



Case Study

ISSN : 2277-3657
CODEN(USA) : IJPRPM

Supplements with Polyprenols: Assessment of the Russian Market Potential

Yuliya Mukhametova¹, Boisjon Tokhiriyon^{2*}, Valeriy Poznyakovsky^{3,4}, Ekaterina Pastushkova², Abduvali Toshev¹

¹Department of Sports, Tourism and Service, South Ural State University, Chelyabinsk, Russia.

²Department of Management, Entrepreneurship and Engineering, Ural State University of Economics, Ekaterinburg, Russia.

³Scientific and Educational Center for Applied Biotechnology and Nutrition, Kemerovo State Medical University, Kemerovo, Russia.

⁴Department of Technological Entrepreneurship, Kuzbass State Agricultural Academy, Kemerovo, Russia.

*Email: tohiriyoni@gmail.com

ABSTRACT

As populations in many countries around the world age, the global supplement industry has been thriving for over a decade. The Russian supplements market has also experienced significant growth, with more consumers acknowledging the lack of essential nutrients in their diets. To meet the increasing demand and capture the opportunity, Russian producers of supplements seek natural bioactive compounds with proven health benefits and enhanced effectiveness. Therefore, Russian supplement manufacturers developed supplements with natural polyprenols from the needles of Siberian conifer trees. Polyprenols possess anti-inflammatory and hepatoprotective functions. Polyprenols participate in the processes of regeneration of damaged liver cell membranes, provide glycosylation reactions in the dolichol phosphate cycle during the synthesis of glycoproteins; control their biosynthesis, maintain the immune status of the cell, transport of immunoglobulins, regulate the reduction of cholesterol levels by activating the transport of dolichol from the endoplasmic reticulum to lysosomes; improve the energy metabolism of the cell, participate in oxidative phosphorylation and activation of mitochondrial function. The present study assesses existing supplements aimed at reducing cholesterol and the market potential for supplements with polyphenols.

Key words: *Natural polyprenol, Lipid metabolism, Russian dietary supplements market, Needles of Siberian conifer trees*

INTRODUCTION

Similar to people in many countries around the world, Russians suffer from various micronutrient deficiencies, namely iodine, calcium, iron, selenium, vitamins (C, D, and B), and fiber deficiencies [1, 2]. To obtain the necessary amount of all the nutrients required by the body to remain healthy, people around the world regularly consume supplements and fortified foods. Consumers in the USA, China, and Japan are reported to take the most advantage of supplement products, while only 2% of the population of Russia add food supplements to their diets regularly (with 23% of Russians buying food supplements occasionally) [3]. The U.S. supplement industry experienced an impressive growth during the Covid-19 pandemic [4]. According to the statistics, in 2020, the USA and China were the leading countries in terms of sales of supplement products, with the volume of the Chinese supplement market amounting to 4.9 billion US dollars, in monetary terms, while the US market added up to 4.6 billion. One of the major reasons was increasing awareness of the need for preventive healthcare. In Russia, the public perception of supplements also demonstrated a significant change in 2020, as consumers paid

more attention to strengthening the immune system and, thus, considered the health benefits provided by supplement products. As reported by DSM Group (marketing agency), in 2021, the volume of the Russian supplement market amounted to 5.5 billion rubles, or 21.9 million packages [5].

While Russian producers of food supplements have recently demonstrated a noticeable growth in revenues, the economic instability has affected the market greatly, and many Russian companies are now faced with increased costs of raw materials and equipment, frozen investments, delayed payments, as well as decreased purchasing power. However, the Russian producers of food supplements are still able to maintain their market leadership, with 56% of the market in monetary terms (82% in packages) [5].

Even though during the Covid-19 pandemic the Russian dietary supplements market experienced significant growth, it is still difficult to forecast short-term market changes for several reasons. One of the reasons is inadequate nutrition knowledge, so healthy food habits need to be promoted. Another reason is a deep distrust of food supplements. This can be explained by several cases when producers had claimed certain health benefits, but the supplements advertised were later proved to be inefficient or dangerous. The third reason worth mentioning is the increasing number of fraudulent supplements sold online. Therefore, there is an obvious need for tighter control over the production and distribution of food supplements from regulatory authorities.

Global trends also significantly influence the Russian market. Supplements are currently produced in many forms, including nutrition shakes, energy bars, and vitamin-enhanced waters, and are increasingly being promoted as an essential part of a healthy lifestyle. These products offer low-calorie content with high nutritional value [6-14].

