

The study of the evolution of biodiesel research in Brazil**O estudo da evolução da pesquisa em biodiesel no Brasil**

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ABSTRACT

With the “birth” of the National Biodiesel Production and Use Program (PNPB) in 2004, there was a need to look for ways to maintain the biofuel production chain throughout Brazil. One of the main goals of this program was the promotion of Social Inclusion, Economic and Regional Development through job creation, human resources and income.

Since the beginning of the National Program and the Brazilian Biodiesel Network, conferences, lectures and events related to the development and technology of biofuel have gotten support and representation on a national level. The importance of the rising of public policies for the development of new technologies aimed at the production of biodiesel on a regional basis, in addition to the study of new techniques and synthetic routes for its production, among the creation of new researches in this field, which was and still is of great value for the productive, economic, scientific and technological sectors. Based on the outcome results of biodiesel study before and after the rising of the government programs, a more detailed study of scientific production on this subject is necessary.

The goal of this work was to statistically analyze, through the 'Web of Science' database, the national evolution of biodiesel technology in Brazil. Making a comparison between different regions of the country, it was possible to observe that the regions (southeast and south) with the largest amount of resources received from the Federal Government (Finep, CNPq, Capes) and from the state (FAPs) in the last 20 years for the development of technologies focused on biodiesel, had proportionally greater quantitative production of scientific works indexed on the analyzed platform.

With these results it was possible to conclude that the most relevant factor in scientific production is the amount of financial resources allocated to the training of human resources (research grants), investments in high quality equipment (laboratories), raw material and other necessary material for the production of new technologies (final product).

Keywords: PNPB, RBTB, biofuel, history of biodiesel, regional development

RESUMO

Com o "nascimento" do Programa Nacional de Produção e Uso de Biodiesel (PNPB) em 2004, houve a necessidade de procurar maneiras de manter a cadeia produtiva de biocombustíveis em todo o Brasil. Um dos principais objetivos desse programa foi a promoção da Inclusão Social, Desenvolvimento Econômico e Regional por meio da criação de empregos, recursos humanos e renda.

Desde o início do Programa Nacional e da Rede Brasileira de Biodiesel, conferências, palestras e eventos relacionados ao desenvolvimento e tecnologia de biocombustíveis têm recebido apoio e representação em nível nacional. A importância do surgimento de políticas públicas para o desenvolvimento de novas tecnologias voltadas à produção regional de biodiesel, além do estudo de novas técnicas e rotas sintéticas para sua produção, entre a criação de novas pesquisas nesse campo, que foi e ainda é de grande valor para os setores produtivo, econômico, científico e tecnológico. Com base nos resultados dos estudos de biodiesel antes e após o surgimento dos programas governamentais, é necessário um estudo mais detalhado da produção científica sobre esse assunto.

O objetivo deste trabalho foi analisar estatisticamente, por meio do banco de dados 'Web of Science', a evolução nacional da tecnologia do biodiesel no Brasil. Comparando as diferentes regiões do país, foi possível observar que as regiões (sudeste e sul) com maior quantidade de recursos recebidos do Governo Federal (Finep, CNPq, Capes) e do estado (FAPs) na região Nos últimos 20 anos, para o desenvolvimento de tecnologias voltadas ao biodiesel, houve produção quantitativa proporcionalmente maior de trabalhos científicos indexados na plataforma analisada.

Com esses resultados, foi possível concluir que o fator mais relevante na produção científica é a quantidade de recursos financeiros alocados à formação de recursos humanos (bolsas de pesquisa), investimentos em equipamentos de alta qualidade (laboratórios), matérias-primas e outros materiais necessários para a produção de novas tecnologias (produto final).

Palavras-chave: PNPB, RBTB, biocombustível, história do biodiesel, desenvolvimento regional

1 INTRODUCTION

With the “birth” of the National Biodiesel Production and Use Program (PNPB) in 2004, there was a need to look for ways to maintain the biofuel production chain throughout Brazil. One of the main goals of this program was the promotion of Social Inclusion, Economic and Regional Development through job creation, human resources and income (NETO, 2000). In fact, the Federal Government's policy trend was to promote social inclusion by creating a partnership between family farming and large industrial biodiesel producers (PRADO, 2017). However, it was not certain that family farming would be able to compete with agribusiness. Perhaps, more than financing, the government should invest in social and technical assistance, this way farmers could become even more competitive as suppliers for the biodiesel production industry (POUSA, 2018).

