Available online at www.sciencedirect.com
ScienceDirect
Phytomedicine 15 (2008) 566–576
Phytomedicine
www.elsevier.de/phymed

# Phytotherapy and psychiatry: Bibliometric study of the scientific literature from the last 20 years

P. García-García[a], F. López-Muñoz[a,*], G. Rubio[b], B. Martín-Agueda[c], C. Alamo[a]

[a]*Department of Pharmacology, University of Alcalá, C/ Juan Ignacio Luca de Tena 8, 28027 Madrid, Spain*
[b]*Retiro Mental Health Services, Department of Psychiatry, Complutense University, Madrid, Spain*
[c]*Teaching and Research Unit, Primary Care Head Office, Guadalajara, Spain*

## Abstract

In diverse areas of therapy, including psychiatry, increasing interest in herbal medicine has been shown in recent years. Plants have a wide range of traditional uses, but only a few have been approved therapeutically. Moreover, to our knowledge, no bibliometric analyses on medicinal plants used in psychiatry have been carried out to date. We performed a bibliometric study on scientific publication related to phytotherapy in the psychiatry area during the period 1986–2006. Using the platform Embase.com, including the EMBASE and MEDLINE databases, we selected those documents including the descriptors *plant**, *herb**, *phytotherapy**, *phytomedicine**, *pharmacognosy**, and *psychiatry** (with all diagnostic criteria). The plants' indications were selected according to the *PDR for Herbal Medicines*. As a bibliometric indicator of the production, Price's Law was applied. Another indicator included was the national participation index (PI) for overall scientific production. A total of 21,409 original documents were obtained. Our data confirm a fulfilment of Price's Law related to scientific production on medicinal plants in Psychiatry. This was observed after we made a linear fit ($y = 135.08x - 466.38$; $r = 0.92$) and another fit to an exponential curve ($y = 132.26e^{0.1497x}$; $r = 0.99$). The plants most widely mentioned in the psychiatric literature were St. John's wort (*Hypericum perforatum* L.; $n = 937$) and ginkgo (*Ginkgo biloba* L.; $n = 694$). The countries with the highest percentages of documents were the United States (29.44%), Germany (9.41%) and Japan (8.75%), and those with highest proportional PI were India (IPa = 0.935) and China (IPa = 0.721). Productivity on medicinal plants in the psychiatry area increased during the period 1986–2006. Nevertheless, documents about therapeutic herbs in this medical field are still relatively few in number.


***Keywords:*** Phytotherapy; Psychiatry; Bibliometry

## Introduction

The use of medicinal plants for the treatment of different pathological disorders has increased considerably in recent years (Mills and Bone, 2000), and this increase may have been accompanied by a rise in scientific production on the topic. In the specific area of mental disorders, the use of St. John's wort (*Hypericum perforatum*) in affective disorders, of valerian (*Valeriana officinalis*) in sleep disorders or of kava-kava (*Piper methysticum*) in anxiety disorders provide clear examples of this phenomenon, extensible to other phytotherapeutic remedies (Donath et al., 2000; Walker, 2006; Kumar, 2007; Sarris, 2007).

*Corresponding author. Tel.: +34 91 724 8210; fax: +34 91 724 8205.
*E-mail address:* frlopez@juste.net (F. López-Muñoz).

0944-7113/$ - see front matter © 2008 Elsevier GmbH. All rights reserved.
doi:10.1016/j.phymed.2008.04.014

Recent studies have confirmed that complementary medicines (including not only herbal remedies, but also food supplements and other organic and inorganic substances) may be used by as many as 54% of patients with psychiatric disorders (Werneke et al., 2006). Likewise, the last 7 years have seen a marked increase in the number of controlled clinical trials and meta-analyses related to the efficacy of medicinal plants in different neuropsychiatric disorders (Vogeler et al., 1999; Stevinson and Ernst, 2000; Akhondzadeh et al., 2001; Whiskey et al., 2001; Pittler and Ernst, 2003; Roder et al., 2004; Linde et al., 2005; Ernst, 2006; Miyasaka et al., 2007). However, despite an extensive literature on diverse pharmacological aspects of phytotherapy in relation to psychiatric disorders, no data are available about the evolution of such scientific production over recent years.

Likewise, the use of bibliometric tools in the area of biomedical disciplines has increased considerably in recent decades (Terrada and López-Piñero, 1991; Camí et al., 1993, 2007; Maltrás and Quintanilla, 1995; López-Muñoz et al., 1996a). Despite their methodological limitations, bibliometric studies are useful tools for assessing the social and scientific relevance of a given discipline or field (White and McCain, 1989; Bordons and Zulueta, 1999), in that they permit an overview of the growth, size and distribution of the scientific literature in that area over a particular time period (López-Piñero and Terrada, 1992a, b). Indeed, such studies constitute an effective complement for the opinions and judgements of experts in each field, providing useful and objective instruments in processes of the evaluation of the results of scientific activity and offering a more realistic view of it and an indication of trends and of how it might evolve (Camí et al., 1997; Bordons and Zulueta, 1999).

The use of bibliometric indicators for studying research activity in a particular field is based on the premise that scientific publication is the essential result of such activity (Bordons and Zulueta, 1999). Our group has studied, with a bibliometric approach, the evolution of scientific literature in psychiatry by specific research groups (López-Muñoz and Rubio, 1995; López-Muñoz et al., 1996a), on different psychiatric disorders (López-Muñoz et al., 2006a, 2007), on aspects related to the discipline (López-Muñoz and Alamo, 1995; López-Muñoz et al., 1996b, 2008) and on specific therapeutic tools in the field of psychopharmacology (López-Muñoz et al., 2002, 2003, 2006b). Nevertheless, within the specific area of phytotherapy in psychiatry there are as yet no studies analyzing the evolution of scientific production. This provided the motivation for the present bibliometric study, which set out to analyze scientific production in journals with an international circulation on the subject of phytotherapy in psychiatry, covering the period from 1986 to 2006.

