

DIVERSITY OF INTACT POLAR LIPIDS IN ENVIRONMENTAL PROKARYOTES: AN EVOLVING DATABASE

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The characterization of inventories of intact polar membrane lipids (IPLs) of prokaryotes is typically motivated by biomedical research objectives and thus focuses on pathogens or compounds of potential pharmaceutical interest. Our interest is to develop these universal cell compounds further into chemotaxonomic tools for studies in microbial ecology in geologically relevant environments. In recent years, we have been assembling systematic information on the inventories of IPLs in prokaryotes of environmental relevance. To date, we have studied the composition of intact membrane lipids in ~100 prokaryotes (30 archaea, 70 bacteria) that were isolated from both continental and marine environments, including extreme habitats. The prokaryotes cover most major branches of the phylogenetic tree of life, enabling us to examine the data set in terms of evolutionary relationships of lipid composition between major phyla. At this point, we have exclusively focused on the determination of structural properties that are analyzable by HPLC-electrospray ionization-ion trap multistage-MS (cf. Sturt et al., 2004). Major distinctive features examined encompass the structures and distribution of polar headgroups, bond types between alkyl chains and glycerol, and the number of carbon atoms and degree of unsaturation in alkyl chains. Archaeal membrane lipids are dominated by mono- and diglycosidic archaeol and/or glycerol dialkyl glycerol tetraether. Phospholipids were observed in less than 50% of our archaeal cultures with phosphatidylethanolamine (PE) being the most common phosphorus-bearing headgroup. Among all prokaryotes, phosphatidylglycerol (PG; ~55% of studied species), PE (~50%), diphosphatidylglycerol (DPG, ~40%), and monoglycosyl derivatives (~40%) are most commonly expressed. The latter headgroup is particularly common among the archaea and the cyanobacteria. In combination, the examined structural features lead to valuable chemical

fingerprints that are taxonomically distinctive on the monospecific level. In environmental communities, however, the situation is more complex and IPL signatures represent ecosystem rather than species fingerprints. Our presentation will highlight the relationship between lipid composition and 16S rRNA-based molecular phylogeny. Results from selected ecosystems based on lipids are compared to those obtained from other techniques; strengths and weaknesses will be examined.

REFERENCES

Sturt, H.F., Summons, R.E., Smith, K.J., Elvert, M., and Hinrichs, K.-U, 2004. Intact polar membrane lipids in prokaryotes and sediments deciphered by ESI-HPLC-MSⁿ – new biomarkers for biogeochemistry and microbial ecology. *Rapid Communications in Mass Spectrometry*, 18, 617-628.