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POLYUNSATURATED FATTY ACIDS IN BACTERIA, ALGAE AND FUNGI–A REVIEW

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Abstract

The ω-3 and ω-6 series polyunsaturated fatty acids (PUFAs) such as eicosapentaenoic acid (EPA), docosahexaenoic acid and gamma linolenic acid have attracted a great attention in the last 15 years, because of their reported health benefits. The research has demonstrated that PUFAs is essential for the development and growth in infants and for improvement of brain function in adults, visual acuity, prevention and treatment of cancer and other chronic disease, in particular cardiovascular disease.

Today fish oil is the main sourced of PUFAs; the source are not satisfactory because it can be contaminated by heavy metals, retain a flavor and odour fishy, and worldwide declining fish stocks.Therefore, there is a need for alternative sources of PUFAs, such as, living organisms, including bacteria, microalgae and fungi, these microorganisms are being explored to get these essential fatty acids, we present a critical review on the state-of-art of production of PUFAs: PUFAs production by microorganisms *(i)* bacteria; *(ii)*microalgae; *(iii)* fungi; and *(iv)* mechanisms of PUFAs biosynthesis.

Studies have shown that bacteria, microalgae and fungi can accumulate high levels of lipids that can be used for PUFAs production. Bacteria cannot compete with fungi as major producers of PUFAs. However, bacteria can increase the production of PUFAs by (a) changing the incubation conditions and growth media; (b) genetic modifications. Random mutations were generated in *Shewanella baltica* MAC1 using the transposon Tn5. The EPA content of the mutant increased 4.5 times more than MAC1 and was able to produce EPA at 30°C while MAC1 did not produce at this temperaturen.

Bacteria from the genera *Shewanella, Collwelia, Moritella* are known to produce PUFAs, such as eicosapentaenoic acid (EPA; 20:5 ω-3) and docosahexaenoic acid (DHA; 22:6 ω-3). These bacteria have been isolated from habitats such as the deep-sea, low-temperature regions like polar areas, and intestines of marine animals. Typical content of EPA in bacteria range from 0.2% to 6.2% dry cell weight basis (dwb).

Some microalgae contain great quantities of high-quality EPA *(Nitzchia frustulum, Phaedactylum tricornutum, Chlorella minutissina)*. They are considered a potential source of this important fatty acid. Typical contents of EPA in microalgae range from 3.9% to 10.2% dwb.

Fungi from the genus *Mortierella* are also able to accumulate high percentages de EPA in the lipid fraction; up to 15% of total fatty acid. Typically, contents of EPA in fungi vary from 5.2% to 8.7% dwb.

Fatty acid biosynthesis in plants occurs in plastids and is believed that these originated from photosynthetic bacterial symbionts and hence fatty acid metabolisms in plants and bacteria are related. PUFAs biosynthesis in microalgaes, fungi and bacteria involves a series of desaturations and elongation reactions. Desaturase enzyme is responsible for inserting a double bond to the carboxyl terminus.

Microorganisms such as bacteria, microalgae and fungi are a viable alternative for the production of polyunsaturated fatty acids. So far, it seems that microbial yields of PUFA are in the order microalgae > fungi> bacteria. Since bacterial-based processes can show many advantages, more efforts are required to increase bacterial PUFA yields. Genetic modification could be an avenue for PUFA yield improvement. Full scale applications of microbial PUFA production, although desirable and necessary, are lacking.