**Table 1.** Search strategy

| Primary descriptor | Secondary descriptor[a] | |
|---|---|---|
| *Plant** | *Psychiatr** | *Obsessive–compulsive disorder* |
| *Herb** | *Mental** | *Stress* |
| *Phytotherapy** | *Mood disorder* | *Eating disorder* |
| *Fitoterapy** | *Depress** | *Anorexia* |
| *Phytomedicine** | *Dysthym** | *Bulimia* |
| *Pharmacognosy** | *Manic** | *Sleep disorder* |
| | *Bipolar** | *Insomnia* |
| | *Cyclothym** | *Hypersomnia* |
| | *Anxiet** | *Dyssomnia* |
| | *Panic* | *Parasomnia** |
| | *Phobia** | *Premenstrual* |
| | *Alzheimer* | *Dementia* |
| | | *Delirium* |

[a]According to DSM-IV-R diagnostic criteria.

## Materials and methods

### Data sources

The databases used in this bibliometric study were MEDLINE (Index Medicus, US National Library of Medicine, Bethesda, MD, United States) and Excerpta Medica (EMBASE) (Elsevier Science Publishers, Amsterdam, The Netherlands), which are considered the most exhaustive databases in the biomedical field, and which both participate in the Embase.com platform (Elservier B.V., Amsterdam, The Netherlands).

Using remote downloading techniques, we selected documents related to medicinal plants and psychiatry, according to the descriptors shown in Table 1, and always for documents published between 1986 and 2006. The descriptors in the second group, that is, those related to psychiatry, were selected in accordance with the diagnostic criteria of the DSM-IV-R (APA, 2000). We then selected those medicinal plants with indications approved by the German E Commission (Blumenthal, 1998) in the area of psychiatry. The plants' indications had been selected according to the PDR (Physicians' Desk Reference for Herbal Medicines, 2004). For the purposes of this study, we considered all the original articles, brief articles, reviews, editorials, letters to the editor, etc., and all duplicated documents were eliminated. In this regard, the Embase.com platform permits the elimination of items that may be duplicated in each of the databases (MEDLINE and EMBASE).

### Bibliometric indicators

As the methodological basis for the analysis of the results, we applied a series of the most widely used

bibliometric models and indicators. Among the bibliometric indicators of production applied is Price's Law (Price, 1963). This law, without doubt the indicator most widely used in analysis of the productivity of a specific discipline or a particular country, reflects a fundamental aspect of scientific production, which is its exponential growth. This phenomenon implies a faster pace of growth for science than for the rest of human activities, so that its size would duplicate every 10–15 years. In order to assess whether the growth of scientific production on phytotherapy in psychiatry follows Price's Law of exponential growth, we made a linear fit of the data obtained, according to the equation $y = 135.08x - 466.38$, and another fit to an exponential curve, according to the equation $y = 132.26e^{0.1497x}$.

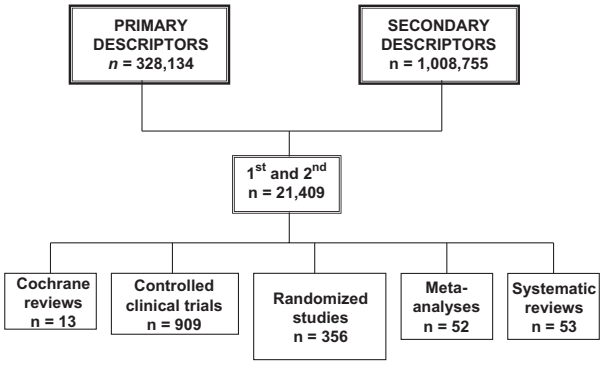


**Fig. 1.** Selection of documents from the EMBASE database and classification of studies according to the EMBASE criteria.

As an indicator of the publications' repercussion we used the impact factor (IF). This indicator, developed by the Institute for Scientific Information (Philadelphia, PA, USA), is published annually in the *Journal Citation Reports* (JCR) section of the *Science Citation Index* (SCI).

Another indicator included in the present analysis is the national participation index (PI) for overall scientific production. The PI reflects the ratio of the number of documents generated by a given country and the total number of documents obtained in the repertoire. Likewise, the PI was correlated with the global PI in biomedical and health sciences (as well as for psychiatry in particular) for the world's 20 most productive countries in the period 1996–2004, according to the results from Camí et al. (2007).

## Results

After a study of the journals analyzed for the period 1986–2006, we obtained 21,409 original documents (articles, reviews, editorials, letters to the editor, etc.) dealing with different aspects related to phytotherapy in psychiatry (Fig. 1). Of the total number of documents, just 6.46% appear as classified (according to the EMBASE database) as controlled clinical trials, controlled and randomized trials, Cochrane reviews, systematic reviews or meta-analyses (Fig. 1).

As can be seen in Fig. 2, over the last 21 years there has been a marked increase in publication related to

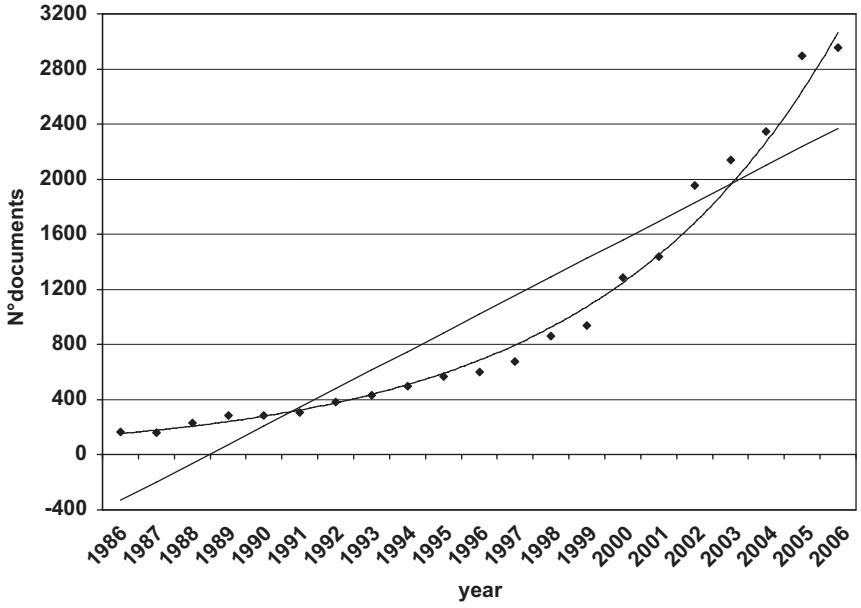


**Fig. 2.** Growth of scientific production on phytotherapy in psychiatry. A linear fit of the data and a fit to an exponential curve were made, in order to assess whether the production fulfilled Price's Law of exponential growth. Linear adjustment: $y = 135.08x - 466.38$ ($r^2 = 0.846$). Exponential adjustment: $y = 132.26e^{0.1497x}$ ($r^2 = 0.99$).

phytotherapy in psychiatry worldwide. The mathematical fit to an exponential curve, shown in Fig. 2, permits us to obtain a correlation coefficient $r = 0.99$, indicating 1.9% of variance unexplained by this fit. In contrast, the linear fit of the measured values provides an $r = 0.92$, and therefore a percentage of unexplained variance of 15.14%. With these data we can conclude that the repertoire analyzed is more in keeping with an exponential fit than a linear one, and that the postulates of Price's Law are fulfilled.

