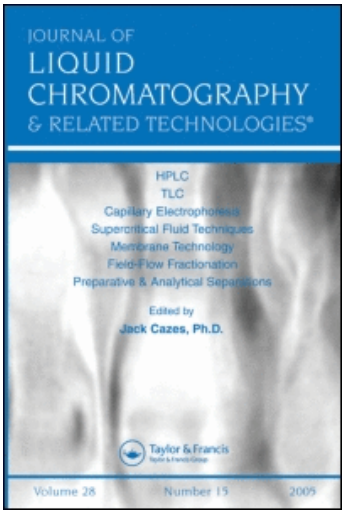


Journal of Liquid Chromatography & Related Technologies
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713597273

Quantitative Analysis of Adulterants in Illicit Heroin Samples via Reversed Phase HPLC

P. A. Hays[a]; I. S. Lurie[a]
[a] Drug Enforcement Administration Special Testing and Research Laboratory 7704, Virginia

To cite this Article Hays, P. A. and Lurie, I. S.(1991) 'Quantitative Analysis of Adulterants in Illicit Heroin Samples via Reversed Phase HPLC', Journal of Liquid Chromatography & Related Technologies, 14: 19, 3513 — 3517
To link to this Article: DOI: 10.1080/01483919108049407
URL: http://dx.doi.org/10.1080/01483919108049407

JOURNAL OF LIQUID CHROMATOGRAPHY, 14(19), 3513-3517 (1991)

QUANTITATIVE ANALYSIS OF ADULTERANTS IN ILLICIT HEROIN SAMPLES VIA REVERSED PHASE HPLC

P. A. HAYS AND I. S. LURIE
Drug Enforcement Administration
Special Testing and Research Laboratory
7704 Old Springhouse Road
McLean, Virginia 22102

ABSTRACT

Methodology is presented using reversed phase liquid chromatography for the simultaneous quantitation of phenobarbital, methaqualone, phenolphthalein, nicotinamide, and N-phenyl-2-naphthylamine in heroin samples. A Partisil 5 ODS-3 column was used with a gradient system using methanol and a sodium dodecylsulfate-phosphate buffer.

INTRODUCTION

In this laboratory illicit heroin samples have contained adulterants whose properties did not lend themselves well to the quantitative methods developed in previous work (1-4). These adulterants include phenobarbital, nicotinamide, phenolphthalein, methaqualone and N-phenyl-2-naphthylamine. Insolubility in the injection solvent and/or coelution with the solvent front, heroin or its alkaloids have prevented the quantitation of these adulterants by HPLC. Poor reproducibility and the need to derivatize compounds such as phenolphthalein can pose problems for GLC.

Dodecylsulfate has been used for drug analyses as an ion pairing reagent to selectively increase the retention time of basic compounds while not affecting the retention times of acidic or neutral compounds significantly (5). Using this approach, an HPLC reversed phase method was developed to quantitate these commonly found adulterants.

EXPERIMENTAL

Materials

Methanol used was Burdick and Jackson(Baxter Healthcare Corporation, Muskegon, Mich.). Sodium dodecylsulfate was obtained from Mallinckrodt

(Mallinckrodt Inc., Paris, Ky.). Other chemicals were reagent grade. Drug standards of USP/NF quality were employed.

Mobile phases were mixed internally from solvent reservoirs containing pure methanol or 90 parts phosphate buffer (pH 2.0) containing 0.02M sodium dodecylsulfate premixed with 10 parts methanol. The phosphate buffer consisted of 870 parts water, 10 parts phosphoric acid and 30 parts 2N sodium hydroxide.

Equipment

The liquid chromatographic system consisted of a Series 4 liquid chromatograph (Perkin-Elmer, Norwalk, CT.), an ISS-100 autosampler fitted with a 50 ul loop (Perkin-Elmer); a Partisil 5 ODS-3 column (11.0 cm X 4.7 mm I.D.)(Whatman International, Maidstone, England); and a Model 1040a photodiode array detection system fitted with a DPU multichannel integrator (Hewlett-Packard, Waldbronn, Germany).

Standard Preparation

Accurately weigh into a 50 ml volumetric flask 7 mg each of phenobarbital, methaqualone, phenolphthalein, nicotinamide, and N-phenyl-2-naphthylamine. Add methanol to volume, sonicate for 15 minutes and mix.

