

TECHNOLOGICAL MAPPING OF VEGETABLE BIOMASSES FOR CONVENTIONAL PLASTICS REPLACING

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SUMMARY

Developed in the 50's, plastic has spread worldwide as an economical and practical alternative to store products. However, its inadequate disposal originated a high volume of solid waste, causing great environmental impact worldwide. One of the alternatives to mitigate the problems caused by plastic waste has been the research and development of biodegradable bioplastics, as more sustainable substitutes for conventional plastics. This project proposes to map innovative technological solutions in bioplastics, produced from vegetable biomass, with emphasis on materials based on pectin (polygalacturonic acid). It used technological data bibliometrics, of Scopus™ and Web of Science™ databases to mining scientific papers with VantagePoint™ v.14.1 software support. The study period was limited to papers published between January 2015 and May 2022, using keywords related to the theme (*biopolymer, film, pectin, nanoparticles, bioplastic, biomass, fruits and packaging*), resulting in 25,286 papers registers. The analysis was complemented with general data of patent deposits extracted from the PatStat™/European Patent Office (EPO) database, in the period from 2010 to 2020, when 18,033 patents were identified. The results showed that the publications of scientific papers have grown in recent years, a scenario opposite to that of patent deposits, whose peak could be observed in 2016. Countries with tradition in research and innovation, such as China and the USA, stand out as the largest applicants of patents in the area. However, countries with tropical climate and abundant and diverse fruits, such as Brazil and Thailand, appears as technology emergence future trends in R&D of pectin-based bioplastics.

Keywords: Tech Mining; Bio-based; Biopolymers; Pectin; Technology Emergence Indicators.

INTRODUCTION

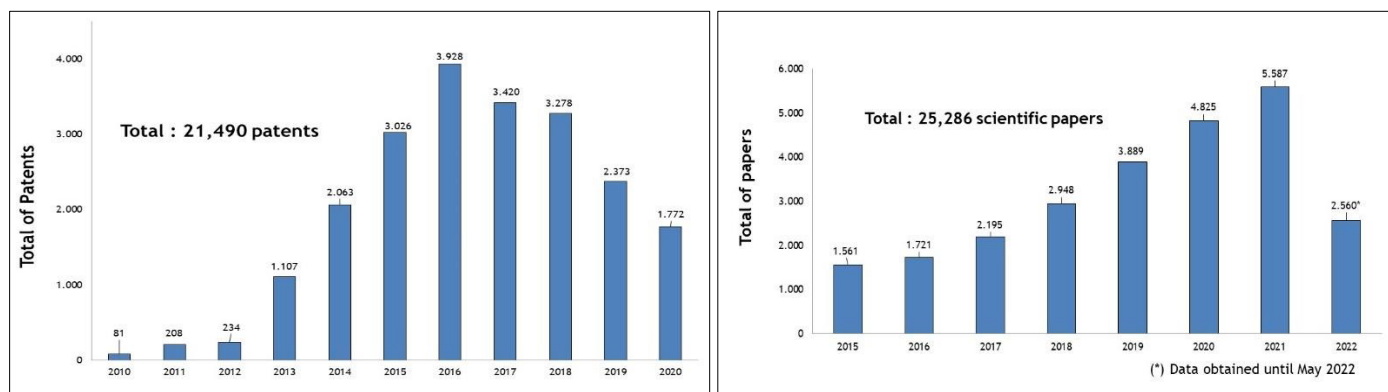
In recent decades, there have been increased efforts to develop bioplastics because of environmental awareness and the implementation of stringent environmental regulations. Bioplastics can be categorized into bio-based plastics - made from renewable resources, not necessarily biodegradable, such as starch, cellulose, wheat gluten, polylactide (PLA), and polyhydroxyalkanoates (PHAs) - and the biodegradable ones^[1].

