THE ANALYSIS OF PHENOL AND AROMATIC ALCOHOLS BY SECOND DERIVATIVE UV-SPECTROSCOPY

A.F. Fell, Department of Pharmacy, Heriot-Watt University, Edinburgh EH1 2HJ

Analysis by uv-spectroscopy of drugs in dosage forms and in biological media is often subject to spectral interference by the formulation or biological matrix. This and non-specific 'irrelevant' absorption may lead to serious systematic errors in the analytical growth curves of absorbance versus concentration. Measurement by difference or differential spectroscopy, where analyte absorbance in the sample is measured against a reference solution of the matrix, is also subject to systematic error when the matrix composition is uncertain. Derivative spectroscopy, where the first, second or higher mathematical derivative of spectral band absorbance is generated with respect to wavelength, offers an elegant and simple approach for resolving spectral overlap and for the quantitation of drugs in pharmaceutical and biological matrices.

Oily Phenol Injection BPC is usually prepared in almond oil, a natural product with strong uv-absorption which varies from batch to batch. The second derivative spectrum of samples diluted in spectroscopic cyclohexane generates an inverted,sharpened spectrum for phenol, the peak amplitude at 277 nm varying linearly with phenol concentration. At constant phenol level, this amplitude measure was independent of almond oil absorbance, which otherwise interferes seriously in the zero-order spectrum. The analytical growth curve was linear, passed through the origin and at the test sample dilution the 95% confidence limits ($n \leq 12$) were 2.50 ± 0.04 mg %. The coefficient of variation ($n = 5$) for a batch of injections was 1.5%, while the recovery relative to synthetic standards of phenol in almond oil was 104.8%.

The bactericidal effectiveness of the aromatic alcohols benzyl alcohol, 2-phenylethanol, 3-phenylpropan-1-ol and 4-phenylbutan-1-ol have been examined in nutrient broth with Pseudomonas aeruginosa and Staphylococcus aureus as the test organisms (Richards & McBride, 1973; Lyall & others, 1977). Monitoring the level of these preservatives by uv-spectroscopy was complicated by the high absorbance of the matrix. The second derivative spectra of these alcohols, however, yield peak amplitudes which are independent of the bacterial concentration or nutrient medium composition. 3-Phenylpropan-1-ol, for example, has been assayed using the amplitude of its second derivative peak at 262 nm, this being independent of the matrix composition. The linear analytical growth curve passed through the origin, and at the test dilution level the 95% confidence limits ($n \leq 12$) were 12.0 ± 0.3 mg %. Benzyl alcohol, 2-phenylethanol and 4-phenylbutan-1-ol have been assayed similarly using the respective second derivative peak amplitude near 260 nm.

Measurement of the first derivative at fixed wavelength may also be used for systems where absorbance changes with time are monitored, as in enzymatic reactions and tablet dissolution studies. Higher derivative spectroscopy, particularly the fourth derivative, offers an alternative procedure for the elimination of complex overlapping spectral interferences (Fell, 1978).

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