MATERIALS AND METHODS

The main intent was to identify the opportunities for supplement industry growth. For this purpose, we studied the Russian supplement market and analyzed the reports and analytical databases on pharmaceutical markets and supplement products prepared by the DSM Group. Our study focused on supplement products with polyphenols (natural bioactive ingredients found in plants) as the prevalence of hypercholesterolemia is one of the major issues currently affecting the Russian population aged 40 and older. Hypercholesterolemia can result in coronary artery disease caused by plaque buildup, atherosclerosis, and ischemic strokes [14-21].

We considered the supplement products using scientific analysis tools and statistical methods.

RESULTS AND DISCUSSION

Analyzing supplements [22, 23] manufactured by two of the largest Russian producers, Evalar and Binnopharm Group, we found no supplements with polyphenols. Evalar mainly focuses on manufacturing anti-aging supplements, herbal teas, laxatives, and liver support supplements. The only supplement for treating and managing cholesterol produced by the company, 'Ateroklefit Bio', contains red clover extract, hawthorns, and vitamins. 'Ateroklefit Bio' is intended to improve lipid metabolism, reduce the absorption of cholesterol into the bloodstream, as well as provide nutrient support in combination therapy.

Biopharm Group manufactures pre- and probiotic supplements to help maintain gut and immune health, supplements for joint health, and plant-based supplements for the nervous system intended to support a healthy nervous system.

The third largest Russian producer, Otcpharm, specializes in vitamin and mineral complexes, liver support supplements, lactase supplements, supplements for the urinary system, as well as anti-inflammatory supplements. The only product with Siberian fir cell sap is an oral rinse, 'Pikhtalor', which is intended to treat mouth inflammation.

At the same time smaller producers, among them VILAVI, Artlife, and Vitamer have heavily invested in research of potential health benefits of Siberian fir cell sap and developed supplements aimed at lowering cholesterol.

For more than a decade, 'Provitam' bioactive complex produced with pine and spruce needles has been recommended for combination therapy and prevention of cardiovascular diseases, opisthorchis infection, and cancer [6-8]. The main ingredient is coniferous concentrate intended for nutrition use (State registration certificate 77.99.11.3.U.2379.4.10 dated 16.04.2010) [10]. The study of the chemical composition of 'Provitam dietary supplement components was performed by a team of scientists supervised by V.I.Roschin, professor of Saint-Petersburg Forest Technical University (Table 1).

Table 1. “Provitam” supplement: the chemical composition

Ingredients	Content, %
Polyprenols	<= 35
Aldehydes and ketones	<= 30
Hydrocarbons	<= 30
Fitol	20–22
Carotenoids	<= 10
Including β -carotene	<= 0,4
Sterols	2.6–3.0
Vitamin E	~ 1

The coniferous concentrate contains 50% of polyprenols (bioactive long-chain alcohols (sterols, aliphatic alcohols), 30% of fatty acid esters, 8.7% of polyhydroxy compounds, 4.9% of hydrocarbons (alkanes, terpenes), 2.8% of aldehydes, and 0.2% of oxides. The chemical composition of a commercial sample of coniferous concentrate is composed of 74.9% unsaponifiable components, 16.6% of bound acids with 16.3% of fatty acids, traces of resinous substances, 0.4% of free fatty acids, 7.3% of phytosterols (including 5.8% of free phytosterols). The most valuable biologically active substances found in coniferous concentrate are phytosterols (β -sitosterol, campesterol, stigmasterol); vitamin E (alpha-, beta-, gamma, and delta-tocopherols, alpha-, beta-, gamma-, and delta-tocotrienols); carotenoids (β -carotene, α -carotene, lutein, xanthophylls); polyprenols, phytol, squalene, and vitamin K.

The Scientific Research Institute of Nutrition, Moscow, certified the total amount of phytosterols in ‘Provitam’ as 15.86% (including β -sitosterol, stigmasterol, and campesterol) and 9.5% of higher aliphatic alcohols. Innovative production technology enables the manufacturer to preserve prenol, squalene as well as vital vitamins created by nature, namely vitamins A, E, D, and K. ‘Provitam’ can be used to:

- replenish deficiencies of phytosterols, vitamin E, and carotenoids;
- prevent and treat cardiovascular diseases, reduce low-density lipoprotein;
- decrease the risk of lung cancer, prostate cancer, and other oncological diseases;
- strengthen the immune system, treat asthenic syndrome which is usually associated with reduced working capacity, bad memory, irritability, and overall weakness;
- prevent and treat helminthiasis [6].

