Bilayers at the ILL

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Functionalized membrane domains: an ancestral feature of Archaea

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The current tree of life is divided into three domains: Bacteria, Eukarya and Archaea. While bacterial and eukaryotic lipids are constituted of sn-3 glycerol on which straight fatty acids are ester-bound, archaeal lipids contain ramified isoprenoid hydrocarbons that are linked through ether bounds on a sn-1 glycerol. As a results, plasma membranes are spatially organized into domains of distinct functions in Bacteria and Eukarya, but membrane functionalization remains a debated question in Archaea. However, the recent reinvestigation of the lipid content of the hyperthermophilic and piezophilic archaeon *Thermococcus barophilus* led to the elaboration of a novel membrane ultrastructure in which monolayered and apolar hydrocarbon-containing bilayered domains may be delineated[1]. To estimate the ubiquity of this novel membrane ultrastructure in and out of the order Thermococcales and all the organizational possibilities it implies, we reassessed the lipid composition of all the Thermococcales type species and all archaea. We show that almost all archaea can synthesize di- and tetraether lipids, which reflect their lifestyle more than their phylogeny and support the universal existence of a functionalized membrane in Archaea. Our findings establish functionalized membrane domains as a universal feature of Archaea, and thus of all living organisms, opening new avenues to understand the membrane physiology and adaptation since the origin of cellular life.

1. Cario A, Grossi V, Schaeffer P, Oger PM. Membrane homeoviscous adaptation in the piezo-hyperthermophilic archaeon *Thermococcus barophilus*. *Front Microbiol.* 2015; 6: 1152.

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