

Effect of Dietary α -linolenic Acid Preconditioning on its Cellular Incorporation and Conversion into Long-chain Polyunsaturated Fatty Acids

Marc Pignitter¹, Michael Lindenmeier², Gaby Andersen², Cornelia Herrfurth³, Ivo Feussner³,
Martin Fulda³, and Veronika Somoza^{1,2}

¹Department of Nutritional and Physiological Chemistry, University of Vienna, Austria

²German Research Center of Food Chemistry, Freising, Germany

³Department for Plant Biochemistry, Albrecht-von-Haller-Institute for Plant Sciences,
University of Goettingen, Germany

The extent of conversion of α -linolenic acid (ALA) to its corresponding long-chain polyunsaturated fatty acids has been associated with the absolute amount, as well as to the ratio of ingested n6 and n3 fatty acids (FA). To study the effect of long term dietary intake of linseed oil with an optimized ratio of 1:2.5 of n6 and n3 FA on the metabolism of ALA, 10 healthy subjects consumed 40 g linseed oil per day, corresponding to 19.7 g ALA/d, for 8 weeks. On day 1, after a 4 weeks wash-out phase, and on day 29, the volunteers received a bolus of 7 g of ¹³C-labeled linseed oil with a ratio of 1:3.5 of n6 to n3 FA and a >52% proportion of double and multiple ¹³C-labeling. For quantifying the concentrations of ALA and its long-chain homologues, eicosapentaenoic acid (EPA), docosapentaenoic acid (DPA) and docosahexaenoic acid (DHA) in plasma phospholipids, erythrocytes and LDL by GC-HRMS, blood samples were collected at 0, 2, 4, 10, 24, 48, 72, 96, 168, 336, 504 and 672 hours after administration of the ¹³C-labeled linseed oil. To estimate the conversion and retro-conversion of n3 FA, a multicompartment model (1) was designed based on the amount of ¹³C-labeled ALA that was ingested by ¹³C-labeled linseed oil. Following the intervention, incorporation of ALA into LDL decreased by 62% after the 4 weeks preconditioning with linseed oil. From ALA incorporated in LDL, 100% were converted to EPA. Conversion rates of EPA and DPA to DPA and DHA, respectively, were highest after the 4 weeks preconditioning, yielding 96% and 99%. Retro-conversion rates from DHA to DPA, from DPA to EPA and from EPA to ALA were 29%, 0.9% and 4.2%, respectively. In erythrocytes and plasma phospholipids, ALA incorporation and metabolism was less pronounced than in LDL. LDL might, therefore, be the more appropriate compartment for studying the conversion of ALA to its long-chain homologues. In conclusion, long term dietary intake of linseed oil with an optimized ratio of n6 and n3 FA may decrease the ALA incorporation but might induce the conversion from ALA to DHA.

(1) Goyens PLL et al. (2005) J Lipid Res 46: 1474-1483