

Survey of Patents involving the plant *Moringa oleifera*

Levantamento de patentes envolvendo a planta Moringa oleifera

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ABSTRACT: A current and growing trend in the pharmaceutical, cosmetics and food industry is the development of natural products, especially of plant origin. The plant surveyed here, *Moringa oleifera*, has various biological properties and is also being used to purify water for human consumption. This study aims to evaluate the use of *Moringa oleifera* analyzing patents based on information collected between the period from 1995 to 2015 using the databases of the World Intellectual Property Organization (WIPO), European Institute of Patent Office (EPO) and National Institute of Industrial Property (INPI). The parameters analyzed were the quantity, the filing date, the title, the abstract, the applicant, the inventor, the international classification and technological focus. These results demonstrate that in Brazil the number of patent applications for *Moringa oleifera* is considerably lower than in other countries, in spite of a number research articles on the subject, leading to a loss of competitiveness this area.

Keywords: EPO, INPI, Intellectual property, *Moringa oleifera*, patent, WIPO.

RESUMO: A tendência atual e crescente na indústria farmacêutica, cosmética e de alimentos é a utilização de produtos naturais, especialmente de plantas. A planta estudada neste trabalho, *Moringa oleifera*, tem várias propriedades biológicas e também é utilizada para purificar água para consumo humano. O objetivo desse trabalho foi de analisar o uso de *Moringa oleifera* por meio da análise de informações coletadas em patentes sobre essa planta no período de 1995-2015 utilizando as bases de dados *World Intellectual Property Organization* (WIPO), *European Institute of Patent Office* (EPO) e Instituto Nacional de Propriedade Industrial (INPI). Os parâmetros analisados foram a quantidade de patentes, a data do depósito, o título, o resumo, a aplicação, o inventor, a classificação internacional e o foco tecnológico. Os resultados demonstram que no Brasil o número de patentes para *Moringa oleifera* é consideravelmente baixo quando comparado a outros países, apesar do número de artigos científicos publicados, levando a uma perda na competitividade na área.

Palavras-chave: EPO, INPI, *Moringa oleifera*, patente, propriedade intelectual, WIPO.

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INTRODUÇÃO

The development of commercial products that contain natural products, especially those of vegetal origin, is one of the leading tendencies in the pharmaceutical, food and cosmetics industries. Brazil is considered megadiverse and almost 13% of the 1.9 million known plant species worldwide are found within its borders (AMARAL; FIERRO, 2013). The greatest percentage is found in the Amazon, Cerrado and Mata Atlântica regions of the country (AZEVEDO; MOURA, 2010).

According to Galdino (2006) one in five products sold in pharmacies contain material extracted from, or with chemical components derived from plants. The pharmaceutical industry, both Brazilian and foreign, has long searched for plant natural products in Brazil due to the enormous biodiversity and due to public demand. The explanation for this rise in demand is due to the desire to find alternatives to traditional synthetic medicines and avoid their side effects. Additionally, scientific validation of the medicinal effects of many plant natural products has also contributed to greater public interest.

It has been noted that there is increasing interest from industry, universities and research facilities in protecting, via patents, the technologies developed for fabrication of plant-containing products. A patent, in addition to conferring legal protection against undue commercialization, also provides information about new technologies. This aids not only investments within a given technological domain, but also helps in the adoption of research projects that aim to reach market niches (ABRANTES, 2011).

The majority of countries possess legal frameworks to protect intellectual creations and provide economic advantages for their creators. Many of these frameworks have been in place for many years and have been adjusted and improved over time – as is the case for the patent system. In the developed world, this system is extremely important, as it is a legal instrument that involves, in many cases, large financial investments. The system avoids that other entities sell, import or use an invention without a license or authorization for a period of up to 20 years (MOREIRA et al., 2005).

The plant species *Moringa oleifera* is the most widely distributed member of the Moringaceae Family, which is native to the Indian sub-continent. However, due to its ability to grow in warm and humid soil, dry soil or even in unfertile and drought-stricken environments, *Moringa oleifera* has become naturalized to tropical and sub-tropical regions worldwide (RAMACHANDRAN et al., 1980; LEONE et al., 2015), including Saudi Arabia (AL-ASMARI et al., 2015).

