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A procedure for the analysis of illicit diamorphine samples

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A procedure for the analysis of illicit diamorphine samples is outlined, which consists of preliminary examination of the material by infrared spectrophotometry, followed by thin-layer and gas-liquid chromatography. Data for eighteen likely contaminants of samples are recorded.

A number of substances other than diamorphine (heroin) are likely to be present in illicit samples of the drug and the amount of sample available for analysis is likely to be small. Most commonly we find the drug to be present in illicit samples in admixture with caffeine, its degradation products O^6-acetylmorphine and morphine, and a diluent, but we have also detected in some samples cyclizine, quinine and barbiturates. The presence of codeine and acetylcodeine has also been reported (Nakamura & Ukita, 1962; Nakamura, 1966, 1969). An analytical procedure was therefore devised which allowed analysis of the diamorphine, concurrent identification of likely contaminants, and which required no extraction or concentration before analysis. The procedure described has been used effectively and is applicable to samples of 5–10 mg.

EXPERIMENTAL AND RESULTS

Infrared spectroscopy

The whole sample for analysis was ground in an agate mortar and 0·5–1 mg prepared for infrared examination as a pressed potassium bromide disc. Spectra were recorded using a Perkin–Elmer 225 Grating Spectrophotometer.

In all samples examined, at least the six major absorption maxima of the spectrum of diamorphine ion (1765, 1740, 1450, 1370, 1250 and 1180 cm^{-1}) were present. Most samples examined also contained caffeine and a composite spectrum was obtained with contributions at 1700, 1660, 1550, 1485, 1240 and 745 cm^{-1} from the caffeine. In the few instances where a barbiturate was present in the sample there was absorption in the 1310–1330 cm^{-1} region, where all barbiturates absorb strongly but caffeine and diamorphine do not. The spectrum of an artificial mixture of diamorphine, barbitone and caffeine (1 : 1 : 2) is shown in Fig. 1.

Thin-layer chromatography

Thin-layer chromatography of the illicit diamorphine was by an adaptation of the paper chromatographic system described for bases by Curry & Powell (1954) and which was later extended by Clarke (1962).

An approximately 5% solution of the ground sample was accurately prepared in a stock solution consisting of aqueous dimethylformamide (50%) containing dibenzyl phthalate (2 mg/ml). This was applied to Merck pre-coated cellulose plates (250 μm) which had previously been dipped in a 5% solution of sodium dihydrogen

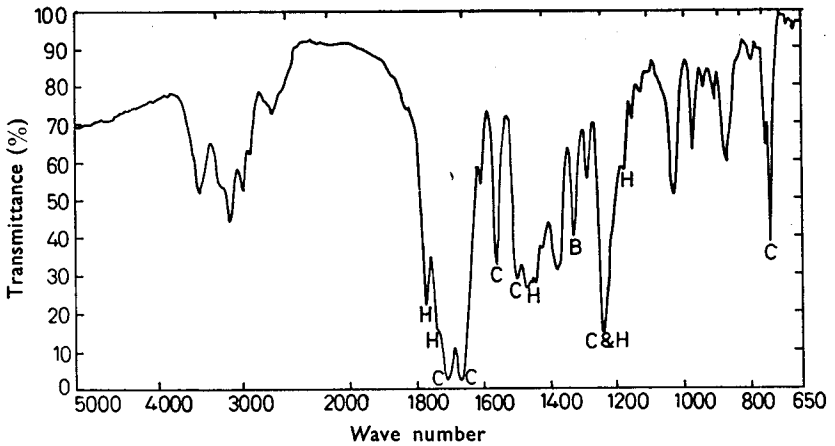

FIG. 1. Spectrum of an artificial mixture of diamorphine HCl (H), barbitone (B) and caffeine (C) (1 : 1 : 2) recorded on a Unicam SP200 instrument.

citrate and dried at 100° for 1 h. The plates were developed in a solution of citric acid (4·8 g) in a mixture of water (130 ml) and n-butanol (870 ml). Components of the illicit diamorphine mixture were located by examination under 254 nm ultraviolet light, followed by spraying with iodoplatinate reagent (platinic chloride, 0·25%, plus potassium iodide, 5%, in water) and then dilute hydrochloric acid.

The Rf values in this system of substances that have been or are likely to be encountered in illicit diamorphine samples are given in Table 1. Of the compounds examined, quinine exhibited a blue fluorescence when viewed under ultraviolet light, and all except caffeine gave a blue coloration with the iodoplatinate spray reagent. Caffeine was located as a pale blue spot on subsequent spraying with dilute hydrochloric acid.