Pipette a 10.0 ml aliquot to a 50 ml volumetric flask. Fill to volume with a solution containing 90 parts phosphate buffer containing 0.02M sodium dodecylsulfate premixed with 10 parts methanol. Inject 50 ul into a liquid chromatograph.

Sample Preparation

Accurately weigh 100 mg sample into a 100 ml volumetric flask and fill to volume with methanol. Sonicate for 15 minutes and then mix.

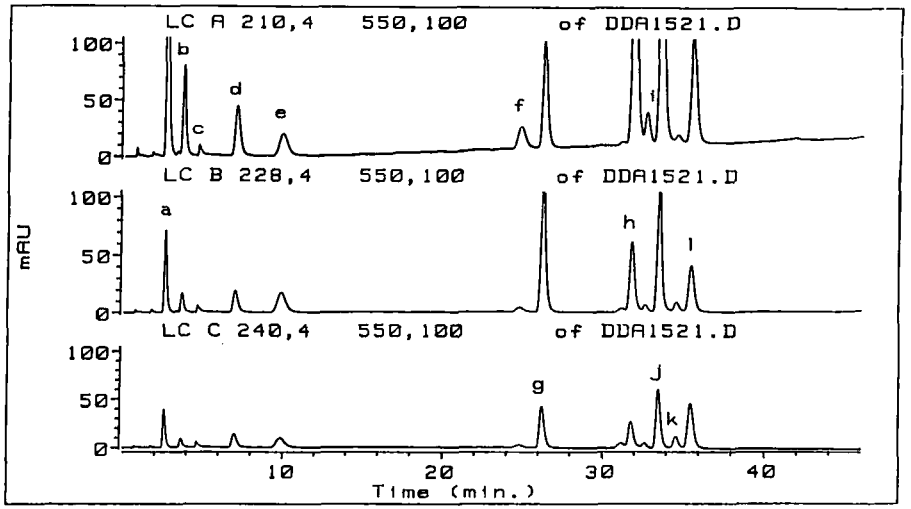
Pipette 10.0 ml into a 50 ml volumetric flask and fill to volume with a solution containing 90 parts phosphate buffer containing 0.02M sodium dodecylsulfate premixed with 10 parts methanol. Inject 50 ul into liquid chromatograph.

Chromatographic Conditions

Initial mobile phase consisted of 28% methanol, 72% sodium dodecylsulfate-phosphate buffer. After a 10 minute hold a linear gradient followed for 36 minutes with the final condition consisting of 82 % methanol, 18% sodium dodecylsulfate-phosphate buffer. Initial conditions were returned using a linear gradient over 5 minutes. Reequilibration time of 15 minutes was used. A flowrate of 1.5 ml/min was employed throughout. Detection wavelengths were 210 nm, 228 nm and 240 nm using the photodiode array detector. External standard calculations were employed for quantitation.

RESULTS AND DISCUSSION

An HPLC chromatographic system was developed which resolved the adulterants of interest from each other, heroin, basic impurities and other adulterants as shown in Figure 1 and Table 1. The baseline for the 228 nm and



1. Multi-wavelength chromatographic separation of heroin base sample cut with various adulterants. Peaks a= caffeine; b= phenobarbital; c= solvent impurity; d= nicotinamide; e= phenolphthalein; f= O6-monoacetylmorphine; g= methaqualone; h= heroin; i= acetylcodeine; j= noscapine; k= papaverine; l= N-phenyl-2-naphthylamine.

Table 1

Retention Data for Heroin, Adulterants and By-Products

Compound	Relative Retention Time	
Acetaminophen	0.06	
Caffeine	0.11	
Aspirin[f]	0.13	
Phenobarbital	0.17	
Solvent Impurity	0.21	
Phenacetin	0.22	
Salicylic acid	0.23	
Nicotinamide	0.30	
Phenolphthalein	0.47	
Morphine	0.71	
Dipyrone	0.86	
Benzocaine	0.88	
O6-monoacetylmorphine	1.00	(26.5 minutes)
Methaqualone	1.05	
Diazepam[s]	1.22	
Heroin	1.25	
Acetylcodeine	1.29	
Strychnine	1.31	
Noscapine	1.32	
Lidocaine	1.34	
Papaverine	1.35	
N-phenyl-2-naphthylamine	1.40	
Diazepam breakdown product	1.46	
Diphenhydramine	1.50	
Chloroquine	1.71	