The plant *Moringa oleifera* is known to possess varying biological properties. These are known to include antimicrobial, anti-trypanosome, hypotensive, antiulcer, hypocholesterolemic, antispasmodic, antioxidant and anti-inflammatory properties (SREELATHA et al., 2011; AWODELE et al., 2012; SATISH et al., 2013; TILOKE et al., 2013; VONGSAK et al., 2013; HANNAN et al., 2014). The seed oil from *Moringa oleifera* is similar to olive oil and is widely used for cooking, cosmiatry as well as in soap and perfume (GHAZALI; MOHAMMED, 2011).

Moringa oleifera has been defined as a multipurpose tree as all its parts can be used in varying applications. The foliage can be used as an alternative food source for cattle in the tropics and is distinguished by high levels of protein that can vary between 20 to 29 % of the dry mass. Additionally, the foliage contains essential amino acids, minerals, calcium, iron, potassium, vitamins (especially C and E), β -carotene, and antioxidant and bioactive compounds (SAFWAT et al., 2015; LEONE et al., 2015).

The main purpose of this article was to survey the number of patents involving the *Moringa oleifera* and compare quantitatively and qualitatively the data in Brazil and in the rest of the world.

MATERIAL AND METHODS

Patent Databases

The search for patents involving the plant *Moringa oleifera* was realized using the following databases as they can be considered the most complete:

- PATENTSCOPE (*World Intellectual Property Organization* - WIPO),
 - Esp@cenet (*European Patent Office* - EPO), and
- Additionally, the database of the organ responsible for patent registration in Brazil –
- Instituto Nacional de Propriedade Industrial (INPI) – was also consulted in order to provide a comparison.

The search technique employed was the scientific name and/or the common name, considering the title and/or the abstract of the patent. The scientific names employed were *Moringa oleifera*, *Moringa moringa*, (L.) Millsp. and *Moringa pterygosperma*; and the common names used (in Brazil) were moringa, acácia-branca, árvore-rabanete-de cavalo, cedro, moringueiro and quiabo-de-quina.

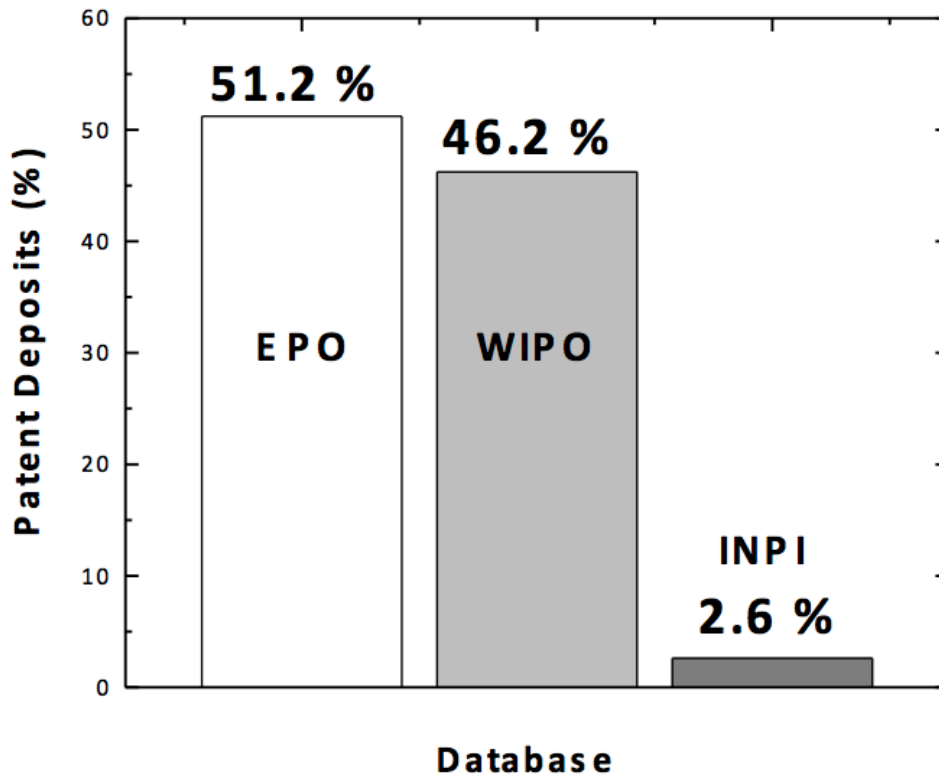
The time window employed was from October 1995 to October 2015. This is because the applications made in 2016 are maintained secret and misleading data may be obtained. According to the results obtained, the recorded data were: patent number, deposit date, title, abstract, applicant, inventor, *International Patent Classification* (IPC) and the technological focus. To aid the statistical analysis the program STATISTICA was employed (STATSOFT, 2004). Using this program a spreadsheet was generated with the data utilized in the patent search. From the spreadsheets, it was possible to produce graphical representations in order to analyze the results.