In 2016, VILAVI launched their ‘T8’ line of dietary supplements produced with saps extracted from Siberian conifers, mainly from fir needles. Most dietary supplements of the ‘T8’(Tayga8) line are aimed at strengthening the immune system, with 85% of polyprenols and juice concentrates from a wide variety of taiga berries (honeyberries, blueberries, sea buckthorn berries, cranberries, blueberries, and lingonberries). As a result of heavy investment both in production and marketing, the ‘T8’ line stands out with its modern packaging design and offers dietary supplements to improve overall health and digestion, slow down aging, meet daily requirements of essential nutrients as well and prevent cancer.

‘ArtLife’, the Russian manufacturer of biocomplexes, cosmeceuticals, nutraceuticals based in Tomsk, produces ‘Oleopren Cardio’ dietary supplement developed to improve the functioning of the cardiac muscle cells. The dietary supplement contains polyphenols that help support the cardiovascular system, regenerate myocardial tissue, improve cardiac muscle function, reduce cholesterol, prevent myocardial infarction, as well as prevent free radical-induced tissue damage [24]. Each capsule of ‘Oleopren Cardio’ contains tocopherol acetate (vitamin E) - 3.75 mg; fir polyprenols - 5 mg; coenzyme Q10 - 3.75 mg; lycopene - 0.62 mg; L-carnitine - 22.5 mg. Pharmaceutical excipients added include sunflower oil, silicon dioxide, and ‘Antioxidant mixture. Fir polyprenols improve heart function and stimulate the regeneration of myocardial tissue. Coenzyme Q10 is involved in the regulation of energy metabolism and helps amplify oxygen consumption [25]. The synergistic interaction of Coenzyme Q10 and vitamin E protects the cardiac muscle cells from hypoxia. Lycopene is a natural antioxidant that is effective in reducing LDL cholesterol. L-carnitine stimulates blood cell production, providing nutritional support to the cardiac muscle.

‘Sitopren’ dietary supplement produced by OOO ‘Vitamer’ comes in tablets and is designed to improve lipid metabolism. The main component of ‘The Sitopren’ dietary supplement is a coniferous concentrate rich in polyphenols. The supplement is prescribed to provide nutrient support during the recovery period after strokes or

heart attacks; to meet specific dietary requirements of patients with liver diseases caused by viruses; to prevent or reduce high blood pressure, and to boost the immune system.

Having identified the manufacturers and the supplements, we carried out an assessment applying the following criteria: the findings of clinical tests (the number of tests, the scope, after-launch supervision); the manufacturer's reputation (including the manufacturing standards); product availability; customer reviews (including overall packaging design and appeal, ingredients listed and ease of use); and price.

Since all the analyzed data carried a certain percentage, the total for each of these criteria was calculated in points from 0 to 2, where 0 refers to the lowest points scored, while 2 refers to the highest score (**Table 2**).

Table 2. The supplements comparison

Evaluation criteria						
Supplement	Clinical tests	Manufacturer's reputation	Product availability	Customer reviews	Price	Total points
'Provitam'	2	2	0	0	2	6
'Tayga8'	0	0	2	2	0	4
'Oleopren Cardio'	2	2	2	1	1	8
'Sitopren'	2	2	0	1	1	6

CONCLUSION

The findings of our study revealed that the Russian supplement market is below saturation and offers potential for supplements with polyphenols. Thanks to Siberian coniferous forests Russian producers of dietary supplements have the opportunity to obtain huge amounts of high-quality raw material at a reasonable price and can manufacture supplements with polyphenols. Although, new product categories are to be developed to meet all the nutritional needs of the aging population.

ACKNOWLEDGMENTS : The team of authors thanks the administration of the Ural State University of Economics for the opportunity to research its basis.

CONFLICT OF INTEREST : None

FINANCIAL SUPPORT : None

ETHICS STATEMENT : The study was conducted according to the guidelines of the Declaration of Helsinki.

REFERENCES

1. Belousova OV, Belousov EA, Ivashchenkova AO. Biologically active additives as a promising direction for the development of the pharmaceutical market. Scientific result. Med Pharm. 2016;2(4):89-94.
2. Bessonova LP, Antipova LV, Cherkasova AV. Consumption of functional products and dietary supplements in Russia: state and development prospects. International scientific and practical conference dedicated to the memory of Vasily Matveevich Gorbатов. 2015;(1):71-4.
3. Revenue of the vitamins & minerals market worldwide by country in 2021. URL: <https://www.statista.com/forecasts/758626/revenue-of-the-vitamins-and-minerals-market-worldwide-by-country> (Accessed on 16.05.2023)
4. Dietary supplement sales success post-COVID: How can the industry keep the momentum going after the pandemic? URL: <https://www.nutritionaloutlook.com/view/dietary-supplement-sales-success-post-covid-how-can-industry-keep-the-momentum-going-after-the-pandemic> (Accessed on 16.05.2023)
5. News and Reports. DSM Group. URL: <https://dsm.ru/news-reports/>
6. Boytsova YS. Specialized food products in the modern world. Int J Humanit Nat Sci. 2020;42(3-1):51-4. doi:10.24411/2500-1000-2020-10203
7. Borzova M. Road map, and dietary supplements market: forecasts and risks. Remedium. 2018;(11):22-4. doi:10.21518/1561-5936-2018-11-22-28

