

SOIL BACTERIAL POPULATIONS AND PROCESSES IDENTIFIED USING BACTERIOHOPANEPOLYOL BIOMARKERS

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The identification of bacteriohopanepolyol (BHP) biomarkers in soil samples from around the world has enabled the assessment of the dominant hopanoid-producing bacterial populations in the soil as well as a number of bacterially mediated soil processes without the need for DNA or RNA analysis of the samples.

Bacteriohopanepolyols (BHPs; e.g. Fig. 1) are bacterial membrane compounds with a high degree of structural variability. They are analogous to steroids in eukaryotes and have been identified in over half of all bacteria tested for their presence. BHPs have a wide range of over 40 different functional groups on the side chain, with up to 6 being present in any structure and, with the possibility of methylation and unsaturation, over 100 individual structures have been identified (e.g. Fig. 1), some of which may be unique to specific bacteria groups and species (Rohmer et al., 1993¹ and subsequent references).

Analysis by reverse phase HPLC ion trap mass spectrometry² of the BHPs extracted³ from soils collected in the UK, Canada, Sweden, Vietnam and other sites around the world clearly shows significant differences in the BHP distributions and concentrations that vary with location, depth, soil type and time of year. Over 29 different BHPs have been identified in soil samples with each soil containing approximately 15 to 20 different BHP structures. This complexity is far greater than that seen in marine and non-marine sediments which have been extensively studied for their BHP content⁴. This reflects not only the complexity of soil microbial communities and soil organic matter but also the sensitivity of the analytical techniques.

BHPs have the potential to be applied as indicators not only of soil bacterial populations but also as indicators of bacterially mediated biogeochemical processes. For example, paddy field soils are known to be producers of high levels of methane and therefore contain high levels of methane oxidising bacteria⁽⁵⁾. Paddy field soil samples from Vietnam have been found to contain a bacteriohopanepolyol marker, 35-aminobacteriohopanepentol, that is specific for Type I methanotrophs and is absent in other soil samples studied to date clearly demonstrating the viability of the technique to describe BHP producing soil bacterial populations in terms of their role within the soil.

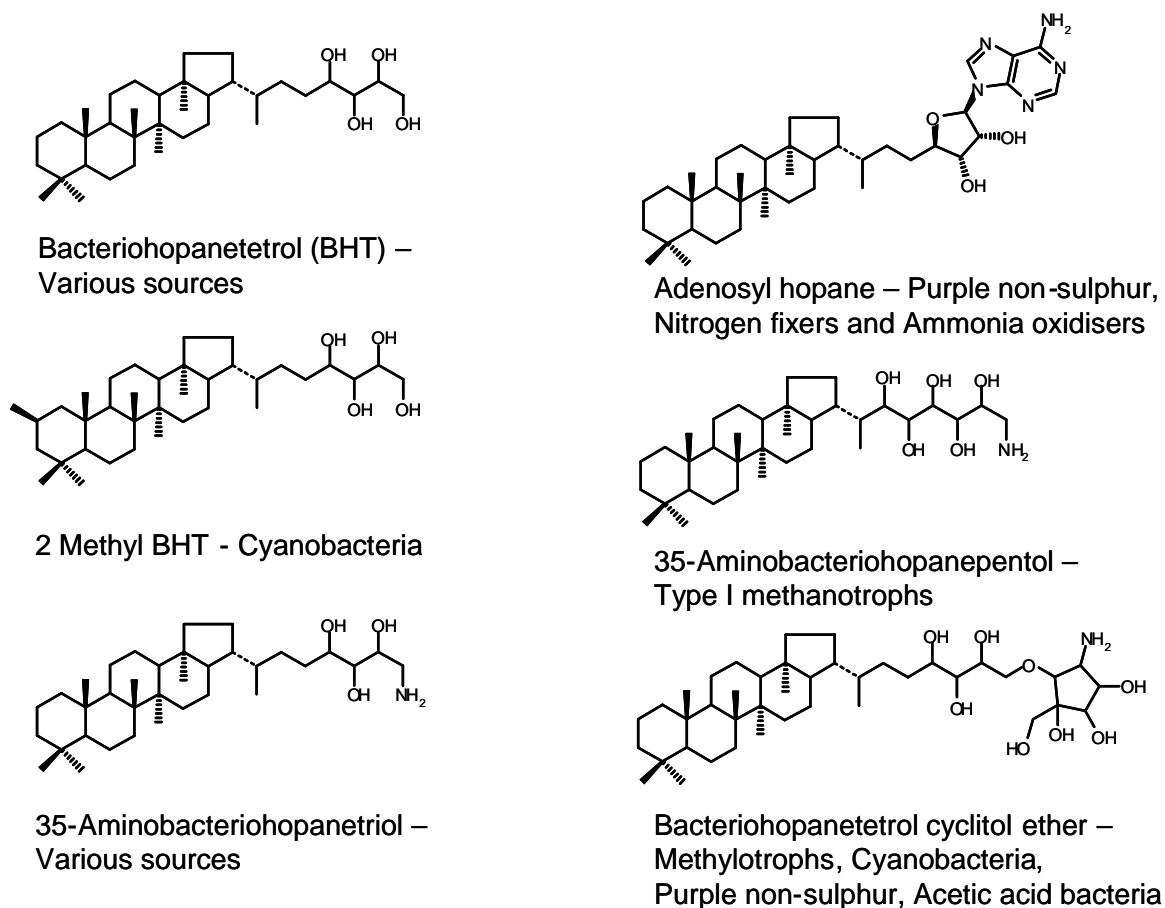


Figure 1. Examples of BHPs found in soils and their known bacterial sources.

This research is only in its initial stages but the potential for providing a fundamentally different approach to the identification of the notoriously complex soil organic matter and soil bacterial population is obvious. Further work will concentrate on investigating different soils and bacteria from around the world to obtain a fuller understanding of the sources of BHPs and their role as soil markers.

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