MICROSTRUCTURAL CHANGES ON EVAPORATION OF NON-IONIC TERNARY SYSTEMS AND CREAMS USING SYNCHROTRON RADIATION

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Static X-ray diffraction data at the Synchrotron radiation source, Daresbury Laboratory has shown large differences in the microstructures of ionic (cetrimide) and non-ionic (cetomacrogol) ternary systems and creams (Eccleston *et al* , 1988). The actual drug delivery system however, is not the bulk cream, but a dynamic, evaporating system. In previous work, the microstructural changes during evaporation of thin layers of ionic bases were followed by simultaneous evaporation and X-ray diffraction using a novel evaporation cell and correlated with static data (Eccleston *et al* , 1989). Evaporation of ionic systems took place in three stages corresponding to (i) loss of extralamellar i.e bulk water, (ii) loss of some interlamellar (with some structural reorganisation of hydrophobic components) and the rest of the bulk water and (iii) loss of the remainder of the interlamellar water. The present work extends these studies to investigate the microstructural changes in non-ionic ternary systems and creams during evaporation.

The results show that as with the static swelling data, non-ionic systems evaporate differently to the corresponding ionic systems. The non-ionics do not evaporate in stages but show a continuous change in the rate of water loss (Fig. 1a). The X-ray diffraction profiles show that the interlamellar spacings do not shift with time as in the ionic systems. However there is a decrease in periodicity, that is, the lamellar spacings are changing within a certain set of reference points resulting in a broadening of the X-ray diffraction peaks (Fig. 1b). This is indicative of some breakdown in the system.

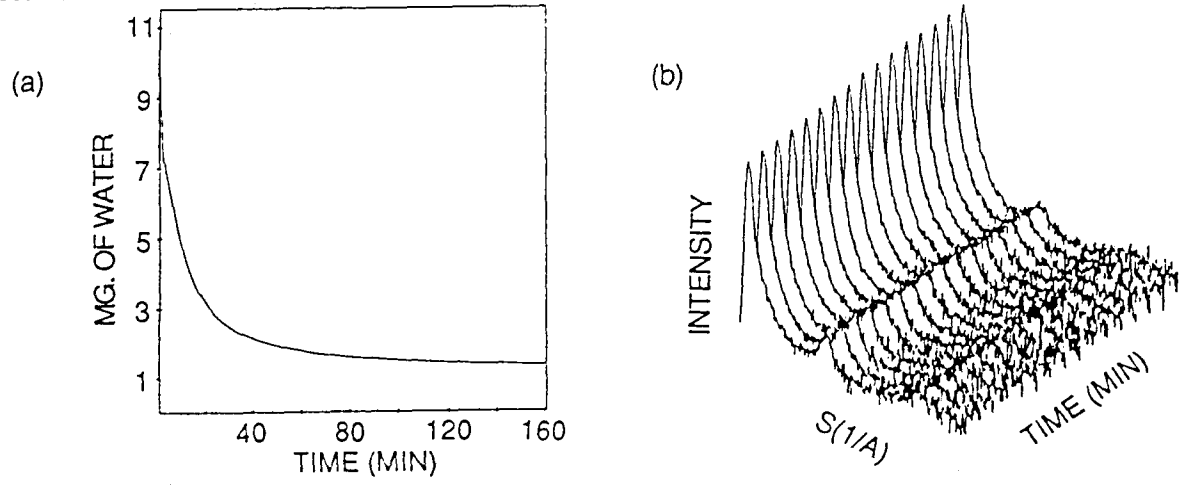

Figure 1. Evaporation of a cetomacrogol ternary system

Static X-ray diffraction measurements have revealed that the comparatively limited swelling of these non-ionic systems is due to the hydration of polyoxyethylene groups of the surfactant (Eccleston *et al* , 1988). The evaporation data show that only bulk water is lost on evaporation as water is strongly hydrogen bound to the polyoxyethylene chains and will not be easily lost. This work has confirmed that the nature of the surfactant, ionic or non-ionic, has a profound effect on both the bulk microstructure and evaporation of the base, and by implication drug bioavailability. This is however, not generally a determining factor in formulation of aqueous creams where compatibility problems and irritancy are primarily considered.

Eccleston, G.M. et al (1988) J.Pharm.Pharmacol., 39, 5P.
Eccleston, G.M. et al (1989) J.Pharm.Pharmacol., 40, 9P