

THE BRAZILIAN FOOD INDUSTRY (IBA): PROFILE AND TECHNOLOGICAL DYNAMICS.

^{1*}Maria Cecília Castelo Branco, ²Carlos Augusto Francisco de Jesus Ribeiro, ³Antônio Martins de Oliveira Júnior and ⁴Rodrigo Tripodi Calumby

^{1,3}Federal University of Sergipe

²Federal University of Bahia

⁴State University of Feira de Santana

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ABSTRACT

This article seeks to identify the main factors behind the Brazilian Food Industries (IBA) innovation process. Initially, we tried to identify which sub-sectors within the food and beverage sector are more innovative than the others, and the role of the different explanatory factors, including competitive strategy that sustain these companies in the national market. In microeconomic incentives to innovate, our results show that there is a limitation of the food industries to innovate in relation to the other processing industries in Brazil, especially in micro and small companies. In addition, our results show that innovation is an essential part of the food industry in order to meet domestic demand and to exceed consumer expectations, as competition in this sector is very heated. Finally, our results indicate that it will be necessary to raise the awareness of entrepreneurs regarding the use of industrial property as a tool for scientific, technological and consequently economic development of the Brazilian food industries.

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INTRODUCTION

From the earliest times, human activities were guided by their technical knowledge. Thus, each technological advance plays a decisive role in raising the standard of living of society. This statement is observed in all sectors of a nation, such as food production, which is considered as one of the bases of any economy, both for its size and essentiality, and for incorporating an immense productive chain composed of numerous agents in different activities and economic development. For the food industry, the need to develop technological innovations became essential from the 1990s, when the process of opening trade to food imports increased competition among companies in the sector, forcing them to seek advantages to differentiate their products in the domestic market from multinationals and imported products. The demands of competitiveness in the Brazilian agrifood sector have become increasingly sophisticated:

in addition to the increase, diversification and functionality of products and production processes, the food market also demands quality (CONCEIÇÃO and ALMEIDA, 2005). The Brazilian Food Industry (IBA), which refers to establishments responsible for the manufacture of food and beverage products, has been distinguished by its high revenues, continuous growth and quality of its products. Knowing that Innovation is one of the factors responsible for business competitiveness, maintenance and conquering of new business, this article seeks to examine the main characteristics of the IBA, present the main current sectoral numbers and relate their efforts in innovation as investments in R and D and patenting to its performance in the national market.

Origin, evolution and profile of the IBA: The food industry is among the main sectors responsible for the beginning of Brazilian industrialization. In the period of Brazil-Cologne, due to the rules of the economic theory of mercantilism, industrial activity could not be practiced in Brazil. Only a small industry for domestic consumption was allowed, which would make life easier for the financially affluent, since the

*Corresponding author: Maria Cecília Castelo Branco,
Federal University of Sergipe.

distance between the metropolis and the colony was considerable. They were footwear, spinning, and containers small factories. In the second half of the eighteenth century, in 1785, Portugal banned factories in the colony, since the Portuguese could not create competition with English products sold in Brazil. People's needs were met with products available seasonally and in each region. National products with minimal technology employed, such as sugar, were intended for the wealthiest. Products such as cod, wheat flour, cheese and butter were still imported (PESAVENTO, 1983). The increase of the herds, both in the Northeast and in the South, required a technological improvement in the preparation and conservation of the meat and soon the meat was incorporated into the Brazilian diet. And with the mining, which gave rise to a rudimentary consumer market, the dissemination of coffee began. The foreign colonization of the country allowed the diffusion of many techniques of preparation, processing and conservation of diverse raw materials, animals and vegetables. However, the propelling factor for the development of industry in Brazil was a consequent conjuncture of the First World War. The barriers to importing basic products that stimulate international production, export the country to the condition of exporter, as in the case of lard, frozen meats, jerked beef, sugar, butter and grains. Highlight the state of Minas Gerais, with dairy products and Rio Grande do Sul, with meat products. With increasing urbanization there has been a process of increasing consumption of processed foods and one of the factors that made it difficult to rapidly expand the activity of buying and selling stores to the units (BAER, 1988). Much has evolved in the course of my current needs, especially in the areas of food packaging and logistics.