8. Guo Y, Wang M, Gao C, Fu FF, El-Kassaby YA, Wang T, et al. Spatial prediction and delineation of Ginkgo biloba production areas under current and future climatic conditions. *Ind Crops Prod.* 2021;166:113444.
9. Gammel IV, Suvorova OV, Zaporozhskaya LI. Analysis of the trend of the Russian market of biologically active food additives. *Pharmacy.* 2017;51(6):154-8.
10. State register of medicines. URL: <https://grls.rosminzdrav.ru/Default.aspx> (Accessed on 16.05.2023).
11. Dudkina IA. Features of marketing research for the development of an innovative project on the example of functional food. *Pedagog Educ Altai.* 2014;(2):378-80.
12. Efimova AA, Vasilyeva VT, Pavlova AI. Prospects for the production of national functional food products. *Probl Nutr.* 2015;84(3):109.
13. Zhevachevsky NG. The art of being healthy: a guide for doctors and consultants. 15th ed., revised. Novosibirsk: Advertising and publishing company 'Novosibirsk'; 2016. 508 p.
14. Tokhiriyon B, Tikhonov S, Tikhonova N, Kolberg N, Diachkova A. Biologically Active Dietary Supplements: Current Situation and Prospects for Tomorrow. *Int J Pharm Res Allied Sci.* 2021;10(4):1-5.
15. Tokhiriyon B, Poznyakovsky V, Belyaev N. Biologically Active Complex for the Functional Support of the Connective Tissues: Scientific Rationale, Clinical Evidence. *Int J Pharm Res Allied Sci.* 2018;7(4):53-8.
16. Tokhiriyon B, Poznyakovsky VM, Andrievskikh SS. Biologically active complex for multifactorial support of the central nervous system: new composition, efficacy. *Carpathian J Food Sci Technol.* 2020;12(1):52-60. doi:10.34302/crpjfst/2020.12.1.5
17. Kuznecova G, Joksta I, Kuznecovs IS, Jegina K. Dolichyl phosphate deficiency and polyprenol supplementation in the treatment of atopic dermatitis. *World Allergy Organ J.* 2020;13(8).
18. Verdaguer IB, Crispim M, Hernández A, Katzin AM. The biomedical importance of the missing pathway for farnesol and geranylgeraniol salvage. *Molecules.* 2022;27(24):8691.
19. Boateng ID. Polyprenols in Ginkgo biloba; a review of their chemistry (synthesis of polyprenols and their derivatives), extraction, purification, and bioactivities. *Food Chem.* 2023:136006.
20. Boateng ID, Soetanto DA, Li F, Yang XM, Li YY. Separation and purification of polyprenols from Ginkgo biloba L. leaves by bulk ionic liquid membrane and optimizing parameters. *Ind Crops Prod.* 2021;170:113828.
21. Janik A, Perlińska-Lenart U, Gawarecka K, Augustyniak J, Bratek-Gerej E, Bernat P, et al. Synthesis of Dolichols in *Candida albicans* Is Co-Regulated with Elongation of Fatty Acids. *Int J Mol Sci.* 2021;23(1):409.
22. Shamova MM, Mukhametova YR, Gaag AV, Chudinova YV, Nikolaeva NY, Avstrieviskikh AA, et al. Biologically active dietary supplement for correction of exchange disorders in nervous system diseases. *La Prensa Méd Argent.* 2019:214.
23. Pishchelko AO, Glazacheva VY, Pan ES, Krutenkova EP, Trusov VB, Yarnykh VL, et al. Plant polyprenols reduce demyelination and recover impaired oligodendrogenesis and neurogenesis in the cuprizone murine model of multiple sclerosis. *Phytother Res.* 2019;33(5):1363-73.
24. Antipina AA, Popov VS, Balabaniyan VY. Polyprenols as an original class of natural compounds having a wide spectrum of pharmacological activity. *Farmaciya (Pharmacy).* 2021;70(5):15-21. doi:10.29296/25419218-2021-05-02
25. Latkovskis G, Saripo V, Sokolova E, Upite D, Vanaga I, Kletnieks U, et al. Pilot study of safety and efficacy of polyprenols in combination with coenzyme Q10 in patients with statin-induced myopathy. *Medicina.* 2016;52(3):171-9.