RESULTS AND DISCUSSION

Breakdown of Patent Origin

Quantitative analyses were performed in relation to the patents involving the plant *Moringa oleifera*. The first analysis was related to the total number of patents as a function of the database employed (**Figure 1**). **Figure 1** demonstrates that, of a total of 260 patents, the greatest number was obtained using the EPO database, followed by the WIPO database. The Brazilian database presented only 2.6% of the total number of patents found, probably due to the fact that the INPI only accepts patent applications deposited in Brazil whereas the EPO and WIPO both have a global scope.

Figure 1. Percentage, from a total of 260, of the patent deposits for the plant *Moringa oleifera* obtained from the INPI, EPO and WIPO databases.



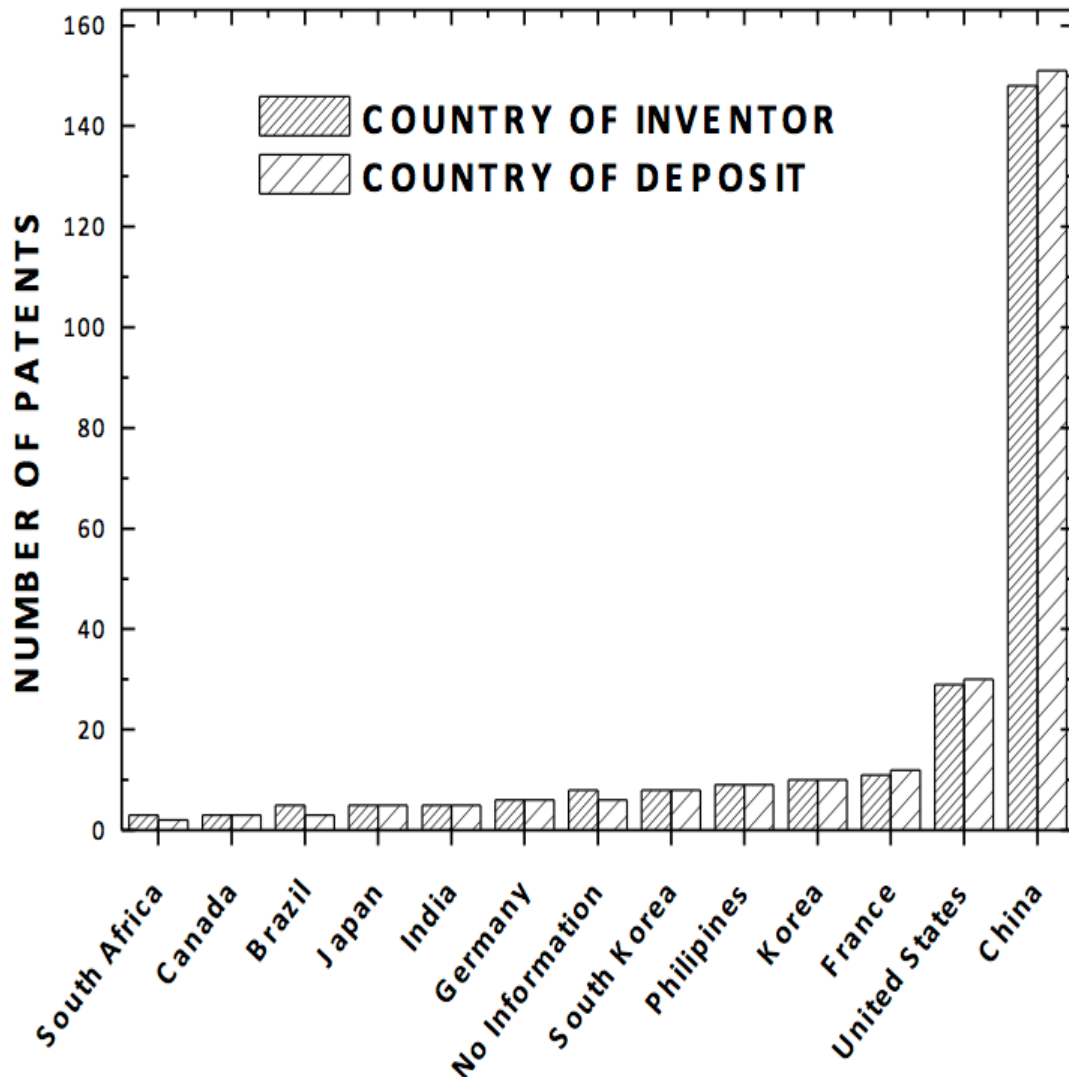
Note: Period: October 1995 to October 2015.