Quality, including competitive in the foreign market. With an opening of the national market, the Brazilian companies started to use diverse strategies for a greater number of customers, besides maintaining the markets already conquered. In order to do so, they seek to establish, in the national industry, the competitive capacity to act together with the consumer, meeting new demands and expectations of new needs. One of the most striking characteristics of the Brazilian Food Industry is that it stimulates innovations throughout the agrifood chain, such as products of industrial origin, agriculture and extractivism, no production sector, additives, equipment, hygiene products, wholesale attack and retailer, in capital goods industries, among others. In addition, the food industry maintains the interface with different technologies, stimulating innovations along the entire production chain, both in the production of demand technologies in the production, chemical, machinery and equipment industries etc. (CABRAL, 1999). Domingues (2008) classified the IBA in the category of "scale-intensive companies", since it includes firms that compete for costs and sell standardized products, commodities, and also firms that adopt competition strategies for differentiation. His studies propose a sectoral division of the food and beverage industry into two groups: (1) commodity oriented; and (2) high value added. In face of the challenges posed by national and international competition faced by the Brazilian Food Industry (IBA), technological resources acquire an important role for the commercial opening of markets, including abroad. It is worth mentioning that the country has also established policies that facilitate the presence of foreign companies in the country. Thus, technological innovation has been identified as one of the main sources of competitive advantage for companies.

IBA has presented promising numbers even in the current economic scenario, characterized by stagnation and/or retraction of growth due to lack of strategic planning, infrastructure and fiscal policy, among other causes. The sector currently has 48,900 establishments in operation. According to the MTE (Ministry of Labor and Employment) in 2015, 81.9% of microenterprises, 13.2% of small enterprises, 3.6% of medium-sized enterprises and 1.3% of large companies, a criterion in which large companies employ more than 500 employees, averages between 100 and 500, small ones between 20 and 99 employees and micro in up to 19 employees. According to the same source, in 2017, the Brazilian Food Industry employed 1,608 thousand workers; 22.4% of the total workforce provided by the whole processing industry. Among the positive results of this sector, we can highlight that last year (2017), despite the Gross Domestic Product (GDP) - the sum of all goods and services produced in the country - a slight increase of 1%¹, the first rise after two consecutive years of retraction, which still does not restore the losses of economic activity in the crisis. In 2016 and 2015, GDP declined 3.5% over the previous year, in the largest recession in recent history. The Brazilian food industry earned R \$ 642.61 billion, of which R \$ 520.7 billion related to the Food Products Industry and R \$ 121.9 billion for the Beverage Industry, which represents 9.8% of GDP and 24 , 8% participation in the Transformation Industry. These data are published by ABIA - Brazilian Association of Food Industries, on its electronic website (2018).

The segments that represented the largest portion of revenues in 2015 were Meat and Derivatives, first (26.3% of net sales), followed by the Dairy sector (13.5%), this year tied with the Improvement sector Coffee, Tea and Cereals, Oils and Fats (10%) and Sugars (9.2%). The Beverage industry's share is responsible for 19% of sales. Regarding foreign demand, the export balance of agribusiness reached US \$ 217.7 billion in 2017; \$ 79.4 billion for agribusiness (or agribusiness), \$ 38.9 billion for processed foods and \$ 36.9 billion for the natural ones. Led by soybeans, seven agribusiness products were among the top ten products exported by Brazil in 2017². Soybeans, chicken and beef, raw sugar, pulp, coffee and soybean meal accounted for 26.8% of the total soybean exports. a total of US \$ 217.74 billion shipped by the country abroad in 2017.

