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Characteristics of the fatty acid composition in the bathyal Calyptogena clam, C. octanii: difference in trophic relationship between surface and vent clams

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The lipids of the bathyal Calyptogena clam (Calyptogena okutanii), which house chemosynthetic symbionts in the gill filaments, assimilate similar unusual n-4 family (n-1/n-4/n-7) long-chain non-methylene interrupted polyunsaturated fatty acids (NMI-PUFA) together with saturated, monounsaturated, and NMI dienoic fatty acids. Similar to the fatty acid composition of lipid of a hadal clam, Calyptogena phaseoliformis, more than 20 kinds of n-4 family PUFA in the clam lipids were found. Noticeable levels of odd-chain PUFA 21:3n-4,7,16 in the Calyptogena clam were also observed. The vent clam, which assimilates thiotrophic bacteria, maintain the plasma membrane by the n-4 family NMI-PUFA. Each symbiont changes the host lipid. Differed from high levels of n-3 PUFA in the surface clams (Mactra chinensis and Ruditapes philippinarum), high levels of n-4 family NMI-PUFA without n-3 and n-6 PUFA in the vent clam lipids indicate the occurrence of unusual membrane lipid systems in the hosts and symbionts. Compared with the fatty acids in the deepest Calyptogena species, C. phaseoliformis, at more than 6,000m depth, the Calyptogena clam ranging at about 1,000m depths has the same kinds of n-4 family PUFA in spite of the marked difference of habitat depths. The occurrence of high diversity in the n-4 family NMI-PUFA suggests adaptation to extreme environments using their membrane fluidities and high biosynthetic potential for similar sulfur-oxidizing bacteria. All the Calyptogena clam lipids thereby exhibit their independence of photosynthetic products and a closed food chain, depending only on geothermal energy from hydrothermal and cold-seep vents.