IDENTIFICATION OF COMPONENT ALKYL CHAINS WITHIN COMMERCIAL SAMPLES OF BENZALKONIUM CHLORIDE MIXTURES BY CHEMICAL IONISATION MASS SPECTROMETRY

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Benzalkonium chloride BP and USP (BAC) are mixtures of benzalkoniums of varying alkyl chain length ($PhCH_2N(CH_3)_2(CH_3)_nCH_3\ ^+Cl^-$, where n=11, 13, 15). The relative amounts of these different species greatly affects both the antimicrobial spectrum and activity of the mixture. The current pharmacopoeial methods of identification of BAC, BP & USP are based upon chemical assay and determine only the net alkyl chain length of the mixture. Variation in the composition of the BAC mixture is therefore possible, greatly affecting antimicrobial effectiveness, yet still conforming to the pharmacopoeial specification. We now describe some initial investigations into the application of mass spectrometry (MS) in the identification and possible quantification of BAC's in commercially available samples. The use of direct impact MS was found to be unsatisfactory for the analysis of these quaternary ammonium compounds due to their involatility. Chemical ionisation MS however, with ammonia as an ionizing gas, produced characteristic fragmentation patterns for these types of molecule. Measurements were conducted on a Kratos MS25 spectrometer, fitted with an EI/CI Source and a DS-55 data system. Samples were applied as methanol solutions by direct inlet technique at 200°C on a glass probe tip and evaporated into the CI plasma. Quantitative studies were carried out by the integrated evaporation technique and the average ion currents for particular diagnostic peaks determined. Calibration curves were constructed for ions of particular interest. Diagnostic ions for pure synthetic standards are given below:-

Diagnostic ion		m/e for n=	9	11	13	15	17
M^+	$PhCH_2N(CH_3)_2(CH_2)_nCH_3^+$		276	304	332	360	388
$(M^+-15)+1$	$PhCH_2N(H)(CH_3)(CH_2)_nCH_3^+$		261	290	318	346	374
$(M^+-91)+1$	$(CH_3)_2NH(CH_2)_nCH_3^+$		186	214	242	270	298
M^+-91	$(CH_3)_2N(CH_2)_nCH_3^+$		185	213	241	269	297

From these data it was possible to determine the M Wt. of BAC molecules, since a significant M^+ ion (2-10%) was always observed. Additionally medium intensity ions at $(M^+-15)+1$, $(M^+-91)+1$ and M^+-91 were observed, attributable to cleavage of a methyl group and benzyl groups respectively from the parent cation followed by protonation in the first two cases. The $(M^+-91)+1$ ion was monitored in mixtures of BAC from commercial sources and their component BAC species determined (below)

Mixture	Source	Relative intensity of $(M^+-91)+1$ ion for, n= 11	13	15	17	19
Empigen M75	Albright & Wilson Ltd.	3.7	5.3	48.4	100.0	0.0
BAC	Sigma Chemical Co. Ltd.	100.0	60.0	10.6	0.0	0.0
BAC	Tennaco Organics Ltd.	100.0	23.2	0.0	0.0	0.0

Calibration curves were constructed by integrating the $(M^+-91)+1$ ion from synthetic standards in an attempt to quantify the relative amount of BAC species in these commercial samples.

0022-3573/81/120008P-01$02.50/0