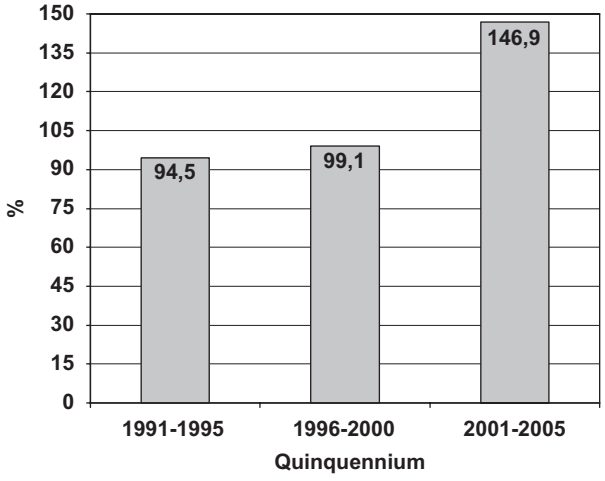


**Fig. 3.** Cumulative growth by 5-year periods of scientific production on phytotherapy in psychiatry. Data from each 5-year period refer to evolution over the previous period. The period of reference is 1986–1990. Data expressed in percentages.

Fig. 3 illustrates this even better. Analyzing the last three 5-year periods, it can be seen that the cumulative growth in scientific production on phytotherapy in psychiatry for each quinquennium over the preceding one remains constant, duplicating the percentage of documents. Notable features are the cumulative growth of literature on this topic (146.9%) during the last quinquennium (2001–2005).

Table 2 shows the 20 journals with the highest IF in the area of psychiatry, according to the JCR of 2006, and the participation index (PI) of the documents in our repertoire within the total of documents published by each journal in the analyzed period. The journals that proportionally devote most scientific production to phytotherapy are *CNS Drug* (PI = 1.15), the *International Journal of Neuropsychopharmacology* (PI = 0.898) and *Psychosomatic Medicine* (PI = 0.739). In Table 3, which shows the 20 journals with the highest IF in the context of the scientific study of plants (JCR, 2006), it can be seen that the publications devoting most attention to psychiatric aspects, within our repertoire, are *Plant Cell and Environment* (PI = 23.31), the *Annual Review of Plant Biology* (PI = 12) and *Plant Physiology* (PI = 11.78).

Table 4 shows the data on the number of documents in our repertoire for the period 1986–2006 that include the plants approved by the German E Commission, with indications for neuropsychiatric symptoms or disorders. Of these, the plants most commonly mentioned in our

**Table 2.** Distribution of documents in our repertoire, based on the 20 journals with highest impact factor in the psychiatry area

| Journal | Ranking JCR[a] | IF JCR[a] | Documents (*n*) | PI |
|---|---|---|---|---|
| *Archives of General Psychiatry* | 1 | 13.936 | 6 | 0.192 |
| *Molecular Psychiatry* | 2 | 11.804 | 3 | 0.186 |
| *American Journal of Psychiatry* | 3 | 8.25 | 27 | 0.245 |
| *Biological Psychiatry* | 4 | 7.154 | 13 | 0.199 |
| *Neuropsychopharmacology* | 5 | 5.889 | 6 | 0.225 |
| *Journal of Clinical Psychiatry* | 6 | 5.533 | 28 | 0.451 |
| *British Journal of Psychiatry* | 7 | 5.436 | 31 | 0.373 |
| *International Journal of Neuropsychopharmacology* | 8 | 5.184 | 4 | 0.898 |
| *Sleep* | 9 | 5.126 | 6 | 0.200 |
| *Journal American Academy of Child and Adolescent Psychiatry* | 10 | 4.767 | 12 | 0.245 |
| *Journal of Clinical Psychopharmacology* | 11 | 4.561 | 16 | 0.559 |
| *American Journal of Medical Genetics part B-Neurosychiatr Gen* | 12 | 4.463 | 0 | 0 |
| *Schizophrenia Bulletin* | 13 | 4.352 | 11 | 0.340 |
| *Psychotherapy and Psychosomatics* | 14 | 4.333 | 4 | 0.260 |
| *Schizophrenia Research* | 15 | 4.264 | 3 | 0.393 |
| *CNS Drugs* | 16 | 4.211 | 12 | 1.15 |
| *Journal of Psychiatry & Neurosciences* | 17 | 4.100 | 3 | 0.392 |
| *Addiction* | 18 | 4.088 | 5 | 0.146 |
| *Acta Psychiatrica Scandinavica* | 19 | 3.857 | 9 | 0.249 |
| *Psychosomatic Medicine* | 20 | 3.857 | 14 | 0.739 |

[a]JCR, Journal Citation Report, 2006; IF, Impact Factor; PI, Participation Index.

**Table 3.** Distribution of documents in our repertoire, based on the 20 journals with highest impact factor in the plants area

| Journal | Ranking JCR[a] | IF JCR[a] | Documents (*n*) | PI |
|---|---|---|---|---|
| *Annual Review of Plant Biology* | 1 | 19.837 | 6 | 12 |
| *Current Opinion in Plant Biology* | 2 | 10.182 | 54 | 7.17 |
| *Plant Cell* | 3 | 9.868 | 219 | 7.63 |
| *Annual Review of Phytopathology* | 4 | 9.000 | 3 | 2.44 |
| *Trends in Plant Science* | 5 | 8.000 | 71 | 8.66 |
| *Plant Journal* | 6 | 6.565 | 325 | 9.90 |
| *Plant Physiology* | 7 | 6.125 | 664 | 11.78 |
| *New Phytologist* | 8 | 4.245 | 57 | 8.07 |
| *Plant Cell and Environment* | 9 | 4.135 | 62 | 23.31 |
| *Molecular Plant–Microbe Interactions* | 10 | 3.936 | 82 | 5.19 |
| *Journal of Experimental Botany* | 11 | 3.630 | 350 | 1.71 |
| *Plant Molecular Biology* | 12 | 3.577 | 412 | 9.51 |
| *Critical Reviews in Plant Cell* | 13 | 3.400 | – | – |
| *Plant Biotechnology Journal* | 14 | 3.378 | 4 | 7.55 |
| *Plant Cell and Physiology* | 15 | 3.324 | 199 | 11.1 |
| *American Journal of Botany* | 16 | 2.969 | 2 | 6.66 |
| *Molecular Plant Pathology* | 17 | 2.963 | – | – |
| *Planta* | 18 | 2.963 | 243 | 10.73 |
| *Theoretical and Applied Genetics* | 19 | 2.717 | 81 | 5.72 |
| *Journal of Phycology* | 20 | 2.580 | – | – |

