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MEDICINAL PLANT HIPPOPHAE RHAMNOIDES: BIOLOGICALLY ACTIVE COMPOUNDS AND OPPORTUNITIES FOR USE IN FOOD PRODUCTS

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Abstract: This article highlights the rich composition of medicinal plants in biologically active compounds and the prospects for their application in the food industry. The positive effects of flavonoids, polyphenols, alkaloids, essential oils, vitamins, and minerals contained in medicinal plants on human health are analyzed based on scientific sources. In addition, the prospects for using extracts obtained from plants belonging to the *Hippophae rhamnoides* family in the production of canned food products are evaluated. The significance of medicinal plants as natural antioxidants and preservatives, their role in extending product shelf life, improving quality indicators, and ensuring food safety has been studied.

Keywords: medicinal plants, biologically active compounds, polyphenols, flavonoids, essential oils, antioxidants, functional food products, natural preservatives, plant extracts, food additives, technological process, food industry, healthy nutrition, product quality and safety.

On a global scale, the cultivation of fruits and vegetables, berries, melons, and spices, as well as ensuring the population's supply of natural food products and additives, represents a major sector. In this process, conducting scientific research on the use of additives derived from medicinal plants in the food industry and developing relevant technologies is of great importance.

Worldwide, extensive scientific and practical work has long been carried out to protect medicinal plants, rationally use available natural resources, establish plantations for medicinal plant cultivation, and process them. Countries such as Japan, India, Korea, Russia, the USA, Malaysia, and several European states have developed this sector, focusing on improving public health by incorporating natural supplements into daily diets while gradually abandoning synthetic additives.

In recent years, consistent reforms have been implemented in the Republic to protect medicinal plants, rationally utilize natural resources, organize medicinal plant cultivation, and expand their processing and application fields. Considering the richness of our country in medicinal plants, more than 4.3 thousand plant species belong to the local flora, of which 750 species are considered medicinal. Among them, 112 species are officially registered for use in scientific medicine and are applied in traditional medicine, pharmaceuticals, and the food industry. In 2024, processed products derived from medicinal plants worth 52 million USD were exported.

The Decree of the President of the Republic of Uzbekistan dated May 20, 2022, No. PF-139, "On measures to effectively use the raw material base of medicinal plants, support processing, and create value-added chains," serves as a legal basis for supporting this sector. The decree defines goals such as effective utilization of medicinal plant raw materials, wide application of medicinal plants in disease prevention and treatment, support for entrepreneurs establishing cultivated plantations of medicinal plants, organization of deep processing, and creation of value-added chains.

Along with population growth, the role of the food industry in maintaining public health is of particular importance. In this context, the demand for obtaining nutritional supplements and extracts from natural plant raw materials and replacing certain synthetic additives currently used in the industry remains relevant.

Based on the above considerations, the composition of local *Hippophae rhamnoides* fruits was scientifically studied and selected as the research object. The development of canned food products based on extracts obtained from the fruit part of the plant was identified as a priority task. This approach makes it possible to replace certain synthetic additives and preservatives used in the food industry with natural alternatives and to enhance the prevention of certain diseases encountered in medicine.

Hippophae rhamnoides belongs to the Elaeagnaceae family and is a small shrub or tree-like plant that may be evergreen or partially leafless. It is widely distributed from Europe to Central Asia and China. Botanically, it has a compact shrub or small tree form with a height usually ranging from 1 to 6 m. Its leaves are elongated, 3–8 cm long, and alternately arranged. The flowers are small and simple, and pollination mainly occurs by wind. The fruits are bright deep-orange berries with a diameter of 6–8 mm.

The plant is highly adaptable and resistant, tolerating drought, saline and salty soils, and cold climatic conditions. Literature sources note that the roots form a symbiotic relationship with microorganisms of the genus *Frankia*, fixing atmospheric nitrogen and increasing soil fertility. Due to its well-developed root system, the plant prevents soil erosion caused by wind and water.

The fruits of *Hippophae rhamnoides* are rich in biologically active compounds, with vitamin C content ranging from 250 to 1200 mg/100 g depending on the degree of ripeness. In addition, they contain high levels of antioxidant vitamins such as E, K, and A. Carotenoids (β-carotene, lutein, zeaxanthin) impart a bright color and exhibit antioxidant properties, while flavonoids and other polyphenols counteract cellular oxidative processes. The fruits also contain unsaturated fatty acids (omega-3, omega-6, omega-7, omega-9), minerals (K, Mg, Fe, etc.), and amino acids.

The fruits contain vitamin C at 200–1500 mg, vitamin E at 5–18 mg, vitamin A (β-carotene) at 3–15 mg, and vitamin K at 110–230 mg. Notably, the vitamin C content is 20–30 times higher than that of lemon and is relatively heat-stable due to the absence of the enzyme ascorbate oxidase. Polyphenols and antioxidants include flavonols such as quercetin, isorhamnetin, and kaempferol, as well as phenolic acids such as gallic, ferulic, and caffeic acids. The ORAC value is very high, indicating strong free-radical scavenging activity. Traditionally, the plant has been used to prepare anti-inflammatory remedies, strengthen capillaries, and slow aging processes.

The fruits and seeds of *Hippophae rhamnoides* contain omega-7 (palmitoleic acid) beneficial for skin regeneration, omega-3 (α-linolenic acid) supporting cardiovascular health, omega-6 (linoleic acid) involved in hormone synthesis, and omega-9 (oleic acid) important for metabolism. It is noteworthy that omega-7 is a rare fatty acid found in very few plant species. Based on these characteristics, the application potential of *Hippophae rhamnoides* in the food industry can be evaluated, including the development of functional beverages, canned products, biologically active extracts, microencapsulated vitamin complexes, and combinations with probiotic products.

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