

AN ION-SELECTIVE ELECTRODE FOR THE DETERMINATION OF THE ACTIVITY OF QUATERNARY AMMONIUM SALTS IN FORMULATED PRODUCTS

S.S. Davis, and O. Olejnik, Pharmacy Department and Medical School, Queen's Medical Centre, Nottingham University, Nottingham NG7 2RD.

The antimicrobial properties of quaternary ammonium compounds are determined by the thermodynamic activity of the free unmicellised species. Formulation additives used in disinfectant solutions (eg. for soft contact lenses) can alter the amount of free species and hence biological activity. A method for the determination of quantity of the unmicellised material in the presence of electrolytes, surfactants and polymers is therefore needed. Such a method also has applications in the determination of critical micelle concentrations (CMC), complexation between large organic ions of opposite charge (ion-pairs), and the binding of compounds to polymers and solid surfaces. To this end we have constructed a novel ion-selective membrane electrode for the analysis of alkyl-trimethylammonium bromides (C_n -TAB) (Fig. 1). By slight modification the electrode can be used to assay other large organic ions of similar molecular weight. The electrode is based on the original design of Muratsugu et al. (1977). The choice of membrane was critical; a range of different materials was examined including cellophane, nylon, millipore filters and ultrafiltration membranes. Silastic (polydimethylsiloxane) membranes were found to provide sensitive and stable electrode systems. The response of the electrode was rapid and its behaviour was almost Nernstian (not usually less than 56 mV per concentration decade). The electrode was highly selective to the chosen organic ion. It responded only very slightly to inorganic ions (Na^+ , Cl^- , H^+ , OH^-) (Table 1) The electrode has been used with success to optimize the activity of preservative systems as well as in studying the stoichiometry of ionic interactions and the determination of CMC values at high ionic strengths.

Fig. 1 The Electrode Assembly

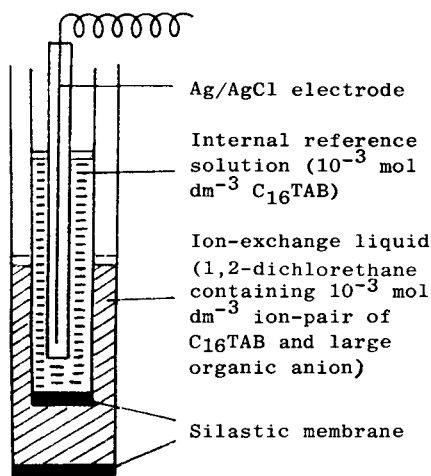


Table 1 Selectivity constants - Electrode constructed to analyse C_{16}^- TAB.

Interfering compound	k_{AB}
$C_{14}TAB$	8.8×10^{-2}
$C_{12}TAB$	1.9×10^{-3}
$C_{10}TAB$	4.6×10^{-14}
NaCl	3.0×10^{-10}
$Na_3C_6H_5O_7$	1.1×10^{-14}
CH_3COONa	$< 10^{-14}$
KBr	6.9×10^{-12}
KNO_3	$< 10^{-14}$
NaOH	4.2×10^{-2}
H_3PO_4	7.6×10^{-9}