[a]JCR, Journal Citation Report, 2006; IF, Impact Factor; PI, Participation Index.

repertoire are St. John's wort (*Hypericum perforatum*) ($n = 937$ documents), ginkgo (*Ginkgo biloba*) ($n = 694$) and ginseng (*Panax ginseng*) ($n = 536$). However, those that present the strongest relationship with psychiatry with regard to the total relevant scientific production during the studied period are kava-kava (*Piper methysticum*) (PI = 31.76), St. John's wort (PI = 26.50) and vitex (*Vitex agnus castus*) (PI = 22.47). Likewise, this table includes the distribution of the documents according to the countries in which the research or reviews were carried out. It is noteworthy, here, how much attention is devoted by the United States and Germany to St. John's wort, and by China to ginseng. In this regard it should be borne in mind that of the total of documents in our repertoire, 13,284 (62.05%) include the section corresponding to institution and country in which the work took place, which are defined by those of the first author or by the address for correspondence in the case of collaborations.

Among the countries generating research on phytotherapy in psychiatry (of the 20 most productive countries in biomedicine), the most significant, as Table 5 shows, is the United States, whose PI is 29.44, followed by Germany (PI = 9.41), Japan (PI = 8.75), the United Kingdom (PI = 8.09) and India (PI = 7.32). This ranking does not follow a pattern similar to that of the general distribution in the field of psychiatry, since while among the most productive countries in psychiatry are the USA, the UK, Canada and Germany, the countries with the highest PI in the phytotherapy area are China and India. However, if we consider the productivity of these countries in this topic in relation to their overall production in the field of psychiatry, only India, of the 20 largest producers in biomedicine and health sciences (in the period 1996–2004), devotes a higher percentage of attention to the study of phytotherapy in psychiatry (Fig. 4).

## Discussion

Bibliometric studies constitute interesting tools for assessing the social and scientific importance of a given discipline or topic over a specific time period (López-Piñero and Terrada, 1992a, b; López-Muñoz et al., 1996a, b, 2003, 2006a; García-García et al., 2005; Camí et al., 2007). The term ''bibliometrics'' was introduced in 1969 by Alan Pritchard, to define the application of mathematical methods and statistics to the process of diffusion of written communication in the field of scientific disciplines, through the quantitative analysis of different aspects of this type of communication (Pritchard, 1969). These analyses provide a picture of the growth, size and distribution of scientific literature related to the discipline or topic and of the evolution of both the biomedical speciality, area of specialization or subject in question and the scientific production of an institution, country, author or research group (Bordons and Zulueta, 1999).

Nevertheless, previous studies have drawn attention to a series of methodological limitations characteristic of

**Table 4.** Documents in our repertoire (period 1986–2006) that include medicinal plants approved by the German E Commission: distribution of documents for the world's 20 most productive countries in biomedicine and health sciences, according to Camí et al. (2007)

| | Adonis | Bugbane | Ginkgo | Ginseng | St. John's wort | Kava | Lavender | Hops | Melissa | Passiflora | Rauwolfia | Valerian | Vitex |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Documents | 2 | 131 | 694 | 536 | 937 | 378 | 63 | 52 | 75 | 89 | 28 | 366 | 89 |
| PI | 1.61 | 16.77 | 15.40 | 10.97 | 26.50 | 31.76 | 4.98 | 7.04 | 11.54 | 19.91 | 8.14 | 19.15 | 22.47 |
| TI[a] | Nervous heart complaints | Premenstrual syndrome | Organic brain dysfunction | Lack of stamina | Anxiety, depressive moods | Nervousness, insomnia | Nervousness, insomnia | Nervousness, insomnia | Nervousness, insomnia | Nervousness, insomnia | Nervousness, insomnia | Nervousness, insomnia | Premenstrual syndrome |
| *Country* | | | | | | | | | | | | | |
| USA | 1 | 55 | 211 | 169 | 837 | 141 | 16 | 6 | 10 | 12 | 9 | 114 | 27 |
| UK | – | 13 | 65 | 38 | 83 | 38 | 11 | 5 | 16 | 9 | 0 | 29 | 10 |
| Japan | 1 | 1 | 41 | 34 | 7 | 1 | 0 | 1 | 0 | 1 | 0 | 10 | 0 |
| Germany | – | 14 | 47 | 15 | 126 | 51 | 1 | 10 | 8 | 8 | 1 | 21 | 8 |
| France | – | 1 | 3 | 3 | 6 | 2 | 0 | 2 | 4 | 7 | 0 | 9 | 2 |
| Canada | – | 16 | 24 | 23 | 21 | 14 | 1 | 1 | 1 | 2 | 0 | 5 | 1 |
| Italy | – | 6 | 10 | 10 | 26 | 6 | 0 | 1 | 1 | 5 | 0 | 15 | 0 |
| The Netherlands | – | 6 | 5 | 4 | 8 | 1 | 0 | 0 | 0 | 1 | 0 | 13 | 0 |
| Australia | – | 1 | 16 | 13 | 22 | 9 | 0 | 0 | 0 | 2 | 0 | 7 | 1 |
| Sweden | – | 0 | 3 | 6 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 |
| Spain | – | 0 | 2 | 3 | 6 | 1 | 0 | 0 | 0 | 0 | 3 | 5 | 1 |
| Switzerland | – | 0 | 15 | 5 | 15 | 3 | 0 | 4 | 2 | 1 | 0 | 8 | 3 |
| Belgium | – | 1 | 1 | 2 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 |
| Israel | – | 1 | 5 | 6 | 3 | 3 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| Finland | – | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 2 | 0 |
| Denmark | – | 0 | 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 |
| Austria | – | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 5 | 0 |
| China | — | 1 | 18 | 30 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 9 | 0 |
| India | – | 0 | 11 | 24 | 4 | 4 | 1 | 0 | 1 | 9 | 5 | 11 | 10 |
| Brazil | – | 0 | 9 | 4 | 1 | 1 | 0 | 0 | 3 | 3 | 0 | 7 | 0 |

PI, Participation Index; TI, Therapeutic Indications.

