Fish Oils: Influence of Fish Lipid Metabolism in Determining Content and Composition

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Fish are a unique source of n-3 long-chain polyunsaturated fatty acids (LC-PUFA) in the human diet. The main factor underpinning this is, in turn, the diet of the fish. Simply, fish inhabit ecosystems with food webs that are rich in these fatty acids that originate in the primary producers, the microalga/phytoplankton. However, there are many metabolic processes in the fish including digestion and absorption, *de novo* synthesis, conversions, oxidation and deposition that combine to affect the final fatty acid composition. All off the metabolic reactions have specificities based on the physico-chemical properties of the lipids and fatty acids, and the biological properties of the enzymes involved, which combine to affect binding and reaction rates. This presentation will review what is known about the biochemistry and physiology of each of the metabolic processes as determined by *in vitro* laboratory studies and *in vivo* nutritional trials. Results from the two types of study can be contradictory and those from the latter often appear to suggest that the metabolism of fish has only a limited effect on the final fatty acid composition. However, it can actually be very significant. For instance, zooplanktonivorous fish in the northern oceans feed on calanoid copepods that store lipid as wax esters containing high levels of 20:1 and 22:1 fatty alcohols. However, the fish generally do not contain either of these lipids as the fatty alcohols produced by hydrolysis of the wax esters are oxidised in the enterocytes to 20:1 and 22:1 fatty acids that are major components of northern hemisphere fish oils. The molecular mechanisms controlling lipid and fatty acid metabolism are beginning to be elucidated and this may aid our understanding of the relationships between diet and body compositions. This is currently of great importance as an increasing proportion of fish are being farmed, and the ability of aquaculture to continue to produce nutritious food in a sustainable way will require dietary formulations that may be considerably lower in n-3 LC-PUFA than used previously in diets based predominantly on fish meal and oils.