

# **CORRELATION BETWEEN SCIENTIFIC PRODUCTION, R&D, INNOVATION AND PATENTS IN THE FUNCTIONAL FOOD SCENARIO**

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## **Abstract**

*Patent filing is considered an index of a country's industrial development, it contributes to the strengthening of research, innovation and production of technological knowledge, that is, patents are considered relevant indicators to assess the country's ability to transform scientific knowledge into products or technological innovations. Thus, the study aimed to investigate whether scientific advancement, R&D and innovation in research institutions or companies are linked to the evolution of the quantity of patent filings in the area of functional food production. The methodology had a descriptive and quantitative nature, in relation to the study variables, they were obtained as follows: a) Patent variable was obtained from Espacenet; b) Scientific articles obtained from the Web of Science (WOS) database; c) The data on the variables (Innovation Index) were obtained by accessing the [countryeconomy.com](http://countryeconomy.com) website; d) The variables (Manufactured Value Added, R&D, High Technology*

Exports) obtained from The World Bank DATA database. The data collection of the variables began in January/2021 and ended on March 22, 2021. To identify the correlation of these variables, Spearman's correlation coefficient was used, and for a better interpretation of the data and answers, the research hypotheses were analyzed from the scatter plot using the logarithmic transformation of the patent variable. The results and discussion showed a weak correlation  $\rho = 0.3038$  between scientific production (articles) x patent filing aimed at the production of functional foods; positive correlation and a moderate degree ( $\rho = 0.6413$ ) regarding investments in research and development x patent filing and a positive and weak correlation ( $\rho = 0.2903$ ) regarding the innovation index x quantitative patents. In the final considerations, it is essential that governments provide the right and necessary incentives to foster the development and dissemination of ideas by the private sector whose objective is to promote a political, economic and institutional environment that encourages companies to invest in science, technology, R&D, intellectual property and innovation.

**Keywords:** Scientific production, Innovation, R&D, Patents

## 1. Introduction

Patent filing is considered an index of a country's industrial development, it contributes to the strengthening of research, innovation and production of technological knowledge, that is, patents are considered relevant indicators to assess the country's ability to transform scientific knowledge into products or technological innovations (OLIVEIRA; PAVANELLI, 2016).

With regard to technological production, universities play a key role in relation to the filing of patent filings in countries. Jorge et al. (2018) corroborates a statistical analysis by the National Institute of Industrial Property - INPI, among the ten largest patent applicants for inventions residing in Brazil, universities prevail in the first positions.

The volume of peer-reviewed publications and the number of patent filings filed can provide information on the development of scientific and technological capacity worldwide. Analyzing the Brazilian performance in scientific production, a study carried out by the Ministry of Science, Technology, Innovations and Communications – MCTIC (2017), using scientific journals indexed by *Scopus*, found the significant growth of Brazil, in scientific publications with worldwide visibility each year.

The analysis of patent filings allows us to measure part of the results of the innovation activities of companies that come from the acquisition and development of the codified knowledge base and expansion of technical skills in the various scientific fields (FORNARI; GOMES; CORREA, 2015).

In this context, investment in Research and Development (R&D) is a globally established indicator to measure the innovation efforts of companies, regions and countries. The same occurs with the number of patents generated. These two indicators are often incorporated into studies that assess technological dynamism (FAN, GILLAN; YU, 2013).

Scudeler and Oliveira (2013) emphasize that the intellectual creation protection system is directly related to the technological development of a country. The absence of an effective system of recognition and protection of creative activity creates a barrier in the capacity for innovation, and economic stagnation of

countries especially to the underdeveloped ones.

