ISSN 1070-3632, Russian Journal of General Chemistry, 2012, Vol. 82, No. 3, pp. 527–534. © Pleiades Publishing, Ltd., 2012.
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Scientometric Assessment of the Progress of Innovative Pharmacy in Russia

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Received November 1, 2010

Abstract—The importance and potential of scientometric assessment of the progress of innovative pharmacy is discussed. Scientometric publications analyzing and forecasting new domestic drug R&D in historical perspective and in contemporary Russia are considered. The role of systemic informational analysis of science as a new methodic tool for research metrics is described.

DOI: 10.1134/S1070363212030310

INTRODUCTION

The development of the pharmaceutical science in Russia presently involves certain problems the most painful of which are insufficient funding and complicated introduction of new services, products, and technologies into industry and practical public health service. These problems exert especially negative impact on innovative drug R&D.

In this connection particular attention should be put on quantitative assessment of the state and trends in research focuses, problems, and concrete projects. The results of such assessment can be used for optimizing pharmaceutical research management, primarily in choosing priority research fields for funding; they can also help to researchers in substantiating urgency and perspectiveness of planned research, as well as to experts in their assessment of completed research projects.

In the present review the author considers the potential of scientometric approaches for assessment of various aspects of pharmaceutical science, in particular, of the state of R&D in innovative pharmacy.

Scientometric Research in Pharmacy: Tasks and Methods

Let us first of all define the term "scientometrics" and the subject of this field of research. Scientometrics is a science that measures different variables relating to the sphere of scientific labor (number of publications and their impact factor, number of scientific workers, absolute and relative funding rates, etc.) and develops parameters which allow one assess investments into research, significance of results, etc. [1]. There is also a more general definition of this science, specifically, scientometrics is a field of science of science, which deals with statistical research of the structure and dynamics of the body and flows of scientific information [2, 3].

The increasing significance of scientometric approaches is associated with their role in developing a substantiated research politics and making strategic social and economic decisions.

Scientometrics relies on a statistical method using as the scientometric parameters all characteristics of an information body, except for the number of publications, references, and separate words (for example, number of science workers, number of journals, etc.); method of counting the number of publications, using as the parameter the number of science products (books, reports, papers, etc.); citation index using as the parameter the number of citations or bibliographic references; content analysis which analyzes a scientific text at a word level (for example, distribution of scientists' names by the frequency of mentioning in publications; application of methods from another field of science, etc.); thesaurus methods which analyses concepts and their classification relationships; and other methods.

Of the scientometric methods, the most suitable for routine research practice are the statistical method, counting the number of publications, and citation index. Analysis of scientometric publications discussed in the present review showed that publication counting is the most widely used method; it allows one to estimate the publication activity of a researcher, research team, or a branch of science, to reveal vigorously developing or moribund research fields, etc.

In the domestic pharmaceutical science, scientometric methods first came into use in early 1970s. The problems solved in pharmacy by means of scientometrics related to assessment and analysis of scientific potential [4, 5]; assessment of the usage of professional journals by scientific and practical workers [6, 7]; analysis of the development of pharmaceutical science [8–11]; and study of certain characteristics of the scientific pharmaceutical information [5, 12, 13] and information about drugs [4, 6, 7].

In 1990s, specialists of the Research Institute of Pharmacy, Ministry of Public Health of the Russian Federation, contributed in the development of scientometrics by theoretically substantiating and developing a technology of a systemic informational analysis of pharmaceutical science for its different levels, i.e. the science as a whole, science discipline, or particular problem [14, 15–18]. The Research Institute of Pharmacy made use of this technology to monitor, from 1992 to 2000, foreign pharmaceutical science [19–21] and also to perform a systemic analysis and make predictions about future development of domestic pharmaceutical research [8, 22–25]. Analytical reviews on the monitoring results were published annually and distributed among research centers of Russia. In 2001, scientometric research in domestic pharmacy was almost curtailed, except for a few projects on pharmaceutical management and economics [26–31], as well as occasional scientometric expert assessments of dissertations. Methodical aspects of the application of the scientometric and systemic informational analysis in planning, conducting, and assessing scientific research have been considered in [31].