[a]Neuropsychiatric indications approved by Commission E (PDR, 2004).

**Table 5.** Distribution of documents in our repertoire for the world's 20 most productive countries in biomedicine and health sciences

| | Country[a] | Biomedicine/health sciences (%)[a] | Psychiatry (%)[b] | Phytotherapy in psychiatry (%)[c] | PI |
|---|---|---|---|---|---|
| 1 | USA | 41.4 | 49.12 | 29.44 | 0.172 |
| 2 | UK | 10.7 | 14.29 | 8.09 | 0.184 |
| 3 | Japan | 8.73 | 1.46 | 8.75 | 0.209 |
| 4 | Germany | 8.02 | 6.42 | 9.41 | 0.268 |
| 5 | France | 5.84 | 2.81 | 5.28 | 0.201 |
| 6 | Canada | 4.95 | 7.13 | 3.75 | 0.203 |
| 7 | Italy | 4.41 | 2.12 | 3.45 | 0.168 |
| 8 | The Netherlands | 3.20 | 3.22 | 1.58 | 0.131 |
| 9 | Australia | 2.89 | 4.97 | 2.35 | 0.204 |
| 10 | Sweden | 2.60 | 2.59 | 1.48 | 0.174 |
| 11 | Spain | 2.41 | 1.15 | 3.89 | 0.286 |
| 12 | Switzerland | 1.99 | 1.57 | 1.44 | 0.197 |
| 13 | Belgium | 1.47 | 0.75 | 1.13 | 0.201 |
| 14 | Israel | 1.33 | 2.08 | 1.52 | 0.311 |
| 15 | Finland | 1.26 | 1.79 | 0.53 | 0.141 |
| 16 | Denmark | 1.26 | 1.32 | 0.65 | 0.150 |
| 17 | Austria | 1.05 | 0.77 | 1.06 | 0.259 |
| 18 | China | 1.07 | 0.92 | 6.51 | 0.721 |
| 19 | India | 0.93 | 0.62 | 7.32 | 0.935 |
| 20 | Brazil | 0.86 | 0.55 | 2.33 | 0.480 |

PI, Participation Index.

[a]The world's 20 most productive countries in biomedicine and health sciences for the period 1996–2004.

[b]Their productivity in the discipline of psychiatry. Data from Camí et al. (2007).

[c]$n = 13{,}284$ (62.05% of the documents in the repertoire). Documents with ascription to country of origin.

this sociometric approach (Gómez and Bordons, 1996), since it is obvious, for example, that the international scientific production in a particular field, such as phytotherapy in psychiatry in this case, is much more extensive. In fact, our repertoire includes only those documents found in the databases consulted, and which mention the descriptors we selected. Thus, despite the wide range of descriptors selected, it may occur, for example, that a certain number of articles deals with little-used medicinal plants, or plants still at the initial research stage, so that their possible psychiatric uses are not mentioned in any of the database fields. However, the criteria set by the databases themselves condition the subsequent development of the material to be studied. For instance, many journals are not indexed in the usual databases; this is also the case of contributions made to scientific conferences and meetings (López-Muñoz et al., 1996a). But in spite of all the limitations mentioned, the acknowledged quality of the publications included in the databases employed in the present study and their coverage mean that the documents selected constitute a more than representative sample of the international research on phytotherapy in psychiatry.

Taking into account these premises, the design of the present analysis allows us to make a global assessment of the growth of scientific literature in relation to phytotherapy in psychiatry. After making the mathematical adjustments shown in Fig. 2, it was found that the number of publications on this topic has a tendency for exponential growth, in line with Price's (1963) theory of the expansion of scientific literature. This tendency, combined with the absence of a saturation point, points to a promising future for the field, all the more so considering the rather limited involvement of phytotherapy in the area of psychiatry to date. Even so, it is not easy to draw conclusions on this point, since phytotherapy and psychiatry are presented as independent disciplines without any apparent connection, at least as regards the JCR groupings or the data provided in the most exhaustive bibliometric analyses made so far, such as those of Camí et al. (1997, 2007). In any case, the results of the present study appear to concur with those obtained in previous work by our group on different aspects of the psychiatric disciplines, such as bipolar disorder (López-Muñoz et al., 2006a), diagnostic criteria (López-Muñoz et al., 2008) or antidepressants of the SSRI family (López-Muñoz et al., 2002, 2003, 2006b).

Another aspect of interest in relation to scientific production that we have analyzed is its quality. To this end, we used the indicators of impact and excellence of the publications on the topic in question. In order to assess the prestige of a journal, or the quality of a publication, we employed as an indicator of repercussion the impact factor (IF), a dynamic indicator

