

BIOLOGICAL ACTIVITY OF SOME COMMERCIAL POLYOXYETHYLENE ETHERS IN THE GOLDFISH

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Nonionic surfactants of the polyoxyethylene alkyl ether class are known to have local anaesthetic activity (Zipf & Dittman 1964) an effect undoubtedly due to their ability to alter the properties of lipid membranes. During work in which the effect of nonionic surfactants on barbiturate absorption across goldfish gill membrane was being studied the toxicity of some of the surfactants was noted. Goldfish weighing between 2.5 and 4.0g were immersed in surfactant solution (200 ml) of varying concentrations and the overturn time (T, min) noted for at least four fish. Fig. 1. shows the results plotted as reciprocal overturn time, which is a measure of the rate of absorption of the compounds and the intrinsic biological activity of the surfactants. The results show the outstanding effect of the surfactants based on a C₁₂ hydrocarbon chain and the effect of polyoxyethylene chain length in this group of compounds, the most active agent being Brij 36T, a polyoxyethylene (10) lauryl ether, with an HLB of about 12.0.

Surfactants based on stearyl, oleyl and cetyl alcohols with HLB values around 12 have a low order of toxicity. The unique nature of the C₁₂ chain in membrane disruption is thus suggested. Sodium alkyl sulphates with alkyl chain lengths of 8 to 18 carbons show maximal human skin irritancy, protein denaturation capacity and toxicity to mice at C₁₂ (Prottey, 1978). The critical concentration for activity of the nonionic surfactants does not peak at HLB 12 but increases with increasing hydrophobicity as does the concentration of surfactant which is equivalent to 0.01% sodium thiopentone (in terms of effect on the fish measured by 1/T). Addition of thiopentone to 0.01% surfactant solution has virtually no effect on 1/T values but at 0.1% surfactant levels there appears to be a marked synergism with Brij 36T.

These results suggest that intrinsic activity increases with increasing hydrophobicity but that the more hydrophobic polyoxyethylene ethers with a C₁₂ hydrocarbon chain have the requisite partition coefficients or elicit maximal response. It may be that at concentrations above 0.01% the C₁₂ compounds have a maximal disruptive effect in membranes which causes their own increased permeation and hence biological effect. Studies on the interaction of the nonionic surfactants with cholesterol phospholipid mixed monolayers support these views.

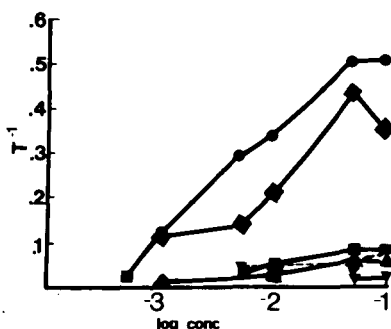


Fig. 1. Reciprocal overturn time (min⁻¹) of goldfish immersed in nonionic surfactant solutions (abbreviated C x E_y to indicate hydrocarbon and oxyethylene chain length) HLB values in parentheses. (●) C₁₂E₁₀(12); (◆) C₁₂E₄(9.7); (■) C₁₂E₂₃(16.9); (▲) C₁₆E₂₀(15.7); (-▼-▼-) C₁₆E₁₀ (12.9); (▼) C₁₈E₁₀(12.4).

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