The systemic informational analysis of science is based on the syncretic concept of scientific pharmaceutical information [16–18]. According to this concept, the documentary system of scientific pharmaceutical information is represented an information field of pharmaceutical science, formed by a multitude of interactions of one material object with another object or an ensemble of objects, transferred by signals generated during scientific research in pharmacy. By signals are meant scientific publication. The sources of signals are specialists published their results and the receivers of signals (information consumers) are scientific and practical workers who are the addressees of these publications. The unit volume of the information field of science is a professional journal (nonrepetitive name).

Unlike traditional scientometric methods which evaluate the progress and results of scientific research by an indirect principle (number of publications as an indicator of scientific progress and number of citations as an indicator of the quality of scientific results), the systemic informational analysis which makes use of a complex of parameters and quantitative indicators differentiated in view of the data set (publications or bibliographic references) allows one to identify the phase of development of the field of science (graphic model of the dynamics in density, inhomogeneity, or system penetrability parameters) and to evaluate an individual and a total scientific product, i.e. the scientific quality of publications, by the expected impact of a publication.

Scientometric Characteristics of the Domestic Research on Drug Development, Completed Before 1991

The “Drug Development” problem includes three principal constituent parts:

(1) Search for new biologically active substances and drugs of the natural (mineral, plant, and animal) origin (this is the subject of the scientific and practical discipline “Pharmacognosy”), biotechnological (microbiological) origin (this is the subject of the “Pharmaceutical Biotechnology, and synthetic origin (this is the subject of the discipline “Pharmaceutical Chemistry,” subsection “Synthesis.”

(2) Development of drugs and drug dosage forms (these problems relate to the discipline “Pharmaceutical Technology.”

(3) Pharmaceutical drug research (biopharmaceutical analysis, preclinical pharmacological and toxicological testing of new formulations and dosage forms, development of procedures for quantitative and qualitative determination of active substances) [28, 32–34].

The science of science research in Russia revealed a new discipline which has in fact (but not legally)

Table 1. Distribution of publications on pharmaceutical disciplines in terms of the expected impact factor (EI) [15][a]

Scientific discipline	Share (%) of publications with the EI					Total	
	≤ 10	11–20	21–30	31–40	> 40	abs	%
Management and economics of pharmacy	42.03	33.75	22.57	1.45	0.21	483	100
Pharmaceutical technology	0.17	19.02	52.53	20.88	7.41	594	100
Pharmaceutical chemistry (analysis)	0.21	19.92	70.76	6.99	2.12	472	100
Pharmaceutical chemistry (synthesis)	0.00	7.36	35.15	26.60	30.88	421	100
Pharmacognosy	3.64	33.33	49.09	9.70	4.24	165	100
Pharmacology and toxicological chemistry	0.97	26.77	55.48	13.55	3.23	310	100
Total	8.75	22.05	47.28	13.66	8.26	2445	100

[a] Analysis of papers from the journals Farmatsiya, Khimiko-farmatsevticheskii zhurnal, and Farmatsevticheskii zhurnal by 1973, 1978, 1983, and 1988.

emerged in the second half of the XX century at the interface of pharmacy, chemistry, biology, biophysics, and other sciences. This discipline has a special goal: To search for new and improvement of existing sources and methods of production of drugs. It has a special subject area: Study of the molecular structure and configuration of biologically active substances (BAS), regularities of action on the organism of compounds with various molecular structures and configurations, and development of technologies of production of such substances, as well as special methods: chemical and biological synthesis, biotechnology, isolation from natural sources, chemical, biological, and pharmacological screening, and computer prediction and design, along with high-performance analytical techniques. This discipline involves different sciences but definitely fits in the problem area "Drug Development" [32, 35, 36].

Let us consider certain results of scientometric works in the framework of the two first constituent parts of the "Drug Development" problem.

Publication Activity and Research Productivity

A large-scale scientometric research on the main problems and subproblems of pharmaceutical science over the period 1958–1981 was performed in [11, 37, 38]. The information body which was analyzed comprised 10 000 of publications. It was established that in early 1980s the greatest attention was given to search for synthetic and natural BAS and phytochemical research (respectively, the first and second most growing number of publications). Expert analysis allowed to reveal factors most affecting the progress of pharmaceutical science: information of public health needs; information on the state of domestic research on a concrete scientific subject; new instrumental and technical research means; research personnel and its qualification structure.

