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TRANSFER OF SPECIFIC FATTY ACIDS THROUGH MARINE FOOD CHAINS

R.R. GATTEN*, J.C. GAMBLE** and J.R. SARGENT*

* Natural Environment Research Council, Institute of Marine Biochemistry, Aberdeen
** Department of Agriculture and Fisheries for Scotland, Marine Laboratory, Aberdeen

— Many fatty acids present in the lipids of marine fish have been traced to their origins in the lipids of primary and secondary producers of food chains (Ackman, 1979). The present work is concerned with changes in the fatty acid composition of neutral lipids of developing herring in a simple food chain.— The work was carried out over a 90 day period in a sheltered sea-loch on the west coast of Scotland during spring 1980 within a sea-water enclosure of 300 cu.m. Fertilized herring eggs were hatched out from racks suspended in the enclosures in water which had been taken from the surrounding sea-loch and thus contained naturally occurring populations of phytoplankton and zooplankton species. The latter were predominantly calanoid copepods. Large coelenterates and fish were excluded to protect the herring larvae from predation.

During early development of the herring larvae the most prominent fatty acids in triacylglycerols were C18:4(n-3), C20:5(n-3) and C22:6(n-3). The levels of each of these fatty acids rose up to approximately 10% of the total fatty acids at 20 days post-hatch. Up to 40% of the total fatty acids in herring triacylglycerols at this time were polyunsaturated fatty acids. Since the natural source of polyunsaturated fatty acids in a marine food chain is phytoplankton lipid (Ackman et al., 1970), the results imply that phytoplankton is probably a major dietary input during the very early life of herring.

Adult N. Atlantic herring are known to include in their lipids the specific fatty acids C20:1(n-9) and C22:1(n-11) which originate mainly in the fatty alcohols of the wax esters present in large quantities in calanoid copepods (Pascal & Ackman, 1976; Sargent et al., 1976). The present study showed that these monounsaturated moieties were abundant in the fatty alcohols and, to a lesser extent, the fatty acids of wax esters in calanoid copepods within the enclosed food chain. They were absent from the triacylglycerols of larval herring until the latter were metamorphosing at about 60 days post-hatch. At this time, growth of the fish larvae became increasingly rapid with an accompanying rapid rise in total lipid due mainly to triacylglycerols. Concomitant with an increased percentage of C20:1 and C22:1 in herring triacylglycerols, together accounting for up to 9% of the total fatty acids, the percentage of polyunsaturated fatty acids decreased to about 21% of the total fatty acids.

In conclusion, the present results establish that the composition of fatty acids in the triacylglycerols of developing herring larvae change markedly at about 60 days post-hatch when the fish metamorphose. Initially the fatty acid pattern resembles that of phytoplankton. After metamorphosis, it increasingly resembles the fatty acid pattern of zooplankton species that clearly begin to dominate the fishes' diet. The results are consistent with a marked change in the feeding behaviour of developing herring post metamorphosis.

Bibliography

Ackman, R.G. 1979. Fish lipids. Part 1. In "Advances in Fish Science and Technology". Conference edition. (J.J. Connell ed.) Fishing News Books Ltd., Farnham, Surrey, England.

Ackman, R.G., Eaton, C.A., Sipos, J.C., Hooper, S.N. & Castell, J.D. 1970. Lipids and fatty acids of two species of N. Atlantic krill (Meganyctiphanes norvegica and Thysanoessa inermis) and their role in the aquatic food web. J. Fish. Res. Bd. Canada 27, 513-533.

Pascal, J-C. & Ackman, R.G. 1976. Long chain monoethylenic alcohol and acid isomers in lipids of copepods and capelin. Chem. Phys. Lip., 16, 219-223.

Sargent, J.R., Lee, R.F. & Nevenzel, J.C. 1976. In "Chemistry and Biochemistry of Natural Waxes". (Kolattukudy ed.) 49-91. Elsevier, Amsterdam, Oxford, New York.