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PRIORITIES FOR THE DEVELOPMENT OF MEDICINAL PLANT GROWING IN A POST-PANDEMIC ENVIRONMENT

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The year 2020 was heavily influenced by the COVID-19 pandemic in all areas of human and social life. Today, it is difficult to imagine sectors of the economy that would not be affected by the pandemic, but the pharmaceutical industry and pharmaceutical companies are facing serious challenges. On the one hand, the pharmaceutical industry is forced to function in restrictions, like any other type of business in a pandemic, and on the other hand, it is forced to ensure uninterrupted production and supply of medicines, quickly increase their production, and strategically plan its activities in the post-pandemic world. All phases of pharmaceutical companies are affected by the pandemic, from the production and procurement of raw materials to research and development and doctor-patient interaction processes. The pharmaceutical industry, along with the health care system, has been at the epicenter of the global fight against the pandemic and its aftermath. In addition to new opportunities for the pharmaceutical industry in the fight against COVID-19, such as vaccine development and clinical trials of medical drugs to treat COVID-19, the pandemic has harmed the supply chain and production of herbal medicinal raw materials. The global pharmaceutical industry has faced the consequences of the closure of China's customs borders for quarantine, as China is currently the leader in the production of medicinal pharmaceutical raw materials, accounting for about 40% of the world's production of medicinal plant pharmaceutical raw materials. China has gained a leading position in the pharmaceutical raw materials industry due to its high production volume and low cost. Closed borders and quarantine-induced lockdown predetermined serious threats in the supply chain for the needs of pharmaceutical production, which was automatically reflected in rising logistics and freight prices. The presented study reviews the current state of the pharmaceutical herbal medicine industry and justifies the priorities of its development in post-pandemic conditions.

Keywords: *pharmaceutical industry; medicinal plant growing; pharmaceutical industry; medicinal plant material; COVID-19; pandemic; post-pandemic*

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ПРИОРИТЕТЫ РАЗВИТИЯ ЛЕКАРСТВЕННОГО РАСТЕНИЕВОДСТВА В УСЛОВИЯХ ПОСТПАНДЕМИИ

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2020 год находился под жестким влиянием пандемии COVID-19 во всех сферах жизни человека и общества. Сегодня сложно представить отрасли экономики, которые бы не затронула пандемия, но фармацевтическая отрасль и фармацевтические компании столкнулись с серьезными вызовами. С одной стороны, фармацевтическая индустрия вынуждена функционировать в ограничениях, как и любой другой вид бизнеса в условиях пандемии, а с другой стороны - вынуждена обеспечивать бесперебойное производство и поставки лекарственных препаратов, оперативно наращивать их производство, а также стратегически планировать свою деятельность в постпандемийном мире. Пандемией затронуты все этапы деятельности фармацевтических компаний – от момента производства и закупки сырья до сферы научных разработок и процессов взаимодействия между докторами с пациентами. Фармацевтическая отрасль, наряду с системой здравоохранения оказалась в эпицентре мировой борьбы с пандемией и ее последствиями. Помимо открывающихся новых возможностей для фарминдустрии в борьбе с COVID-19, таких как разработка вакцин и клинические испытания медицинских препаратов для лечения COVID-19, пандемия негативно отразилась на цепочках поставок и производстве растительного лекарственного сырья. Глобальная фармацевтическая отрасль столкнулась с последствиями закрытия таможенных границ Китая на карантин, т.к. Китай на сегодняшний день является лидером производства лекарственного фармацевтического сырья, на его долю приходится порядка 40% объема мирового производства лекарственного растительного фармацевтического

сырья. Китай завоевал передовые позиции в индустрии фармацевтического сырья благодаря высокому объёму производства и низкой себестоимости. Закрытые границы и локдаун, вызванный карантинном, предопределили серьезные угрозы в цепочке поставок для нужд фармацевтического производства, что автоматически отразилось на росте цен на логистику и грузоперевозки. Представленное исследование посвящено рассмотрению современного состояния отрасли фармацевтического растительного лекарственного сырья, а также обоснованию приоритетов его развития в условиях постпандемии.

