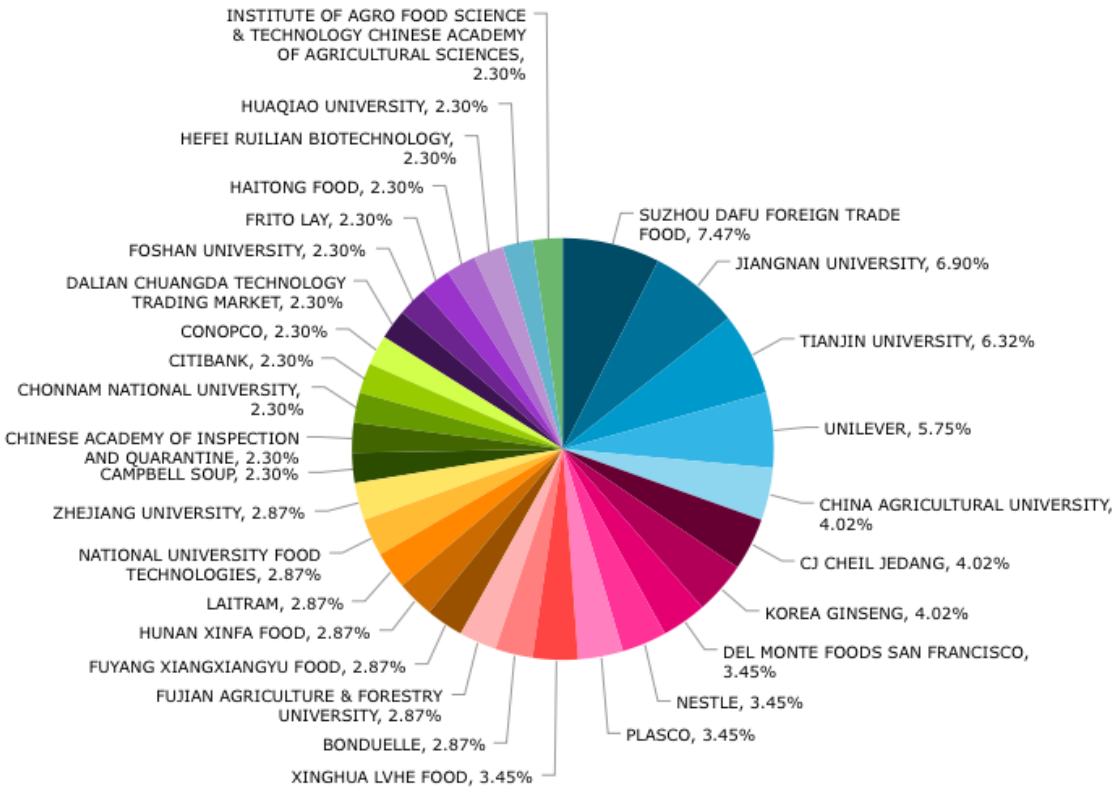
3. Results and Discussion

The progress found in the country's intellectual production compared to major world powers reveals the incentive of national entities to increase the prominence in research in various sectors, especially in the area of food. As a result, the demand for the recognition of national raw materials increased, seeking its use in the application of new products (Gomes & Teixeira, 2017).

In Brazil, one of the products widely used by the agroindustry is sugar cane, a vegetable that attracts prominence as the world's largest producer in the country and is used mainly in the production of sugar and alcohol. With the completion of its extraction, the sugar and alcohol industry produces a co-product that is being studied, bagasse (Teixeira, 2013).

In order to guide technological prospecting regarding the production of flour obtained from sugarcane bagasse for human consumption, the search was conducted in order to better explore the information that these bases could provide regarding the distribution of patents by country and by International Patent Classification (IPC). The IPC classifies patents according to their application where, for research, the classification A23B 7/005 was used, in which: section A addresses human needs; A23B chemical preservation or ripening of fruits or vegetables; and 7/005 conservation by heating, including the research object (Figure 1).

Figure 1. Distribution of patent applications entity by Orbit Intelligence.



Source: Orbit Intelligence (2019)

The data represented in Figure 1 shows the distribution of entities (companies) that have orders and patents deposited in the referred databases of dads with the same evaluated descriptors, as well as the material that is the focus of the research. It is clear that the interest in filing patents is of great relevance and several public and private entities are increasing their requests at national and worldwide levels (Table 1).