In view of the above, the study in question was justified by understanding the relationships between the efforts of research institutions, companies in filing patents for their inventions and how this has an impact on scientific production, innovation, research and development so that the industry offers functional foods that increasingly meet consumer expectations, as well as boosting the socioeconomic development of a country or region. These factors corroborate so that there are public policies that fund R&D spending, stimulate interaction between research institutions and the productive sector among other strategies, which will promote the strengthening of the competitiveness of the economy in international markets. In this context, the following hypotheses were constructed:

- a) There is a positive and strong correlation between scientific production and the quantity of patent filings in the area of functional foods;
- b) There is a positive and strong correlation between investment in R&D and the quantity of patent filings in the area of functional foods;
- c) There is a positive and strong correlation between the innovative process and the amount of patent filings in the area of functional foods;

Thus, the study aimed to investigate whether scientific advancement, R&D and innovation in research institutions or companies are linked to the evolution of the quantity of patent filings in the area of functional food production.

## **2. Theoretical Foundation**

### **2.1. Scientific Production**

The analysis of scientific production contributes to identify and visualize the behavior of scientific communities, institutions, subjects, areas of knowledge and countries, highlighting their scientific elite, research front, more vigorous themes, as well as the links within and between these instances, among others. Since its inception, Bibliometrics has played an important role in this context, by consigning the indicators for the analysis of science (ALMEIDA; GRÁCIO, 2019).

Júnior; Costa (2015) argue that the increase in the production of scientific papers enables a firmer process of access to journals, especially those with a higher impact factor, thus ensuring a higher quality of what is conveyed. Over time, citations were adopted as a *proxy* for the impact and, consequently, the quality of scientific papers.

With the advancement of New Information and Communication Technologies - NICTs, *online* journals have gained prominence due to the fact that it allows the dissemination of information on a global scale. Due to the convenience provided by such technologies, today there are numerous scientific publications, which presupposes the need to establish standards and criteria that determine the editorial quality of these vehicles, ensuring that the scientific community can choose and identify which of these have greater credibility (SANTOS; RABELO, 2017).

In the case of Brazil, Law 9.394, of December 20, 1994, established guidelines and bases for national education, establishing that universities should integrate as research institutions to the National System of Science and Technology, brings the purposes of higher education in its 43rd article. Among the main

intentions are:

I - encourage cultural creation and the development of the scientific spirit and reflective thinking;

II - train graduates in the different areas of knowledge, suitable for insertion in professional sectors and for participation in the development of Brazilian society, and collaborate in their continuous training;

III - foster the work of scientific research and investigation, aiming at the development of science and technology and the creation and dissemination of culture, and thus develop the understanding of mankind and the environment in which they live;

IV - promote the dissemination of cultural, scientific and technical knowledge that constitutes a heritage of humanity and communicate knowledge through teaching, publications or other forms of communication;

V - arouse the permanent desire for cultural and professional improvement and enable the corresponding realization, integrating the knowledge that is being acquired in an intellectual structure that systematizes the knowledge of each generation;

VI - to foster knowledge of the problems of the present world, in particular national and regional ones, to provide specialized services to the community by establishing a relationship of reciprocity;

VII - promote extension, open to the participation of the population, aiming at the dissemination of the achievements and benefits resulting from cultural creation and scientific and technological research generated in the institution (BRASIL, 2021).

## **2.2. Patents**

For large multinational companies, commercial organizations and research centers and universities, research in the area of patents is becoming increasingly relevant. According to the World Intellectual Property Organization (WIPO) Report, much of the world's Research & Development (R&D) results are covered in patent publications (OLIVEIRA; PAVANELLI, 2016).

The patent is a competitive resource available to organizations, due to the monopolistic exploitation of a given product or production process, a privilege capable of creating or adding value to the wealth of companies and their partners. Patent documents and their information have, in general, the observance of different purposes, such as: 1) guaranteeing intellectual property rights; 2) Science, Technology and Innovation indicator; and 3) source of technological information (MACHADO et al., 2018).

The filing of the patent for an invention confers exclusive rights for the holder to use and exploit the invention, allows a strong position in the market in the face of competition, returns on investment in research adding value to the inventor, improves the business image by being recognized by the high level of technical knowledge, stimulates competitors to seek alternative innovations, facilitates the monitoring of research activities of competitors from technological prospecting, maps strategic sectors of innovation and avoids duplicity of research and development (PINTO; SILVA; SILVA, 2017).

