Scientometric analysis: Five years of genetic polymorphisms

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Genet. Mol. Res. 17 (2): gmr16039913
Received Apr 03, 2018
Accepted May 01, 2018
Published May 04, 2018
DOI: http://dx.doi.org/10.4238/gmr16039913

ABSTRACT. Scientometrics is a quantitative evaluation of scientific and technological activities. The main objective is to point the number of methodologies used in scientific studies or even the structure of several research centers. This type of metric study belongs to the area of sociology of scientific knowledge. It covers quantitative analyzes of scientific activities through the use of mathematical and statistical techniques for the development of the study. A literature review was conducted using the Genetics and Molecular Research (GMR) database. GMR is a fully electronic journal available at no cost to readers through the Internet at http://www.geneticsmr.org. We performed a quantitative analysis regarding genetic polymorphisms on the GMR scientific production between 2009 and 2013. We used the keywords polymorphism AND genetics OR molecular marker in order to conduct the literature survey. We found 423 articles related to genetic polymorphism and 87% were original articles. Six countries account for about 89% of publications and China is responsible for 56% of all publications. Moreover, the number of papers grew each year, from 3.8% in 2009 up to 35.5% in 2013. The organisms most studied in those articles were humans (61.2%). Techniques such as sequencing, RFLP (Restriction Fragment Length Polymorphism), SSCP (single-strand conformational polymorphism), RAPD (random amplified polymorfic DNA) and Multiplex were used, and these methods and their validation are efficient in the study of gene polymorphisms. Moreover, polymerase chain reaction (PCR) is the technique most used in the field of genetic polymorphisms (74%).

Key words: Scientometrics; Genetic polymorphisms; PCR

INTRODUCTION

Endowed with criticality and dynamism, Science represents a social tool that aims to generate knowledge about all aspects of nature (Pinheiro and Ferneda, 2007). Price, in 1969, defined scientometry as the quantitative research of all things pertaining to science which can be assigned numbers (Nonato, 2003). The term originated in the former Soviet Union and became better known in the 1970s through a publication in a Hungarian magazine, *Scientometrics* (Vanti, 2002). Vanti (2002) emphasizes that the academics began to have more interest by the scientometry in the 1980s due to the creation of a database provided by the former Institute for Scientific Information (ISI, which is called Thomsom ISI today). Thomas ISI has information about publications of several journals, in different approaches and related to several fields of knowledge (Strehl and Santos, 2002). Scientometrics is a quantitative evaluation of scientific and technological activities**.** The main objective is to point the number of methodologies used in scientific studies or even the structure of several research centers (Vanti, 2011). This type of metric study belongs to the area of sociology of scientific knowledge (Tague-Sutckiffe, 1992), covering quantitative analyzes of scientific activities through the use of mathematical and statistical techniques for the development of the study (Spinak, 1998).

Scientometric studies are not able to replace an analytical method on a particular subject but it has the ability to raise the visibility of survey data. It is an important resource for identifying which areas need greater concern and attention (Laurindo and Mafra, 2010). Scientometrics is a relevant field, highlighting quantitative aspects related to generation, propagation and use of scientific information of a country, scientific community, or institutions (Groesser, 2012; Gupta, 2012). It also contributes to identify trends and the development of knowledge (Spinak, 1998).

Over the last few decades there has been an ever-increasing expansion of science and technology. Scientometrics points out trends in a variety of fields, authors and researches, institutions and countries regarding their scientific and technological advances (Macias-Chapula, 1998; Strehl and Santos, 2002). This led to a comparison of the productivity rates of the research centers and individual researchers in order to identify the institutions and areas that presented the greatest potentiality and to establish priorities for the designation of public resources (Vanti, 2002). The advance in the science of information and Science in general is due to the constant elaboration of new researches and the dissemination of their results (Queiroz and Noronha, 2004). Spinak (1998) points out that science can be seen as a company of inputs and results since it is possible to measure these corollaries generated by the scientific community, which is the basis of scientific indicators.

The generation of data related to the area of genetics is quite diverse. Thus, scientific production in the field is qualitatively and quantitatively large (Brufrem and Prates, 2005). The genetic field has been target by scientometry studies. Quixabeira and colleagues (2010), for example, performed an extensive scientometric survey involving several publications in the area of Genetics. Brose (2000) emphasizes that genetic alterations play a decisive role in the appearance of several human neoplasias. Generally, genetic alterations take place in a single somatic cell, which divides, and continues to develop until it forms a cancer. More rarely, when malignant neoplasm occurs as part of a hereditary cancer syndrome, the initial changes are inherited through a germ line present in all cells of the organism (Nussbaum et al. 2002). Polymorphisms can serve as genetic markers since their transmission is associated with other genes located in the chromosomal region next to them. Thus, if a gene next to a marker causes a disease, all affected individuals in the family receive both the marker and the gene that causes the disease (Balasubramanian et al.2004).