In early 1990s, the author and co-workers performed a research of the publication activity in the field of drug development by the publication counting method [15, 22]. The analyzed information data set comprised 2445 publications, including 1180 works on the problem of drug development, from three leading pharmaceutical journals by 1973, 1978, 1983, and 1988. It was found that the greatest share in this data set fell on publications on pharmaceutical technology (on average, 24.50%); appreciably less publications were found on pharmaceutical synthesis (17.38%) and pharmacognosy (6.82%). Further on the share of publications on pharmaceutical technology and pharmacognosy decreased by 7.16% and 10.28%, respectively; a light tendency for increase in the share of publications on the synthesis of new BAS and their pharmacological activity testing was revealed (by 3.09%).

Systemic informational analysis was first applied to assess research productivity and impact of co-authorship on this parameter [15]. Research productivity was assessed by the expected impact of a scientific paper (EI, score), which integrates assessments of the novelty, practical value, and reliability of scientific results. Table 1 lists the research productivities, calculated for each publication and for the disciplines in focus as a whole. As seen from the table, of pharmaceutical research projects in total the greatest

Table 2. Research productivity of publications with different number of authors [15]

Number of authors	Number of papers	Average expected impact (EI), points		Actual EI gain, %
		theoretic	actual	
1	388	17.80	17.71	–
2	399	35.60	21.27	20.10
3	279	53.40	22.28	4.75
4	133	71.20	24.62	10.50
5	70	89.00	25.51	3.62
6	37	106.80	25.65	0.55
7	14	124.60	28.00	9.16

Table 3. Dynamics of the principal parameters of the Informational Field of Pharmaceutical Science System in 1973–1988 [15]

Parameter	Value			
	1973	1978	1983	1988
Individual informational product, points	23.17	24.30	23.99	23.66
Total informational product, points	1144	1496	2312	2832
Research labor productivity[a]	0.12	0.12	0.13	0.15
Researcher's productivity[a]	8.32	8.18	7.55	6.70
System fundamentality[a]	0.72	0.75	0.90	0.94
System development potential[a]	0.57	0.64	0.62	0.67
Integration with other science systems[a]	1.15	–	–	2.47

[a] Index; parameter ratio.

share (47.28%) belonged to papers with EI 21−30. The greatest share of papers with high or maximum EI values (31−40 and above 40) fell on pharmacognosy (13.94%), technology (28.29%), and pharmaceutical synthesis (57.48%). This finding points to a high level novelty and general productivity of publications on drug search and development.

The dynamics of co-authorship in scientific papers showed the tendency for increase in all disciplines. Thus, the average number of authors per one publication in the pharmaceutical technology gradually increased from 3.32 (1973) to 3.57 (1988), in pharmaceutical chemistry (synthesis), from 3.79 to 5.14, and in pharmacognosy, from 2.26 to 3.47. This tendency is illustrated by the data in Table 2. As the number of authors per paper increased (by 100%), research productivity increased, on average, by 8.11% ("actual" EI), rather than by 100% ("theoretical" EI). The highest EI values were observed for papers with 8 authors: The actual EI in this case was 35.25, i.e. as little as double that for papers with one author.

The natural consequence of increase of the number of authors in publication on drug development was decrease of individual research productivity and increase of research labor intensity. This fact was confirmed for the pharmaceutical science as a whole (Table 3). These data suggest that in 1970−1980 the works on drug development were primarily extensive, i.e. irrational, in nature; the gain of the total informational product was reached primarily due to increased human resource of science, rather than due to increased efficiency and use of advanced technologies.

Research Directions

Scientometric research aimed at revelation, analysis, and generalization of principal tendencies and achievements in domestic and foreign pharmaceutical science has been performed for 30 years (1971–2000) at the Research Institute of Pharmacy under the Ministry of Public Health of the USSR and then at the Researh Instute of Pharmacy under the Ministry of Public Health of the Russian Federation (RIP) [19–21, 39–41]. This research was, as a rule, performed using a large data set of publications, which allowed the authors to obtain reliable characteristics of traditional and new research directions. The results of scientometric analysis were reported to govermental bodies responsible of management of pharmaceutical research (Ministry of Public Helath, Academy of Medical Sciences of the USSR, and Russian Academy of Sciences).

