Prevalent Drug In Dollar Bills

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I. Introduction

Chemical dependency has been a growing problem within the borders of the United States. A particular drug, cocaine, has been prevalent not only within people but also the US dollar bills. Essentially, any bill that was used to inhale a powder containing cocaine would contain small amounts of the drug retained by the fiber of the paper (Esteve-Turrillas, et. al). It is important to understand that US dollar bills can hold multiple substances and humans are handling theses bills without realizing that they are transferring the substances. The mode of contamination is unknown, but an idea was proposed that cocaine was transferred by it sticking to oil residues that are placed by our fingers on to the bill which imbeds itself into the matrix of the bills (Smith, et. al). Looking at the contamination as a whole, humans are ones who are transferring the substances from between bills through handling. If not, transferring through bills from being stacked upon each other.

When it comes to drugs, money has always been the exchange for substances. Not only that, cocaine users tend to snort cocaine using rolled up bills. Cocaine does not have to be correlated to bills, there has been research done on cocaine that involves the analysis of: human hair, urine, and fingerprints (Heide, et. al, Morris-Kukoski, et. al, Oyler, et. al, Smith, et. al). Those investigations convey that cocaine particles can be trapped on the surface of human hair and metabolites of cocaine can be excreted from our bodies as waste.

Although, these investigations are thought to be within the borders of the United States, there have been investigations done in other countries. Chemical dependency is also an international problem that has recorded research (Almeida, et. al, Armenta, et. al, Dixon, et. al, Esteve-Turrillas, et. al, Heide, et. al, Heller, et. al, Mackuľak, et. al, Morris-Kukoski, et. al, Oyler, et. al, Smith, et. al). In one particular research study, their parameters for collection were from 14 cities, and the results stated that there was a high concentration of 1327µg found. They also found that 79% of bills had concentrations above 0.1µg and 54% above 1.0µg (Oyler, et. al). Table I (below), showed Olyer's group results on their bills.

Table I. Cocaine concentrations in United States Paper Currency ($1 denominations) from Selected Cities (Olyer, et. al).

City	Number positive (>0.1µg/bill)	Number positive (>1.0µg/bill)	Mean amount (µg/bill)	Range (µg/bill)
Baltimore, MD	9	9	75.7	0-597.0
Miami, FL	3*	2*	2.5	0-13.1
Chicago, IL	7	4	0.7	0-2.2
Honolulu, HI	10	5	3	0.2-9.9
Kansas City, KS	9	8	6.3	0-24.3
Las Vegas, NV	9	5	3.9	0-13.9
Los Angeles, CA	9	6	3.9	0-11.4
Minneapolis, MN	8	6	63.8	0-559.8
Spanish Fort, AL	9	7	9	0-70.3
Ft. Wayne, IN	9	6	3.8	0-16.6
Pittsburgh, PA	4	1	0.4	0-2.6
Yellowstone, WY	5	2	1.9	0-14.5
Whitefish, MT	7	4	0.9	0-3.0
Portsmouth, OH	10	9	136.9	0.5-1327.0

*N=10 for all collection points except Miami, FL, where N=6

Another study was conducted between Rockford and Chicago where a total of 18 bills with denominations of $20 and $1 were investigated. The results showed that 92.8% of the bills were identified to have cocaine, and the range in this experiment was found to be 0-10.02µg (Negrusz, et. al). What was also done in that investigation, four one-dollar bills were uncirculated served as the control group. From table 2 (below), showed that three of the four were found to have cocaine on them.

The main objective of this research was to identify and quantify the cocaine in one dollar-bill, US currency. There is a collection of these bills from the all 50 states of the USA including Washington D.C.

Table 2. Amount of cocaine on $20 and $1 denominations collected randomly from general circulation in two Illinois Cities: Rockford and Chicago. (Negrusz, et. al).

Denomination	Bill No.	Amount of Cocaine (µg/bill)
$20	1	4.54
$20	2	2.17
$20	3	3.43
$20	4	5.98
$20	5	1.04
$20	6	10.02
$20	7	0.47
$20	8	0.65
$20	9	0.16
$20	10	0.14
$1	11	2.99
$1	12	0.31
$1	13	N.D.*
$1	14	<0.05

*Not Detected

II. Experimental

2.1 Materials and reagents

Cocaine Hydrochloride (±5% in methanol) and Deuterated Cocaine Hydrochloride (±5% in acetonitrile) were obtained from Sigma Aldrich. The organic solvent, dichloromethane, is HPLC grade and used to extract the cocaine compound from each one-dollar bill. Solid Phase Extraction C-18 column, 5µ Octadecylsilyl, size 250x4.6mm i.d., Extract-Clean, was purchased from Grace Davison Discovery Sciences**.**

2.2 GC/MS Analysis

The gas chromatograph was an Agilent 6890A equipped with a BPX-5 capillary column: 0.25mm i.d., 0.5µm film thickness, and 30m long with a mass spectrometer detector Agilent 5975C. The auto sampler 7693 will be set to an splitless injection. The mass spectrometer was operated under selected ion monitoring mode (SIM) using a quantification ion, and two confirming ions for each analyte for the two compounds, Cocaine Hydrochloride and Deuterated Hydrochloride. The instrument

operated with a resolving power of 1000 with 10% valley, in electron ionization of 70eV and 450 V setting for the photomultiplier detector. The carrier gas was set for constant flow mode with a flow rate of 1.2mL min^{-1}.