## **2.3 Innovation**

Schumpeter defined innovation as the introduction of a new good, the introduction of a new production method, the opening of a new market, the conquest of new sources of supply and the establishment of new forms of organization (LAPPE; POLI; MAZZIONI, 2017).

The definitions linked to the term innovation may vary in theory, but all emphasize the need to involve the

aspects of development and deepening of new knowledge, not only of its invention, since “innovation is more than simply having good ideas; it is the process of making them evolve to the point of having a practical use” (TIDD; BESSANT, 2015).

The Oslo Manual (2007) defines innovations in four dimensions: product innovations, process innovations, organizational innovations and *marketing* innovations. Souza and Faria (2013) understand that product innovation is when a company offers the market new or significantly improved goods and services, improving its form and capacity of use. By meeting the wishes of customers or consumer market launching new products or services, the company in question will have a greater prominence when compared with other companies in the same segment (GONÇALVES FILHO, VEIT and MONTEIRO, 2013). Process innovation would be changes in the production method or in the way of providing products or services, including the implementation of changes in techniques, equipment or software used (LAPPE; POLI; MAZZIONI, 2017).

Marketing Innovations refers to any marketing method (product/packaging design, positioning, pricing, promotion, among others) as long as it has been used for the first time in the company (GUIMARÃES; TANURE; GRIEBLER, 2017).

Scarpelli; Junior (2013) mention that the initiative of the Organization for Economic Cooperation and Development - OECD was to seek an international standardization of the methods of collecting and disclosing the results of innovation indicators linked to economic development research, to mention:

- I. Expenditures and personnel directly applied in Research and Development - R&D;
- II. Balance of payments of intangible asset transactions (Patents) – financial and/or economic circulation (transactions) between licensees and holders of intangible assets (patents, *know-how*, industrial models and designs, trademarks and franchises, technical services and financing of industrial R&D abroad);
- III. Technological innovations of products and processes in companies, that is, stimulate investments in innovation and its impact on business recognition and satisfactory positioning in specific rankings;
- IV. Evolution of the number of filings and granting of patents;
- V. Human resources engaged in scientific and technological activities;

The dynamics of the markets are affected by several factors, ranging from the socioeconomic conditions of consumers, to the ability of a firm to present an innovative product for consumption. Technological and innovation advances have contributed to the economic development of countries over the decades. Much has been attributed to the level of qualification and education of workers, as one of the most important factors in productive growth and improvements in all aspects. In a way, innovation has become, for many companies, the main competitive strategy for survival and growth, in addition to the possibility of taking advantage of market opportunities, generating competitive advantages (TALE; JÚNIOR; VACCARO, 2016).

This context shows that success in the global competition of the 21st century is subordinated to the development of products that are innovative and that provide a quick response to companies (ARCURI, 2016).

De Mori (2011) considers that studies on technological patterns and technical changes in agro-industrial

production systems promote the understanding of the evolution of sector dynamics, thus allowing the monitoring and targeting of strategic activities related to Science, Technology and Innovation (ST&I) (RAIMUNDO; BATTLE; TORKOMIAN, 2017).

In the world competitive market, it is believed that companies that have a higher technological and innovative performance are able to obtain higher rates of economic development, as well as serving the domestic market of the country still provides their segments of operation for the foreign market. In this way, the resources accumulated by industries can contribute to job creation, improve quality of life and economic growth (SILVA, 2016).

Competitiveness is achieved by strengthening the bases of the national economy, increasing the economic, industrial and business competitiveness of a country, introducing cutting-edge technology, innovation, intellectual property protection, and the training of skilled and entrepreneurial labor (JULIEN, 2017).

### **2.4 Research & Development - R&D**

From the distinction between research (R) and development (D), Christensen (1995) separates the assets involved in technological development into four groups: scientific research, which relates to the stock and development of new knowledge – originates in the development of basic sciences or the link between basic and applied science; process innovation, including production technologies (equipment, system integration and work organization); product innovation, referring to resources and capabilities necessary for activities related to the improvement and/or creation of new products; and aesthetic design, which includes product aesthetics, packaging, brands, among other aspects related to the promotion and marketing of the product – very important because it is the direct interaction between producers and customers (FORNARI; GOMES; CORREA, 2015).