These polymorphisms are variations on the DNA sequence that alter restriction enzyme recognition sites and may be associated with only a single base. The frequency of heterozygous alleles for genetic polymorphisms occurs in more than 2% of the population. In some cases such changes will take place in non-coding sequences of the gene and then they have no effect on their functions. Some other changes could occur in coding sequences, which may lead to the production of defective proteins. Moreover, polymorphism may increase cancer and other genetic diseases susceptibility (Lodish et al., 2002).

In the present paper, a literature review was conducted using the Genetics and Molecular Research **(**GMR**)** database between 2009 and 2013. We found 423 articles related to genetic polymorphism and 87% were original articles. PCR is the technique most used in the field of genetic polymorphisms

MATERIALS AND METHODS

We conducted a literature review using the GMR database. GMR is a fully electronic journal available at no cost to readers through the Internet at http://www.geneticsmr.org. GMR was chosen due to the numerous publications related to the areas of Genetics and Molecular Biology. We performed a quantitative analysis regarding genetic polymorphisms on the GMR scientific production between 2009 and 2013. We used the keywords polymorphism AND genetics OR molecular marker in order to conduct the literature survey. We conducted the search for genetic polymorphisms through the platform ALL ISSUES on the GMR site. All selected articles were read and then we collected the necessary information which included year of publication, type of work performed (review or research), country where the work was performed, genetic techniques used and model organisms (human or other animal, plant and fungi). The data were tabulated in Microsoft Excel®2010 worksheet and analyzed through descriptive statistics and simple frequency.

RESULTS

We found 423 papers related to genetic polymorphism published in GMR between 2009 and 2013. Analyzing the type of publication (review or original research) on polymorphisms, 87% (367/423) were original articles with experimental procedures, 7% (30/423) were literature reviews and 6% (26/423) meta-analyses (Figure 1).

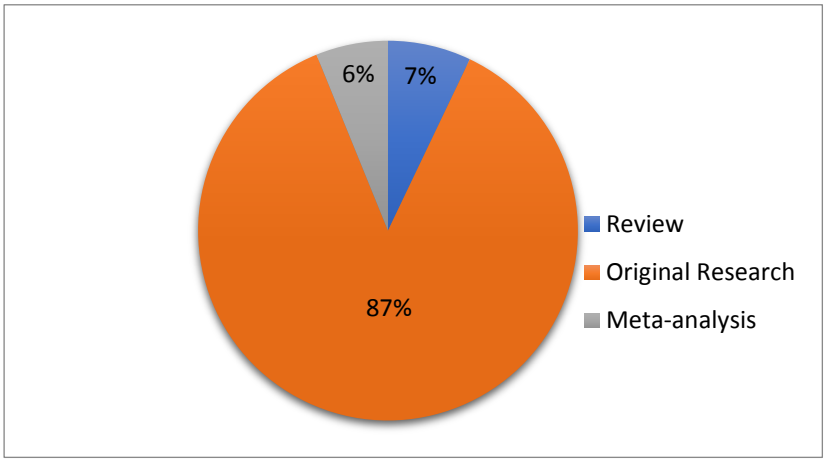

Figure 1. Distribution of genetic polymorphisms publications from 2009 to 2013 according to the type of publication.

Regarding the countries where the study was conducted, six countries make up about 89% of the publications of genetic polymorphisms during the period of the survey. China ranks first with 56% of the publications (236/423), followed by Brazil with 16% (69/423), Turkey with 7.0% (30/423), Thailand with 4.3% (18/423), Iran with 2.4% (10/423), Malaysia with 2.2% (9/423) and other countries with 12.1% (51/423) (Table 1).

Table 1. Number of papers according to the geographical area where the study was carried out.

Countries	Number of published articles in GMR	%
China	236	56.0
Brazil	69	16.0
Turkey	30	7.0
Thailand	18	4.3
Iran	10	2.4
Malaysia	9	2.2
Other countries	51	12.1
Total	**423**	**100**

Regarding the year of publication, we found that 3.8% (16/423) of the papers were published in 2009, 15.3% (65/423) in 2010, 22.7% (96/423) in 2011 and 2012 and 35.5% (150/423) in 2013 (Figure 2).

