

INNOVATIVE APPROACHES TO THE USE OF FLOWER POLLEN IN SPORTS NUTRITION

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Abstract. This paper explores innovative bioengineering approaches to enhance the bioavailability of flower pollen in sports nutrition. It analyzes methods such as nanoencapsulation, enzymatic hydrolysis, probiotic fermentation, complexation with adaptogens, and the use of biopolymeric matrices. The proposed approaches improve nutrient absorption by 5–10 times, presenting new opportunities in sports nutrition.

Keywords: flower pollen, sports nutrition, bioengineering, bioavailability, nanoencapsulation, fermentation, adaptogens.

Introduction. Athlete nutrition requires a specialized approach to meet energy demands, support tissue regeneration, and strengthen overall health [1]. Flower pollen is a biologically valuable substance rich in proteins, vitamins, antioxidants, and microelements [2]. However, its bioavailability is limited due to the presence of a chitinous outer shell that hinders effective nutrient absorption [3].

Research Objective – to analyze and summarize bioengineering methods that enhance the bioavailability of flower pollen for application in sports nutrition.

Research Results and Discussion. One promising solution is the nanoencapsulation of bioactive pollen components. Encapsulation of flavonoids and amino acids in liposomes facilitates efficient cellular membrane transport, while alginate and polysaccharide coatings ensure controlled release in the

intestines [4]. Enzymatic hydrolysis of pollen’s outer shell using cellulase, chitinase, and amylase enhances nutrient bioavailability up to 90%, compared to just 10–15% without treatment. Probiotic fermentation using *Lactobacillus* and *Bifidobacterium* improves the availability of active compounds and generates a synbiotic effect beneficial to athletes’ microbiota. Complexation with adaptogens such as *Rhodiola rosea*, *Withania somnifera* (ashwagandha), and ginseng enhances endurance and accelerates recovery after physical exertion [5].

The use of biopolymeric matrices based on chitosan or sodium alginate ensures prolonged nutrient release in the gastrointestinal tract [6]. Additionally, hydrogel matrices and water-soluble powders formulated with beta-glucans improve bioavailability and facilitate rapid transportation of active substances into the bloodstream [7].

Conclusions. Bioengineering methods significantly enhance the effectiveness of flower pollen as a dietary supplement for athletes. The proposed approaches can increase nutrient bioavailability by 5–10 times. Future research should focus on developing combined products that integrate these methods to boost athletic performance and overall health.

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