Since 2005, the importance of information and research networks as sources of information for innovative development has grown considerably. Technological advances in terms of information technology, as well as the importance of licensing and patents and testing, testing and certification institutions, explain and justify this situation (RAIMUNDO; BATTLE; TORKOMIAN, 2017).

R&D institutes, therefore, contribute to the development and maintenance of national economies through interaction with industry and innovation systems, by providing technical services to foster their innovative activities (ALBERT *et al.*, 2016).

## **3. Methodology**

The research in question, has a descriptive and quantitative nature, in relation to study variables were obtained as follows: a) Patent variable was obtained in *Espacenet* because it is a database of the European Patent Office (EPO), which allows the research and analysis of more than 120 million government patent documents worldwide, from more than 100 countries; b) The scientific articles obtained from the *Web of Science* (WOS) database is presented as the largest scientific information platform, which aggregates the analysis and evaluation of the scientific quality of publications; c) The data of the variables (Innovation and Competitiveness Index) of the main patent applicants were obtained by accessing the *countryeconomy.com* website; d) The variables (Manufactured Added Value, R&D, High Technology



Export) were obtained from the *World Bank DATA* base . The data collection of the variables began in January/2021 and ended on March 22, 2021.

To identify correlation of these variables, Spearman's correlation coefficient analysis was used. The Spearman coefficient ( $\rho$  or rho) is the most used to evaluate the correlation between two ordinary quantitative variables, when the data are interpreted by ranks ordered and when there is a need to analyze the ranking of variables. For the purpose of representativeness of the analysis between two or more variables by Spearman correlation, the values assume values from -1 to +1, passing through zero when there is no correlation of the variables, however, if it is closer to these extremes, the greater the association between the variables The positive coefficients ( $\rho > 0$ ) indicate direct correlation between the variables, the closer it is to these extremes, the greater the association between the variables; negative coefficients ( $\rho < 0$ ) mean an inverse correlation, that is, the higher categories of one variable are associated with lower categories of the other variable (MIOT, 2018). Table 1 shows the classification of Spearman's Correlation Coefficient.

Table 1- Classification of Spearman's Correlation Coefficient. ( $\rho$ )

Value of r (+ or -)	Correlation Classification
0.00 to 0.19	Very weak
0.20 to 0.39	Weak
0.40 to 0.69	Moderate
0.70 to 0.89	Strong
0.90 to 1.00	Very Strong

Source: (MIOT, 2018).

The Spearman Correlation Coefficient is calculated with the following expression:

$$r = 1 - \frac{6 \sum_i d_i^2}{(n^3 - n)}$$

- n is the number of pairs (xi, yi);
- $d_i = (x_i \text{ ranks among } x \text{ values}) - (y_i \text{ ranks among } y \text{ values})$ ;

Note that if the points of x are exactly equal to the points of y, then all  $d_i$  will be zero and r will be 1.

#### 4. Results and Discussion

The Global Innovation Index (GII) was developed jointly by Johnson Cornell University, World Intellectual Property Organization (WIPO) and The Business School for the World (INSEAD), in 2007, classifies the innovative capacity of countries based on the following parameters: (1) Institution and Policy, (2) Human Capacity, (3) Infrastructure, (4) Technological Sophistication and (5) Business Markets (AMON-HÁ, *et al.*, 2019).

Table 2 shows the *ranking* of the 31 patent applicant countries in the area of functional foods. Switzerland presented its best position, in the ranking of the countries that most innovated, obtaining a score of (68.4), in 2nd place appears the Netherlands (63.32), 3rd place Sweden (63.08), 4th place the United Kingdom

(60.13) and in 5th place Singapore (59.83).