According to [40], in 1960–1970 the progress in research on drug synthesis was associated with overall progress in chemical science and chemical industry. Biologically active substances were discovered in two ways: search for new, more effective substitutes for natural substances and purposeful structural modification of natural substances. Correlations between structure and parmacological effect and mechanism of action were studied. An objective condition for purposeful search for new substances was knowledge of the mechanisms of interaction of drugs with the organism. Molecular modification (stereoisomeric factors) formed a basis for purposeful development of new BAS.

The search for new BAS was performed in the following principal pharmacotherapeutic groups: antihypertensive, antispasmodic, antiphychotic, and tranquilizing drugs.

One of the principal lines of research on drug flora in 1960–1970 involved search for and assessment of resources of wild drug plants with aim to develop the raw materials basis of the country, as well as phytochemical research focused primarily on plats containing alkaloids, saponines, flavonoids, anthraxglycosides, furanocoumarins, and essential oils.

A series of research works on the domestication of certain valuable wild plants, as well as on the effect of environmental and geographic factors the accumulation of pharmacologically effective substances.

In 1960–1970 the following works were performed in the field of pharmaceutical technology: (1) development of new drug dosage forms (prolonged release capsules or spansules, foam aerosols, etc.; (2) improvement of existing drug dosage forms; (3) use of biopharmaceutical research; (4) study of technological processes and properties of various drug dosage forms; (5) search for high-efficiency excipients; and (6) instrumental modernization.

According to the information of specialists of the RIP [8, 39, 41], in 1980s synthetic chemists increasingly used, along with traditional methods, mathematical methods of experiment planning and data processing, as well as the most advanced instruments. Computerization opened up wide possibilities for prediction of probable types of biological activity of newly synthesized compounds and for shortening the terms of pharmaceutical screening. Over the period from 1986 to 1990 more than 7000 biologically active compounds were synthesized by pharmaceutical chemists, and 200 of these compounds were recommended for detailed pharmacological testing; preclinical tests of 20 and clinical tests of 6 preparations were reported.

The priority goal was the search for BAS showing anticonvulsant, antiviral, analgesic, tranquilizing, local anesthetic, hypolipidemic, antimicrobial, hypoglycemic, and antiallergic activity.

Among pharmacognostic works, the greatest share in 1980s fell on resource studies. Distribution maps and recommendations on rational use were developed for drug plants in 19 territories of Russia, including the Central, Central Black Earth, and Ural Regions, Tatarstan, and Altay Territory. Researchers focused on plants containing polyphenols (flavones, flavonols, and isoflavonoids), essential oils, and alkaloids. A characteristic feature of research projects in this discipline was that they combined in a single research cycle pharmacognostic, chemotaxonomic, phytochemical, and technological aspects. As new BAS sources, isolated plant cell and tissue cultures were considered. Studies of drug plants from the geochemical viewpoint were found to hold great promise.

The most popular research directions in pharmaceutical technology in 1980s were the following: search for new technological approaches to development of rational drug dosage forms with a high therapeutic activity (target-oriented drugs, controlled bioavailability drugs, etc.); study of theoretical foundations of extraction of drug raw materials; development of dosage forms for children; search for new excipients; development and modernization of solid and soft dosage forms. Accelerated development of biotechnology, including development of preparations from tissue cultures of drug plants was stated to be an urgent task.

Trends and Principal Directions of Development of Innovative Pharmacy in Contemporary Russia

Gritsaenko et al. [19–21] presented data of informational monitoring of the pharmaceutical science in 1990s, which was performed by means of traditional scientometrics (publication counting) and systemic informational analysis. This research resulted in the scientific substantiation and development of approaches to predicting trends in the pharmaceutical science in Russia: multivariate prognosis or research management and conceptual prognoses of trends in the development of research into the principal problems of pharmacy over the period until 2005 [42].

