Comparison between polyvinyl pyrrolidone- based and polyoxazoline nonionic surfactants: their physico-chemical and solubilisation behaviour

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School of Health and Life Sciences

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Sakina Sultana

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Department of Pharmacy

King's College London

ABSTRACT

Novel nonionic surfactants containing either a polyvinyl pyrrolidone (PVP) or a polymethyl oxazaline (POz) head group have been characterised. For the PVP–containing surfactants the hydrophobe was attached to the PVP either through an ether group on to the carbon backbone or *via* an ester linkage at position 5 of the pyrrolidone ring: these surfactants are denoted $C_R PVP_n$(ether) and $C_{12} PVP_n$(ester) respectively where n is the number of carbons in the hydrophobic chain and x is the number of vinylpyrrolidone units. For the polyoxazoline- based surfactants the head group was directly attached to an alkyl chain via an amine linkage; these surfactants are denoted by $C_R(POz)_n$. Each series of novel surfactant consisted of a number of surfactants of varying head group to hydrophobe ratio.

The physico-chemical characteristics of each surfactants in aqueous solution have been determined using light scattering, viscometry and surface tension measurements. Light scattering studies showed that the PVP-based surfactants form small aggregates with aggregation numbers in the range 1-6 with the extent of aggregation being determined by the hydrophobe to head group ratio. Viscometric studies showed that the aggregates are heavily hydrated and that the extent of hydration (assuming spherical aggregates) is less for the 'ester' series than the 'ether' series of surfactants. Surface tension studies showed that both classes of PVP-based surfactants are moderately surface active with γ_{cmc} of around 49±5 mN/m. Drug solubilisation studies showed that the PVP-containing surfactants have higher drug solubilising capacities than the more commonly used polyoxyethylene nonionic surfactants. However not surprisingly the solubilisation capacity of the surfactants is dependent upon the ratio of head group with the surfactant containing the hydrophobe possessing the lowest ratio demonstrating the greater solubilising ability. Cloud point studies showed that some of the PVP-based surfactants exhibited a phase separation upon

increasing the temperature with the existence of a cloud point being again dependent upon the relative number of hydrophilic to hydrophobic units.

Unlike the PVP-based surfactants, the polyoxazoline surfactants demonstrated a large dependence of aggregation behaviour on surfactant concentration, with the extent of aggregation increasing with increasing surfactant concentration above the critical micelle concentration. As a consequence of their continuous aggregation behaviour, no viscometric studies were performed on these surfactants. Surface tension studies showed the polyoxazoline surfactants to be relatively surface active with γ_{cmc} ranging from 27 to 51 mN/m. A solubilisation study showed an unusual pattern of solubilising behaviour for these surfactants with drug solubilising capacity tending to decrease as surfactant concentration increased. Phase separation studies did not demonstrate the existence of a cloud point for these surfactants, irrespective of the ratio of head group to hydrophobe present.