Country of Origin

The inventor/creator is the person who had the original idea and/or participated in its development and execution. The nationality of the inventor is an important parameter as it can indicate the level of technological development and investment in Research and Development (R&D). In the patents identified, a total of 19 nationalities are represented and Figure 2 shows the breakdown for the 1995 – 2015 period. China presents a much greater number of patents when compared to other nations, with 148 inventors (56.92%), followed by the United States with 29 (11.15%) and France with 11 (4.23%). The remaining nations present a number of 10 or fewer deposits.

Figure 2 also presents the nationalities, considering one nationality per patent, of the patent applicants and it can be observed that the greatest number of applicants come from China with 151 applications (58.08%). The United States presents 30 applications (11.54%) and France 12 (4.62%).

Figure 2. Number of patents involving *Moringa oleifera* as a function of national origin (country of deposit) and national origin of the inventor.

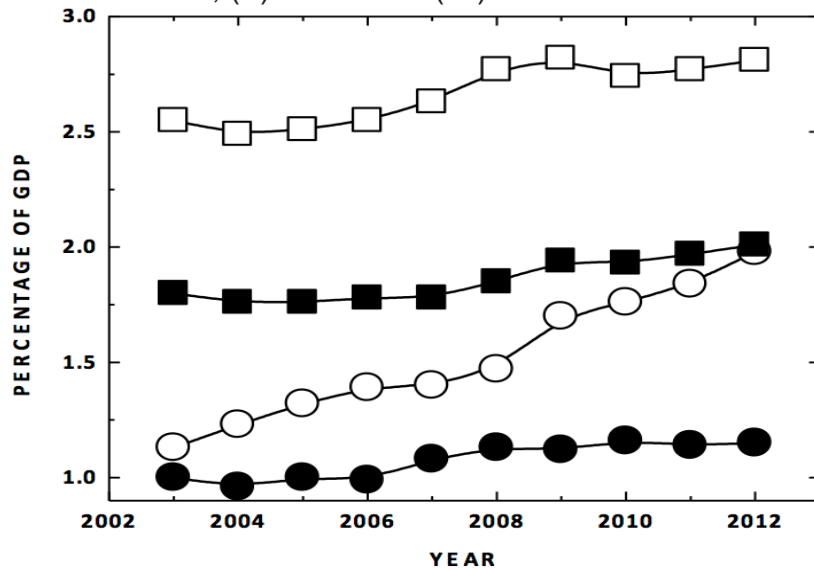


Note: Databases used INPI, EPO and WIPO. Period: 1995 – 2015.

The results presented in **Figure 2** can be understood by analyzing how much of its Gross Domestic Product (GDP) each nation invests in Research and Development (R&D). According to data obtained from Eurostat (2015) and World Bank (2016) in **Figure 3**, the United States presents the greater investment as a proportion of GDP between 2003 and 2012, followed by the European Union. China presents the greatest *increase* in GDP spending on R&D, which might explain the considerable number of patents involving *Moringa oleifera* attributed to China. It is also possible to understand Brazil's position, not just as regards *Moringa oleifera*, but also in general. R&D spending in Brazil is little more than 1%, much lower than the quantities spent in developed countries (**Figure 3**).

