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Food innovation in Brazil from the point of view of industries: an evaluation of PINTEC data

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Abstract

Data published in 2016 PINTEC (Innovation Survey), conducted by the Brazilian Institute of Geography and Statistics for the 2012-2014 triennium with 13,846 food companies, showed that only 45% innovated in products and/or processes. Acquisition of machinery / equipment was considered the most important innovative activity followed by personnel training. The products quality improvement and the productive capacity increase were the greater impacts observed. Only 9% of companies claim to spent on R&D activities. The high cost of innovation, the lack of appropriate funding and the excessive economic risks were the main problems pointed out by companies, followed by qualified personnel lack.

Keywords: Food industries; Investments; Products and/or Process; Research and Development.

1. Introduction

The Innovation Survey (PINTEC), carried out by the Brazilian Institute of Geography and Statistics (IBGE), aims at the construction of national and regional sectoral indicators of innovation activities in the extractive and transformation industries, as well as in the electricity and gas and selected services. Recognition of innovation as one of the main factors that positively impacts competitiveness and economic development underlines the importance of producing statistical data that contributes to the understanding of its process of generation, diffusion and incorporation by the productive sector as well as institutional conditions that influence it. This information constitutes of vital inputs for the design, implementation and evaluation of public policies and private strategies (IBGE, 2014)[1]. IBGE

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published the first edition of the PINTEC 2000 Technological Innovation Survey, in 2002, covering the triennium (1998-2000). Since then, four more editions of the research have already been carried out: PINTEC 2003 triennium (2001-03), PINTEC 2005 triennium (2003-05), PINTEC 2008 triennium (2006-08) and PINTEC 2011 triennium (2009-11). IBGE published the results of the sixth edition of the Innovation Survey - PINTEC 2014 triennium (2012-14), with the objective of providing information for the construction of indicators of innovation activities of Brazilian companies (IBGE, 2016).

The food industry has a share of 10.1% in the Gross Domestic Product (GDP) and 25.4% in the manufacturing industry. With regard to employment, the sector accounts for 22.4% of jobs in the manufacturing industry, where the food industry comprises 48,900 formal industrial establishments. Of these, 78.1% are micro establishments, 15.1% are small, 5.0% are medium-sized, and only 1.8% are large, according to data from 2016 of the Brazilian Association of Food Industries (Abia) [2,3]. This article aims to highlight in numbers the innovation profile of the food industry in Brazil. Statistical information regarding the level of investment in innovation, the participation of universities (and research centers) in the research and development stages of new products and / or processes, and the type of impact caused by innovation in companies are some of the data presented and discussed in this paper.

2. Material and Methods

The data used in this work were obtained directly from the 27 worksheets published by IBGE containing the data referring to Brazil, from the Research of Technological Innovation - PINTEC 2014 triennium (2012-14), published in December 2016 (IBGE,2016) [4] , in order to provide information for the construction of indicators of the innovation activities of Brazilian companies. Continuing with the adoption of PINTEC 2014, PINTEC 2014 has published its results according to the National Classification of Economic Activities - CNAE 2.0, with research activities in the extractive and manufacturing industries as well as in the electricity and gas sectors and selected services.

3. Results and Discussion

PINTEC DATA

THE PROFILE OF INNOVATIONS

In the 2012-2014 triennium, there were 115,268 processing industries participating in PINTEC, food manufacturing is part of this sector and contributed to it 13,846 companies that participated in the questionnaire (12%). Of the 13,846 companies in the food business, about 6,168 of them (44%) stated that they had implemented product and process innovations, 478 of the companies (4%) had incomplete or unfinished projects. Regarding innovations in marketing and / or organization, 3,790 companies reported introducing some innovative activity in these areas (27%).