[f] slowly breaks down to salicylic acid
[s] quickly breaks down in solution

Table 2

Quantitation of Heroin sample spiked with known amount of adulterants

Adulterant	Actual(%)	Experimental(%)[f] 210nm	228nm	240nm	CV[g](%)
Caffeine	9.1	9.3	9.2	9.2	0.6
Phenobarbital	5.2	5.2	5.2	5.2	0.6
Nicotinamide	5.0	5.1	5.1	5.1	0.7
Phenolphthalein	2.4	2.5	2.4	2.4	1.4
Methaqualone	5.2	5.7	5.4	5.4	1.0
N-phenyl-2-naphthylamine	5.5	5.3	5.2	5.3	1.5

[f] based on HPLC determination on 5 separate sample weighings. Each determination was based on the average of 2 injections.
[g] coefficient of variation based on five determinations using 228 nm wavelength. Phenobarbital coefficient of variation at 210 nm is 0.4%.

240 nm signals was flat resulting in good integration for these signals. The baseline began moving up over time for 210nm signal causing integration errors for methaqualone and N-phenyl-2-naphthylamine. A small impurity peak appears at 5.6 minutes, well away from compounds of interest. The linearity range was determined to be from 0.03 ug to 3.0 ug on column using either the 210 nm, 228 nm or 240 nm wavelengths. The 210 nm wavelength needed to be used for phenobarbital below 0.12 ug and for nicotinamide and phenolphthalein below 0.06 ug because of their low response at other wavelengths. Because of the integration errors mentioned earlier, the quantitation of methaqualone and N-phenyl-2-naphthylamine used the 228 nm and 240 nm wavelengths. The correlation coefficient for all compounds was 0.999 or greater. Injecting more than 3.0 ug on column caused carryover problems and problems with precipitation in the injection solvent.

In a previous HPLC system (3) nicotinamide eluted at the solvent front while noscapine, depending on the age of the column, co-eluted with phenobarbital. The use of the highly lipophilic counter ion dodecylsulfate, via an ion-paring mechanism, moved the weakly basic nicotinamide away from the solvent front and the moderately basic noscapine away from the acidic phenobarbital. Also previously developed HPLC methodology (3) precluded the quantitation of phenobarbital, methaqualone, phenolphthalein, nicotinamide and N-phenyl-2-naphthylamine due to insolubility in the hydrophilic injection solvent. The chromatographic conditions used in the present work allows for a more lipophilic injection solvent which solubilizes the compounds of interest.

A representative sample was made by mixing known amounts of the adulterants of interest with an illicit heroin exhibit. This heroin exhibit was determined via HPLC (3) to contain 60% heroin as well as various manufacturing impurities. Caffeine was also added to show the applicability of the methodology to other adulterants of interest. The chromatographic separation of this sample is shown in figure 1. Good accuracy and precision were obtained for the HPLC analysis of this sample as shown in Table 2 . A detection wavelength of 210 nm was chosen for phenobarbital because of its significantly greater response at this wavelength. The 228 nm wavelength was

preferred for the quantitation of methaqualone and N-phenyl-2-naphthylamine. At this wavelength the baseline was flat and these compounds exhibited greater response than at 240 nm. The use of the diode array detector both with multiwavelength chromatograms and UV spectra allows for the determination of peak purity and the confirmation of peak identity.

REFERENCES

1. Lurie, I.S. and Carr, S.M., The Quantitation of Heroin and Selected Basic Impurities via Reversed Phase HPLC. I. The Analysis of Unadulterated Heroin Samples, J. Liquid Chromatogr., 9, 2485 (1986).

2. Lurie, I.S. and McGuinness, K., The Quantitation of Heroin and Selected Basic Impurities via Reversed Phase HPLC. II. The Analysis of Adulterated Samples, J. Liquid Chromatogr., 10, 2189 (1987).

3. Lurie, I.S., The Use of Multiple Detectors for HPLC Forensic Drug Analysis, LC.GC, 8, 454(1990).

4. Sperling, A., A Rapid Quantitative Determination of Heroin and Some Common Adulterants by Capillary Gas Chromatography, J. Chromatogr., 538, 269 (1991).

5. Lurie, I.S., Moore, J.M., Cooper, D.A. and Kram, T.C., Analysis of Manufacturing By-Products and Impurities in Illicit Cocaine via High-Performance Liquid Chromatography and Photodiode Array Detection, J. Chromatogr., 405, 273(1987).