Guerbet glycolipids from mannose: liquid crystals properties

Melonney Patrick, N. Idayu Zahid, Manfred Kriechbaum and Rauzah Hashim

Centre for Fundamental and Frontier Sciences in Nanostructure Self-Assembly, Department of Chemistry, Faculty of Science, University of Malaya, Kuala Lumpur, Malaysia; Institute of Inorganic Chemistry, Graz University of Technology, Graz, Austria

ABSTRACT
Using mannose as the sugar head, five Guerbet glycolipids with chain ranges from C8 to C24 were synthesised and studied for their liquid crystal behaviour. Differential scanning calorimetry, optical polarising microscopy and small-angle X-ray scattering were employed to determine the thermal, phase and structure properties. Unlike monoalkylated glycolipids, these Guerbet mannosides showed a glass transition below 0°C, except for α-Man-OC14C10. In the dry state, lamellar was observed for α-Man-OC6C2 and α-Man-OC8C6, while α-Man-OC14C8 and α-Man-OC14C10 formed non-lamellar phases, including inverse bicontinuous cubic phase of space group Ia3d and inverse hexagonal phase, respectively. The phase for middle-chain mannoside (α-Man-OC12C8) could not be assigned conclusively at room temperature, but this metastable phase forms lamellar above 37°C. The partial binary phase diagrams in water were also determined. Under excess water conditions at room and physiological temperatures, these materials form normal micellar solution, lamellar, inverse bicontinuous cubic of space group Pn3m and inverse hexagonal phases. The results were compared with those from other monosaccharide glycolipids from the same sugar Guerbet family. Although these compounds are obvious candidate material for lyotropic applications such as drug carrier and protein crystallisation medium, possible thermotropic application is now being explored.

1. Introduction
The word 'mannose' or 'mannitol' is derived from manna, which appears in both the Bible (The Bible 16.31) and the Quran (The Qur’an 2.57) and refers to the food (of plant origin?) God provided the Israelites during their exodus. That aside, mannosone is obtained from mannan, hemicellulose or cellulose of both plant and microorganism origins via chemical hydrolysis or enzymatic processes [1]. Common sources of mannosone include spent coffee grounds (21%) [2], baker’s yeast (16%) [3] and Chinese jujube (13%) [4]. Fruit like orange peel [5], mango [6] and cranberries [7] also contain mannosone. It has a wide range of applications including a source of dietary supplements, as starting material for the synthesis of drugs and in the treatment of urinary-tract infections [1,8]. Chemically mannosone is a simple sugar from the aldohexose series and is a C-2 epimer of glucose [9] with a small structural difference – the hydroxyl group is at the ring C-2 position axial instead of equatorial (in glucose), but the physical behaviours of mannosone differ from those of glucose [10]. Furthermore, the two possible stereoisomers (α/β-D-mannose) from the two likely