Scientific Paper

Bibliometric analysis about the published studies on *Morus alba* L.

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Abstract

The objective of the study was to analyze the scientific production on *Morus alba* L. recorded in international databases during the period 2013-2017. A search was carried out in *ScienceDirect, Springer, Redalyc* and *Scielo*, of the papers that have in the title the phrase "*Morus alba*"; once the overlapping cases were eliminated 125 records were recovered. The evaluated variables were: number of publications per year, productivity per journal, authors' productivity, relation among authors and keywords. The most productive year was 2016 and the highest quantity of manuscripts was published in the Cuban journal *Pastos y Forrajes.* The main collaboration networks were found among authors from Cuba, Spain, India and South Korea. In the period, the research about the phytochemical indicators of this plant for its use in animal and human health prevailed. The scientific information about *M. alba* in the period 2013-2017 is abundant and a growth in the number of publications is shown. The most enhanced thematic area corresponds to its phytochemistry and its potential uses in animal and human health.

Keywords: forages, animal production, scientific information, bibliometry

Introduction

Morus alba L. is a plant that originated in Asia and belongs to the family *Moraceae*, genus *Morus* (Greuter y Rankin-Rodríguez, 2017). This plant is studied in several countries for its antioxidant (Yuan *et al*., 2015), anticancer (Fathy *et al*., 2013) y anti-inflammatory characteristics (Chen *et al*., 2013).

In agriculture, the studies conducted in sheep (Aguilar-Urquizo *et al*., 2013), pig (Caro *et al*., 2013), rabbit (Canul-Ku *et al*., 2013), poultry (Santos *et al*., 2014) production, among others, show the high nutritional value of *M. alba*, as an option in the feeding of these species.

In Cuba, diverse studies have been conducted on the use of *M. alba* in animal husbandry, where the agronomic results of this species are promising (Martín *et al*., 2000), about the effect of cutting age (Pentón-Fernández *et al*., 2016) and its yield and bromatological quality (Noda *et al*., 2007). Its benefits in milk production (Casanovas *et al*., 2004), parasite control (García *et al*., 2005), reduction of methane production (Delgado *et al*., 2007) and other aspects related to ruminant nutrition (Martín *et al*., 2007) were also proven.

On the other hand, the literature generated in Cuba in recent years on *M. alba* is abundant; nevertheless, it is necessary to determine the international trend of the scientific studies about this plant, which is published in the main journals, institutions and countries, as well as its use in Cuban agriculture. Hence the objective of the research was to analyze the scientific papers indexed in international databases about *M. alba* during the period 2013-2017.

Materials and Methods

A search was carried out in the databases *ScienceDirect, Springer, Redalyc* and *Scielo* (table 1), of the papers that contain in the title the phrase "*Morus alba*", published between 2013 and 2017. One hundred and sixty records were recovered and the fields: title, author, year, journal title and keywords were imported to the bibliographic manager EndNote X7 for their analysis, and 35 duplicates were discriminated, being understood as overlapping cases among the analyzed databases.

The analyzed variables were: number of publications per year, productivity per journal, authors' productivity, relation among authors, and most used keywords. The relation among authors, as well as among keywords, was obtained from the co-occurrence matrix in a net file generated with the Bibexcel software version 2014-03-25 (Persson *et al*., 2009). For visualizing both networks the Pajek software version 64 5.01 (Mrvar y Batagelj, 2017)

Table 1. Number of records per databases.

Database	URL	No. records
ScienceDirect	https://www.sciencedirect.com	71
Springer	https://www.springer.com	37
Redalyc	https://www.redalyc.org	18
Scielo	https://www.scielo.org	34
Total records		160
Overlapping cases		35

was used. The utilized design was *Energy*/Kamada-Kawai/*Separate components*. The co-authorship matrix was made up with the authors that published three or more papers and the keyword matrix, with those words that were assigned three or more times

Results and Discussion

In the analyzed period the number of publications per year about *M. alba* had an increasing behavior, with the highest productivity in 2016 (27 publications), and the trend is towards increasing the number of papers in the next three years (figure 1).

