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THE FORMATION OF GLYCEROL MONODECANOATE BY A DEHYDRATION/CONDENSATION REACTION: INCREASING THE CHEMICAL COMPLEXITY OF AMPHIPHILES ON THE EARLY EARTH

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Dehydration/condensation reactions between organic molecules in the prebiotic environment increased the inventory and complexity of organic compounds available for self-assembly into primitive cellular organisms. As a model of such reactions and to demonstrate this principle, we have investigated the esterification reaction between glycerol and decanoic acid that forms glycerol monodecanoate (GMD). This amphiphile enhances robustness of self-assembled membranous structures of carboxylic acids to the potentially disruptive effects of pH, divalent cation binding and osmotic stress. Experimental variables included temperature, water activity and hydrolysis of the resulting ester product, providing insights into the environmental conditions that would favor the formation and stability of this more evolved amphiphile. At temperatures exceeding 50^0 C, the ester product formed even in the presence of bulk water, suggesting that the reaction occurs at the liquid interface of the two reactants and that the products segregate in the two immiscible layers, thereby reducing hydrolytic back reactions. This implies that esterification reactions were likely to be common in the prebiotic environment as reactants underwent cycles of wetting and drying on rare early landmasses at elevated temperatures.