DHA and EPA Interaction with Raft Domains Observed With Solid-State ^{2}H NMR Spectroscopy

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Research continues to examine the health benefits of omega-3 polyunsaturated fatty acids (n-3 PUFA) found in fish oils. The major bioactive components are eicosapentaenoic acid (EPA, 20:5), with 20 carbons and 5 double bonds, and docosahexaenoic acid (DHA, 22:6), with 22 carbons and 6 double bonds. However, their molecular modes of action remain unclear. A suggested hypothesis is that these fatty acids are incorporated into membrane phospholipids and modify the structure and organization of lipid rafts, thus affecting cell signaling. We used solid-state ^{2}H NMR spectroscopy to compare molecular organization in mixtures of 1-palmitoyl-2-eicosapentaenoylphosphatidylcholine (PEPC) and 1-palmitoyl-2-docosahexaenoylphosphatidylcholine (PDPC) with the raft-stabilizing molecules sphingomyelin (SM) and cholesterol. Our spectra for PEPC-d_{31} and PDPC-d_{31}, analogs of PEPC and PDPC with a perdeuterated palmitoyl *sn*-1 chain, showed that DHA has a greater tendency than EPA to incorporate into raft-like domains enriched in SM and cholesterol. By using PSM-d_{31}, an analog of SM with a perdeuterated *N*-palmitoyl chain, we now directly observe one of the raft-forming molecules and analyze the molecular order within the raft. These results will add to the growing information on how EPA and DHA differentially modify lipid domain organization in bilayers.

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