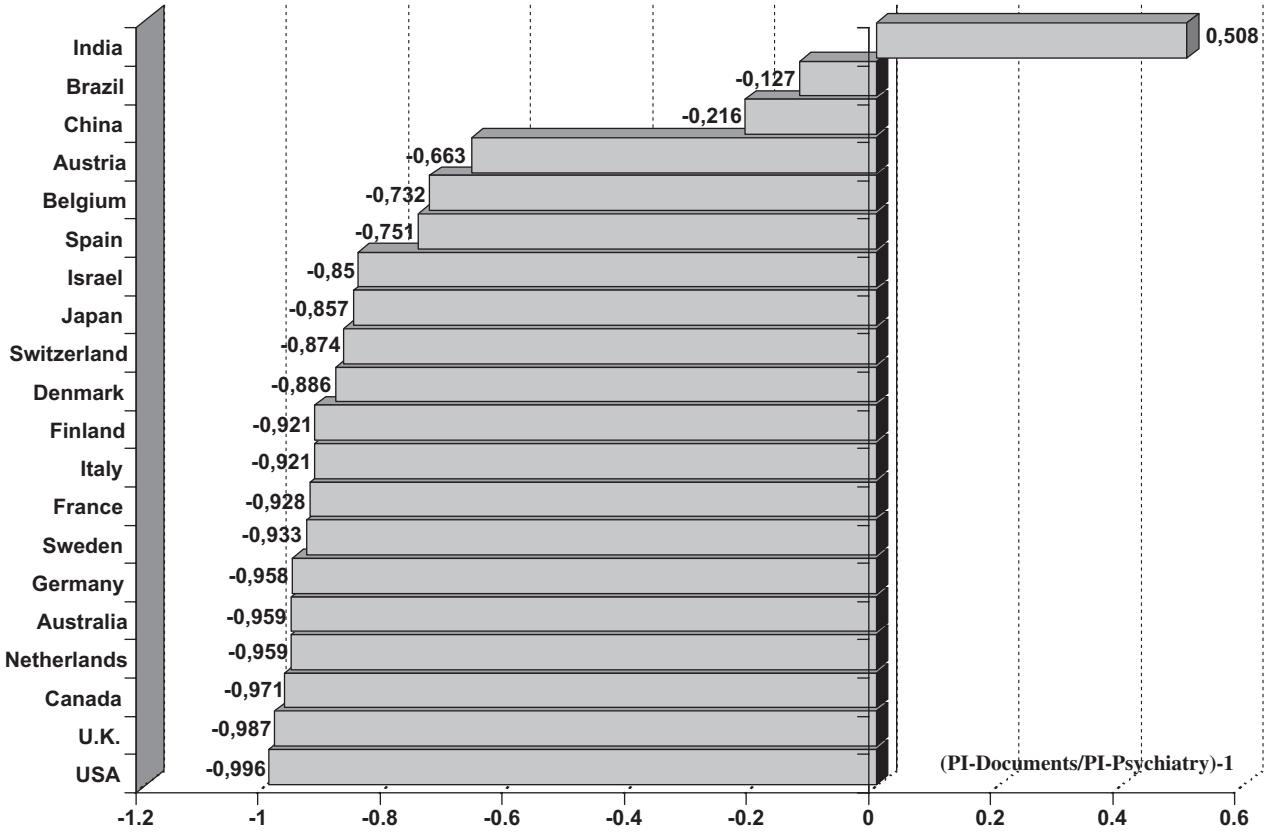


**Fig. 4.** Relationship between production of scientific literature on phytotherapy in psychiatry and total production in the discipline of psychiatry in the world's 20 most productive countries in biomedicine and health sciences. PI, Participation Index. Data on total scientific production in psychiatry for the 20 countries correspond to the period 1996–2004, and were obtained from Camí et al. (2007).

employed since 1971, published in the *Journal Citation Reports* (JCR) section of the *Science Citation Index* (SCI) and calculated by the Institute for Scientific Information (Philadelphia, USA) for cataloguing scientific journals. The JCR considers scientific journals by specific area, ascribing to each of them its corresponding IF, thus establishing a ranking of "prestige" (Gervás et al., 1990). IF does also have some limitations and disadvantages, such as discrimination against original articles in favor of reviews, higher scores for journals published in English or the unfavorable attitude towards topics covered by a small number of researchers (Lehrl, 1999). Nonetheless, IF is the tool most widely used by the scientific community for assessing the quality of research work or the prestige of a given journal (Garfield, 1979; López-Piñero and Terrada, 1992a). In our repertoires, the fact that such prestigious journals as *Plant Cell* (IF = 9.868), *Plant Journal* (IF = 9.565), *Plant Physiology* (IF = 6.125), *Journal of Experimental Botany* (IF = 3.630) or *Plant Molecular Biology* (IF = 3.577) publish articles related to psychiatry is an important factor in this regard, and which indicates the great relevance the topic of mental disorders has acquired in recent years in the field of medicinal plants.

On the other hand, the journals with the highest IF in the area of psychiatry appear to publish fewer studies related to medicinal plants (they have a much lower PI than journals from the field of plants), which may indicate a discrepancy between basic research, more common in plants journals, and clinical research, more common in journals from the field of psychiatry. By way of example, the journal with the highest PI in the area of plants, *Plant Cell and Environment* (PI = 23.31), covers different aspects of basic research, such as those of biochemistry, molecular biology, biophysics or cellular physiology, together with structural, genetic and pathological aspects related to plants' function. However, journals dealing more specifically with clinical phytotherapy (not shown in Table 3 due to their low IF) have PIs higher than the mean for journals in the plants field, examples being *Phytomedicine* (PI = 16.6; IF = 1.403), *Phytotherapy Research* (PI = 10.96; IF = 1.144) or the *Journal of Ethnopharmacology* (PI = 7.27; IF = 1.625).

Continuing with quality-related aspects, despite the great quantity of documents included in our repertoire, there are very few clinical studies carried out according to quality methodological criteria, such as controlled

and randomized clinical trials, meta-analyses or systematic reviews: these account for only 6.46% of the sample. These data support those reported by Kamagaté et al. (2005), who reviewed the literature on clinical trials carried out with medicinal plants during the period 1980–2000, identifying just 48 controlled clinical trials, of which 85.4% were randomized, 87.5% were comparative (95.2% versus placebo) and 81.3% employed double-blind methodology. Although the majority of these studies were short-term and with rather small samples, they were nevertheless generally performed in accordance with the recommendations of the World Health Organization.

As shown in Figs. 2 and 3, from the early 2000s we can observe a definitive upturn in publications on phytotherapy in psychiatry. This finding coincides with the launching of St. John's wort as an antidepressant in Germany and the USA from 2000, which might be seen to mark the beginning of the gradual clinical introduction of new medicinal plants for different psychiatric disorders. The scarcity of literature on phytotherapy in psychiatry before the late 1990s may be explained by the fact there was, in general, no need to publish articles in support of the properties of plants, since many of them had well-established traditional uses (Blumenthal, 1998). By way of example, one of the pioneering countries in clinical studies with medicinal plants was Germany; only relatively recently did more publications begin to appear in English. This, combined with the fact that certain journals published in German are not included in the databases used here, may explain this less extensive diffusion of scientific information in the field of phytotherapy (Walker, 2006).

