

CHROM. 4886

ASSAY OF COCAINE IN THE PRESENCE OF PROCAINE AND QUININE
BY COLUMN CHROMATOGRAPHY

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(Received June 18th, 1970)

SUMMARY

A column chromatography method is presented for the separation and quantitation of cocaine in the presence of procaine, quinine and lactose. Separation procedures are described to afford purification of cocaine for infrared absorption spectrum examination.

INTRODUCTION

Illicit cocaine is examined in the forensic laboratories as a fine, white powder, invariably occurring as a hydrochloride salt; occasionally crude-appearing brown samples have been examined. Adulteration and dilution are effected by illicit dealers with procaine and lactose respectively; and less frequently, quinine is used as an adulterant. The dilution has been mostly in the range of 10 to 60%.

The rapid detection tests for cocaine are described in the U.S. Treasury Manual¹. The preferred methods are in the use of cobalt thiocyanate test and in the formation of the characteristic microcrystals with platinic chloride. These tests afford a rapid and convenient procedure for the presumptive identification of cocaine.

Procaine is detected by the Sanchez color test¹ for cyclic aromatic amines resulting in a vivid red color. Quinine possesses an intense blue fluorescence under UV light, and is readily characterized by placing a sample preferably in an acid solution under fluorescent light.

Thin-layer method for chromatography is recommended if materials other than those mentioned, *i.e.*, procaine, quinine, and lactose are suspected. COMER AND COMER² have reviewed a number of papers describing the use of thin-layer chromatography (TLC) for the separation of different kinds of drugs. He has listed some sixteen different TLC systems for separating cocaine from a number of local anesthetics and

from a number of analgesics-antipyretics. In addition, this paper offers a simple TLC system using Eastman Chromatogram sheets for separating cocaine from procaine and quinine. We have not hitherto encountered adulterants other than procaine and quinine in the illicit samples.

YOUNG³ reported a chemical method for the determination of cocaine in the presence of procaine in which cocaine is hydrolyzed to yield methanol as a product. Methanol is distilled and is measured colorimetrically, using the well-known permanganate oxidation procedure. The method proved time-consuming for forensic work and a number of chloroform shake-out methods¹ were adapted to provide a final residual product suitable for volumetric titration. This procedure proved to be not only laborious but was attended by losses in recovery simply because of its many manipulative steps.

The manual¹ also describes a determination of cocaine, procaine, and tetracaine, employing a direct reading of the three components in alkaline solution and calculating the amounts by simultaneous equation.

The method is beset by the errors introduced by overlapping curves and these errors have been compensated by the introduction of experimental factors. The errors introduced for cocaine determination become more pronounced when proportionally more adulterant is present in the sample than cocaine.

The present method employs the principle of ion pair formation and its extraction by partition chromatography. This principle is discussed by HIGUCHI *et al.*⁴ and it has been adapted by LEVINE and co-workers⁵⁻⁸ for the separation of a large number of pharmaceutical amines.

Among the common anions tested, including chloride, phosphate and sulfate, nitrate proved to be the most efficient for quantitative purposes. Potassium nitrate in HCl solution is used as a stationary phase and chloroform for elution. HCl acts to retain quinine and possibly other basic materials⁹ which may be present in the cocaine sample. The eluant from the column is acidified and measured by UV absorption.

PROCEDURE

Mix 4 g of Celite 545 (Johns Mansville) with 2 ml of 1 M KNO₃ in 0.1 N HCl and transfer to a column, such as used by LEVINE⁵. Tamp the mixture on a pad of fine glass wool. Pipette 1 ml of aliquot of solution containing 50 mg of sample in 1 M KNO₃ in 0.1 N HCl onto the surface of the column. Irrigate the column with 45 ml of chloroform saturated with water (spectro-grade solvent preferred); collect the eluant in a 50-ml volumetric flask containing 5 ml of methanol and 5 drops of concentrated HCl. Bring the solution to 50 ml mark with chloroform and read its UV spectrum from 340 to 255 nm, max. at 275 nm, using chloroform as a reference.