At the launch of this program, the Brazilian Biodiesel Technology Network (RBTB) was also created in 2005, with activities focused on the main pillars of the sector related to biofuel, such as: storage, agriculture, usage of co-products, production and trading, application and utility, chemical processes, sustainability, and biodiesel quality control (VIGLIANO, 2003).

An event of high recognition by RBTB was the II Conference of the Brazilian Technology Network for Biodiesel Production, held in the capital of Brazil, in November 2007. The event was highly successful when compared to previous years, increasing the number of participants three times, in addition to submitted and accepted papers. However, it was expected that this Conference would manifest itself in a more decentralized manner and surrounded by greater technical and scientific standards, and that it would be able to show the technological results of the chain, and not only the isolated initiative of some Brazilian research groups (VIGLIANO, 2003). Perhaps the main problem is related to the lack of coordinated and participative management, even to guide the decision of the Federal Government, development agencies and national research centers. Over the years, several problems have been resolved; in addition, the number of investments by development agencies has increased, with a greater number of laboratories spread across the country related to the development and technology of biodiesel.

The importance of the rising of PNPB and RBTB for the development of new technologies on a national level, in addition to the study of new techniques and synthetic routes for the production of biofuel that is less environment aggressive, was and is of great value for the productive, technological and economic sectors (ELLIOTT, 2000; RBB, 2017). Based on the outcome results of biodiesel study before and after the rising of the government programs, a more detailed study of scientific production on this subject is necessary.

The goal of this work was to statistically analyze, through the ‘Web of Science’ database and the “Clarivate Analytics” platform, the national evolution of biodiesel technology in a historical and productive context, and the viability aimed at the five regions of the country using vegetable and animal raw materials as a model.

2 MATERIALS AND METHODS

A survey was carried out through the Capes news portal, through an advanced search through the ‘Web of Science’ database, to verify the quantity of articles published with the word “biodiesel” in the title and the address of different “regions” in the country. Subsequently, data analysis was performed by year, by location and participating institutions, in order to list the main regions of more prominence in number of publications before and after the creation of PNPB and RBTB, starting in the year 2000 and ending in 2019.