Table 1. Number of patents filed per database involving the different descriptors used.

Descriptors	INPI	WIPO	USPTO	ESPACENET
Cana-de-Açúcar OR Sugar Cane	386118	15937	02	10000
Farinha OR Flour	240	78760	43375	10000
Bagaço de Cana-de-Açúcar OR Sugar Cane Bagasse	386119	08	0	485
Farinha AND Bagaço AND Cana-de-açúcar OR Flour AND Bagasse AND Sugar cane	0	01	0	19

Source: Own authorship (2019)

For due interest, it is possible to observe, according to Table 1, the search in the patent bases according to the number of patents filed, per database, using the terms that were selected of interest for the search. The research that surrounds sugarcane in Brazil shows

many results, where these compiled refer to the fact that the country is considered the largest world producer.

With the found, we can observe the number of patents deposited in the databases for each analyzed term. The descriptor sugar cane stood out with the highest amount in almost all bases, totaling 412,057 orders. Because it is a very broad term, its patents encompassed many products derived from its exploitation, such as sugar, alcohol and derivatives, which cited sugarcane in the title and/or summary.

For the descriptor flour, there were many results regarding its use in foreign databases. The smallest amount was found in the Brazilian data office NIIP (240) and most of the results included the use of fruit residues in the production of most of these flours.

The descriptor sugar cane bagasse applied in the research revealed some results that coincided with those already seen for the term sugarcane in an isolated way, however, its use covered several areas that use the material in the improvement of technological development and/or industrial.

With the crossing of the words made by the boolean operators, it is possible to guide the research as a filter for the main target: the sugar cane bagasse flour. In the bases surveyed, the presence of 20 patents on flour was noted, with 1 patent found in WIPO not being classified in the area of food science and technology, and 19 results in the SPACENET office, where its application did not involve human food. Although the searches present these results, they are not representative for the purpose of the research and that there is no patent on flour for food use or a by-product of this flour.

It is notorious that the use of this material is of great value, since its use has been shown in animal feed, in the production of biodegradable plastic, as a means of growing fungi and among several other vehicles for use that were exposed in results for this flour (Table 2).

Table 2. Number of articles published per database involving different descriptors used

Descriptors	SciELO	Web of Science	PubMed	Periódicos CAPES
Cana-de-Açúcar OR Sugar Cane	2296	9713	1973	49065
Farinha OR Flour	1800	38632	12475	77203
Bagaço de Cana-de-Açúcar OR Sugar Cane Bagasse	4	1927	266	14188
Farinha AND Bagaço AND Cana-de-Açúcar OR Flour AND Bagasse AND Sugar Cane	0	18	4	672

Source: Own authorship (2019).

Contributing to patent research, the scientific analysis carried out is extremely useful to present the state-of-the-art of a certain technological area, with the objective of generating

information on its past trajectory and on market trends and perception of weak signals. The results found for the scientific analysis are shown in Table 2. In the databases analyzed, using the same patent search descriptors, the only platform that did not show results for the combination of all terms was SciELO.

The other bases showed scientific work using sugarcane bagasse flour in several areas. It is worth mentioning, of all the works found, each was analyzed, verifying the descriptor, title, summary and publication area, with emphasis on food science and technology.

For the Portal de Periódicos Capes, a platform that presented the most significant amount of published articles, it was noted that, of relevance to the researched material, only the study by Sangeetha et al. (2011) who verified the influence of cooked sugarcane bagasse on the microbial, nutritional, rheological and quality characteristics of the cookies, not fitting in the study of flour. The other works found covered chemical composition, culture media, fertilization, planting and feeding of ruminant animals.

When a comparative analysis of technological prospecting with scientific prospecting is carried out, it is evident that in the academic community in general, including developed countries, the use of patent bases is an uncommon practice, which would be indispensable to avoid spending on repetitive research.

4. Final Considerations

The technological and scientific prospecting study encompasses great contributions to science, demonstrating the importance of the production chain and product development in the food area. However, the results permits us to conclude that, in case of flour obtained from sugarcane bagasse for human consumption, there are no patent deposits or articles published in the different research bases.

Therefore, it is necessary, then, to conduct researches on the food potential of this flour, especially in Brazil, since the country is considered the largest producer of sugarcane, having a vast material to be explored, developing functionality in the development of new products and increasing intellectual property in the area.

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