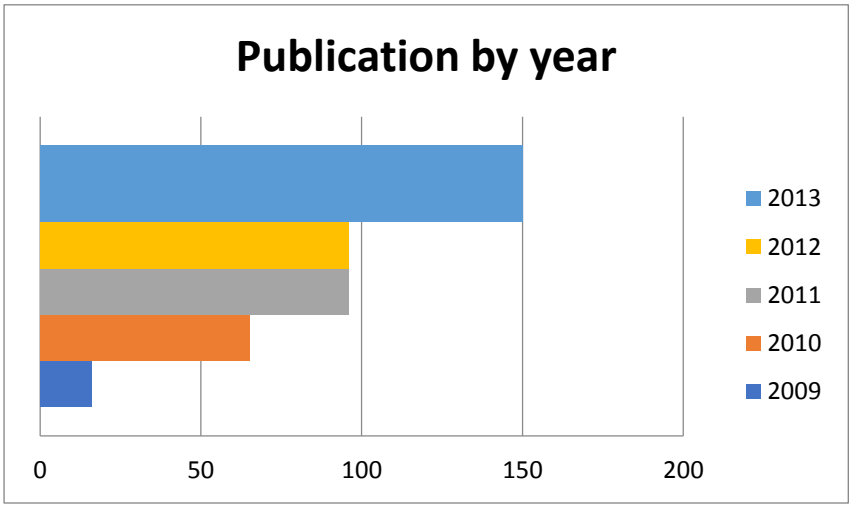

Figure 2. Number of published articles on genetic polymorphisms in GMR between 2009 and 2013.

There was a 1.56-fold increase in the number of publications in the year 2013 compared to the prior two years (2011-2012). The organisms most studied in the articles were humans (61.2%), non-human animals (27.4%), plants (10.9%) and fungi (0.5%). The review articles (29 articles) that included more than a type of organism were not included in this classification (Table 2).

Table 2. Number of papers on genetic polymorphisms published in GMR according to the organism under study.

Organism	Number of papers	%
Humans	241	61.2
Non-human animals	108	27.4
Plants	43	10.9
Fungi	2	0.5
Total	**394**	**100**

Regarding genetic or molecular techniques used in the studies, we found that PCR appears as the most used technique to detect polymorphism (74%), followed by other molecular techniques (1.9%) and other non-molecular techniques (24.1%) (Table 3).

Table 3. Main genetic or molecular techniques used in the selected articles.

Techniques	Number of articles	%
PCR		
PCR/Sequencing	182	58
RFLP	97	31
SSCP	12	3.8

RAPD	06	1.9
Multiplex	06	1.9
QRT	04	1.3
ARMS	02	0.6
M-AFLP	01	0.3
IRAP	01	0.3
MSAP-PCR	01	0.3
SNPs	01	0.3
Total	**313**	**100**
Other molecular techniques		
Cytogenetics	02	0.25
MassARRAY	02	0.25
Genotyping	01	0.12
Genetic markers	01	0.12
Electrophoresis	01	0.12
Microarray	01	0.12
Total	**08**	**100**
Non-molecular techniques Meta-analysis	57	56
HPLC	01	1.0
ELISA	01	1.0
Cromatography	01	1.0
Immunonephelometry	01	1.0
None	41	40
Total	**102**	**100**
Total	**423**	**100**

DISCUSSION

Scientometry aims at the development of knowledge and seeks the improvement of social and public policies. It has, therefore, a multidisciplinary role. Its goal is to generate information and discussions that contribute to overcoming the challenges characteristic of modern Science (Shtovba e Shtovba, 2013). Review articles were the lowest publication rate compared to original research. The former can be a time-consuming work, and some may not consider a literature review as a high-level work (Moreira, 2004). It has been shown that theoretical studies are less frequent than experimental or descriptive studies (Quixabeira et al., 2010; carneiro et al., 2008). However, despite the low frequency of theoretical articles, these are often the articles with the greatest number of citations (Leimu and Koricheva, 2005).

In recent years, the 10 countries that invested the most in research development in the world accounted for 80% of all global investment. The United States has been leading the rank for years, but China's publications have been gradually growing. Scientific publication from third world countries remain at low levels (Grueber and Studt, 2013). India, Brazil and China are hosts to some of the world's most diverse habitats and home to some of the Earth's richest biodiversity (Wilson, 1999) and this has driven scientific growth in such countries. The growth of scientific knowledge is related to the increase of the articles published. The number of publications is used as a measure to quantify the progress and evolution of Science (Verbeek et al., 2002).

The PCR technique was the most frequent in the articles studied it is a powerful technique in molecular genetics allowing rapid cloning and DNA analysis. Its speed, accessibility, sensitivity, robustness and the possibility of analysis of degraded samples are some advantages that enabled the technique to be a revolutionary factor in the field of Genetics (Antonini et al. 2004; Koch and Andrade, 2008). Usually, PCR and its variations such as RAPD-PCR is a good option because of its ability to rapidly detect genetic polymorphisms. Several molecular techniques are currently available and each one can be suitable for analysis of any species and they are able to identify a high degree of polymorphisms in a variety of cases (Nath et al., 2010).

CONCLUSION

In the present research we found a predominance of original article publications over reviews. The country with the most number of publications was China, followed by Brazil. Most of the publications focused on humans. The most commonly used molecular technique was PCR. Our results show a development in the scientific development of countries such as Brazil and China.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

ACKNOWLEDGMENTS

We would like to thank the Pontifical Catholic University of Goiás, Goiânia, Brazil (Replicon / Prope / MGene / FAPEG / CNPq) to have contributed and supported this research.

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