South Korea, which is the largest holder of patent filing (7597), ranks 12th in the innovation *ranking* with *score* (56.63); soon after that comes Russia with 2274 patents in the 46th position with *score* (37.9) and in 3rd place the United States with 1784 patent filing *ranked* 6th in the innovation ranking with *score* (59.81). The growth in South Korea's innovation index was due to the government's incentive, there was the installation of research and development (R&D) centers, stimulating domestic technology production, making the country increasingly independent and self-sufficient in innovation (FORTUNE, 2018). Russia, on the other hand, has the Namdiatream project, which was considered the best European project in the area of nanotechnologies, stimulating the expansion of research in this area (SPUTNIK BRASIL, 2015). Brazil ranked 64th in the Innovation Index in 2018, rising five positions since 2017. The country has advanced due to investments in creative products, business sophistication, scientific knowledge and technology. The upward movement of Brazil in the Institutions was due to the removal of the variable ease of payment of taxes. (DUTTA *et al.*; 2018).

Table 2 – Ranking and Innovation Index of the main patent applicant countries in the area of functional foods

COUNTRIES	INNOVATION RANKING	INNOVATION INDEX
Switzerland	1°	68.4
Netherlands	2°	63.32
Sweden	3°	63.08
United Kingdom	4°	60.13
Singapore	5°	59-83
United States	6°	59.81
Finland	7°	59.63
Denmark	8°	58,39
Germany	9°	58.03
Ireland	10°	57,19
Israel	11°	56,79
South Korea	12°	56,63
Japan	13°	54,95
China	14°	54,62
Luxembourg	15°	54,53
France	16°	54,36
China	17°	53,06
Canada	18°	52,98
Australia	20°	51,98
Czech Republic	27°	48,75
Spain	28°	48,68



<b>Italy</b>	31°	46,32
<b>Malaysia</b>	35°	43,16
<b>Poland</b>	39°	41,67
<b>Ukraine</b>	43°	38,52
<b>Russia</b>	46°	37,9
<b>Romania</b>	49°	37,59
<b>India</b>	57°	35,18
<b>Brazil</b>	64°	33,44
<b>Iran</b>	65°	33,44
<b>Argentina</b>	80°	30,65

Source: Prepared by the author based on countryeconomy.com data (2021).

Initially, the statistical tests of Spearman correlations were performed as described in table 3, in which it was possible to identify evidence of the positive and frank relationship between the Production of Scientific Articles x Patents  $\rho = (0.244)$ ; and a moderate relationship between Innovation Index x Patent  $\rho = (0.515)$ ; R&D x Patent  $\rho = (0.588)$ .

Table 3 – Spearman Correlation Map

	<b>Article</b>	<b>Patent</b>	<b>Innovation Index.</b>	<b>R&amp;D</b>
<b>Article</b>	1	0.244	0.176	0.415
<b>Patent</b>	0.244	1	0.515	0.588
<b>Innov. Ind.</b>	0.176	0.515	1	0.782
<b>R&amp;D</b>	0.415	0.588	0.782	1

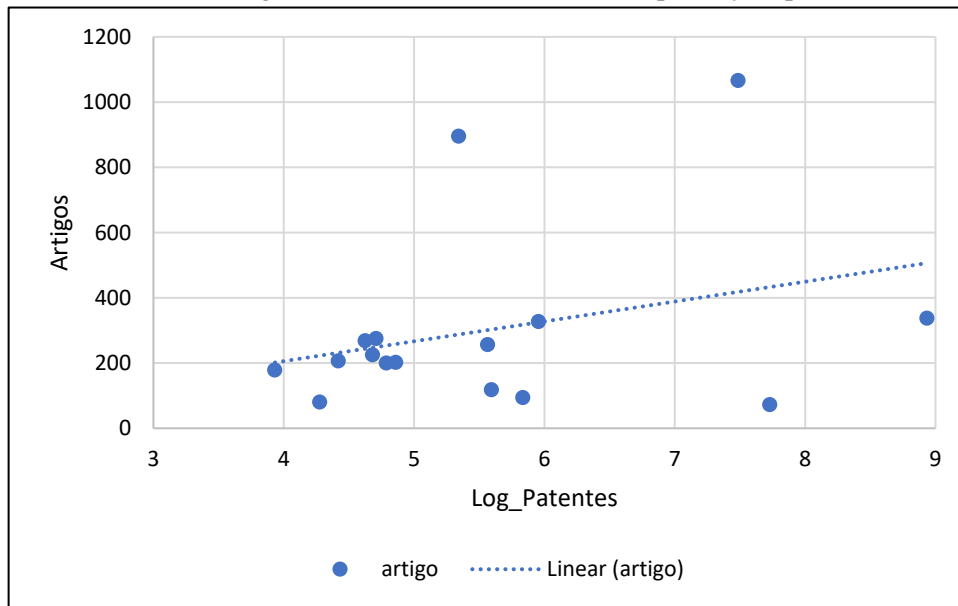
Source: Made by the author (2021).

