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Microbial community diversity associated with moonmilk deposits in a karstic cave system in Ireland

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Microbial ecology in subterranean systems has yet to be fully studied. Cave systems present highly unusual and extreme habitats, where microbial activity can potentially play a major role in nutrient cycling and possibly contribute to the formation of characteristic subaerial structures. How microorganisms actually function in cave systems, and what ecological roles they may perform, has yet to be widely addressed, although recent studies using molecular techniques combined with analytical geochemistry have begun to answer some questions surrounding subterranean microbial ecology (Northup et al., 2003).

Moonmilk has a 'cottage-cheese' like consistency, comprised of fine crystal aggregates of carbonate minerals, commonly calcite, hydromagnesite and gypsum, and is believed to be at least partially precipitated by microbial activity (Baskar et al., 2006). Microbial metabolic processes have been implicated in the formation of moonmilk, probably a result of biochemical corrosion of bedrock under high moisture conditions. Mineral weathering via bacterial activity has become accepted as a major influence on subsurface geochemistry and formation of belowground structures (Summers-Engel et al., 2004). While many studies focus on bacterial communities in subterranean systems, fungal community structure is also likely to be important in cave systems, given the important role fungi play in the transformations of organic and inorganic substrates (Gadd, 2004) and the significant role of fungi in mineral dissolution and secondary mineral formation (Burford et al., 2003).

In general, it is agreed that both biotic and abiotic processes influence moonmilk formation, yet the diversity of the microbial community associated with moonmilk formations has not been characterised to date. Ballinamintra Cave (Waterford County, Ireland) is largely protected from human influence due to accessibility difficulties and thereby offers an opportunity to study microbial community structure that has been unaltered by human disturbance or practices. The aim of this study was to examine microbial community diversity associated with moonmilk deposits at Ballynamintra Cave, Ireland using automated ribosomal intergenic spacer analysis (ARISA).

The results revealed considerable bacterial and fungal diversity associated with moonmilk in a karstic cave system, suggesting that the microbial community implicated in moonmilk formation may be more diverse than previously thought. These results suggest that microbes may have important functional roles in subterranean environments. Although the moonmilk in this study was largely comprised of calcite, microbial involvement in calcite precipitation could result in the bioavailability of a range of organic compounds for subsequent microbial metabolism.

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