Of the companies that implemented product and process innovations (6,168), 730 (12%) implemented only product innovations, 2,779 (45%) of them implemented

process-only innovations and 2,659 (43%) implemented product innovations and processes. It is important to emphasize that the greatest number of innovations in products and / or processes were only "new" to the company itself (already existing in the market). In the case of products for example, less than 10% represented innovation for the domestic market and in the case of process innovations for the domestic market was only 5%. There have also been cases of companies that have implemented innovations and owned other projects for innovation. This was the case of 2,948 companies. Of this total, there were companies that were with incomplete projects, abandoned and both cases. The survey shows that 45% of the companies had incomplete projects, 38% of them had abandoned projects and 17% with both cases (abandoned and incomplete). The data also show that there were companies that did not implement innovations but had projects. In total, 478 companies presented this situation, with 280 companies (58%) with incomplete projects, 176 companies (37%) with abandoned projects and 22 companies (5%) with both situations. Of the companies that have implemented innovations, it is possible to analyze the degree of novelty for the market of what was innovated / implemented. The classification levels used in the research were: if the novelty was for the company itself; if the novelty was for the national market; or whether the novelty was for the global market.

It is possible to identify that firms improve their existing processes more (62%) than their current products (42%). The opposite effect can be observed in relation to completely new products for the company (58%) and completely new processes for the company (38%).

The same happened when the innovations were declared as new for the national market. Completely new products for the national market accounted for 65% of cases and for processes, only 20%. The opposite occurred for the improvement of new products for the domestic market. Processes (80%) are more improved over product enhancement (35%). The difference is more pronounced than the previous case for new ones only for companies. It is possible to notice that there is a difference when analyzing innovation classified as new versus the world market in products and processes. It innovated more in completely new products for the company (66%) than the improvement (34%). In the case of the processes, the difference is more pronounced than in the products, being 92% of processes completely new to the company and only 8% of improved ones.

Regarding the main responsible for the development of the products and processes in the companies that implemented innovations, it is possible to identify a different profile in the attributions defined by the companies when the innovation is in product or process. For product innovations, the predominant responsibility was related to the companies themselves, representing 78% of the cases, followed by 11% in cooperations, approximately 10% with other companies or institutes and only 1% with other companies in the group. This greater proportion related to the own company can be due to the fact that research and innovation in products is an activity whose result is extremely uncertain and directly related to innumerable areas within the own company. This difference is noted when the innovations in process are

analyzed, because in this case 74% of the responsibility was attributed to other companies or institutes, 21% owned by the companies themselves, 5% in cooperation and less than 0, 5% by other companies in the same group.

Regarding the companies that implemented innovations in products and processes, 1,084 of them answered on the strategic (non-formal) protection methods used. The industrial secret was the method used by 598 companies (55%), followed by lead time in the market by 300 companies (28%), design complexity, 144 companies (13%) and other methods not mentioned, 47 companies (4%).

The companies that implemented innovations answered the questionnaire about the degree of importance of the innovative activities that were carried out. The acquisition of machinery and equipment was considered by the food industry as the most important activity, with a total of 3,517 companies (36%) prioritizing this topic of the 6,168 companies that presented innovative activities in products and processes, according to data presented in Figure 1. Training was the second most important activity for 2,326 companies (24%). On the other hand, activities directly related to research and development (R & D) were the least important for companies, both in in-house activities (490 companies, 5%) and in external (outsourced) acquisition of R & D (185 companies, 2%) for the 6,168 innovative companies in the sector.