With an increase of 9.0%, poultry meat exports generated a total of US \$ 6.428 billion (3.0% share of the country's total exports), while pulp exports generated US\$ 6.345 billion (2.9% of the total exported). Beef (US \$ 5.075 billion in revenue), soybean meal (sales of US \$ 4.973 billion) and coffee beans (exports of US \$ 4,600 billion) were, respectively, the eighth, ninth and tenth products most shipped by Brazil to overseas markets. Given this importance for the Brazilian Industry, the Food Industry, has a significant participation in the manufacturing industry in terms of employment and billing and also to incorporate a productive chain that integrates a network of sectors directly and indirectly related, such as agriculture, of services, and of inputs, additives, fertilizers, agrochemicals, capital goods and packaging, as highlighted above. In order to better understand the diversity of the IBA branches and how their activities are

¹ Source: IBGE - Brazilian Institute of Geography and Statistics, disclosed on March 1, 2018.

²Source: Ministry of Industry, Foreign Trade and Services (MDIC, 2017).

accounted for, the present study is based on the National Classification of Economic Activities³ (CNAE), which is a classification used to standardize identification codes of the productive units of the country in the registers and records of the public administration in the three spheres of government, especially in the tax area, contributing to the improvement of the quality of information systems that support the decisions and actions of the State, making, therefore, the greater articulation between the systems possible. Figure 1 shows the description of the Economic Activities that form the productive sector of the country.

From this general classification, a new classification is observed in other categories; Section C, Transformation Industries, is, in turn, also subdivided into subsections, as shown in Table 1, and these are further divided into more specific sectors, which can be checked in the CNAE 2.0 detailed structure - sections, divisions, groups, classes and subclasses. It is worth mentioning that item 11, which refers to the Manufacture of Beverages, is also being considered as part of the food industry. According to data presented on IBA's production and billing, the international market has contributed to steady growth. The exposure of the industry to external competition leads to continuous improvement of product quality and productivity rates. It is also worth mentioning its contribution, in macroeconomic terms, to the country's external accounts, since it is a sector that exports more than it imports (in this type of segment). The markets served by the national food industry show many differences in cultural and economic terms; Europe and the Middle East⁴ are the main consumer markets for these products. Thus, a large part of the sector's external sales refers to food preparations, that is, products with a higher degree of value added and that meet the requirements of each consumer segment.

Brazil has some important characteristics for the performance of the IBA: good climatic conditions and the availability of natural resources (which distinguishes it among the largest world producers of commodities, the main inputs for the design of industrialized foods), besides the large consumer market. However, there is a need to improve some support services that are essential, so as not to jeopardize the development of the sector, such as the Brazilian road transport system, which is currently a bottleneck volumes due to high costs. In addition, national ports have high prices when compared to other countries. The input industry has positioned itself to develop new technologies with a high cost-benefit ratio, always focused on the final consumer. In this way, the creation of a new variety of grains, for example, considers not only their productivity, but also their return potential to the agribusiness and its adaptation to the demands of the buyers. Changes in consumer habits, tastes and preferences, and also in their lifestyle have created new demands on the IBA. New patterns of consumption are perceived: concern with the microbiological and nutritional quality of the products; with the preservation of the environment; the need and search for information on the packaging and the appreciation of the design of the same. The effects of these trends on the sector are intense competition for market share; shorter product life

cycle; profusion of new releases; changes in production, transport and packaging technologies; new modes of purchase and consumption; new modes of communication with the final consumer (WEDEKIN and NEVES, 1995). In view of this scenario, IBA began to develop strategies that would enable the implementation of technical and operational competence, involving product and process, to face competition within the new global market and ensure its capacity for survival and expansion. At the industry level, "innovation can be recognized as the main source of competitive advantage" (GRUNERT, 1995). Schumpeter (1942) suggests that innovation is the main driver of capitalist development and a source of business profit. Innovation can be considered as one of the main driving forces of economic development and also of business competitiveness. The next topic will address the technological dynamics in the IBA and its relation with the innovation process of this segment.