With regard to the PI of the different countries in scientific production on phytotherapy in psychiatry, it should be borne in mind, first of all, that the databases normally used in this type of analysis, as is our case with MEDLINE and EMBASE, only include in their AD section (*address of authors*) the address of the first signatory or corresponding author. Thus, the PIs of the different countries reported in this study will always be an approximation to the places in which research on phytotherapy in psychiatry is generated, generally a fairly faithful one, but not totally accurate. The small variations with respect to the reality will be determined by the presence of collaborative projects between research groups from different countries (multicenter and multinational clinical trials, etc.). Bearing this in mind, the ranking of producer countries is led by the United States, which generates almost a third of the total scientific production in this field (29.44%). An indication of North-American interest in products of natural origin, as reported by Newman et al. (2003) on the basis of a survey by the US National Cancer Institute (NCI), is that the percentage of small molecule, new chemical entities that are nonsynthetic has remained at 61% (of the 877) averaged over the period 1981–2002 and were inspired in natural products. In second place in the ranking from our study is Germany (9.41%), which has a broad tradition in the use of medicinal plants and has been carrying out clinical studies since the 1980s (European Scientific Cooperative on Phytotherapy, 2003).

Table 5 shows the data from the 20 most productive countries in biomedicine and health sciences, according to a recent study published by Camí et al. (2007), and compares the data for general productivity in the psychiatry discipline with productivity in the specific field of phytotherapy in psychiatry. It is worthy of note how some countries, such as India, Brazil or China, sit near the top of the ranking for phytotherapy production (Fig. 4), reflecting their special interest in research in this field. Only India, though, presents greater proportional interest in the study of medicinal plants in psychiatry than in psychiatric studies *per se*. Other countries, such as Switzerland, Austria or Belgium, maintain rates of productivity in phytotherapy research that are in proportion with their global index for psychiatry. At the other end of the scale, it is interesting to note the lower relative interest in this specific field, within the context of their general production in psychiatry, of countries such as the United Kingdom, Canada, The Netherlands or Australia.

Given the wide variety of plants employed in medicine, and more specifically in the area of psychiatry, it was considered appropriate in this work to restrict ourselves to studying those plants with the most scientific support behind them, and in selecting them we employed the list provided by Germany's prestigious E Commission. Thus, the medicinal plants with the highest PI coincide with those traditionally most widely used in the different disorders of the psychiatric spectrum, such as kava-kava, valerian and, above all, St. John's wort (Donath et al., 2000; Werneke et al., 2006; Kumar, 2007; Mitchell, 2007; Miyasaka et al., 2007). Even so, the majority of authors call for more research and controlled clinical trials for testing the hypothetical efficacy of all the plants currently employed, within the framework of their traditional uses, in the psychiatric field (Walker, 2006; Sarris, 2007).

By way of conclusion, we can assert that, despite the limitations of bibliometric studies, thanks to the design used we have been able to describe the representativeness and evolution of international research on phytotherapy in psychiatry, taking into account the parameters of quality and diffusion most widely employed at an international level. The results of our bibliometric analysis provide evidence of the exponential growth of scientific literature on this topic, still more commonly found in specialist publications on plants than in psychiatry or psychopharmacology journals. Indeed, the tremendous increase in the amount of

literature on this topic and its diffusion in some of the most prestigious scientific journals suggest that the study of medicinal plants in psychiatry is a topic whose development is in full swing from both the basic and clinical research perspectives.

## References


Akhondzadeh, S., Naghavi, H., Vazirian, M., Shayeganpour, A., Rashidi, H., Khani, M., 2001. Passionflower in the treatment of generalized anxiety: a pilot double-blind randomized controlled trial with oxazepam. J. Clin. Pharm. Ther. 26, 363–367.

American Psychiatric Association, 2000. Diagnostic and Statistical Manual of Mental Disorders, fourth ed., text revision. American Psychiatric Association, Washington, DC.

Blumenthal, M. (Ed.), 1998. The Complete German Commission E Monographs. Therapeutic Guide to Herbal Medicines. American Botanical Council, Austin.

Bordons, M., Zulueta, M.A., 1999. Evaluación de la actividad científica a través de indicadores bibliométricos. Rev. Esp. Cardiol. 52, 790–800.

Camí, J., Fernández, M.T., Gómez, I., 1993. La producción científica española en biomedicina y salud. Un estudio a través del Science Citation Index (1986–1989). Med. Clin. (Barc.) 101, 721–731.

Camí, J., Zulueta, M.A., Fernández, M.T., Bordons, M., Gómez, I., 1997. Producción científica española en biomedicina y ciencias de la salud durante el período 1990–1993 (Science Citation Index & Social Science Citation Index) y comparación con el período 1986–1989. Med. Clin. (Barc.) 109, 481–495.

Camí, J., Suñén-Piñol, E., Méndez-Vásquez, R.I., 2007. Mapa bibliométrico de España 1996–2004: Biomedicina y Ciencias de la Salud. Informe del Instituto de Salud Carlos III-Fondo de Investigación Sanitaria Available at: 〈http://www.isciii.es/mapabiomedico〉.

Donath, F., Quispe, S., Diefenbach, K., Maurer, A., Fietze, I., Roots, I., 2000. Critical evaluation of the effects of valerian extract on sleep structure and sleep quality. Pharmacopsychiatry 33, 47–53.

Ernst, E., 2006. Herbal remedy for anxiety – a systematic review of controlled trials. Phytomedicine 13, 205–208.

European Scientific Cooperative on Phytotherapy, 2003. Monographs: The Scientific Foundation for Herbal Medicinal Products, second ed. Thieme, New York.

García-García, P., López-Muñoz, F., Callejo, J., Martín-Agueda, B., Alamo, C., 2005. Evolution of Spanish scientific production in international obstetric and gynecology journals during the period 1986–2002. Eur. J. Obstet. Gynecol. Reprod. Biol. 123, 150–156.

Garfield, E., 1979. Citation Indexing. Its Theory and Application in Science, Technology and Humanities. Wiley, New York.

Gervás, J.J., Pérez, M.T., García, P., 1990. Science Citation Index: posibilidades y utilización. Med. Clin. (Barc.) 95, 582–588.

Gómez, I., Bordons, M., 1996. Limitaciones en el uso de los indicadores bibliométricos para la evaluación científica. Polít. Cient. 46, 21–26.

Kamagaté, M., Die-Kacou, H., Balayssac, E., Yavo, J.C., Daubret, P.T., Kakou-Augustine, K., Gboignon, V.M., 2005. Clinical trials using medicinal plants: bibliographical review and methodological analysis. Therapie 60, 413–418.