Figure 2.1 1µL of the analyte will be will injected into the Agilent gas chromatography mass spectrometry for analysis.

2.3 Collection of samples

Paper currency of US one-dollar denominations, in sets of five, were collected from a town or city in every state, including Washington D.C. At the time of collection, the bills were in circulation. Upon the collection, the bills were placed in a mail envelope or a small zip lock bag and stored in a refrigerator until analysis. All samples were analyzed within a year of collection.

Figure 2.2 Samples were placed in envelopes like the figure above

2.3 Cocaine extraction

Each bill (five from each city) was folded in an accordion style, and placed separately in a 40mL glass vial containing 30mL of dichloromethane, and these vials were agitated using a shaker for 4 hours. Each sample was concentrated to final volume 300µL. If needed, the final volume can be 100 µL or 200 µL but 300 µL is the smallest vial in stock.

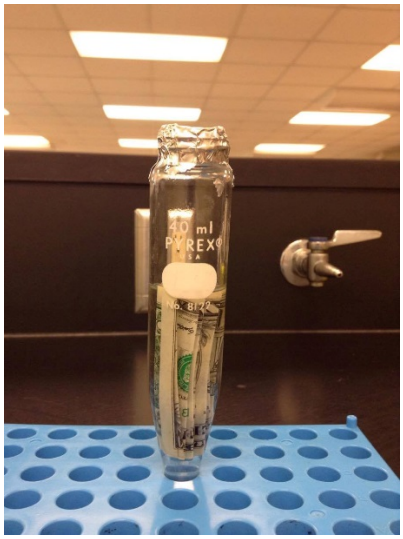

Figure 2.3 A folded bill submerged in dichloromethane to extract cocaine.

2.4. SPE Analysis

The extract was eluted through a C-18 column for a solid phase extraction (SPE). The purpose for this is to extract the analyte and keep the impurities extracted from the bills in the column. The extraction column was preconditioned with 5mL of dichloromethane, which will then be eluted until it solvent reaches the top the bed. After that, 1mL of the sample will be pipetted then the sample will be eluted with 5 mL of dichloromethane. After extraction, the analytes were extracted using 5mL of dichloromethane which were concentrated to 100µL as final volume.

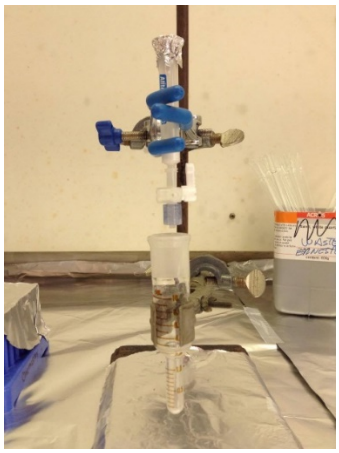

Figure 2.4 SPE column eluates the cocaine analyte from the bills

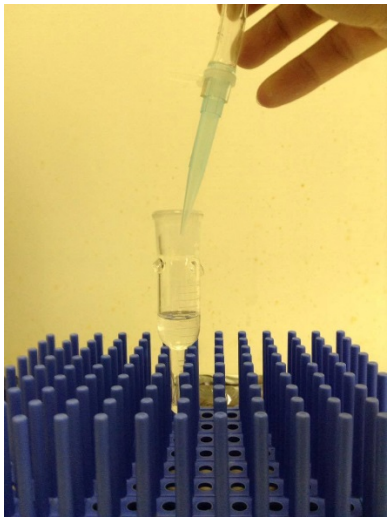

Figure 2.5 The eluate analyte concentrated using a gentle dry air current.

III. Results

3.1 Standard Test

The main objective in this research was to develop an analytical method for simultaneous analysis of cocaine and deuterated-cocaine for identification and quantitation. During analyzing of Cocaine Hydrochloride and Deuterated Cocaine Hydrochloride standards in the gas chromatography/mass spectrometry (GC/MS) under select ion monitoring (SIM) at concentrations of 10, 1 and 0.1ppm. Results of the Cocaine Hydrochloride standard showed that there are three characteristic ions: 303, 182, and 82 mass over charge (m/z). These ions are most abundant fragment ions that the cocaine molecules break into. The Deuterated Cocaine Hydrochloride standard has the next characteristic ions: 306, 185, and 85 m/z. Both peaks were retained closely. The length of time that both compounds stayed in the column

contributed to both peaks having an overlap greater than 10% which means that there was a bad resolution. The effort was made to tamper with the temperature program to see if the overlap would diminish or separate into two peaks. Due to this, compounds will be represented separately in their respective chromatograms.

3.2 Future Tests

3.2.1 Cocaine extraction samples – one dollar bills

Apply the methodology that has been used for the standard testing.

3.2.2 Calibration curve

Prepare a calibration curve using five different standard concentrations and repeat the injection three times. Inject the samples and calculate the concentration using this calibration curve.

3.2.3 Limit of detection

The gas chromatography/mass spectrometry (GC/MS) can read low concentrations. The limit of detection will be determined.

3.2.4 Blank

A blank will be provided in the experiment to ensure quality control.

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