Search for New Biologically Active Substances

In 1990s the efforts of synthetic chemists were directed on search for new BAS possessing psychtropic, anticonvulsant, analgetic, antiinflammatory, anestetic, antoarhitmic, antimicrobial, antallegric, antioxidant, detoxifying, and radiobinding activity. On average, 700–1000 of new compounds were synthesized annually.

Enhanced interest was observed in the more rational use of known drugs via their chemical modification. For example, chemical modification of microbial polysaccharides gave a new generation of drugs, viz. physiologically active nontoxic polymers with an immunomodulating, antiviral, and antibioltic activity. One more notable direction is associated with search for BAS on the basis of vital (essential) metals which, being a component of enzymes, are necessary for normal functioning of the organism. New complexes, including those with antimicrobial and antifungal properties, were synthesized.

In the field of search for new BAS of natural origin, by the end of 1990s change of emphasis occurred. The most vigorous progress was observed in chemotaxonomic and phytochemical research, as well as complex and wasteless use of natural drug raw materials. The revealed change of emphasis was logical and was associated in no small part with the formation of a drug market, where an important share belongs to phytopreparations and drug plant raw materials.

As new sources of plant BAS there were studied aster, lily, amaryllis, bean, and other family plants; species and sorts of clover, corydalis, aconite, gentian, peony, sage, rhodiola, and many others. Particular emphasis was put on such groups of plant BAS as flavonoids, coumarins, alkaloids, polysaccharides, anthocyans, lipids, essential oils, and amino acids.

Research and Development of New Drugs and Dosage Forms

The nineties of the XX century proved to be quite an unfavorable period for research in pharmaceutical technology, which was objectively reflected by a decreased number of original scientific publications in specialized journals and an almost double decrease of the number of fulfilled and defended dissertations: from 26 in 1992 to 12 in 1999.

At the same time, the revolutionary changes in domestic and global pharmaceutical technology, observed in 1970–80s [8, 21], predetermined the character of development of the Russian pharmaceutical science in the subsequent years. A typical methodical approach to drug development involved a combination of technological and biopharmaceutical research. The progress in the search and development of new excipients, for example, biodegradable polymers, and facilitated development of new-generation dosage forms with controlled drug action.

The leading directions in the period in focus were development of topical drug dosage forms (gels, suppositories, ointments); development and perfection of sterile dosage forms; complex processing of drug plant raw materials and production of purified preparations. In foreign countries the most frequently developed and studied were such dosage forms as pellets, solutions, and modified release preparations. In Russia, unlike foreign countries, the primary attention was given to soft dosage forms (on average, the third part of technological publications). The share of Russian research on sustained-release targeted-delivery drug forms was much smaller than abroad.

In the middle of the last decade of the XX century, Russian scientists performed pioneering research and development of new drugs of the microbiological, hydrocole, and biotechnological origin. The principal trend in 1990s was a sharp increase of research activities on the development of new phytopreparations.

Combining expert assessments and scientometry is among the most effective methodical approaches to prediction of science development. This approach was used to reveal the most promising research directions and problems in the discipline "Pharmaceutical Technology and Biopharmacy" in Russia [23]. Development and study of liposomes, pellets, sustained-action forms, granules, gels, and transdermal therapeutic systems were found to hold the greatest promise.

It was noted [43] that the works in the field of innovative pharmacy in Russia by 2000 resulted in the approval for medical use of 22 new domestic drugs, 73 new drug dosage forms, 30 phyto- and biopreparations, and 7 complex homeopathic remedies. Seventy one domestic drugs were at different stages of R&D.

According to the conclusions drawn from the results of informational monitoring of the pharmaceutical science over 1992–1999, it is only pharmacognostic research in Russia that was a slightly higher level than abroad, and resource research showed priority growth rates [19–21].

CONCLUSIONS

The review of the possibilities and practical examples of the use of scientometry in innovative pharmacy gives a new sight to methods which are fairly exotic for traditional pharmaceutical science. Scientometric analysis is quite reasonably perceived as a kind of marketing research of scientific production.

Scientometry allows one to evaluate the competiveness of research projects and the quality of completed research projects, compare the scientific level of domestic and foreign innovative drugs, identify priority directions, and develop a rational research policy both at the state and at the institution or enterprise level.