With the considerable increase in R&D spending (**Figure 3**) over the last decade, a considerable increase in the number of patent applications in China and by Chinese nationals can be observed. Although the data presented here is related to the plant *Moringa oleifera*, it is probable that the results presented are typical of most sectors.

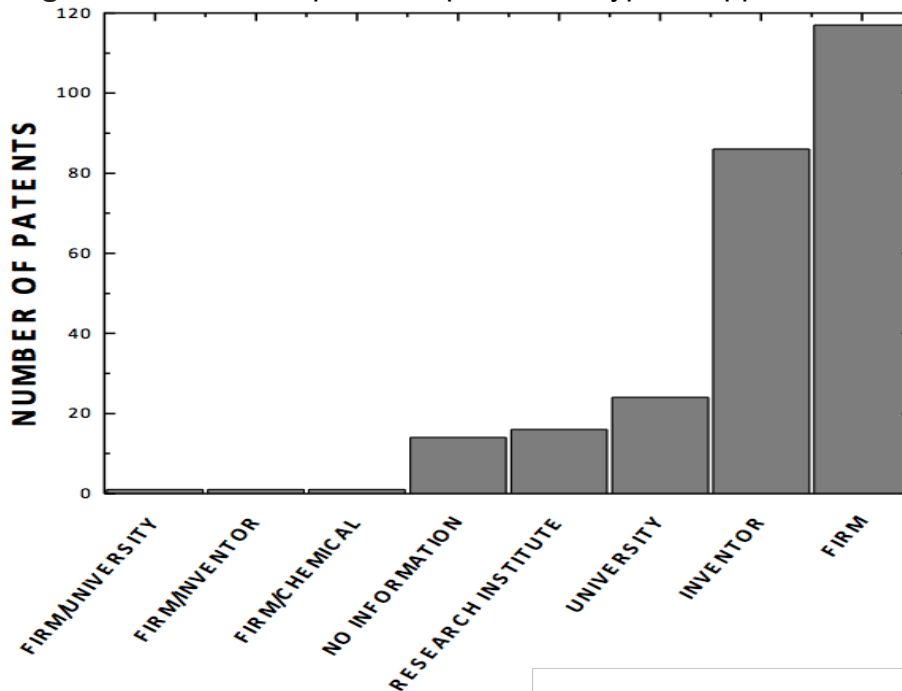
Figure 3. R&D spending as a percentage of GDP over the period 2003-2012 for the (■) European Union, (□) United States, (○) China and (●) Brazil.



Economic Activity

Figure 4 presents the commercial nature of the patent applicants divided between private companies, universities, research institutes or independent inventors. It can be observed that the greater part of the deposited patents are from private companies with 117 deposits (45%), followed by 86 deposits from independent inventors (33.08%). This data is interesting as it confirms that there is a strong commercial interest in the *Moringa oleifera* plant. This reflects the wide range of uses of this plant that include wide spectrum of biological activity of this plant and its use as food supplement.

Figure 4. Number of patent deposits and type of applicant.