Ключевые слова: фармацевтическая индустрия; лекарственное растениеводство; фармацевтическая индустрия; лекарственное растительное сырьё; COVID-19; пандемия; постпандемия

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Introduction

In most countries of the South Asian macro-region, the demand for herbal medicines is growing dynamically, on average by 10–15% per year, and the resource opportunities for the development of the industrial medicinal plant industry in the South Asian region, where over 50% of the world's population lives, have serious limitations due to overpopulation, land scarcity and environmental problems [16; 20; 26; 39]. Meanwhile, the Russian Federation has a significant amount of environmentally safe land resources in a variety of natural, climatic, and geographical zones, which is a unique opportunity for the agro-industrial complex of Russia towards the development of industrial medicinal plant growing. According to preliminary estimates, industrial medicinal raw materials have significant export potential, comparable in the medium term with military exports, and in the long term with the export potential of hydrocarbons [15; 19; 21; 25; 10; 14]. This circumstance allows occupying a worthy market share of herbal medicinal raw materials and concentrated liquid, dry and granular extracts of herbal medicinal raw materials, with a focus on the huge developing market of South Asian countries.

The economic impact on the public health system due to the prolonged crisis is still difficult to calculate, but it is already clear that these consequences will be extremely large. Thus, the International Monetary Fund has already recorded a crisis in the health systems of many countries [12]. Drug manufacturers are

warning of reduced production due to the cessation and reduction of supplies of raw materials from China and other countries. The authorities of the countries most affected by the pandemic are forced to take additional measures quickly to mitigate the impact of the COVID-19 pandemic on the pharmaceutical supply chain. It has been noted that drug shortages have been increasing for several years, and the pandemic has exacerbated the problem, mainly due to the blocking of countries and factories that normally supply drugs, export bans, and logistical complications caused by border closures [41; 42; 40].

The production of medicinal plant raw materials is an important element of the Russian economy, which makes it possible to fully meet the needs of the domestic pharmaceutical industry in medicinal plant raw materials [1; 30; 33]. Based on a retrospective analysis of growing and harvesting of medicinal raw materials, it is substantiated that this production direction, based only on the principles of self-organization, cannot solve the problems arising and increase the profitability of production. Solving the problems of developing the industry of medicinal plant production and increasing the production of medicinal herbal raw materials requires effective state regulation of business entities in this area, as well as finding land suitable for environmentally safe cultivation of medicinal plants [31; 6; 24].

The increased interest in the industrial production of medicinal plants is due to two important factors. The first factor is the healing properties of medicinal plants that affect the human body. The second factor is determined by the wide range of uses of medicinal raw materials in many industries. So, the dynamics of the production of medicinal raw materials today cannot fully satisfy the needs for it in the intensively developing industries, in particular the pharmaceutical industry. [3; 5; 11; 13]. In the context of economic sanctions, the government has developed an import substitution strategy focused, among other things, on the production of domestic medicinal raw materials.

Industrial medicinal plant growing is a strategically important and promising direction of the agricultural sector [22; 23]. Collection of wild medicinal plants is considered more environmentally friendly, as well as less costly, but wild medicinal raw materials are an exhaustible resource, do not allow optimizing the use of labor resources, have uncontrollable quantitative and qualitative characteristics [37; 38; 8; 32; 28; 29].

The demand for medicinal plant raw materials in recent years has been quite stable, even during periods of economic crisis, the dynamics of demand for raw materials did not decrease. Since 2012, there has been an increase in the area under medicinal crops in Russia. Mainly large agricultural enterprises are en-

gaged in medicinal plant growing. For example, in 2016, the area of cultivated medicinal herbs was about 9 thousand hectares, the area of essential oil crops was about 130 thousand hectares [20; 17; 18].

Material and methods

The theoretical and methodological basis of the presented study was the scientific works of scientists devoted to the issues of industrial production of medicinal herbs, the development of relations between producers and processors of herbal raw materials, reports of the Russian Academy of Sciences, legislative acts of the Russian Federation, regulatory documents of foreign countries. The methodological basis was a systematic approach that allowed ensuring complexity and purposefulness. Analytical, abstract-logical, computational-constructive, economic-statistical, and monographic research methods were also used in the work.

Results and discussion

The spread of the virus across the planet will affect all areas of activity, including the global economy. These conditions have become a kind of catalyst in the direction of solving many long-standing problems. The solution to these problems is possible through the combined efforts of the pharmaceutical industry, the state, patient, and medical communities. There was an increase in the consumption of drugs since some drugs began to be used to treat a new coronavirus infection, and before the pandemic, the production of these drugs in such quantities was not planned [7; 9; 34; 43]. Due to the closure and restriction of borders, it is necessary to ensure the supply of medicinal plant raw materials for the production of medicines in Russia, as well as to ensure the necessary import.

In the current pandemic phase, the necessary long-term rehabilitation of COVID-19 survivors should not be forgotten. This will take time, as well as medicines, dietary biologically active additives, vitamin forms, thus, the pharmaceutical industry's demand for medicinal raw materials will increase. Table 1 shows the countries most affected by the pandemic.

