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Genetic background has an effect on the metabolism of essential fatty acids, shows study

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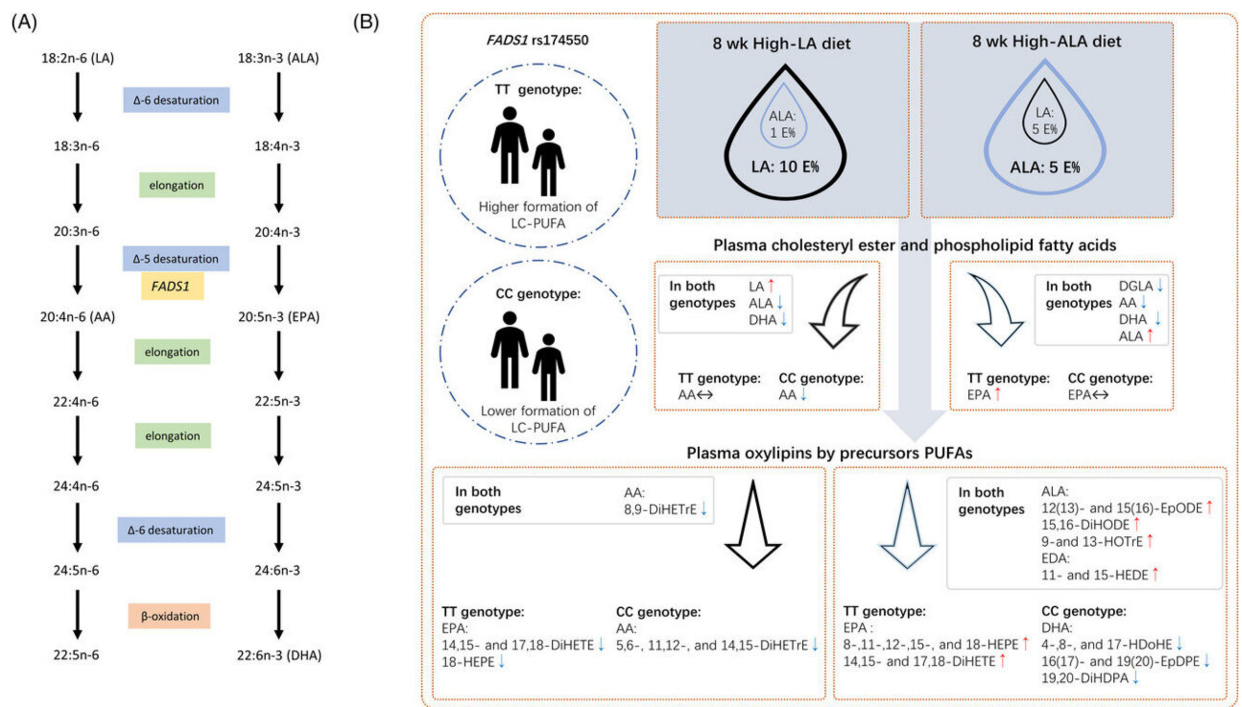

A) Metabolic pathway of n-6 and n-3 PUFAs. B) Study design and the main results of the study. Participants with FADS1 rs174550 TT and CC genotypes were randomized to receive either high-LA or high-ALA diet for 8 weeks. Direction of the changes in the concentration of plasma cholesteryl ester and phospholipid PUFAs and lipid mediator concentrations are illustrated with arrows, genotype (TT or CC) specific changes and shared changes in response to diets are separated. Credit: *Molecular Nutrition & Food Research* (2022). DOI: 10.1002/mnfr.202200351

Genetic background has an effect on the metabolism of the essential polyunsaturated fatty acids alpha-linolenic acid and linoleic acid, a recent study from the University of Eastern Finland shows.

Supplementing the diet with camelina oil rich in alpha-linolenic acid, or with sunflower oil rich in linoleic acid altered the concentrations of the metabolites of these fatty acids in the body; however, the changes were dependent on the study participants' FADS1 genotype. The study was conducted among carriers of two different FADS1 genotypes.

"Camelina oil increased the plasma concentration of eicosapentaenoic acid produced from alpha-linolenic acid in only one of the genotypes studied," says Researcher and first author Topi Meuronen of the University of Eastern Finland.

Both diet and genes have been found to have an effect on the concentrations of different fatty acids in the body. The FADS1 gene regulates the metabolism of polyunsaturated fatty acids, and the FADS1 genotype has previously been associated with glucose and lipid metabolism disorders, and with the risk of type 2 diabetes.

Linoleic acid and alpha-linolenic acid are essential fatty acids not produced by the human body, i.e., they must be obtained from food. Linoleic acid is the most common dietary fatty acid in the omega-6 family. Alpha-linolenic acid, on the other hand, belongs to the family of omega-3 fatty acids. Varying concentrations of both are found in vegetable oils, seeds and nuts. Of vegetable oils, sunflower oil is particularly rich in linoleic acid. Camelina oil and linseed oils, on the other hand, are rich in alpha-linolenic acid.

High intake and plasma concentration of linoleic acid has been associated with, e.g., a lower risk of type 2 diabetes and cardiovascular disease, but the association of alpha-linolenic acid remains unclear. As metabolites of linoleic acid and alpha-linolenic acid, the body produces lipid mediators which are important, but some of them also pro-inflammatory.

In the new study, the researchers explored whether rs174550 point mutations in the FADS1 gene modify the effect of alpha-linolenic acid and linoleic acid on the composition of fatty acids in plasma, and the concentrations of lipid mediators derived from polyunsaturated fatty acids. Carriers of two different FADS1 genotypes were recruited from among men participating in the Metabolic Syndrome in Men study, METSIM. They supplemented their diet with 30–50 ml of camelina oil or sunflower oil daily for eight weeks.

"Our research design, i.e., recruiting subjects on the basis of their genetic background, has proven effective in investigating the interactions between diet and genes," Postdoctoral Researcher Maria Lankinen of the University of Eastern Finland says.

The body can produce eicosapentaenoic acid from alpha-linolenic acid, and arachidonic acid from linoleic acid, for example. These long chain fatty acids, and lipid mediators produced from them, are involved in many functions in the body, such as inflammatory response and vascular function.

The study showed that the FADS1 genotype plays a major role in, for example, how efficiently essential fatty acids are converted to arachidonic acid and eicosapentaenoic acid. The FADS1 genotype also affected the concentrations of metabolites derived from them.

The use of camelina oil rich in alpha-linolenic acid increased the concentration of eicosapentaenoic acid and lipid mediators derived from it in only one of the genotypes studied. In contrast, the use of sunflower oil rich in linoleic acid did not increase the concentration of arachidonic acid or its derived lipid mediators in carriers of either genotype.

"The changes we observed in the plasma concentration of eicosapentaenoic acid were at the same level as in our previous study, where people ate fatty fish containing eicosapentaenoic acid. However, an interesting observation is that when camelina oil was used, the changes occurred only in one of the genotypes studied," says Meuronen.

According to the researchers, the results give cause to consider whether it is possible to give increasingly individualized guidelines on the intake of alpha-linolenic acid and linoleic acid. However, further research is needed.

The study was carried out in collaboration with Karolinska Institutet, and the findings were published in *Molecular Nutrition and Food Research*.

More information: Topi Meuronen et al, The FADS1 rs174550 Genotype Modifies the n-3 and n-6 PUFA and Lipid Mediator Responses to a High Alpha-Linolenic Acid and High Linoleic Acid Diets, *Molecular Nutrition & Food Research* (2022). DOI: 10.1002/mnfr.202200351

Provided by University of Eastern Finland