3 RESULTS AND DISCUSSION

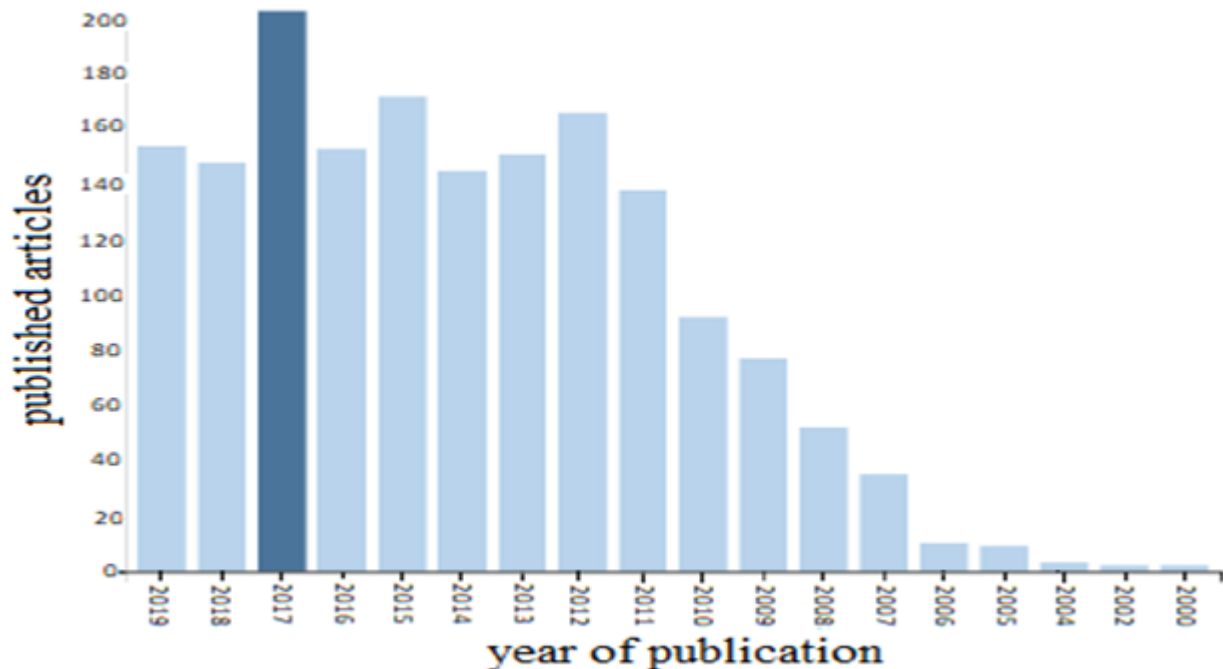
Table 1 indicates a substantially growth in the publication of scientific papers related to Biodiesel technology by Brazilian research groups in the last 20 years. The advance in the production of articles on the topic is evident after the creation of the PNPB and RBTB in late 2004, through the act of the former Ministry of Science and Technology (MCT), currently named as Ministry of Science, Technology, Innovations and Communications (MCTIC). Before the creation of public policies that came to promote the creation of the biodiesel technology programs, only 4 articles had been published in the first quinquennium analyzed (2000-2004). In the second quinquennium (2005-2009) almost 200 articles were published on the topic Biodiesel in Different Regions of Brazil. In the last decade (2010-2019), more than 1600 articles with a high impact factor were published in national (Journal of the Brazilian Chemical Society, Brazilian Journal of Chemical Engineering) and international (Fuel, Renewable Energy, Talanta) magazines.

Table 1 - Number of articles published per quinquennium over 20 years (2000-2019).

Years	2000 - 2004	2005 - 2009	2010 - 2014	2015 - 2019
Articles	04	178	687	775

Chart 1 represents the number of national and international articles in partnership with Brazilian research groups published in specialized magazine using the Clarivate Analytics (Web of Science) data platform from 2000 to 2019. It is worth mentioning that there may be publications in smaller magazines that are not included in the database of this platform and, therefore, were not counted in this work.

Chart 1 - Number of articles referring to Biodiesel published by at least one Brazilian Institution versus the year of its publication.