A total of 74 journals that published about *M. alba* was recorded, and 55,4 % of the papers were found in the journals shown in figure 2. The most productive periodical was the Cuban *Pastos y Forrajes.*

Below are the main results found about *M. alba* in this journal, which started publishing about the

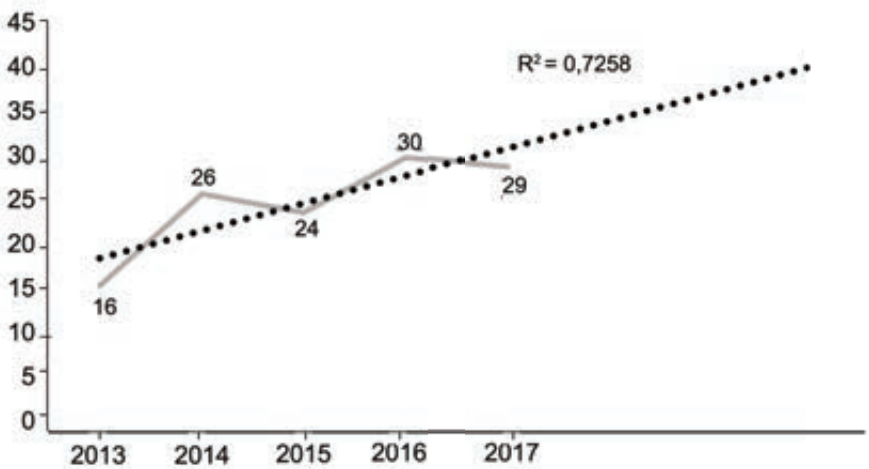

Figure 1. Number of papers published per year and their trend in the analyzed years.

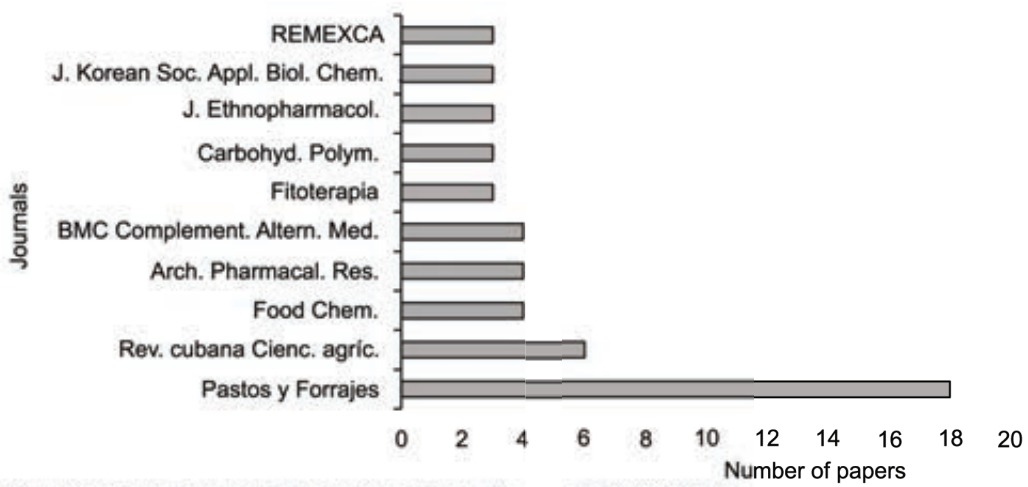

Figure 2. Journals with more publications about *M. alba* in the period 2013-2017.

species in mid-1990, with 30 papers in the period 1990-2006 and 23 during 2007-2016 (Armengol-López, 2017); and in the period 2013-2017 18 papers, as observed in its web page.

This journal published in the period the results of the research about *M. alba*, and mainly the following topics were approached: effect of chemical and biological fertilization from AMF and nutritional quality of this plant in sorghum (*Sorghum almum*) silage.

The authors' co-occurrence network is shown in figure 3. An intense relation stands out between authors from the Pastures and Forages Research Station Indio Hatuey (EEPFIH) and the National Institute of Agricultural Sciences, all of them Cuban.

With works about phytochemical evaluation, specifically of polyphenols, the Plant Production and Microbiology Department at the University Miguel Hernández de Elche in Spain in collaboration with the Food Science Department at the University of Parma in Italy stands out. It can also be observed that there are several mini-networks formed by authors from South Korea and India.

Figure 4 shows the most frequent keywords, among which the following stand out: phenolic constituents, flavonoids, antioxidant activity, *Diabetes mellitus*, rumen, polysaccharides; this indicates that the most enhanced thematic area corresponded to the phytochemistry of this plant and its potential usages in human health.

