INFLUENCE OF THE CATION ON THE HYDROTROPIC ACTIVITY OF BENZOATE SALTS

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Hydrotropic agents have been recently redefined as ionic or non-ionic planar molecules which at a concentration sufficient to induce a stack-type aggregation, considerably enhance the aqueous solubility of various insoluble substances (Saleh and El-Khordagui 1985). Hydrotropy appeared to be associated with a change in water structure to a more hydrophobic mode (Saleh et al 1983). Since different metal ions, due to their different electropositivity, size and extent of hydration, are expected to exert varying effects on the properties of hydrotropic salt solutions, the objective of the present work was to study the influence of the type of cation on the hydrotropic activity of three benzoate hydrotropes, namely potassium, sodium and lithium benzoates. The comparative hydrotropic activity of these salts was assessed by determining their solubilizing power and their effects on the gelling properties of gelatin solution.

The solubilizing power of the benzoate hydrotropes was compared by determining the solubility of riboflavine as a function of hydrotrope concentration (0-1.6 M) at 30°C. The results were expressed in terms of the hydrotropic index, A (Table 1), calculated using the equation $S = AM^b$ (Durand 1948) where S is the relative increase in the substrate solubility, M is the molar concentration of the hydrotrope and b is a constant. Furthermore, solubilization of water in butanol in the presence of 0-8 mM of the hydrotropes was determined at 22°C. The number of moles of water solubilized in 5 ml butanol in the presence of 5 mM of the salts (W_s) is shown in Table 1.

Table 1. Comparative hydrotropic activity of alkali benzoates

Alkali benzoate	A (30°C)	W_s (22°C)	C_i (22°C)
Potassium benzoate	18.8	0.414	0.31
Sodium benzoate	15.6	0.397	0.36
Lithium benzoate	11.3	0.377	0.38

Hydrotropic agents are known to affect macromolecular systems. In the present study, the minimum hydrotrope concentration in moles/liter inhibiting the gelling of an aqueous 2% gelatin solution at 22°C (C_i) was obtained and shown in Table 1. The results in the table indicate that the hydrotropic activity of the salts under study is in the order potassium benzoate > sodium benzoate > lithium benzoate. This order parallels the cation electropositivity which suggests a greater tendency of the more electropositive cation for ion-pair formation, thus increasing the tendency of the hydrotrope to aggregate and resulting in a greater hydrotropic activity.

From the results of this study, it is evident that the type of cation does affect the hydrotropic activity of anionic hydrotropes.

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