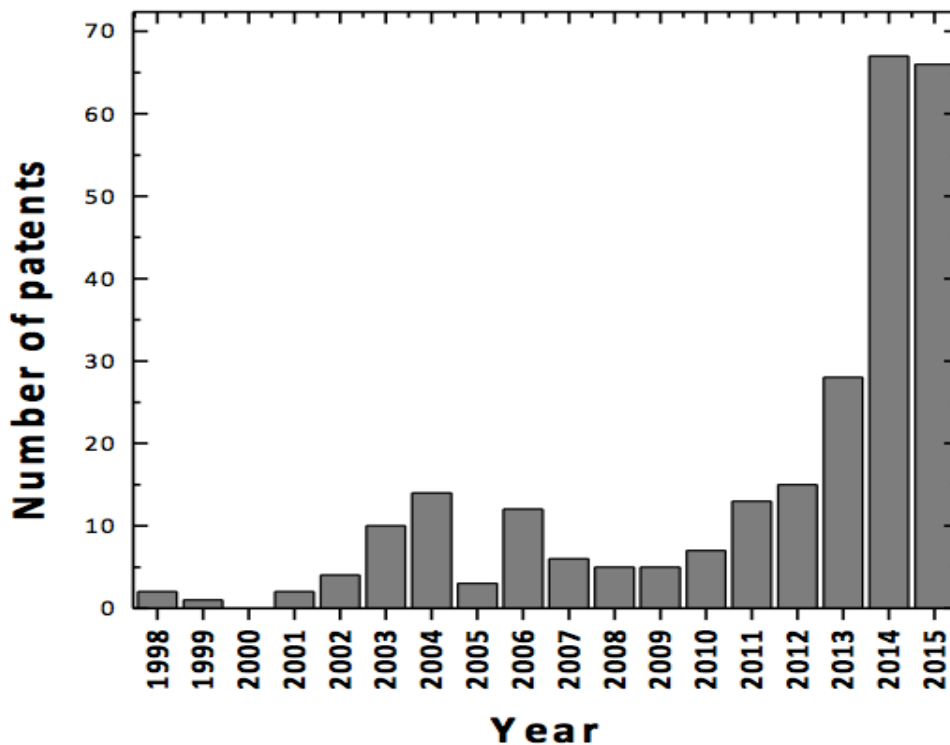


Note: Databases used INPI, EPO and WIPO. Period: 1995 – 2015.

Temporal Evolution

The temporal evolution of the number of patents involving *Moringa oleifera* is given in **Figure 5**. For the years 1995 to 1997 there were no records and as a result the period does not appear in **Figure 5**. It can be noted that there is an increase in the number of patent applications over the period, starting with low numbers between 1998 and 2010. After this point, a rapid increase to 2014 is observable. Although the growth in deposits is unsteady, the increase over the time studied is evident and this, once again, goes hand-in-hand with the levels of R&D funding – especially in China.

Figure 5. Timeline for the number of patents involving *M. oleifera*.



Note: Databases used INPI, EPO and WIPO. Period: 1995 – 2015.

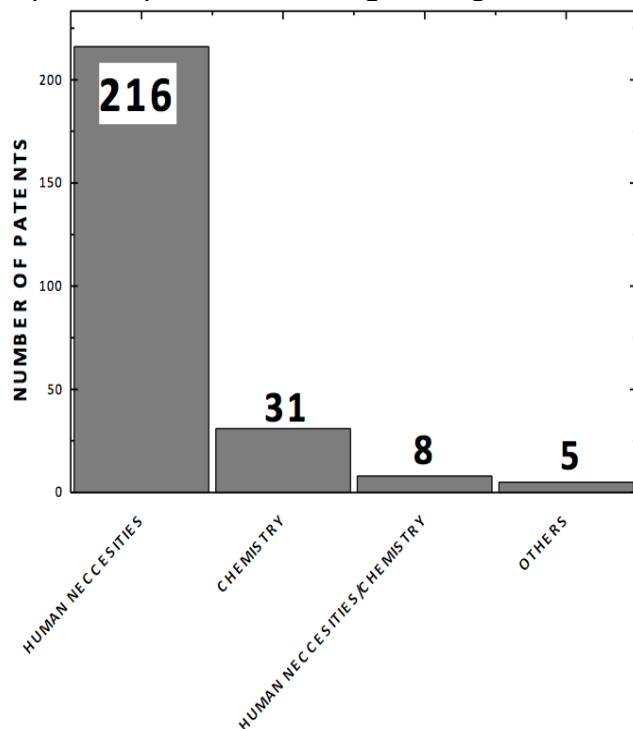
Additionally, the increasing consumer demand for natural products could also be related to the expressive increase in deposits in recent years. Above all, the results presented in **Figure 3** demonstrate the importance of the patent system as a protection mechanism for the results of R&D involving plants.