The most studied topics were the importance of this plant for health due to its antioxidant activity (Kim and Lee, 2017) and the reduction of blood glucose levels (Jiao *et al*., 2017). In addition, the determination and quantification of metabolites in different parts of the plant through phytochemical methods (Chan *et al*., 2016) and genetic studies (Liu *et al*., 2017) were relevant. Aspects related to the nutrition of the *M. alba* crop from the application of nitrogen fertilization and mycorrhizae (Pentón-Fernández *et al*., 2014) and the use of green manures from *Leucaena leucocephala* (Lam.) de Wit (Ruz *et al*., 2015) were also approached.

Conclusions

The scientific information about *M. alba* in the period 2013-2017 is abundant and growth is shown in the number of publications. The most enhanced thematic area corresponds to the phytochemistry and to its potential uses in animal and human health.

The most productive journal was *Pastos y Forrajes*, which approached the management of agrotechnical variables in the *M. alba* crop for feed production; while the main authors' collaboration networks are found among national research groups.

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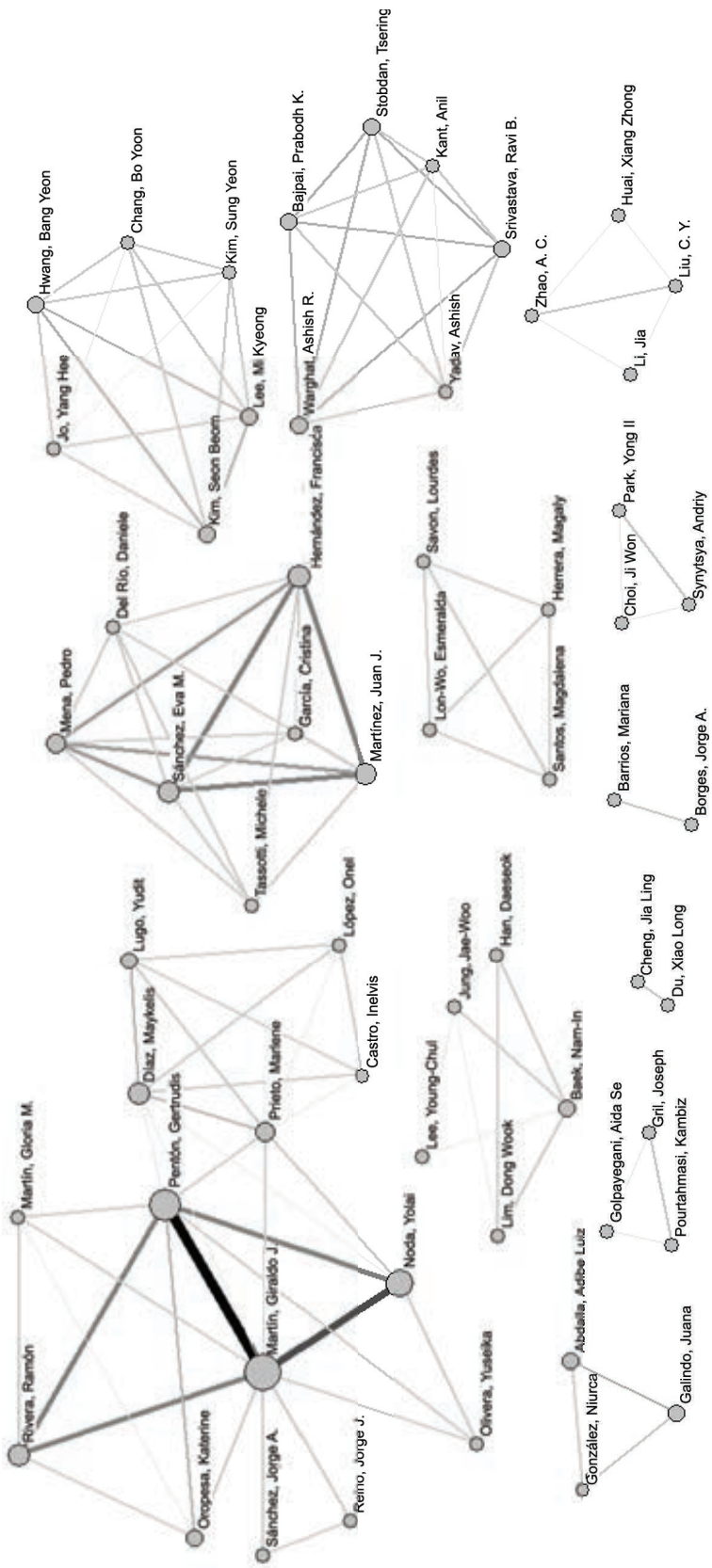

Figure 3. Authors' co-occurrence network 2013-2017.

