Analysis and Application of Novel Polyunsaturated Fatty Acid Metabolism in Gut Bacteria

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Microorganisms in the gastrointestinal tract interact with their host in many ways and contribute significantly to the maintenance of host health. Dietary fats are metabolized not only by humans but also by microbes in our gastrointestinal tracts. Lipid metabolism by gastrointestinal microbes generates multiple fatty acid species, such as conjugated fatty acids and *trans*-fatty acids that can affect host lipid metabolism. However, lipid metabolism by gastrointestinal microbes has not been explored in detail.

The author screened representative gut bacteria, the lactic acid bacteria, for the ability to produce conjugated linoleic acid (CLA) from linoleic acid (*cis*-9,*cis*-12-octadecadienoic acid), and selected *Lactobacillus plantarum* AKU 1009a as a potential strain. Further analyses on conjugated fatty acid synthesis in *L. plantarum* AKU 1009a demonstrated that this strain can transform the *cis*-9,*cis*-12 diene structure of C18 fatty acids such as linoleic acid, α-linolenic acid (*cis*-9,*cis*-12,*cis*-15-octadecatrienoic acid), γ-linolenic acid (*cis*-6,*cis*-9,*cis*-12-octadecatrienoic acid), and stearidonic acid (*cis*-6,*cis*-9,*cis*-12,*cis*-15-octadecatetraenoic acid) into the corresponding conjugated diene structures, *cis*-9,*trans*-11 and *trans*-9,*trans*-11. In addition, this strain can saturate these conjugated dienes into the *trans*-10 monoene, that is, CLA was found to be synthesized, in part, through the reactions of a newly discovered polyunsaturated fatty acid saturation metabolism in *L. plantarum* AKU1009a. This metabolism generates several types of fatty acids such as hydroxy, oxo, conjugated, and non-methylene-interrupted fatty acids, and consists of four enzymes, *i.e.*, CLA-HY (hydratase/dehydratase), CLA-DH (dehydrogenase), CLA-DC (isomerase), and CLA-ER (enone-reductase) [1]. With these enzymes, the author was succeeded in production of the corresponding intermediates (hydroxy, oxo, conjugated, and partially saturated fatty acids) from linoleic acid, α-linolenic acid, γ-linolenic acid, and stearidonic acid. Furthermore, physiological function of intermediates in this saturation metabolism was revealed. For example, 10-hydroxy-*cis*-12-octadecenoic acid (HYA) has immunomodulatory activity and ameliorates intestinal epithelial barrier impairment [2]. In addition, 10-oxo-*cis*-12-octadecenoic acid (KetoA) activates PPARγ and stimulates adipogenesis [3]. Through these experiments, the author would like to establish a new health promotion technology by controlling intestinal lipid metabolism using the enzymes and microorganisms.

References

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[3] Goto T., *et al.*: Biochem. Biophys. Res. Commun., 459: 597-603 (2015).