THE ANALYSIS OF TRACE ALKALOIDS IN HEROIN BY SECOND-ORDER DERIVATIVE HIGH PRESSURE LIQUID CHROMATOGRAPHY WITH RAPID SCANNING DETECTION

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A number of digital methods have been proposed for the quantitative analysis of fused peaks commonly observed in high-pressure liquid chromatography (Fell et al, 1983). These methods, include transformation of the elution profile (A,t) to its first, second or higher derivative (dA/dt, d^2A/dt^2, ...). The quantitative performance of this technique is hitherto uncharacterised. This work presents the first study of the quantitative performance of first and second derivative chromatography, applied to the analysis of the trace alkaloids, noscapine (NOS) and papaverine (PAP). These alkaloids characterise the impurity profile of heroin and are of interest in quality control and for forensic purposes.

Chromatograms were run on a column (100 x 5 mm ID) packed with 5-µm amino-propyl silica. A rapid-scanning LKB 2140 UV-detector capable of scanning eluent over the range from 190 to 370 nm was used. The detector was interfaced with an IBM Personal Computer and peripherals, so that the data matrix (A,λ,t) acquired during chromatography could be stored for post-run evaluation including time domain derivative transformation. Variation in the resolution of NOS and PAP was readily achieved by selected mobile phase ratios for water-acetonitrile in the range (30:70, v/v) to (5:95, v/v).

Although Heroin is well separated from other trace alkaloids (Baker & Gough, 1981), it is difficult to establish the presence and relative amounts of NOS and PAP, as required in characterising the source of illicit drug. A transformation, d^2A/dt^2, of the conventional chromatographic profile at a fixed wavelength improved the non-homogeneity detection limit of co-eluting symmetrical NOS and PAP peaks ($\Delta t_R \geq 2.4$ sec) from a minimum required separation of 0.50 $\bar{w}$ to 0.18 $\bar{w}$: where minimum separation is expressed in terms of the ratio of the difference in retention time, (Δt_R), to the average full-bandwidth at half-height ($\bar{w}$).

Quantitation of NOS and PAP in the presence of each other can be achieved using the optimised time-domain derivative of the elution profile. Measurement of the optimised peak amplitudes of the first, ^1D, and second derivative, ^2D, for mixtures of the alkaloids in the range 5:3 to 3:5 w/w, were compared with the corresponding single-component systems. The recovery of each alkaloid was found to be dependent on the ratio $\Delta t_R:\bar{w}$, other factors being the epsilon ratio of the components at the observation wavelengths, and their relative concentrations. In Table 1 the percentage recoveries of fixed concentrations of PAP and NOS are presented when using the optimum ^1D and ^2D measurements, and compared with the conventional zero-order (^1D) peak height data, for a separation of 0.8 $\bar{w}$ (4.5 sec). In general, it was found that in the first and second derivative chromatogram amplitudes furthest away from the potentially interfering component, gave the best recoveries. In the second derivative sensitivity may be readily increased by using the peak minimum for each component. The multiwavelength capability of the detector system permits a 3-dimensional biplanar projection of derivative chromatograms to be presented for visual inspection of peak homogeneity.

PAP:NOS (w/w)	NOS recovery at 310 nm (%)			NOS:PAP (w/w)	PAP recovery at 280 nm (%)		
	^0D	^1D	^2D		^0D	^1D	^2D
0.33:1.0	105	99	100	0.33:1.0	105	98	99
0.66:1.0	109	101	98	0.66:1.0	110	102	100
1.0 :1.0	112	100	101	1.0 :1.0	118	102	98
1.33:1.0	116	98	101	1.33:1.0	121	97	97
1.66:1.0	121	97	103	1.66:1.0	124	93	98

Table 1: Recoveries of NOS and PAP in various contributions.

Fell, A.F. et al (1983) J. Chromatogr, 282: 123-140
Baker, P.B. and Gough, T.A. (1981) J. Chromatogr. Sci. 19: 483-489