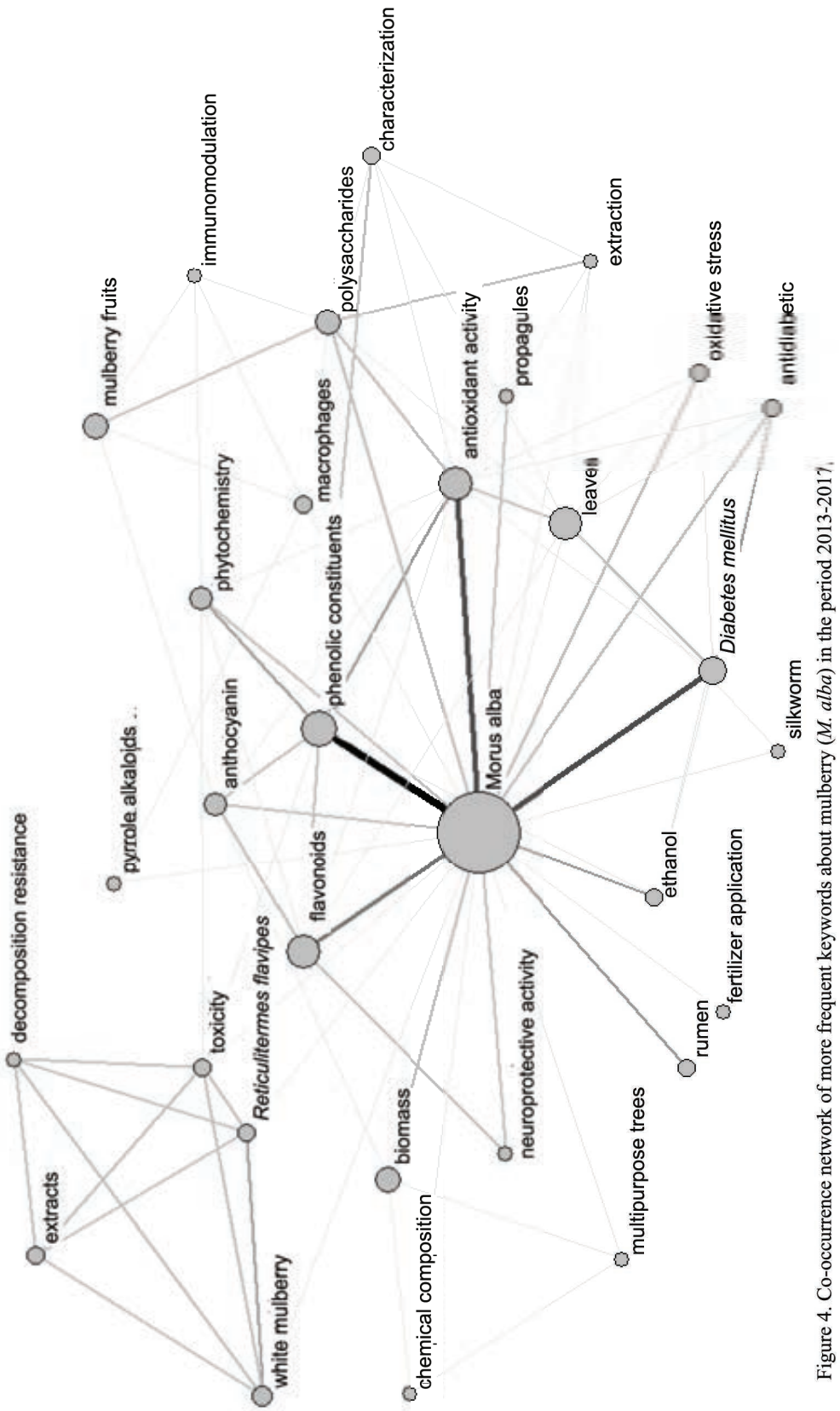

Figure 4. Co-occurrence network of more frequent keywords about mulberry (*M. alba*) in the period 2013-2017.

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