Importance of PUFA/HUFA Function and Other Trace Elements in Marine Organisms (Finfish / Shrimp)

A Brief Synopsis of the Affects and Benefits of the Fatty Acid: DHA.

The requirement for 22:6n-3 (DHA) fatty acids in marine fish and shrimp nutrition has been established by Kanazawa, Watanabe and others via feeding diets both rich and deficient in these lipids. The exact mechanism for this requirement is well documented for fish and vertebrate animals but less so for shrimp. The most likely answer may be in the postulate that biological membranes (cells) rich in di-22:6 (n-3) phosphoglycerides have a phase structure that is relatively constant in the face of changing environmental variables such as temperature, pressure and salinity and also a normal and unchanging bilayer width. These considerations rest heavily on the facts that the double bonds in naturally occurring PUFA/HUFA are methylene-interrupted in the *cis* orientation and that the more double bonds there are in a fatty acid, the more the fatty acid is structured by these double bonds. This effect reaches a maximum in 22:6 (n-3).

- **This generates the favored minimum-energy conformational "angle iron" form of the molecule. It would account for the highly beneficial effect on stress tested shrimp containing high levels of this 22:6 (n-3).**

- **A second requirement for PUFA/HUFA and 22:6 (n-3) can be found in the vitellogenic process and precursors for the enzymatic and hormonal processes within the shrimp.**

- **Production of ecdysone for molting, growth and egg production require highly mobile and flexible energy sources as found in PUFA/HUFA.**

Fish phosphoglycerides generally contain about 50% of their total fatty acids as n-3 PUFA/HUFA with a ratio of 22:6 (n-3) : 20:5 (n-3) of about 2:1. This is seen most clearly in the phosphoglycerides of fish eggs.

The lipids of diatoms contain large quantities of 20:5 (n-3) with appreciable quantities of C16 (n-3) PUFA/HUFA but negligible amounts of 22:6 (n-3), whereas the lipids of dino-flagellates contain large amounts of 22:6 (n-3) and also 18:5 (n-3).

- **Most hatcheries do not culture high PUFA/HUFA species of micro-algae to supply 22:6 n-3 sources to the larvae and thus the origin of substitution PUFA/HUFA to the diet of shrimp (and other marine eukaryotes) with commercial products containing high levels of these lipids.**

Innumerous comparisons of oil-based enrichments vs. whole cell preparations of AlgaMac (*Schizochytrium* sp.) have shown that not all of the pigmentation and eye spot development of larval fish could be attributed to fatty acid composition of the larvae.

- **Whole cell preparations of AlgaMac supply a broader profile of nutrients such as carotenoids, sterols, phosolipids and vitamins than oil-based enrichment products and may account for this observation.**

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