REFERENCES

1. *Entsiklopedicheskii sotsiologicheskii slovar'* (Encyclopedic Sociologic Dictionary), Osipov, G.V., Ed., Moscow: Inst. Sotsial Polit. Issled. Ross. Akad. Nauk, 1995.
2. Khaitun, S.D., *Naukometriya. Sostoyanie i perspektivy* (Scientometry. State and Perspectives), Moscow: Nauka, 1983.
3. *Filosofskii entsiklopedicheskii slovar'* (Phylosophic Encyclopedic Dictionary), Moscow: Sovetskaya Entsiklopediya, 1989.
4. Shopabaeva, A.R., *Cand. Sci. (Pharm.) Dissertation*, Moscow, 1987.
5. Parnovskii, B.L., *Doctoral (Pharm.) Dissertation*, Moscow, 1978.
6. Moshkova, L.V., *Doctoral (Pharm.) Dissertation*, Moscow, 1988.
7. Urusova, T.I., *Cand. Sci. (Pharm.) Dissertation*, Moscow, 1985.
8. Korzhavykh, E.A., Moshkova, L.V., and Fedonyuk, L.S., *Novoe v farmacii: Ekspress-inform* (New in Pharmacy. Express Information), Moscow: Soyuzmedinform, 1991, no. 5.
9. Parnovskii, B.L. and Zaliskaya, O.N., *Provizor (Khar'kov),* 2005, no. 1, pp. 8–11.
10. Parnovskii, B.L. and Smirnova, L.F., *Farmatsiya*, 1985, no. 2, pp. 10–13.
11. Shuraeva, T.K., *Cand. Sci. (Pharm.) Dissertation*, Lvov, 1984.
12. Sapegina, L.P. and Moshkova, L.V., *Farmatsiya*, 1989, no. 3, pp. 92–93.
13. Fedonyuk, L.S., *Materialy IV Vsesoyuznogo s'ezda farmatsevtov* (Proc. IV All-Union Meeting of Pharmacists), Moscow, 1986, pp. 78–80.
14. Korzhavykh, E.A., *Nauch. Tr. NII Farmatsii (Moscow),* 1993, vol. 31, pp. 159–168.
15. Korzhavykh, E.A., *Cand. Sci. (Pharm.) Dissertation*, Moscow, 1995.
16. Korzhavykh, E.A., Abstracts of Papers, *Nauchaya konferentsiya posvyashchennaya 50-letiyu NII farmatsii* (Scientific Conf. Devoted to 50th Anniversary of Research Institute of Pharmacy), Moscow, 1994, pp. 46–47.
17. Korzhavykh, E.A. and Moshkova, L.V., *Ibid.*, pp. 48–49.
18. Korzhavykh, E.A. and Moshkova L.V., *Nauch. Tr. NII Farmatsii (Moscow),* 1993, vol. 31, pp. 152–158.
19. Gritsaenko I.S., Gorchakova N.K., Korzhavykh, E.A., et al., *Analiz razvitiya pharmaceutical nauki v Rossii i za rubejom za 1999 g* (Analysis of the Development of the Pharmaceutical Science in Russia and Abroad in 1999), Moscow, 2000.
20. Gritsaenko, I.S., Gorchakova, N.K., Korzhavykh, E.A., et al., *Analiz razvitiya farmatsevticheskoi nauki v Rossii i za rubezhom za 1998 g* (Analysis of the Development of the Pharmaceutical Science in Russia and Abroad in 1998), Moscow, 1999.
21. Gritsaenko, I.S., Gorchakova, N.K., Garbuzova, A.P., et al., *Razvitie farmatsevticheskoi nauki v Rossii i za rubezhom (1991–1995 gg.)* (Development of the Pharmaceutical Science in Russia and Abroad: 1991–1995), Moscow, 1996.
22. Korzhavykh, E.A., *Materialy nauchno-prakticheskoi konferentsii, posvyashchennoi 25-letiyu farmatsevticheskogo fakul'teta Samarskogo meditsinskogo universiteta* (Proc. Scientific and Practical Conf. Devoted to 25th Anniversary of the Pharmaceutical Department of Samara Medical University), Samara, 1996, pp. 32–34.

