J. Pharm. Pharmacol. 1998, 50 (Supplement): 67

© 1998 J. Pharm. Pharmacol.

Sorbitan monostearate organic gels: the gelation process observed

S. MURDAN, G. GREGORIADIS AND A. T. FLORENCE

Centre for Drug Delivery Research, The School of Pharmacy, 29-39 Brunswick Square, London WC1N 1AX

We have previously reported the gelation of a number of organic solvents e.g. hexadecane, isopropyl myristate, by the non-ionic surfactant, sorbitan monostearate [Murdan *et al*. 1996]. The gels are prepared by dissolving/dispersing sorbitan monostearate (10%w/v) in the solvent at 60°C and allowing the solution/suspension to cool and thereby set to the gel. The resulting thermoreversible gels are opaque, with a smooth 'silky' feel while their microstructures consist of a 3-dimensional network of tubular aggregates (figure 1). In an attempt to understand the sol to gel transformation and the formation of the gel skeleton, we observed the gelation process as a sol was cooled (from 60°C to room temperature) using a hot-stage attached to a light microscope.

On cooling the suspension, the solubility of the gelator in the oil decreases with consequent reduction in solvent-gelator affinities. As a result, the gelator molecules self-assemble to shield the solvophobic head groups and toroidal vesicular structures are formed (figure 2, at 44°C). We think these structures are analogous to other well-known vesicles, liposomes and niosomes, except for their toroidal (rather than spherical) shape and their inverted nature as the hydrophobic alkyl chains of the surfactant molecule project outwards into the organic solvent. As in liposomes and niosomes, the surfactants in the vesicular structures are thought to be arranged in bilayers, each toroid consisting of several bilayers.

The toroidal vesicles are rather short-lived structures and only exist at the sol to gel transition temperature. Upon further cooling (at 41°C), the toroids are converted into tubules. We do not know at present how such a transition occurs, the toroids may contract and elongate into tubules on cooling, or they may split into rod-shaped cylindrical tubules. This transition has not been visually observed so far, possibly as a consequence of the rapidity of events. The newly-formed tubules then join with one another, contact points are established and a 3-dimensional network which acts as the gel skeleton is produced. Figure 3 shows 2 sequential stills obtained from a video recording which illustrates the movement of one tubule to join another one through the organic fluid medium. Extensive interactions among the surfactant tubules thus results in the creation of the gel skeleton which immobilises the solvent as the sol is converted to the gelled state.

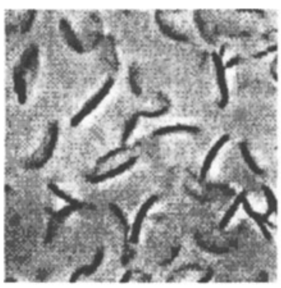

Figure 1: Gel microstructure

Figure 2: Toroidal vesicles at the sol to gel transition

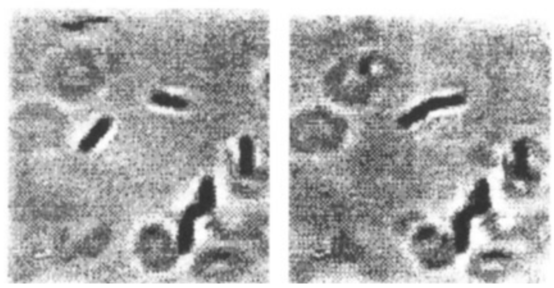

Figure 3: The formation of a junction point.

1. Murdan S, Gregoriadis G and Florence A T, (1996), STP Pharma Sci., 6, 44-48.