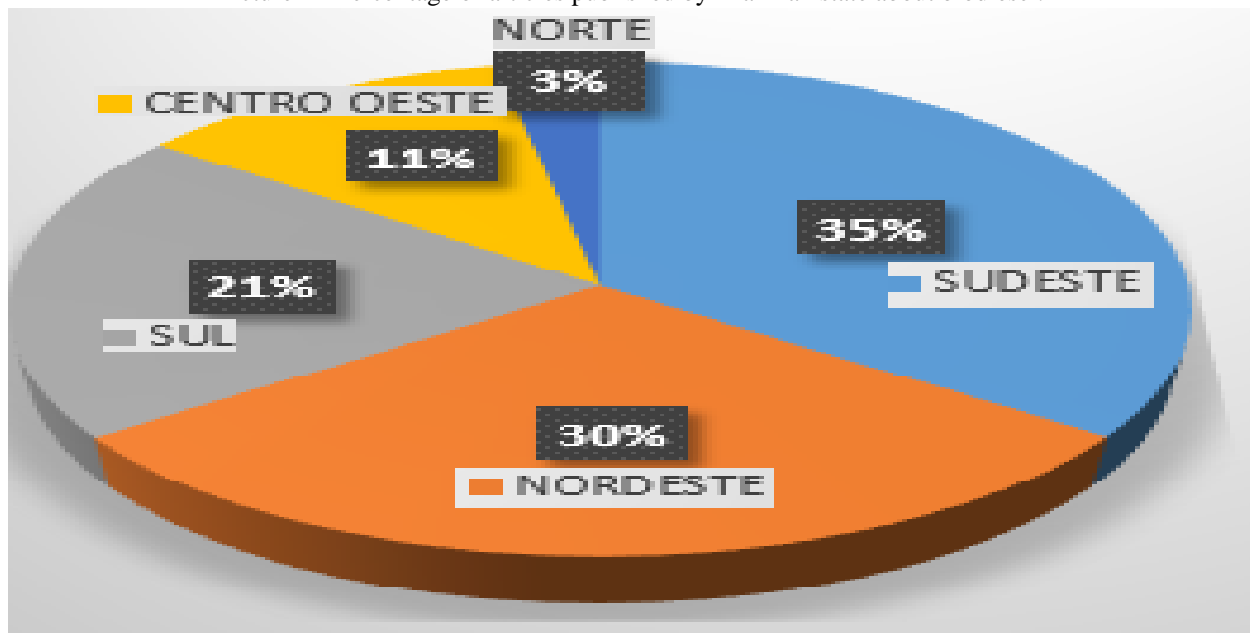


It's possible to observe that has been a significant increase in the number of articles published since 2008 in line with the creation of the National Program for the Production and Use of Biodiesel, in mid 2007. In addition, massive investments made by the MCTIC in this period were made (ARANDA, 2015), by State Research Support Foundations – FAP's and Financially Project Sponsors – Finep (PRADO, 2017), in addition to the resources provided by the National Council for Scientific and Technological Development – CNPq (ARANDA, 2015) and by the Coordination for Higher Education Personnel Improvement – Capes, through Federal Investments, in addition to the Research Incentive Laws (Law of Good and Law of Simples) and resources linked to Sectorial Funds – FNDCT (BRAGA, 2012).

Picture 1 refers to the percentage contribution of articles published by the five regions of the country. It is important to note that the Northeast region, despite not receiving a greater financial contribution for research development, is in second place in the Brazilian ranking. The Southeast region leads the scientific production with greater development in Science and Technology, mainly due to resources from the “São Paulo State Research Support Foundation” (Fapesp). Another region that deserves to be highlighted positively for almost 200 published articles is the Midwest region, with a low number of the Federal Universities, but a high index of publication on Biodiesel technology.

On the other hand, in a more concerning way is the North region with only 3.1% of the total publications, indicating a low performance due to the contribution of its Research Support Foundations, Incentive Laws and resources from CNPq, Sectorial Funds, Capes and Finep.

Picture 1 - Percentage of articles published by Brazilian state about biodiesel.



Although the Midwest region contributed with approximately 11% of the publications during the two decades, its placement was also behind the most affluent regions (south and southeast), reinforcing again the premise that the most relevant factor for the development of Science and Technology (Research & Development) is the amount that financial resources invested in public Higher Education Institutions, which correspond to 95% of articles published (MARCOVITCH, 2018; FORAY, 2012) in the country.

The southern region produced over the last two decades more than 20% of the articles indexed on the platform. This region obtained a very relevant and considerable percentage since it has only three states and a small number of federal universities when compared to the north and northeast regions.

4 CONCLUSION

After analyzing the data available in the Web of Science database, it was possible to observe the dispersion of publications on the “biodiesel” subject in Brazil. It was concluded that the most affluent and scientifically developed Brazilian states have had the highest percentage of articles in the last twenty years (2000-2019), since the beginning of Scientific Production and studies on biodiesel technology (beginning of the 21st century).

The importance of the creation of PNPB in mid-2004 and RBTB in 2005 is notorious, exponentially increasing the national publication from 4 articles in the first five years (2000-2004) to 178 articles at the end of the subsequent five years (2005-2009), in all regions of the country. The creation of public policies aiming Development and Technology, linked to Financial and Scientific Assistance from public institutions such as CNPq, CAPES, Finep, FAPs, represent the national advance of public Higher Education Institutions in search of Scientific, Economic and Technological growth in Brazil, before other countries in the world.

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