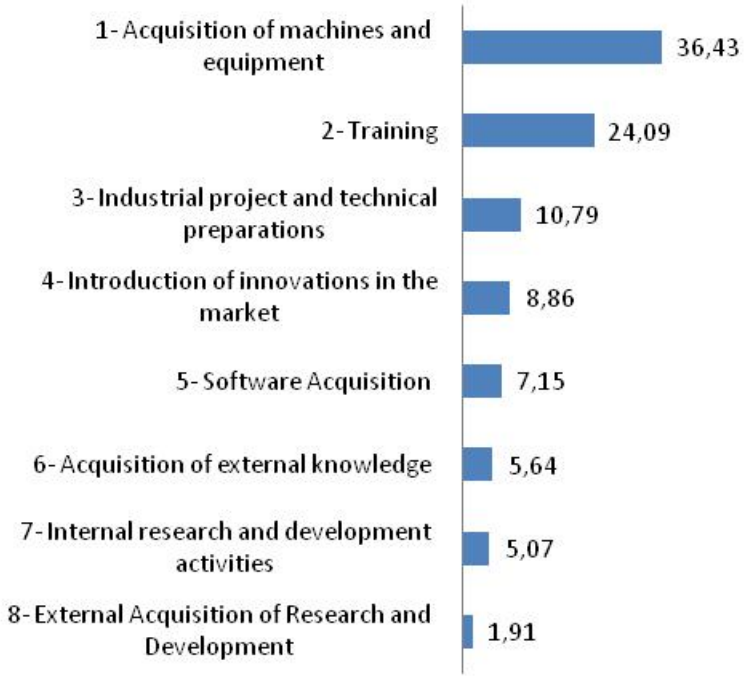

Figure 1 - Ranking of the innovative activities developed during the innovation of products and processes, considered with a high degree of importance (in percentage) by the companies of the food and beverage manufacturing segment in the period 2012-2014. (IBGE, 2016) [4].

Companies that have implemented product and / or process innovations responded if they carried out any biotechnology and nanotechnology activities. Of the 6,168 companies that implemented innovations, 1745 (28%) claimed to have carried out biotechnology activities and only 34 (0.5%) in nanotechnology. Of the 1745 that carried out activities in biotechnology, 1011 companies (58%) declared some kind of innovation by mode of use: end user, integrating user, producer and R & D, according to Figure 5. Among the 34 companies that performed activities in nanotechnology, 25 (72%) also declared some kind of innovation by mode of use.

At PINTEC (2014) it is also possible to analyze the impact caused by the innovation of products and processes by degree of importance (high, medium and low or not relevant) attributed by food companies in different areas of the business, such as: products offered, increase of production capacity, reduction of production costs and opening of new markets. Figure 2 shows the ranking of all 16 impacts assessed as high degree of importance. The improvement in product quality was the impact of the largest number of innovative companies (2286) that indicated a high degree of importance (approximately 47% of indications in this impact). Second was the increase in production capacity, whose high impact judgment was carried out by 2,773 companies (45%). On the other hand, the impacts with lower indication of high importance were related to environmental issues and natural resources, such as reduction of raw material consumption, reduction of water consumption and reduction of energy consumption, 9%, 4% and 3,5% respectively.

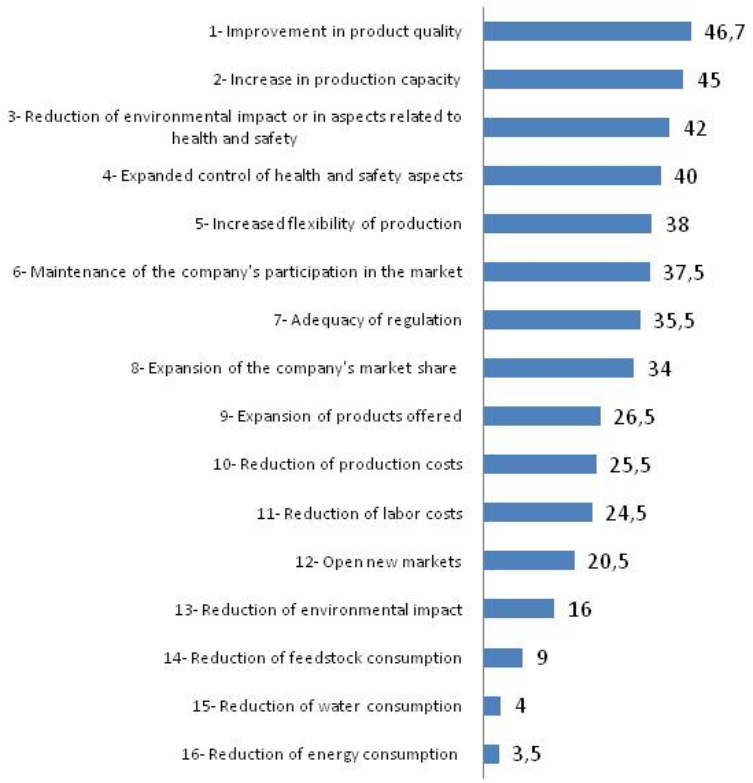

Figure 2 - Ranking and percentage of each impact caused with indication of a high degree of importance by food companies that implemented innovations in products and / or processes - Brazil - Period 2012-2014 (IBGE, 2016).

