FUTURE RENEWABLE SOURCES OF OIL FOR ATALNTIC SALMON AQUACULTURE
Or
STEARIDONIC ACID (18:4ω3) INCREASES OMEAGA 3 LONG CHAIN POLYUNSATURATED FATTY ACIDS IN TISSUES

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Object Salmon aquaculture is fast approaching a road block. The worldwide increase in aquaculture production and the concurrent decrease of wild fish stocks has made the replacement of fish oil in aquafeeds an industry priority. Global production of farmed fish has more than doubled in the last 15 years where as fish stocks globally have been decline. High levels of ω3 LC-PUFA, which are found in salmon, cannot be biosynthesised from plant based oils and therefore must be provided to the fish in their diet. Renewable source of oil from plant sources such as canola, linseed and sunflower have been extensively studied but they lack omega 3 long chain polyunsaturated fatty acids (ω3 LC-PUFA). The reduction of ω3 LC-PUFA in the diet has been shown to reduce ω3 LC-PUFA levels in the fish which has been shown to reduce the cardiovascular protective and other beneficial properties that are associated with eating salmon (1). Renewable source of oil which provides ω3 LC-PUFA is needed to replace fish oil in the diet.

Methods Oil from a unique plant source *Echium plantagineum,* has high levels (14%) of Stearidonic acid (SDA, 18:4ω3) in its fatty acid profile which is a is an ω3 LC-PUFA precursor. Atlantic salmon parr were fed a control fish oil diet (FO) or one of 3 experimental diets of graded replacement of canola oil (CO) with SDA rich oil, O% (CO), 50% (MX) and 100% (SO) for 42 days. It is also being increasingly recognized that not only is the fatty acid composition of lipids important, so too are the particular combinations of fatty acids within individual phospholipid and triacylgercerol lipids. Electrospray ionization reversed-phase liquid chromatography-mass spectrometry (ESI RP-LC-MS) and ^{13}C nuclear magnetic resonance (^{13}C NMR) provide rapid and accurate methods to measure regio specific molecular species in phospholipids and triacylglycerol respectively.

Results There were no differences in the growth or feed efficiency between the four diets. However, there were significant differences in the fatty acid (FA) profiles of the red and white muscle tissues. Significantly higher levels of SDA, eicosapentaenoic acid (20:5ω3, EPA), docosahexaenoic acid (22:6ω3, DHA) and total ω3 occurred in the muscle of fish fed SO and FO compared with those fed CO, with the SO diet resulting in levels of the LC-PUFA comparable to the FO diet. Diet significantly affected the regiospecific phospholipid profile of the cell membrane but didn't affect the regiospecific nature of the triacylgercerol storage lipids.

Major conclusions To our knowledge, this is the first evidence that the dietary inclusion of a LC-PUFA precursor SDA supplied in plant oil, that increased tissue concentrations of total ω3, and DHA and EPA in cultured Atlantic salmon. This has major implications in the aquaculture industry as oil rich in SDA may provide a source of ω3 LC-PUFA for Atlantic salmon. Genetically modified oil seed crops may provide a cheap renewable source of a oil for aquafeeds.

Key Words: Atlantic salmon (*Salmo salar L*); Replacement oil; Stearidonic acid; Thraustochytrid; Genetically modified oil crops.

1. Seierstad SL et al. 2005. Euro. J. Clin. Invest. 35(1). 52-59.