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Lytotropic Phase Behaviour of Glycolipids: A Review

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Structured Abstract

Background: Lyotropic liquid crystals (LLCs) are produced when a certain concentration of material is dissolved in a solvent. Glycolipids are amphiphiles that exhibit liquid crystalline characteristics as a result of the polar and non-polar components of the molecule's propensity to separate the sugar headgroup that makes up the polar hydrophilic element, whereas an aliphatic hydrocarbon chain makes up the non-polar hydrophobic component. They are amphitropic, which can self-assemble to form lyotropic liquid crystal phases due to the complex interactions between water and the hydrophilic head groups of lipids such as lamellar, hexagonal and cubic phases.

Methods: Small-angle X-ray scattering (SAXS) characterisation was performed to precisely characterise the internal structure of LLCs. Polarised light microscopy (PLM) is a visualisation technique used for the preliminary identification of lyotropic liquid crystal structures. The glycolipids studied have the same hydrocarbon tail but distinct headgroups. Glycolipids of β -Mal- $C_{12}C_8$ and β -Glc- $C_{12}C_8$ are used for comparison. The result shows that β -Glc- $C_{12}C_8$ exhibits a hexagonal pattern with a distinct fan-like texture whilst β -Mal- $C_{12}C_8$ exhibited a myelin-like structure that belongs to the lamellar phase.

Factors Affecting Phase Behaviours: One of the most significant elements in the transition from the liquid to the crystalline phase has been found to be the molecular structure of various amphiphilic lipids, including the size of the sugar head group. Studies on glycolipids have demonstrated that variable liquid crystalline behaviour can result from differences in the sugar headgroup, such as those between monosaccharides and disaccharides. The simplest kind of carbohydrate is a monosaccharide, which cannot be further broken into smaller subunits, for example, glucose. Meanwhile, two monosaccharide molecules make up a disaccharide.

Conclusion: Glycolipid liquid crystals are intriguing self-assembled structures with diverse phase behaviours and applications. The combination of hydrophilic sugar groups and hydrophobic lipid chains leads to the formation of various liquid crystal phases. The phase behaviour of glycolipids can vary depending on the number of hydrophilic headgroups, with glucoside and maltoside glycolipids exhibiting different behaviours. PLM and SAXS are commonly used to characterise these phases.

Keywords: Liquid crystals, lyotropic, glycolipids, phase behaviour

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