This study focuses on the group of bio-based and biodegradable plastics from agro resources^[2], especially those based on pectin (polygalacturonic acid), a structural acidic heteropolysaccharide contained in several plants and fruits, whose main component is galacturonic acid, a sugar acid derived from galactose. It seeks technology emergence indicators (EI)^[3] through a combination of bibliometrics and text analyses, from the Scopus™, Web of Science™ and PatStat™/European Patent Office (EPO) databases of scientific papers and patents, with VantagePoint® v.14.1 support.

RESULTS

The volume of patents filed worldwide (Figure 1a), was incipient 20 years ago (only one in 2000, adding up to 162 by 2010), showing accelerated growth from 2013 to 2016 (when it reached a maximum of 3,928) and decreasing thereafter (reaching 1,772 in 2020). The opposite trend of scientific interest in the theme (Figure 1b), according to publications of papers in Scopus® and Web of Science®, with accelerated growth in the analyzed period from 2015 to 2021 (from 1,591 to 5,587).

Figure 1 - Published Papers (2015-May2022) and Patents filed (2010-2020)



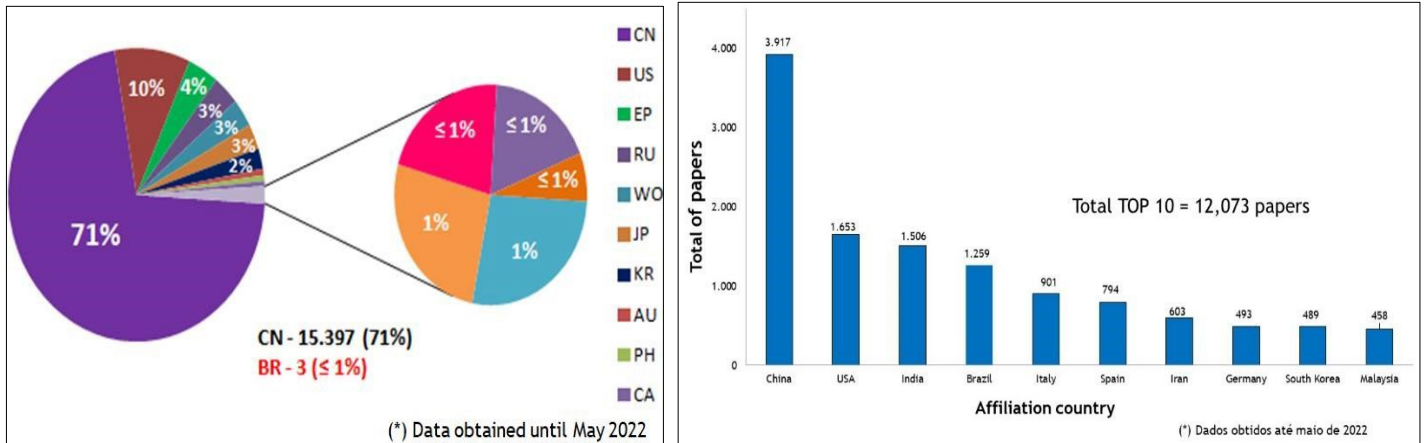
(a) Patents published from 2010-2020

(b) Scientific papers published from 2015-May2022

Countries with tradition in research and innovation, such as China (71% of patents and 15% of papers) and the United States (10% of patents and 6.5% of papers), are references in the area (Figure 2). While emerging countries have irrelevant participation in the effort of intellectual protection (less than 1% of patents), India and Brazil stand out for their investment in scientific research (respectively as 3rd and 4th places in the group of the top 10 countries in the publication of scientific papers).

Brazil also stands out in the emerging technology indicators (Figure 3), both as the country (99 papers, 1st position, score 10.3 - Figure 3a) and by researcher's groups (Figure 3b), especially from the Federal Universities of São Carlos (UFSCar, at São Paulo state) and Lavras (at Minas Gerais state)^[4]. This trend was followed by Thailand, 2nd emerging country (36 papers, score 6.1), driven by the leadership of researchers such as Nathdanai Harnkarnsujarit (score 9.2) and Phanwipa Wongphan, both from the Faculty of Agro- Industry-Kasetsart University, in Bangkok^[1].