Secondly, to facilitate the understanding of the data, better interpretation of the data and answers to the research hypotheses, an analysis was performed based on the scatter plot using the logarithmic transformation of the patent variable. In Figure 1, when crossing the variables, evidence of weak correlation was found  $\rho = 0.3038$  between scientific production (articles) x patent filing aimed at the production of functional foods, that is, a small impact between the variables, but not so sensitive to a linear relationship between two variables. It is observed that the country Japan was in the linear line presented logarithm of patents (5,955837369) and production of articles in the WOS base (327), which shows a strong correlation between these variables, other countries respectively had close to the line as Italy, India, Brazil, with logarithm of patents (4.709530201); (4.624972813); (4.418840608); (4.787491743); (3.931825633) and production of articles (275); (268); (206); (200); (178), while the United States and China, considered as the holders of patents respectively logarithm of patents (7.486613313); (5.342334252) and production of

articles (1066); (895) were well away and above the linear line showing that scientific production does not follow the pace of filing and patents in these countries. Not so different happened with the countries of South Korea and Russia with respectively logarithmic patents (8.935508712); 7.674 and production of articles (337); (72).

Even presenting differences between scientific articles and patents, both complement each other in the scientific-technological scenario, representing the consolidation of knowledge, science and technique.

Figure 1 – Correlation of articles x quantity of patents

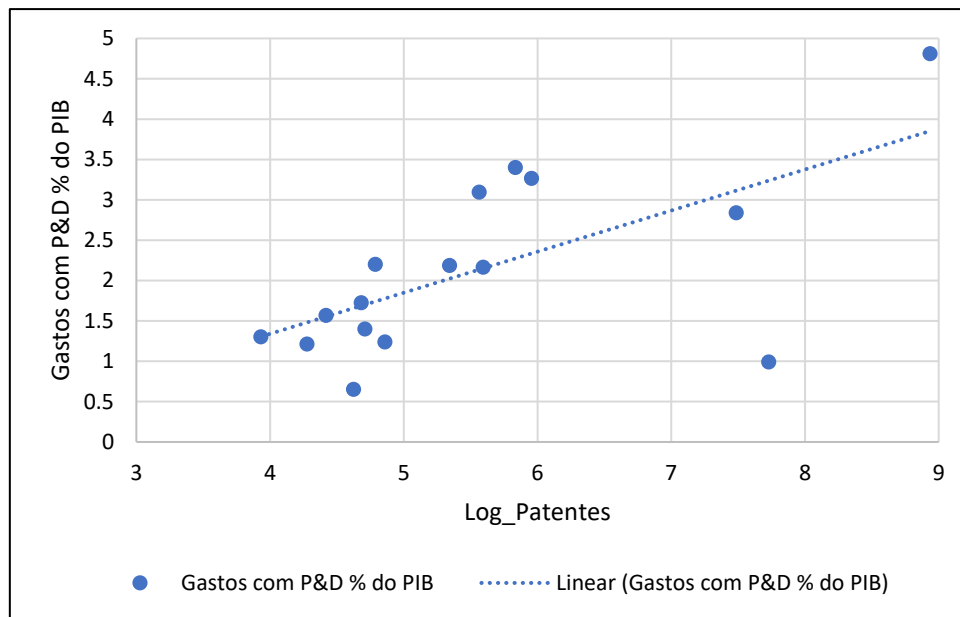


Source: Made by the author (2021).