IBA's technological dynamics: Innovation and patenting:

The development and launch of new food products has increased significantly in the global food industry, for reasons such as globalization and increasing consumer demand and appreciation. The new technologies linked to the flow of information and transport allow these new products to be distributed more and more quickly in different markets, a fact that has generated changes in the habits of food consumption worldwide (NANTES et al., 2006). It can be said that the consumption of certain foods has become globalized. Although they present considerable numbers in the economy, food companies are no less innovative than the average manufacturing industry in Brazil. However, the country is little innovative in a global perspective, especially small and medium-sized enterprises, which do not have the resources to invest in R&D (SIDONIO, et al., 2013). However, according to Rodrigues (2003), customer oriented food companies are relatively innovative and work with a shorter and more efficient response time, allowing the appearance of a new production pattern based on a new pattern of consumption. There are currently changes in the products, in the processes of manufacture and in the form of organization of the companies. Such changes are of great importance because of consumers' ability to discern the quality, value, appearance and functionality of the products they purchase.

Some initiatives are of great relevance in this dynamic, such as research institutes and universities, producers of scientific knowledge and important partners in the technological development of products and processes in all links of the productive chain, such as Brazilian Agricultural Company (Embrapa), whose results are widely known. The adoption and development of technological innovations represent an essential strategy for increasing the competitiveness of companies, regardless of their size and field of activity. Indeed, the adoption of innovative product, process, and management practices has become a necessary condition for market survival. According to Carvalho & Furtado (2013), the intensification of technological and innovative dynamics can be understood as [...] a positive and simultaneous evolution of the indicators of innovation efforts and results, also involving the establishment of technological strategies with tendencies more offensive or defensive and less dependent or imitative. According to Nantes and Machado (2005), in the food industry technological development happens mainly in the field of scientific knowledge applicable to production, not necessarily incorporating the production process.

³ Source: Brazilian Institute of Geography and Statistics (IBGE, 2016).

⁴ YEARBOOK OF BRAZILIAN LIVESTOCK - ANUALPEC. Yearbook 2005. São Paulo: FNP - Consultoria & Agroeinformáticos, 2014.

Figure 1.National Classification of Economic Activities (CNAE)

Section	Divisions	CNAE Description
A	01...03	Agriculture, livestock, forestry, fisheries and aquaculture
B	05...09	Extraction industries
C	10...33	Manufacturing industries
D	35...35	Electricity and gas
E	36...39	Water, sewage, waste management and decontamination activities
F	41...43	Construction
G	45...47	Trade, repair of motor vehicles and motorcycles
H	49...53	Transport, storage and mail
I	55...56	Accommodation and food
J	58...63	Information and communication
K	64...66	Financial, insurance and related services activities
L	68...68	Real estate activities
M	69...75	Professional, scientific and technical activities
N	77...82	Administrative activities and complementary services
O	84...84	Public administration, defense and social security
P	85...85	Education
Q	86...88	Human health and social services
R	90...93	Arts, culture, sport and recreation
S	94...96	Other service activities
T	97...97	Domestic services
U	99...99	International organizations and other extraterritorial institutions

Source: IBGE (2016).

Table 1. Detail of the Groups of Activities of the Divisions related to the IBA in the CNAE.

10 MANUFACTURE OF FOOD PRODUCTS
10.1 Slaughter and manufacture of meat products
10.2 Preservation of fish and manufacture of fish products
10.3 Manufacture of preserved fruit and vegetables
10.4 Manufacture of vegetable and animal fats and oils
10.5 Dairy products
10.6 Milling, manufacture of starch products and feeding stuffs
10.7 Manufacture and refining of sugar
10.8 Roasting and grinding of coffee
10.9 Manufacture of other food products
11 MANUFACTURE OF BEVERAGES
11.1 Manufacture of alcoholic beverages
11.2 Manufacture of non-alcoholic beverages

Source: IBGE (2016).