Products of the pharmaceutical industry are very much in demand; in 2020 alone, the total growth of the Russian pharmaceutical market was over 14%. The strongest competitive advantage of the agrarian sector of Russia is the potential opportunity to grow, cultivate, and reproduce medicinal plants, as well as the collection of wild-growing environmentally friendly and high-quality raw materials for the pharmaceutical industry [2; 27; 4; 36; 47; 50]. The Asso-

ciation of Producers and Consumers of Traditional Herbal Medicines has been established in Russia, which aims to unite legal and physical persons involved in growing agricultural medicinal plants, producers and consumers of herbal medicines. The main task of the Association is to solve the issues of the Association of producers and consumers in the field of cultivation, collection, storage, logistics, and processing of herbal medicines.

Table 1.

Rates of COVID-19 spread in the world as of December 22, 2020

No.	Countries	Sick, people	Died, people	Cured, people	Active cases, people
1	USA	17,844,690	317,668	0*	-
2	India	10,055,560	145,810	9,606,111	303,639
3	Brazil	7,238,600	186,764	6,408,517	643,319
4	Russia	2,877,728	51,351	2,295,362	531,017
5	France	2,477,166	60,239	163,252*	-
6	UK	2,042,776	67,453	1,535*	-
7	Turkey	2,024,601	18,097	1,800,268	206,218
8	Italy	1,953,183	68,799	1,261,626	622,760
9	Spain	1,797,236	48,926	150,376*	-
10	Argentina	1,541,285	41,813	1,368,346	131,126
11	Germany	1,514,692	26,400	1,123,725	364,837
12	Colombia	1,507,222	40,475	1,373,332	93,415
13	Mexico	1,320,545	118,202	978,002	224,321
14	Poland	1,202,700	25,397	938,269	239,034
15	Iran	1,158,384	53,625	885,054	219,705

* – Data not specified

Source: according to the data of [46]

The world market for organic agricultural products, including organic medicinal raw materials, continues to grow dynamically and steadily. Thus, a study “The World of Organic Agriculture 2017” noted that the total global turnover of the industry amounted to more than 75 billion euro, and the total area of certified organic land in 2016 reached more than 50 million hectares, increasing compared to 2007 by more than 20 million hectares [20].

The authors propose to expand the market of domestic organic agricultural products through the creation of specialized agricultural enterprises, the activities of which are certified for compliance with international and national standards to implement the strategy of development of organic agricultural production of medicinal plants in the regions of the Russian Federation. When

choosing the specialization of such an enterprise, it is necessary to focus on the demand for medicinal plant products in the conditions of the region and the existing pharmaceutical processing enterprises [35; 44; 49].

The current difficult economic situation and the low purchasing power of the population, as well as the high cost of imported medicines, determine the development of pharmaceutical production of medicines from domestic medicinal plant raw materials. This direction is promising and a priority in the field of agricultural production. The high level of requirements of pharmaceutical companies for the quality of medicinal raw materials presupposes the ecological safety of their cultivation [45].

The study has revealed that the agricultural regions of the Russian Federation have the necessary natural and climatic conditions and resources, there are sufficient land and labor potential for agricultural production, cultivation, and processing of medicinal plant raw materials. System analysis and assessment of the possibilities of application of the world practice of agricultural cultivation of medicinal plants in connection with the existing agricultural system of the Russian regions are prerequisites for the priority development and strengthening the position of medicinal plant growing in the national economy. The authors assume that environmentally friendly medicinal plant growing is a new priority for the development of the pharmaceutical and agricultural industries.

After a sharp decline in the late 1990s, the area under medicinal plants in Russia has been growing in recent years and in 2018 amounted to 8,768 hectares, from which about 7,000 tons of medicinal plant raw materials were collected [4]. In recent years, the medicinal plant industry in Russia is beginning to recover as part of the “Revival of the medicinal plant industry in the Russian Federation” project in the “Preventive Medicine” area of the “HealthNet” Roadmap of the National Technology Initiative. According to the roadmap, by 2035 Russia plans to launch more than 25 scientific and educational agrarian techno parks for the production of herbal medicines and concentrates, and create about 300 thousand organizations, in the form of agricultural production cooperatives, which will engage in agricultural production, primary processing and storage of medicinal raw materials.

In a pandemic, the triune element of the basis for development – science, education, and production – must interact more closely and dynamically. For large-scale production and processing of medicinal plant raw materials, it is necessary to open plants for processing of medicinal plant raw materials in the regions of Russia, in localization of raw materials production.

Table 2.

