

Lipids in Aquaculture

Regulation of Fatty Acid Metabolism in Atlantic Salmon

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Introduction of vegetable oils in commercial feed has created renewed interest for lipid, and especially fatty acid, metabolism in farmed atlantic salmon. Already back in 1987 we tested the effects of increasing substitution of fish oil by rapeseed oils or soybean oil on growth, liver, heart and muscle fatty acid composition and sensoric quality of salmon. The results showed, as many later studies, that the fatty acid composition of all organs are to a great extent controlled by the composition in feed, and that the content of the very long chain omega-3 fatty acids EPA and DHA decreased with increasing levels of vegetable oils in the feed. Growth and sensoric quality were, however, only slightly influenced.

Later, in a series of studies, we have investigated in more detail the activities and the regulation of the enzyme systems responsible for the desaturation and elongation of polyunsaturated fatty acids in salmon. We have shown that omega-3 fatty acids are essential fatty acids for salmon and that salmon has the ability to produce EPA and DHA from linolenic acid. This capacity is, however, too limited to secure a high level of the very long chain fatty acids when their content in feed is reduced. Results from studies of competition between omega 3 and omega 6 for the desaturase and elongase systems will further be commented upon.

Also the ability of salmon to use fatty acids from vegetable oils as the source of energy has been studied. As in other species, the 16 and 18 carbon chain fatty acids have been found to be good substrates for beta-oxidation in salmon, and we have shown that the level of both mitochondrial and peroxisomal beta-oxidation activity can be regulated by feed additions such as fibrates and non-beta-oxidable fatty acids. In 1997 we were able to show that also fish contains the family of nuclear receptors termed peroxisome proliferator activated receptors (PPARs), and that the transcription is increased by fibrates. At present we are studying the influence of the addition of 3-thia-fatty acids to salmon feed upon the capacity of white muscle for fatty acid oxidation activity, and by that the capacity for metabolic energy production in specific time periods during the seawater periods. Some recent results will be presented.