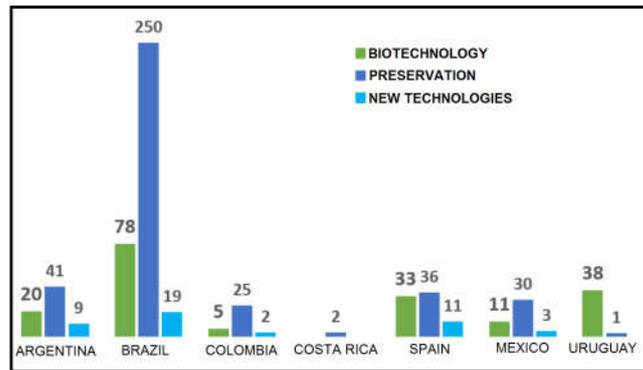
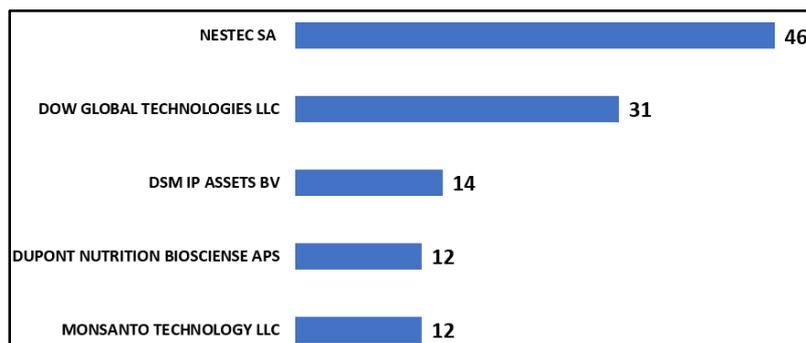


Figure 2.Deposits of patents of the food area in IBEPI countries in 2016.Mainclassificationsobserved



Source: IBEPI (2017).

Figure 3.Companies that most filed patent applications in offices of IBEPI component countries in 2016

This means that a product can undergo some technological improvement in one of its characteristics without the need for a new manufacturing process, such as the purchase of new machines and equipment. When it comes to the agroindustrial sector, the conquest of spaces in the international market depends directly on the innovative capacity of the agents and the degree of coordination between "support industries" that contribute to innovation in the sector (packaging, additives, machinery and equipment, information etc.). Consequently, for the IABs the challenges lie in the need to combine gains of scale with product differentiation in order to add value and reach segmented markets (DE PAULA and BASTOS, 2009). Innovations in the food industry are mostly incremental. According to Gouveia (2006), the major innovations occur mainly in the area of formulation of ingredients and additives, transgenic, packaging and functional foods, the development of components of the latter being the most innovations in food. Other growing trends that have stood out are organic foods, concern for a healthy diet, and semi-ready foods, for the need to reduce the time spent preparing meals.

In the medium and long term, current investments point to development in the following aspects: Microencapsulation and nanoencapsulation for the design of state-of-the-art ingredients, Chemical Image for quality control and food safety, Internet of Things, Intelligence Artificial and Big Data processes (digitalization of processes and improvements in quality control and decision making, reduction of production costs), among others. On the other hand, the steady growth of global competition and the ever-increasing demands of variety, convenience and quality by consumers pressure the food and beverage industry to differentiate their products and increase the quality of their innovative processes. The pressure also comes from the need to guarantee food safety and the nutritional quality of the products, together with the biotechnological revolution and all the new processing possibilities that it proposes (FORTUIN and OMTA, 2009). Another point to consider is that in process innovations in the food industry it is common to adapt machines and equipment already existing in the plant. These adaptations aim to allow the company to increase productivity while at the same time reducing costs, increasing competitiveness in the final price of the product (SANTINI et al., 2005). Price is a very important factor for the companies that manufacture products with low differentiation, since the competition between these products is much greater in relation to the products with greater differentiation and added value.

Therefore, it is noted that the low complexity of food processing technologies makes them more vulnerable to imitative processes and reduces their appropriateness. Thus, the sector is characterized by the significant absence of technological product ruptures; a large part of the technological advances of the sector is of incremental character, developed internally in the companies of the sector. On the other hand, technological breakdowns are usually linked to new process and management technologies, which are developed by so-called agroindustrial support industries (SIDONIO et al., 2013). De Mori (2011) states that each sector has specificities in the process of development and technological evolution, and the particularities of the production process and the profile of the final product condition the intensity and the technological dynamism of this same sector. Analyzing the definition of an innovative process, it will be possible to identify processes in which companies