**Stages of the production process of medicinal plant raw materials
(the accelerated model in the context of a pandemic and post-pandemic)**

Construction stages	Indicators
1.	Selection of plots of arable land for cultivation of medicinal crops meeting pharmaceutical standards
2.	Scientific and practical agrotechnical and organizational measures for the agricultural cultivation of medicinal plants
3.	Justification and selection of the optimal crop rotation for cultivated medicinal plants
4.	Experimental sites for sowing medicinal crops using various agricultural technologies
5.	Scientific and practical measures to increase the productivity and yield of medicinal crops
6.	Organization of the process of cultivation and collection of medicinal plants
7.	Optimization of the technological process for the preparation and drying of medicinal plants, preparation and packaging of medicinal raw materials
8.	Organization of the technological process of primary processing and packaging of medicinal raw materials
9.	Organization of the technological process of further storage and logistics of medicinal raw materials

Source: Elaborated by the authors based on [48, p.174].

During the study, the following main conclusions were formulated:

- The Russian market of medicinal raw materials and derivatives of medicinal products tends to grow, but the volume and share of the domestic segment in the total volume of the global pharmaceutical market today is about \$12 million or 1–1.5%.
- Despite the low production volumes, the market for medicinal raw materials is a very promising segment of the Russian pharmaceutical market. In the current conditions of shortage of medicinal raw materials during the pandemic, numerous foreign companies are showing interest in Russian manufacturers of medicinal raw materials.
- Currently, there are about 100 manufacturers of medicinal raw materials in Russia. Most of them provide only the regional needs of pharmaceutical manufacturers, selling products only within their regions. Only a fifth of Russian manufacturers of medicinal raw materials operates on a national scale.

- A small share of agricultural organizations engaged in the production of medicinal raw materials is explained by the significant difficulties in the process of cultivating medicinal plants. Also, a serious problem is a long lag in the return on investment of an agricultural organization from the time of sowing medicinal herbs to the moment they are sold to a pharmaceutical company in the form of medicinal raw materials. herbs to the moment of obtaining plant raw materials, sometimes this period is 23 years.
- The leading Russian manufacturers of medicinal raw materials operating within Moscow and the Moscow Region are Krasnogorskleksredstva JSC, ST Mediafarm CJSC, Medical Company “Narodnaya medicina” LLC. The major manufacturers of medicinal herbs and preparations operating in the regions are Evalar CJSC, Altayvitaminy JSC, Herbs of Bashkiria LLC, and others.
- Russia is an exporter of medicinal raw materials. In European markets, medicinal plant raw materials produced in Russia are considered top-class products. This is possible with a combination of favorable climatic and geographical factors. Russian medicinal raw materials are saturated with high-quality biologically active substances.
- In the Russian pharmaceutical market, there is dynamic growth in the consumption of medicinal herbs and preparations. In a post-pandemic environment, this growth will undoubtedly continue.

Conclusion

In the course of the study, the following conclusions were made:

The restoration and development of the medicinal plant industry in the context of a pandemic, as well as a post-pandemic, is a matter of national importance. The following important conditions must be met as priorities for the dynamic development of the industry:

- state support for the development of medicinal plant growing;
- creation of high-tech developments in the field of processing of medicinal plant raw materials;
- formation of organizational and economic mechanisms for the development of the medicinal plant industry.

The processes of strain renovation of existing medicinal plants, development of breeding centers, creation of new productive varieties and hybrids of medicinal plants based on both the existing gene pool of medicinal plants and the gene pool of wild medicinal plants should be of great importance. Strain reno-

vation today is necessary for almost all types of currently cultivated medicinal plants. First, the process of strain renovation should be launched for the most commercially important medicinal plants – valerian, peppermint, calendula, chamomile, plantain, Echinacea purpurea, cumin, fennel, etc. It is necessary to intensify the search for promising populations of species. Development of technology for protecting cultivated medicinal plants from weeds, pests, and diseases at the minimum acceptable level of pesticide use are important. It is necessary to review the existing quality standards of medicinal plant raw materials – all medicinal raw materials must be environmentally friendly and safe.

In the current conditions of the pandemic, in the future post-pandemic, the formation of specialized enterprises for the cultivation and processing of medicinal plants is strategically correct and economically justified. For these purposes, it is possible to involve fallow or unused fertile arable land in the production turnover, which will eventually provide pharmaceutical companies with high-quality medicinal raw materials and create a multiplier effect in related sectors of the economy.

It is a fact that the COVID-19 pandemic has changed the socio-economic space in Russia – the state and society are in a new reality. The health care system has received a significant boost and should reconsider the direction of its development in the current conditions. The shocks of the COVID-19 pandemic will expand the areas of operation of the pharmaceutical industry and give a new impetus to the development of industrial medicinal plant production.

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