Table 1. *Rf values of substances that have been or are likely to be encountered in illicit diamorphine samples,* (The system is described in the Experimental section)

Morphine	0·15	Caffeine	0·65
O^6-Acetylmorphine	0·20	Pethidine	0·68
Dihydromorphine	0·20	Ethoheptazine	0·73
Codeine	0·22	Dextromethorphan	0·75
Dihydrocodeine	0·24	Orphenadrine	0·75
O^6-Acetylcodeine	0·43	Dextromoramide	0·76
Cocaine	0·43	Cyclizine	0·78
Diamorphine	0·43	Dexropropoxyphene	0·78
Quinine	0·60	Methadone	0·80
		Dipipanone	0·83

Gas-liquid chromatography

Analysis of the solution of illicit diamorphine in aqueous dimethylformamide prepared earlier for thin-layer chromatography was now made using a Pye 104 Gas Chromatograph at two isothermals (200° and 250°), the dibenzyl phthalate in the solution acting as internal marker and standard. The gas chromatograph was equipped with a flame ionization detector, a Kelvin Electronics Servoscribe Recorder

and a Kent Chromalog Integrator. The column was 5 ft glass, i.d. 4 mm, packed with 80–100 mesh acid washed Chromasorb W coated with 3% cyclohexanedimethanol succinate. A hydrogen pressure of 18 lb/inch^2, air 7 lb/inch^2, and a nitrogen flow rate of 60 ml/min was used throughout.

Amounts of 1–2 μl of the solution for analysis were injected onto the column with the oven temperature at 200°, integrated peak areas not being measured at this stage. After 30 min the oven temperature was raised to 250° to purge the column. After a further 30 min, 1–2 μl of the solution for analysis was injected onto the column at the new oven temperature of 250° and with the integrator in operation. The concentration of diamorphine was obtained by calculating the ratio of peak areas of the drug to that of the internal marker and relating this to a previously constructed calibration curve of diamorphine in the same stock solution. Table 2 gives the retention times in minutes of substances that have been or are likely to be encountered in illicit diamorphine samples. Morphine, dihydromorphine and quinine although falling into this category of compounds are not detected under these conditions. The retention time of dibenzyl phthalate, the internal standard, is approximately 20 min. O^6-Acetylmorphine and O^6-acetylcodeine were prepared by hydrolysis of diamorphine and acetylation of codeine respectively as previously described (Wright, 1874; Nakamura & Ukita, 1962).

Table 2. *Retention times (min) of substances that have been or are likely to be encountered in illicit diamorphine samples*

Compound	200°	250°
Pethidine	1·7	—
Ethoheptazine	3·5	—
Orphenadrine	3·6	—
Cyclizine	5·3	—
Dextropropoxyphene	6·0	—
Methadone	6·3	—
Dextromethorphan	8·3	—
Caffeine	11·4	—
Cocaine	14·5	2·5
Dipipanone	20·3	3·2
O^6-Acetylcodeine	—	5·5
Dihydrocodeine	—	7·2
Codeine	—	7·4
O^6-Acetylmorphine	—	8·4
Diamorphine	—	14·5
Dextromoramide	—	18·4

DISCUSSION

The procedure for analysis outlined has resulted from the necessity to obtain the maximum information about the components of an illicit diamorphine sample regardless of the minimal amount of material available. The initial examination of the crude material by infrared spectrophotometry is an essential first step because this method of analysis is non-destructive, uses only a small amount of material, and in most instances we have found that it virtually confirms the presence of diamorphine in the sample. Should the infrared spectrum not suggest the presence of the drug, its absence should not be assumed and it would be prudent in this event to continue at least to the thin-layer stage of the procedure.

Our results, with the adaptation to thin-layer of the paper chromatography system of Curry & Powell, parallel those of Haywood & Moss (1968), who, using a similar adaptation but with hand-spread cellulose plates, found that Rf values within a limited range of compounds examined were similar in thin-layer and paper chromatographic systems. Since the Rf values of over 450 alkaloids are recorded for the paper system, the chance of identifying other basic components of an illicit diamorphine sample by use of this more rapid thin-layer adaptation is high. When diamorphine is separated from other contaminants by the thin-layer procedure (and it has been in all our experiments), amounts of 0·5 μg are readily detected.

We have, in a few cases, found barbiturates in samples. Although their possible presence was indicated from the infrared spectrum of the crude material, their identification was by use of the thin-layer and gas-chromatographic methods of Curry & Fox (1968) and Blackmore & Jenkins (1968) respectively.

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