EXPENSES, FINANCING AND SALES

The data of the 4,841 innovative companies that presented expenditures with innovative activities are summarized in Figure 3. The amount that was spent in the food sector was higher than 7 billion reais, and approximately 4 billion went to the acquisition of machinery and equipment, which is directly related to the degree of importance in innovative activities pointed out by the companies. Differently from training, which, in terms of degree of importance, came in second place, but in the expenditures, training expenditure was in the penultimate position, with a value of just over 10 million reais. The values of expenditures related to in-house R & D activities deserve special mention. In the evaluation of the degree of importance of the innovative activity, in-house R & D activities rank second to last, but in the scope of expenditures, in the third, with approximately 776 million reais. The data presented in figure 8 refer to the 4,841 innovative companies (which declared expenditures in innovative activities) of the total of 6,168. Thus, 1,327 companies (21.7%) reported not having spent any on innovative activities.

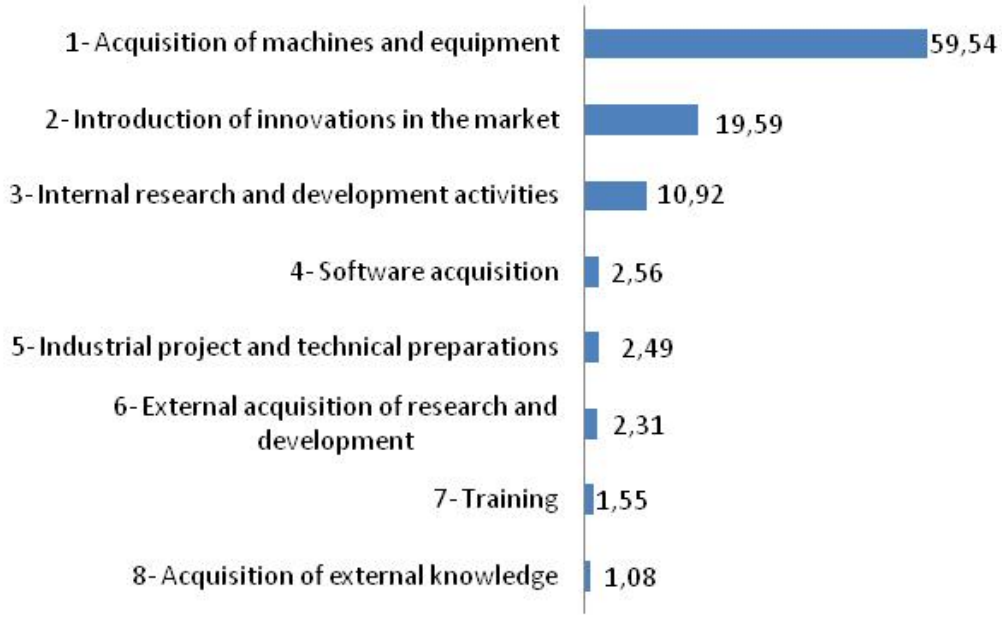

Figure 3 - Percentage of net sales revenue, indicating the amount of expenditures related to the developed innovative activities according to the activities of the food industry - Brazil - 2014 (IBGE, 2016).

The company's own financing is predominant both in in-house research and development activities and in other activities, which include external R & D acquisition (outsourcing), due to the fact that the research activity is high risk, providing positive results or damages for investors. Note that 78% of companies assumed their own R&D activities, 18% have acquired public financing and only 4% have financing from other companies or from abroad. In other innovative activities, it was possible to observe similar behavior in

financing: 77% came from own resources, 20% from the public sector and 3% from the private sector.