With regard to figure 2, which comprises R&D expenses % of GDP x quantity of patents, it showed a positive correlation and a moderate degree of correlation ( $\rho = 0.6413$ ), that is, the more investments in research and development in universities and in the food industry, the greater the probability of patent deposits of technologies, products and ingredients for the production of functional foods and consequently expansion of more innovative and attractive products for the local and international market. The countries, respectively, such as Brazil, Canada, the Netherlands and the United Kingdom, were in the linear line in the dispersion chart, presenting patents logarithm(3.931825633); (4.418840608); (5.59471138); (4.682131227) and R&D % of GDP (1.3); (1.56625); (2.16374) and (1.72412). Evidence of a correlation between R&D and patent filing. Although South Korea and Russia presented respectively logarithmic patents (8.93550871150322); (7.72929567431048) and R&D % of GDP (4.81009); (0.98988) both were well away from the linear line, the first one was above the line and Russia was below. In the case of South Korea, even though they do not present a correlation of the variables, they foster R&D in other fields of research. According to the researcher at the Korean Institute for Industrial Economy and Commerce (KIET), Lee Hang-Koo, South Korea has achieved success in entrepreneurial industrial policy with government support; low capital price; extremely dedicated employees; technological innovation; vertically integrated industrial structure; well-developed related industries (LETTER IEDI, 2018). Patents are paramount as a way to recover R&D costs when they are ascending, including the existence of deep

uncertainties regarding their results, particularly at a stage of technological development in which the market structure is not yet defined (GALINA, *et al.*, 2008).

Figure 2– Correlation of expenses with R&D % of GDP x quantitative of patentes



Source: Made by the author (2021).

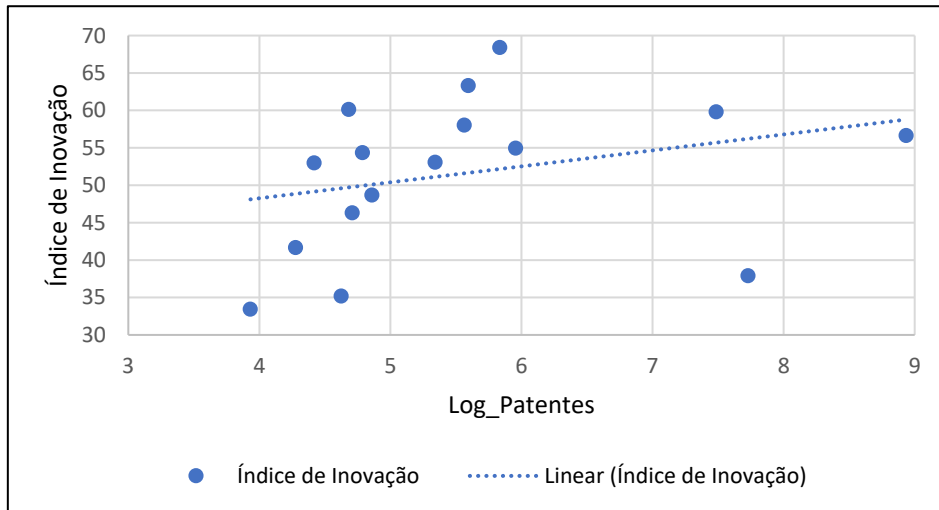
Figure 3 shows that after the logarithmic transformation of patents, the correlation of the innovation index x quantitative of patents remained positive, but weak ( $\rho = 0.2903$ ), before the transformation the value was ( $\rho = 0.515$ ) as shown in table 3 – Spearman Correlation Map.