Kumar, V., 2007. Potential medicinal plants for CNS disorders: an overview. Phytother. Res. 20, 1023–1035.

Lehrl, S., 1999. Der Impact-Faktor als Bewertungskriterium wissenschaftlicher Leistungen. Das Recht auf Chancengleichheit. Strahlenther. Onkol. 175, 141–153.

Linde, K., Berner, M., Egger, M., Mulrow, C., 2005. St. John's wort for depression. Meta-analysis of randomised controlled trials. Br. J. Psychiatry 186, 99–107.

López-Muñoz, F., Alamo, C., 1995. Los estudios farmacoeconómicos en psiquiatría: análisis bibliométrico. Rev. Esp. Farmacoecon. 1 (IV), 25–38.

López-Muñoz, F., Rubio, G., 1995. La producción científica española en psiquiatría: estudio bibliométrico de las publicaciones de circulación internacional durante el periodo 1980–1993. An. Psiquiatr. 11, 68–75.

López-Muñoz, F., Marín, F., Boya, J., 1996a. Evaluación bibliométrica de la producción científica española en neurociencia. Análisis de las publicaciones de difusión internacional durante el periodo 1984–1993. Rev. Neurol. 24, 417–426.

López-Muñoz, F., Boya, J., Marín, F., Calvo, J.L., 1996b. Scientific research on the pineal gland and melatonin: a bibliometric study for the period 1966–1994. J. Pineal Res. 20, 115–124.

López-Muñoz, F., Alamo, C., Rubio, G., García-García, P., Martín-Agueda, B., 2002. Analisi bibliometrica delle pubblicazioni scientifiche sugli inhibitori selettivi della ricaptazione della serotonina nel periodo 1980–2000. Minerv. Psichiatr. 43, 259–274.

López-Muñoz, F., Alamo, C., Rubio, G., García-García, P., Martín-Agueda, B., 2003. Bibliometric analysis of biomedical publications on SSRIs during the period 1980–2000. Depression Anxiety 18, 95–103.

López-Muñoz, F., Vieta, E., Rubio, G., García-García, P., Alamo, C., 2006a. Bipolar disorder as an emerging pathology in the scientific literature: a bibliometric approach. J. Affect. Disord. 92, 161–170.

López-Muñoz, F., Alamo, C., Guerra, J.A., Rubio, G., 2006b. Twenty-four years of scientific publications on selective serotonin reuptake inhibitors (SSRI): a bibliometric approach. In: Shirley, A.C. (Ed.), Focus on Serotonin Uptake Inhibitor Research. Nova Science Publishers, Inc., New York, pp. 191–219.

López-Muñoz, F., García-García, P., Quintero-Gutiérrez, F.J., Alamo, C., 2007. Evolution of ADHD scientific production: a bibliometric study. J. Neural. Transm. 114 (7), 99.

López-Muñoz, F., García-García, P., Sáiz-Ruiz, J., Mezzich, J.E., Rubio, G., Vieta, E., Alamo, C., 2008. A bibliometric study of the use of the classification and diagnostic systems in psychiatry over the last 25 years. Psychopathology 41, 214–225.

López-Piñero, J.M., Terrada, M.L., 1992a. Los indicadores bibliométricos y la evaluación de la actividad médico-

científica. III. Los indicadores de producción, circulación y dispersión, consumo de información y repercusión. Med. Clin. (Barc.) 98, 142–148.

López-Piñero, J.M., Terrada, M.L., 1992b. Los indicadores bibliométricos y la evaluación de la actividad médico-científica. IV. La aplicación de los indicadores. Med. Clin. (Barc.) 98, 384–388.

Maltrás, B., Quintanilla, M.A., 1995. La producción científica en España (1982–1991). Front. Cienc. Tecnol. 7, 4–7.

Mills, S., Bone, K., 2000. Principles and Practice of Phytotherapy. Churchill Livingstone, Edinburgh.

Mitchell, P.B., 2007. St John's wort for depression. Med. Today 8, 67–68.

Miyasaka, L.S., Atallah, A.N., Soares, B.G.O., 2007. Valeriana para los trastornos de ansiedad (translated Cochrane Review). In: La Biblioteca Cochrane Plus, Número 2. Update Software Ltd., Oxford Available at 〈http://www.update-software.com〉.

Newman, D.M., Cragg, G.M., Snader, K.M., 2003. Natural products as sources of new drugs over the period 1981–2002. J. Nat. Prod. 66, 1022–1037.

PDR for Herbal Medicine, 2004. Third edition, 2004. Thompson Healthcare, Montvale.

Pittler, M., Ernst, E., 2003. Kava extract for treating anxiety. Cochrane Library, 2003; issue 4. Update Software, Oxford.

Price, D.J.S., 1963. Little Science, Big Science. Columbia University Press, New York.

Pritchard, A., 1969. Statistical bibliography or bibliometrics. J. Document. 25, 348–369.

Roder, C., Schaefer, M., Leucht, S., 2004. Meta-analysis of effectiveness and tolerability of treatment of mild to moderate depression with St. John's wort. Fortsch. Neurol. Psychiatr. 72, 330–343.

Sarris, J., 2007. Herbal medicines in the treatment of psychiatric disorders: a systematic review. Phytother. Res. 21, 703–716.

Stevinson, C., Ernst, E., 2000. Valerian for insomnia: a systematic review of randomized clinical trials. Sleep Med. 1, 91–99.

Terrada, M.L., López-Piñero, J.M., 1991. La producción científica española y su posición en la comunidad internacional. In: López Piñero, J.M. (Ed.), España. Ciencia. Espasa Calpe, Madrid.

Vogeler, B., Pittler, M., Ernst, E., 1999. The efficacy of ginseng. A systematic review of randomized controlled trials. Eur. J. Clin. Pharmacol. 55, 567–575.

Walker, A.F., 2006. Herbal medicine: the science of the art. Proc. Nutr. Soc. 65, 145–152.

Werneke, U., Turner, T., Priebe, S., 2006. Complementary medicines in psychiatry. Br. J. Psychiatry 188, 109–121.

Whiskey, E., Werneke, U., Taylor, D., 2001. A systematic review of *Hypericum perforatum* in depression. Int. Clin. Psychopharmacol. 16, 239–252.

White, H.D., McCain, K.W., 1989. Bibliometric. Annu. Rev. Inform. Sci. Technol. 24, 119–186.