Prepare a quantitative standard by dissolving 10 mg of cocaine·HCl in 50 ml chloroform containing 5 ml methanol and 5 drops HCl. Absorbance at 1%/1 cm was 32.5 using a Cary 15 spectrophotometer under these conditions. Calculate % cocaine, as hydrochloride, using the following equation:

$$\frac{A_{\text{sample}}}{A_{\text{standard}}} \times \frac{10}{50} \times 100 = \% \text{ cocaine} \cdot \text{HCl}$$

Clean-up for IR examination

Shake the chloroform eluant saved from the assay with 10 ml of water. Discard the chloroform phase. Adjust the pH of the aqueous extract with dilute NH_4OH just to alkalinity (observe white precipitate) and extract with 50 ml chloroform twice. Filter the chloroform extract into a beaker and then treat the filtrate with sodium sulfate to remove water. Filter and evaporate the extract to dryness. Press the resulting crystalline material into KBr for IR spectrum examination for cocaine base.

DISCUSSION

While most forensic laboratories do not quantitate fillers or adulterants present in illicit narcotic samples, procaine and quinine can be eluted from the column using triethylamine in chloroform according to a procedure by LEVINE⁵. 1 N HNO_3 or 1 M KNO_3 can be used in the column *per se* if procaine is the only adulterant in the illicit cocaine.

In the clean-up procedure, there is the hazard of hydrolyzing cocaine to benzyl-ecgonine and methanol in the presence of water and heat⁹. Therefore, a desiccant such as sodium sulfate is used to dry the chloroform extract prior to evaporation over a hot steam bath.

For the clean-up, 10 mg of cocaine can be recovered by the method. If sufficient amount of material cannot be recovered, ca. 100 mg of sample can be passed through the column to recover enough material for IR examination.

On occasions, this laboratory has analyzed brown colored cocaine powder preparations containing procaine as an adulterant. The interference due to the presence of chloroform-soluble colored component was removed by washing the sample in the column, under standard conditions, with 50 ml of water-saturated 1,1-dichloroethane, which has been used in the clean-up of brown heroin¹⁰. The cocaine which was eluted subsequently with chloroform yielded a UV curve similar to those obtained with standard cocaine; recovery values of cocaine standards under standard conditions are shown in Table I.

TABLE I

RECOVERIES OF COCAINE STANDARDS

<i>mg added</i>	<i>mg recovered</i>	<i>% recovery</i>
15.00	14.89	99.2
12.00	11.90	99.2
10.00	9.95	99.5
8.00	7.91	99.1
5.00	4.92	98.9

HEAGY¹¹ reported that cocaine can be purified sufficiently for IR determination by its relative solubility in methylene chloride over procaine which is sparingly soluble in this solvent at room temperature. To a sample of illicit cocaine mixed with procaine, just enough methylene chloride is added to the mixture to dissolve cocaine. The extract is filtered immediately and evaporated to dryness. The residue is recrystallized with petroleum ether and pressed into KBr for IR spectrum reading.

TABLE II

TLC OF COCAINE, PROCAINE AND OTHER COMPOUNDS OF FORENSIC INTEREST

Solvent mixture: 40 ml chloroform, 10 ml ethyl acetate, and 10 drops conc. NH_4OH . Chromatography sheet: Eastman Chromatogram.

<i>Compounds</i>	<i>Typical R_F</i>
Cocaine	0.84
Procaine	0.45
Quinine	0.05
Heroin	0.34
Codeine	0.11
Morphine	0.00
LSD	0.34
Mescaline	0.05
STP	0.13
PCP	0.89
Nupercaine	0.45
Benzocaine	0.67
Tetracaine	0.11
<i>dl</i> -Amphetamine	0.00
DMT	0.10

In addition to those TLC solvent systems listed by COMERS AND COMERS² the authors suggest a very simple, rapid procedure using a solvent mixture containing 40 ml chloroform, 10 ml ethyl acetate and 10 drops of ammonium hydroxide. Eastman chromatoshets are cut to approximately 1½ in. and 4 in. and irrigated in the solvent mixture in a small bottle accommodating this sized sheet. The spots are revealed by using iodoplatinate reagent. Table II shows the typical R_F values obtained for cocaine, procaine, quinine and other forensically important compounds.

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