The countries that most distanced themselves from the linear line located on the axis of the top were Russia, Switzerland, and the Netherlands, with respectively logarithmic patents (7.72929567431048); (5.8348107370626); (5.59471138); and innovation index ( 37.9); (68.4); (63.32). Switzerland stands out, even though it does not show the correlation of the innovation index x quantity of patents, it is important to emphasize that the company Nestlé is headquartered in this country and concentrates great efforts to incorporate new functional products, increasing diversification towards a more technology-intensive industry, such as pharmaceuticals.

Brazil was on the axis of the lower part, presented a departure from the linear line in the graph and weak correlation between the innovation index x quantitative of patents, however, it is notorious that from the Innovation Law No. 10,973 there were great advances in the research, for example many researchers linked to public institutions were able to partner with private companies, in addition to regulating the commercialization of intellectual property resulting from this interaction. This legal measure allowed both public and private initiatives to share physical, human, material and financial resources (DE NEGRI, 2018). Spain, China, South Korea, France and the United States with patent logarithm (4.85981240436167); (5.34233425196481); (8.93550871150322); (4.78749174278205); (7,48661331313996) and innovation index (48.68); (53.06); (56.63); (54.36); ( 59.81) were close to the linear line and with greater evidence of correlations of the 2 variables. China works rapidly to consolidate a sophisticated and results-oriented innovation support system, following market trends, this country has implemented its 13th Five-Year Plan,

prepared for the period from 2016 to 2020, weaves as the following priorities: Innovation as a strategy to achieve economic and social development.; Support for the development of advanced manufacturing.; Focus on emerging industries, including biotechnology, low-carbon industry, information technologies and new materials; and on strategies such as aerospace, nuclear and life sciences (ZANCUL, *et. al*; 2018).

Figure 3– Correlation between innovation index and quantitative of patentes



Source: Made by the author (2021).

Nowadays, the developed and developing economies of all market segments promote innovation to achieve economic and social development. There is an awareness that innovation should occur in all domains of the economy and not only in *high-tech* companies and in technological sectors. The result is that economies have firmly focused their attention on the creation and conservation of solid and dynamic innovation networks and ecosystems (VICENT; LANVIN; DUTTA, 2019).

### 5. Final Considerations

Thus, the study aimed to investigate whether scientific advancement, R&D and innovation in research institutions or companies are linked to the evolution of the quantity of patent filings in the area of functional food production.

Thus, it identified that in the global innovation index, South Korea is the largest holder of patent filing 7597 ranking 12th in the innovation *ranking* with *score* (56.63); then comes Russia with 2274 patents in the 46th position with *score* (37.9) and in 3rd place the United States with 1784 patent filing ranked 6th in the innovation ranking with *score* (59.81). Brazil occupied the 64th position in the innovation *ranking*, rising five positions compared to 2017.

Responding to the hypotheses of the study showed a weak correlation  $\rho = 0.3038$  between scientific production (articles) x filing of patents aimed at the production of functional foods; positive correlation and a moderate degree ( $\rho = 0.6413$ ), regarding investments in research and development x patent filing and a positive and weak correlation ( $\rho = 0.2903$ ) regarding the innovation index x quantitative patents.

The United States and China, considered as the holders of patents respectively logarithmic patents

(7.486613313); (5.342334252) and production of articles (1066); (895) were well apart and above the linear line showing that scientific production does not follow the pace of filing and patents in these countries. Although South Korea and Russia presented respectively logarithmic patents (8.93550871150322); (7.72929567431048) and R&D % of GDP (4.81009); (0.98988) both were well away from the linear line.

Spain, China, South Korea, France and the United States with patent logarithm(4.85981240436167); (5.34233425196481) ;(8.93550871150322) ;(4.78749174278205); (7.486613313996) and innovation index (48.68) ; (53.06) ;(56.63); (54.36);( 59.81) were close to the linear line and with greater evidence of correlations of the 2 variables.

Therefore, it is essential that governments offer conditions for institutions, companies to continue implementing technological innovation, transform science into assets for the market and society, so it is essential that our researchers and managers have the right tools to foster progress whose objective is to promote a socioeconomic and institutional environment linked to the development of science, technology, R&D, intellectual property and innovation.

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