Regarding the expenditures made in the internal R & D activities of the companies that carried out innovations, the way the activities were carried out, whether they were continuous or occasional, was subclassified. Of the 572 companies that claimed this type of activity, approximately 80% reported continually occurring and about 20% occasionally. The amounts spent are predominantly from ongoing activities. Of the 776 million reais invested in this area, 750 million reais are for continuous activities and 26 million for occasional activities. Of the 6,168 companies that implemented innovations in the manufacture of food products, 46.5% were supported by the government. The financing was predominant as a government support program for companies, 95.5% of which were financed for the purchase of machinery and equipment used to innovate, 3% related to R & D projects without partnerships with universities and only 1.5% funding with R & D projects in partnerships with universities. Regarding tax incentives, 95.5% of the companies that had this kind of government support were with incentives for research and development under Law No. 8,661 and Chapter 3 of Law No. 11,196, while the remaining 4.5% of companies that used the tax incentive was with the ITLaw (Law No. 10,664 and Law No. 11,077).

The participation bands percentage in total domestic sales of innovative food companies that implemented new or substantially improved products. It is a natural process in the introduction of new products on the market, they do not present great initial adhesion of the consumers due to lack of confidence or knowledge on the product. This is usually one of the main reasons why sales stakes are predominantly below 40%. In addition, companies usually have a portfolio of products that are superior in marketing (in number) to innovators, which provides a dilution factor for the share of innovations. However, it is possible to notice that 43% of companies indicated that new or substantially improved products had a share of 10% to 40% in total sales.

R&D STAFF

Regarding the occupation of workers involved in-house R & D activities within the food industries that implemented innovations in products and / or processes, it can be noted that out of the total of 6,237 employees in the R & D area, 49.5% are of exclusive full-time dedication and 50.5% of part-time dedication. PINTEC also presents the data of full-time employed people in in-house Research and Development activities, obtained from the sum of the number of people in exclusive dedication and the number of people in partial dedication, weighted by the average percentage of dedication in the activities of R & D within companies. In this case, 4,039 employees are presented for all of Brazil in in-house R&D. People engaged in in-house research and development activities in the role of researchers and technicians can be divided according to the level of qualification. PINTEC pointed out that the number of graduates was predominant among researchers, representing 70% of the total. For the role of technician, only 34% of professionals are graduates. Among the researchers, the percentage of people who have fundamental or high school level is only 13.5%, and among technicians, this percentage is 66%. It is worth was built based on the number of professionals on a full-time basis, the percentage remains the same when the comparison is made with professionals on a part-time basis.

In the food industry, one out of every three researchers are female. These data, despite showing a great gender imbalance, can still be considered favorable in Brazil since it

is above the general average for all the activities of the evaluated industries from PINTEC 2016, which is one woman out of every five researchers.

SOURCES OF INFORMATION AND PARTNERSHIPS

Sources of information for the innovations was also a topic addressed by PINTEC 2016 with the food industries. Figure 4 shows that the "computerized information networks" was predominant among the mentioned options, ranking approximately 50% of high degree importance. Suppliers followed up with 34% and customers with 33%. Other sources used are also organized by degree importance in figure 4.

The universities, research and testing institutions were one of the last to rank high in the information sources according to industries, with less than 10% each among the 6,168 companies that innovated in food, being ahead only of "other group companies".

Figure 4 - Ranking and percentage of sources of information, indicated as high importance by food companies - Brazil - Period 2012-2014 (IBGE, 2016)

The sources of information by location were divided into: Brazil or abroad. It is noted that, even though there were some small changes in the classification of information sources, the computerized information network (83.5%), customers (77%) and suppliers (75%) maintained the lead. The same behavior also occurred for the sources pointed out as with less importance: institutions of tests, tests and certifications; universities or other higher education centers and research institutes or technology centers. It is worth mentioning that these sources that remained in the last positions presented values below 40%. In addition,

the sources of information from abroad were less used by the food innovation companies responding for less than 5% of the total of the companies.

Of the 6,168 food companies that implemented innovations, 11% performed in partnership with some other organization. In addition to the partnerships, the companies also reported the importance of each partnership. It is possible to verify that the companies evaluate as more important the partnerships with the suppliers. This characteristic can be explained by the fact that the suppliers present great proactivity with the food companies, seeking to maintain the existing commercial relationship or the construction of new business opportunities. However, the influence of final customers in the partnership can be interpreted mostly because of the easy-to-do interaction provided by the communication channels that offer feedback to the entrepreneurs on customer`s needs and expectations. Universities, in this respect, appear in the third position.