develop and implement innovations in goods and services that are new to them, regardless of whether they are new to their competitors (CASSIOLATO and LASTRES, 2000). To hold a sustained advantage, it is necessary to accumulate competencies based on the new technology, making it harder for competitors to copy (Barbosa, 2009). In general, the most common effects and objectives related to technological innovation include: productivity increase, better use of inputs, product improvement (adding value and increasing the contribution margin), saving resources and reducing risks and accidents at work (RODRIGUES and ORNELLAS, 1987). According to Jamrog (2006), the most important promoters of innovation in a company are: consumer focus, teamwork, appropriate resources and organizational communication. Other important factors include the ability to select promising ideas and the freedom to innovate. On the other hand, the lack of resources and the absence of a formal innovation strategy, as well as excessive administrative regulations, constitute the biggest barriers to the success of the innovation process. The major barriers to innovation in the food industry are: (1) the lack of concrete guidelines for effective implementation of consumer-oriented development, (2) the sequential approach to the innovation process, and (3) the lack of coordination or integration between the R and D sector, marketing activities and company know-how (COSTA and JONGEN, 2006).

Regarding the culture of Intellectual Property in the IBA and its modalities, patent protection is very expensive, given the high turnover and high degree of differentiation inherent in the products. Therefore, the innovation protection methods most often used by firms are still brands and industrial secrets, which promote greater appropriability and profitability, as well as, traditionally, more strongly loyal consumers (CARVALHO and FURTADO, 2013). Although innovation studies point out that incremental changes in products and processes require less R and D support and thus are less likely to be protected by patents when compared to the radical innovations observed in high technology industries (CHRISTENSEN et al., 1996), it registered it was noted that, between 2005 and 2008, there was an increase in the use of patents as a protection method (PINTEC-IBGE, 2005/2008), which means that the generation of new knowledge for the industry could be protected. The 5th Bulletin of Technological Information in the Food Sector of the Ibero-American Industrial Property Program (IBEPI), published in May 2017, points out Brazil as a country with above-average patent performance in relation to the other component countries of the Program (Argentina, Brazil, Colombia, Costa Rica, Spain, Mexico and Uruguay). Patent applications and utility models were analyzed. Of the 569 patent applications filed in national offices of IBEPI countries in 2016, approximately 54% (306 applications) are Brazilian. Of these, 81% requested by legal entities and 14% of universities. The rest were assigned to independent inventors. Patents were mostly classified in the areas of Biotechnology (27%), Food Preservation Technology (62%) and New Technologies (11%). Figure 2 shows the ranking of patent applications in IBEPI countries. Brazil stands out with requests in the area of Food Conservation. The holders of the inventions were mostly companies, as already reported. The report points out the main depositors in these countries, according to Figure 3.

Final Considerations: The food and beverage industry in Brazil has an easily perceived importance at a global level, as we can see factors such as: the great number of

organizations/producers/services involved in this chain of business; the amount of monetary resources that it drives, the significant numbers in the generation of jobs and income, besides being a vital sector that has gained relevance with the consumer market, increasingly demanding quality, safety and sustainability. In view of the observations, there is the need and the right to protect innovations, inventions, utility models and differentiated processes developed on Brazilian soil. Given that food and beverage production in Brazil continues to grow, both quantitatively and technologically, it is essential that all the links involved in this sector address the issue, in order to guarantee and protect the knowledge behind the national product, preventing foreign companies from taking possession of the technologies developed in the national soil, or even if they have the institutional guarantees, in the case of producing on Brazilian soil. Because it is an emerging topic whose different approaches lead to controversial discussions, it is necessary to deepen the knowledge, to spread the domain, to offer a deeper analysis on the subject as well as to compare data and information of the involved markets, so that the references and practices can evolve in this time of knowledge. For this, the culture of Intellectual Property must be stimulated and at the same time practiced, under penalty of loss of the stimulus to its development. Industrial Property has been a differential in the modern economic environment, allowing not only organizations, universities and research centers, but also that nations have distinguished themselves in the global geopolitical scenario. Thus, stimulating, protecting, financing and establishing a legal framework geared towards its full development becomes strategic for developed nations.

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