P182-TU

# MOLECULAR CHARACTERISTICS OF MICROBIAL MATS FROM WARNER VALLEY, OREGON: FORMATION OF WAX ESTERS DURING DESSICATION

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Lakes in Warner Valley, Oregon, experience significant changes in water balance caused by seasonal- to decadal-scale droughts. They are fed by springs of varied temperature (9 - 71°C) and pH (6.5-8.3), typically originating from fractures within Oligocene basalt, are HCO3- dominated, and support microbial mats. From late spring through summer the lake waters are concentrated by evaporation, which produces wide variations in their chemistry and thermal structure from the interplay of supply/evaporation. Water chemistries range from moderately to highly alkaline to sulfate-chloride dominated, and vary widely in pH (8.3-10.5) and total dissolved solids (TDS; 25-300,000 ppm). Throughout the system, microbial mats in the lakes, playas, and springs are controlled by temperature (psychrophiles, mesophiles, thermophiles, and hyperthermophiles) and chemistry (alkalophiles and halophiles), and are augmented by seasonally dynamic microbial populations that respond to profound shifts in temperature, pH and ion and metal concentrations.

The production and abundance of wax esters is enhanced in microbial mats undergoing desiccation compared to equivalent hydrated mats. Wax esters are markedly lower in abundance (~18 μg/g C) among the lipids from live mats in alkaline waters (average alkalinity = 122 mg/l as total $CaCO_3$, pH = 9.1-10.5, TDS = 237 ppm; temperature = 19.6°C), than in analogous desiccated mats (~60 μg/g C; Fig. 1). The wax esters range from $C_{26}$ to $C_{50}$ and are comprised of a simpler range of carboxylic-acid moieties than those found in marine (e.g. Wakeham et al., 1983) and hot-spring environments (e.g. Sheia et al., 1991). However, they include isoprenoid components only previously observed among the lipids of marine bacteria fed on phytol (Rontani et al., 1999), and components with α-tocopherol as the alcohol moiety. The longer chain length of the wax esters from dessicated mats affords lower solubilities and greater resistance to degradation and oxidation. Seasonal rehydration in an alkaline environment would naturally saponify the wax esters, regenerating acids and alcohols. Thus, breakdown of these wax esters effectively provides lipids and high molecular-weight materials for cell walls for the next viable microbial generation, and represents a significant evolutionary pathway in lipid biosynthesis and usage.

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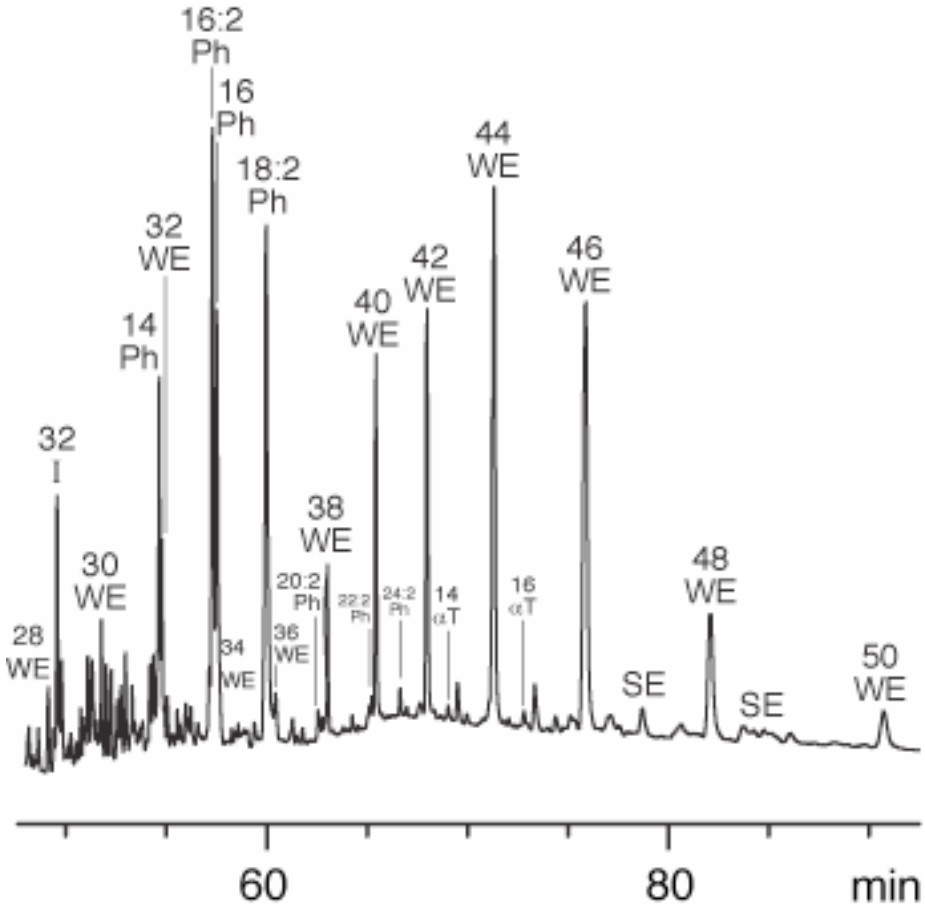


Figure 1. Partial gas chromatograph highlighting the concentrations of wax esters (WE), isoprenoids (I) with phytyl (Ph) and α-tocopherol (αT) side chains, and steryl esters (SE). Numbers denote the number of carbon in the WE, or the size of the acid moiety in the esters comprised of phytol or α-tocopherol.