Regarding the cooperation relations with other organizations, 685 companies (10% of the companies that innovated) responded to the question of cooperation. 432 companies (63%) claimed that the object of the most used cooperation was with suppliers, 340 companies (50%) with customers or consumers whereas the least used relationships were with other companies in the sector with 144 companies claiming that (21%) and Centers for professional training and technical assistance with 120 companies (18%). It must be emphasized that the object of cooperation was in relation to the R&D sector and trials for product testing.

COMPANIES THAT DO NOT INNOVATE AND PROBLEMS IN INNOVATION

Of the 13,846 companies manufacturing food products interviewed by PINTEC 2012-2014, 52% did not implement innovations and did not have projects. Market conditions were the main cause pointed out by not having implemented, representing 50% of the total of the companies that did not innovate. Previous innovations accounted for 22% and other impeding factors accounted for 28% of the causes.

Barriers to innovation are shown in Figure 5. The high cost of innovation was the main problem and obstacle identified as a reason for non-innovation by food companies with a 57% indication as high degree of importance, according to the survey, followed by excessive economic risks (49.5%) and the lack of appropriate sources of financing (43.5).

Of the food companies that implement innovations, the high costs of innovation were pointed out by 51.5% of companies as a problem and obstacle with the highest degree of importance. Also highlighted were the difficulties represented by the scarcity of appropriate sources of financing (41.8%) and excessive economic risks (41%). As a result, obstacles of economic nature have once again emerged as the main obstacles to innovation. Nevertheless, the lack of qualified personnel (23.5%) also reached the fourth position in the ranking of innovation bottlenecks.

Figure 5 - Ranking and percentage by high degree of importance of the problems and obstacles pointed out as reasons for not innovating of food companies that did not implement innovation and without projects due to other factors - Brazil - Period 2012-2014 (IBGE, 2016).

ORGANIZATIONAL AND MARKETING INNOVATIONS

There was also the case where the companies did not innovate in products or processes, but they carried out organizational or marketing innovations. Of the 7,199 companies that did not innovate in products and processes, 77% made organizational innovations and 42% innovations in marketing. Organizational innovations were subdivided into four areas: management techniques (33.7%); environmental management techniques (25.5%); work organization (28%); and public relations (12.5%). In marketing, 42.3% of companies implemented innovations in marketing concepts and strategies and 57.7% in aesthetics, designs or other changes. It has been implemented much more in organization than in marketing in the category of companies that have not implemented products or processes but have implemented in other topics.

There are companies that have implemented in products and processes and also innovated in organization and marketing. Of the 6,168 innovative companies in products and processes, 73.5% of them also implemented organizational or marketing innovations. From the organizational level, 32.8% implemented innovations in management techniques, 20.8% in environmental management techniques, 34.6% in work organization and 11.8% in public relations. From marketing, 44.6% of companies innovated in concepts and marketing strategies and 55.4% in aesthetics, designs or other changes. Finally, some companies did not implement innovations in products and processes but had projects that were able to

implement organizational and marketing innovations. Of the 478 companies in this situation, 37.7% innovated in management techniques, 16.2% in environmental management techniques, 36% in work organization and 10% in public relations. Approximately 20% of these companies implemented innovations in more than one organizational area. In the marketing question, 66% of companies that had projects implemented innovations, 49.2% in marketing concepts and strategies and 50.8% in aesthetics, design or other changes.

4. Conclusions

In the triennium of 2012-2014, PINTEC data show that 36% of companies in all segments in Brazil introduced innovations in products and processes. For the food industry, the report shows that 44.5% of the interviewed companies implemented product and / or process innovations in the same period. These values show that the food industry is above the general average of the Brazilian industrial innovation profile. However, food companies are still far from showing a strong appetite for innovation when we look at and compare data with the soap, detergent, cleaning products, cosmetics, perfumery and personal care industry, which 64% of companies implementing innovations in products and processes in the same triennium. The research also showed that innovations were much more in processes than in food products, pointing out that only 10% of innovative companies created new products for the domestic market. It is also noted that the focus of innovation aimed at improving products, such as quality improvement to the detriment of creation of new products in the search for market opportunities not yet exploited.

Acknowledgments

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