Functional Lipid Production by Unique Microbial Metabolisms: Beyond Common Polyunsaturated Fatty Acids

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Microorganisms are promising as producers of polyunsaturated fatty acids (PUFAs) and as catalysts transforming them into various molecular species beyond common PUFAs. Filamentous fungus *Mortierella alpina* 1S-4 produces triacylglycerols rich in arachidonic acid. Mutants derived from *M. alpina* 1S-4, defective in Δ5 and Δ6 desaturases, accumulate triacylglycerols rich in unique PUFAs, i.e., dihomo-γ-linolenic acid and Mead acid, respectively. Various mutants derived from *M. alpina* 1S-4 have led to the production of oils containing n−1, n−3, n−4, n−6, n−7, and n−9 PUFAs[1,2].

Unique PUFA-transforming activities were found in anaerobic bacteria. Lactic acid bacteria isomerized linoleic acid to conjugated linoleic acid. The conjugated fatty acid synthesis was found to be a part reaction of biohydrogenation and the complex metabolic pathway was revealed[3,4]. The enzyme system was found to consist of four enzymes, i.e., hydratase, dehydrogenase, isomerase, and enone reductase, and generated unique PUFA species such as hydroxy, oxo, and conjugated fatty acids as intermediates. Other unique PUFA transformations were also found in anaerobic bacteria[5,6]. *Pediococcus* sp. produced a variety of hydroxy fatty acids including a dihydroxy fatty acid from C18 PUFAs. *Clostridium bifermentans* saturated C20 PUFAs of arachidonic acid and EPA into corresponding partially saturated fatty acids with conjugated isomers of arachidonic acid and EPA as intermediates, respectively.

We applied these metabolisms and reactions to the production of rare fatty acids and evaluated their potential as functional foods and chemical materials.

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