Technological Focus

The International Patent Classification system was created from the Strasbourg Agreement in 1971, and presents technological classifications from A to H. Within each class there exists a hierarchical system with subclasses and main groups. Thus, the subclass of each patent encountered was analyzed. It should be noted that the same patent can be classified in more than one subclass. **Figure 6**, displays the different sectors of application for *Moringa oleifera*. Of a total of 260 patents, the category Human Necessities (subdivided in to Agriculture, Foodstuffs; Tobacco, Personal Or Domestic

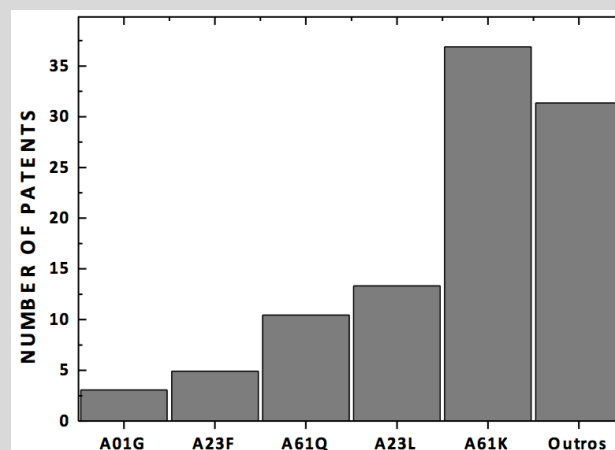
Articles, Health; Life Savings and Amusement) presents the greatest application with 216 followed by Chemistry with 31 patents deposited.

Figure 6. Technological focus of the deposited patents involving *Moringa oleifera*.



Note: Databases used INPI, EPO and WIPO. Period: October 1995 – October 2015.

Figure 7. Subclasses (IPC Classification) of patent deposits.



Note:

A01G: Horticulture
 A23F: Coffee; Tea; their Substitutes
 A61Q: Specific use of Cosmetics or Similar Toilet Preparations
 A23L: Foods, Foodstuffs, or Non-Alcoholic Beverages
 A61K: Preparations for Medical, Dental, or Toilet Purposes.
 Databases used INPI, EPO and WIPO. Period: 1995 – 2015.

The subclasses of the classifications presented in **Figure 6**, were also studied as regards their breakdown in to subclasses (**Figure 7**). The greatest number (37%) is attributed to the subclass A61K (preparations for medical, dental, or toilet purposes), followed by A23L (foods, foodstuffs, or non-alcoholic beverages) and A61Q (use of cosmetics or similar toilet preparations) with 13 and 10% respectively. The subclasses A23F with 5% (coffee; tea; their substitutes; manufacture, preparation, and infusion thereof) and A01G with 3% (culture of vegetables, flowers, fruit, vines, and hops; forestry; watering).

The results presented in **Figure 7** corroborate data presented by various authors that demonstrate the wide range of biological activities and possible use as a food supplement of *Moringa oleifera* (SREELATHA et al., 2011; AWODELE et al., 2012; SATISH et al., 2013; TILOKE et al., 2013; VONGSAK et al., 2013; HANNAN et al., 2014; LEONE et al., 2015).

In the general innovation ranking, Brazil is in 70th place behind not only South American neighbors such as Uruguay (68th), Colombia (67th) and Chile (42nd), but also Panama (62nd), Mexico (52nd) and Costa Rica (51st) in Central America (Cornell University, 2015). Allied to this, the number of patents is considered low, demonstrating the need for greater investment in R&D. Additionally, there is a need to install a culture of innovation as compared to only publishing research. Whereas approximately 123 scientific articles have

been published on the subject of *Moringa oleifera* between 1998-2015 by Brazilian authors (Web of Science, 2016), and only 5 patents on the subject have been deposited in Brazil in the same period – 0.04 patents per article. In contrast, Chinese authors accounted for only 23 articles over the same period – 6.6 patents per article.

On the other hand, many Brazilian researchers complain that the waiting time to obtain a patent is overly long. According to Monaco (2014), between the years 2003 and 2013, the INPI conceded **34,189** patents, at an average of **3,108** patents/year. In addition to the fact that the volume of deposits/concessions is low, the average time from deposit to concession has doubled over the same period. In 2003 the average wait was approximately 6 years. By 2008 this wait had increased to 9 years, and in 2013 reached 11 years. Depending on the area of the patent, the wait can be even longer. For example, in the area of food and plants the wait has reached almost 14 years (MONACO, 2014).