23. Korzhavykh, E.A., Gritsaenko, I.S., and Sautenkova, N.L., *Ibid.*, pp. 47–48.
24. Korzhavykh, E.A., Moshkova L.V., and Sautenkova, N.L., *Farmatsiya*, 1993, no. 6, pp. 19–24.
25. Moshkova, L.V. and Korzhavykh, E.A., *Ibid.*, 1993, no. 3, pp. 57–60.
26. Korzhavykh, E.A., *Sbornik materialov mezhdunarodnoi nauchno-prakticheskoi konferentsii* (Proc. Int. Sci. Pract. Conf. (Belgorod, November 20–21, 2008), Belgorod: Belgorod. Gos. Univ., 2008, pp. 19–23.
27. Korzhavykh, E.A., *Remedium,* 2003, no. 11, pp. 30–33; no. 12, pp. 25–28.
28. Korzhavykh, E.A. and Voronovich, I.V., *Vestn. Ross. Univ. Druzhby Narodov*, 2007, no. 7, pp. 114–119.
29. Moshkova, L.V., Korzhavykh, E.A., and Tret'yakova, E.V., *Ibid.*, 2007, no. 7, pp. 138–144.
30. Tret'yakova, E.V., Moshkova, L.V., and Korzhavykh, E.A., *Novaya Apteka*, 2008, no. 10, pp. 58–62; no. 11, pp. 65–68.
31. Moshkova, L.V., Korzhavykh, E.A., and Tret'yakova, E.V., *Rossiiskie issledovaniya po upravleniyu i ekonomike farmacii (1991–2009 gg.). Metod. Posobie* (Russian Research on Management and Economics of Pharmacy [1991–2009], Methodical Textbook), Moscow, 2010.
32. Korzhavykh, E.A., *Farmatsiya*, 2002, no. 4, pp. 35–40.
33. Korzhavykh, E.A., *Farm. Prom-st'*, 2005, no. 5, pp. 71–77.
34. Shvarts, G.Ya., *Entsiklopedicheskii slovar' terminov farmakologii, farmakoterapii i farmatsii* (Encyclopedic Dictionary of Terms in Pharmacology, Pharmacotherapy, and Pharmacy), Moscow: Litterra, 2008.
35. Korzhavykh, E.A. and Dremova, N.B., *Novaya Apteka*, 2006, no. 8, pp. 70–79; no. 9, pp. 67–77; no. 10, pp. 64–78; no. 11, pp. 66–77.
36. Schavlinskii, A.N., Tikhonova, Yu.A., Bogrova, Yu.V., et al., *Materialy konferentsii "Strategiya razvitiya rossiiskoi farmatsii"* (Proc. Conf. "Strategy of Development of Russian Pharmacy," Moscow, 2008, pp. 129–130.
37. Shuraeva, T.K. and Saenko, Yu.I., *Farm. Zh. (Kiev),* 1988, no. 3, pp. 58–62.
38. Shuraeva, T.K. and Saenko, Yu.I., *Ibid.*, 1983, no. 2, pp. 72–73.
39. *Analiticheskii obzor rezul'tatov issledovanii, zavershennykh v 1990 g. i XII pyatiletke po osnovnym napravleniyam pharmaceutical nauki* (Analytical review of the Results of Research Completed in 1990 and XII Five-Year Plan by the Main Directions of the Pharmaceutical Science), Moscow: Znanie, 1991.
40. Tentsova, A.I., Panchenko, E.I., and Semenova, T.D., *Farmatsiya v SSSR* (Pharmacy in the USSR), Moscow: Meditsina, 1973.
41. Moshkova, L.V., *Materialy mezhdunarodnoi konferentsii "Rossiiskaya farmatsiya from natsionalizatsii k privatizatsii: razvitie po spirali"* (Proc. Int. Conf. "Russian Pharmacy from Nationalization to Privatization: Spiral Development," Moscow, 1999, p. 15.
42. Moshkova, L.V., Gritsaenko, I.S., Gorchakova, N.K., et al., *Zdravookhr. RF*, 1999, no. 4, pp. 27–30.
43. Ovcharov, V., Varpakhovskaya, I., and Ustinova, I., *Remedium*, 2000, no. 4, pp. 3–10.