INVESTIGATION OF THE POSSIBILITIES FOR IMPROVING THE BIOTECHNOLOGY OF CAROTENOID PRODUCTION

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Carotenoids are natural lipophilic pigments with high antioxidant activity, widely used as food additives, pharmaceutical agents, and cosmetic ingredients. These compounds play a key role in human health, including vision protection, immune support, and reduction of oxidative stress. Among the various natural sources of carotenoids, microbial fermentation is gaining significant attention due to its sustainability, scalability, and controllability [1, 2].

The analysis of scientific research literature has shown that, one of the most effective biological producers of carotenoids, especially beta-carotene, is the zygomycete fungus *Blakeslea trispora*. This heterothallic microorganism requires the co-cultivation of (+) and (–) mating types for the induction of sexual reproduction, which is strongly associated with carotenoid biosynthesis. The accumulation of carotenoids in *B. trispora* cells is closely linked to the formation of zygospores and the expression of key biosynthetic genes, such as carRA, carB, and carT, involved in the desaturation and cyclization of lycopene precursors.

According to literature, optimal conditions for beta-carotene production include a temperature of 26 – 28 °C, pH 6.5 – 7.0, and a co-cultivation ratio of (+):(–) between 1:1 and 2:1. The supplementation of the culture medium with vegetable oils (soybean, corn, sunflower) significantly increases lipid availability, enhancing carotenoid biosynthesis. The addition of metabolic precursors and inhibitors of competing pathways (e.g., tripalmitin, norflurazon) further boosts productivity. Under optimized conditions, beta-carotene yields can reach up to 3.5 g/L in submerged fermentation systems [1, 2].

Furthermore, the use of agro-industrial by-products, such as molasses, corn steep liquor, and whey, as nutrient sources provides a cost-effective and environmentally friendly approach. The downstream recovery of carotenoids typically involves solvent extraction with acetone, hexane, or ethanol, achieving high extraction efficiencies exceeding 90 %.

Thus, *Blakeslea trispora*-based biotechnology represents a promising platform for natural carotenoid production. Continued research focused on metabolic regulation, strain improvement, and process optimization will contribute to the development of efficient and economically viable industrial processes for producing high-value carotenoids.

References:

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