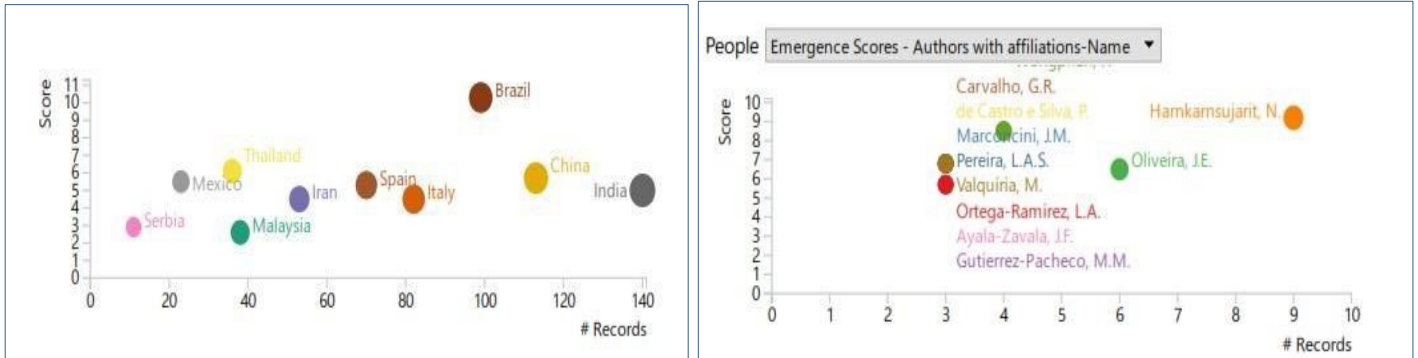
Figure 2- Technological production by country (2015-May2022)



(a) Affiliation of the patent applicants

(b) Affiliation of papers' authors - Top 10 Countries

Figure 3 - Indicators of emerging trends in R&D (Countries and Researchers)

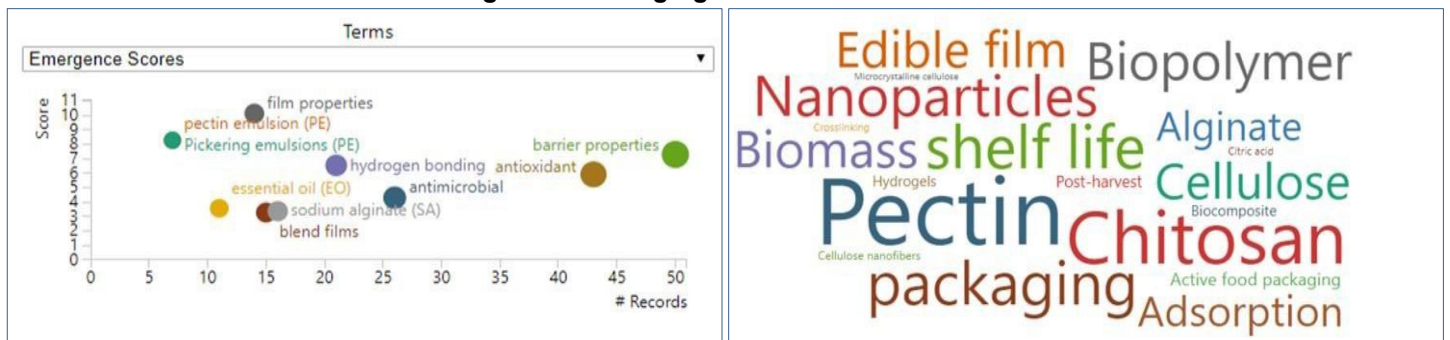


(a) Emerging country indicators

(b) Emerging researcher indicators

Regarding the research focus, both the Word Cloud (Figure 4b) obtained as well as the emerging technology indicators calculated (Figure 4a) point to research on the mechanical properties of the obtained bioplastic materials (mainly film and barriers ones) and the emulsion production technique for biopolymers pectin-based.

Figure 4 - Emerging terms in R&D



(a) Emerging Indicators

(b) Word Cloud

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