In order to confront the data reported by Monaco (2014) with the present study, 7 patents were randomly chosen and the waiting time (initial deposit to acceptance) analyzed (**Table 1**). Although the results refer only to *Moringa oleifera*, they reflect the general trend observed by Monaco (2014), but with waiting times that are not as long as those reported by the author.

Table 1. Waiting time from the date of deposit to the date of publication for patents involving *Moringa oleifera*.

Database	Deposit number	Deposit date	Publication date	Wait (Months)
INPI	PI 0604944-3 A2	11/2006	07/2008	20
	PI 1009944-1 A2	11/2010	04/2013	29
	BR 10 2012 003623 1 A2	02/2012	03/2014	25
	BR 11 2013 030848 6 A2	06/2012	08/2014	26
	BR 11 2013 031318 8 A2	06/2012	08/2014	26
	BR 10 2012 031785 0 A2	12/2012	10/2014	22
	BR 10 2014 001479 9 A2	01/2014	05/2015	17
			Average wait:	23.6 months
WIPO	WO/2003/011234	07/2002	03/2003	8
	WO2004043364	11/2003	05/2004	06
	WO2012168722	06/2012	12/2012	06
	WO2013118094	02/2013	08/2013	06
	WO2004087726	03/2003	10/2004	07
	WO1998037863	02/1998	09/1998	07
	WO2010149895	06/2010	12/2010	06
			Average wait:	6.6 months
EPO	WO9837863 (A3)	02/1998	09/1998	07
	CN103893100 (A)	03/2014	07/2014	04
	CN104256814 (A)	09/2014	07/2015	10
	PH22014000179 (U1)	04/2014	12/2014	8
	CN104396757 (A)	11/2014	03/2015	04
	CN104489026 (A)	01/2015	04/2015	03
	KR20150091460 (A)	07/2015	08/2015	01
			Average wait:	5.3 months

Note: Databases used INPI, EPO and WIPO. Period: 1995 – 2015.

One of the principal motives for the delay in the concession of patents in Brazil is the lack of specialized staff. A study by the National Confederation of Industry (*Confederação Nacional da Indústria - CNI*) in 2010 (CNI, 2010) demonstrates that the number of processes per INPI examiner is much greater than for other patent offices around the world. In 2010 the INPI had 273 examiners for 30,000 patent deposits – 109.9 patents per examiner. At the same time, for the EPO there were 150,000 patents for 3700 examiners – 40.5 patents per examiner.

Brazil

In Brazil a total of 8 patents were registered in the time window studied here. The country of origin and type of patent conceded by the INPI (in Brazil only) are presented in **Table 2**. The principal subclass of patent applications of *Moringa oleifera* is in the area of oils for use in cosmetics and food applications. This data is in agreement with a number of previous studies that demonstrate possible applications for *Moringa oleifera* in these technological areas (SREELATHA et al., 2011; AWODELE et al., 2012; SATISH et al., 2013; TILOKE et al., 2013; VONGSAK et al., 2013; HANNAN et al., 2014; LEONE et al., 2015).

Table 2. Patent deposits for the plant *Moringa oleifera* in Brazil obtained from the INPI database.

Country/State	Type	Quantity
Brazil/São Paulo	Independent	2
Brazil/Pernambuco	Firm	2
Brazil/Pernambuco	Independent	1
Brazil/Sergipe	Independent	1
United Kingdom/Denmark	Firm	2
Total		8

Note: Period: October 1995 to October 2015.

CONCLUSIONS

From the data presented, it can be concluded that the number of patents deposited, over the period 1995-2015, in Brazil involving *Moringa oleifera* is low when compared to other countries. This contrasts with the fact that a considerable quantity of articles has been published over the same time by Brazilian authors. Even though the waiting time for patent concession was under 3 years in the INPI, studies indicate that this wait needs to be reduced. This reduction in waiting time will only be achieved by an increase in the number of examiners. It would be hoped that such a reduction would encourage more patent applications. The lack of stimulus provided by many higher education institutions to convert scientific research in to patents causes a large loss of possible products and processes.

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