

Methamphetamine Contaminated Currency in the Birmingham, Alabama Metropolitan Area

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ABSTRACT: GC-MS Analyses of extracts of one dollar bills collected from in and nearby the Birmingham, Alabama metropolitan area in 2012 indicated that 42% of them were contaminated with methamphetamine. This is the first time that methamphetamine was identified on one dollar bills since the laboratory began testing them in 2008.

KEYWORDS: methamphetamine, cocaine, currency, gas chromatography-mass spectroscopy, trace analysis, forensic chemistry.

Analysis of one dollar bills (USD1s) acquired in and near the Birmingham, Alabama metropolitan area for cocaine contamination has been an ongoing study at the University of Alabama at Birmingham Forensic Chemistry Laboratory since 2008. Most of the bills that have been analyzed were acquired in sets of 20 USD1s from local stores and banks. Since the program inception, between 40 and 85 percent of the bills in each set have tested positive for cocaine. Other reports of cocaine contamination of U.S. currency have given values ranging from 67 to 97 percent; however, most of these reports were for analyses of higher denomination bills [1-5].

In February 2012, a set of 20 USD1s was collected from a home improvement store in north Jefferson County, Alabama, about eight miles north of Birmingham (designated as NJC 1 in Table 1 and Figure 1). The results of the analysis of the 20 USD1s were unexpected. Only eight of the collected bills tested positive for cocaine, but 17 tested positive for methamphetamine. This was the first time that methamphetamine had been identified on a set of USD1s analyzed by this laboratory. In order to determine if these findings were a one-time occurrence or rather was indicative of a fundamental change in the drug contamination of bills in the Birmingham area, additional sets of 20 USD1s were obtained and analyzed, from: A) The same store in north Jefferson County (NJC 2); B) Downtown Birmingham (B'Ham); C) Bessemer (BES, about 15 miles southwest of Birmingham); and D) Grant (about 85 miles northwest of Birmingham). In addition, the chromatograms from the previously collected and analyzed bills (i.e., 2008 – 2011) were re-examined to determine if they had also been contaminated with methamphetamine, but not recognized as such at the time.

Experimental

The USD1 sets from north Jefferson County, Bessemer, and Grant were all collected from home improvement stores, whereas the downtown Birmingham set was collected from a fast food restaurant. At each location, all 20 bills were collected from a single cash register (our previous work with cocaine contaminated USD1s had shown that there were no differences in bills collected from a single versus separate registers; that is, there was no evidence of cross contamination from cashier handling or passive contact within an individual register). Each set of bills was placed in a zip-lock plastic bag

by the respective cashier, and laboratory gloves were worn by the analysts who subsequently handled the bills. The serial numbers of the bills were recorded in the order they were analyzed (subsequently, the respective Federal Reserve Bank locations were recorded for additional data evaluation; however, because the date of issue does not necessarily correspond to the year the bill was printed, the dates of issue were not recorded).

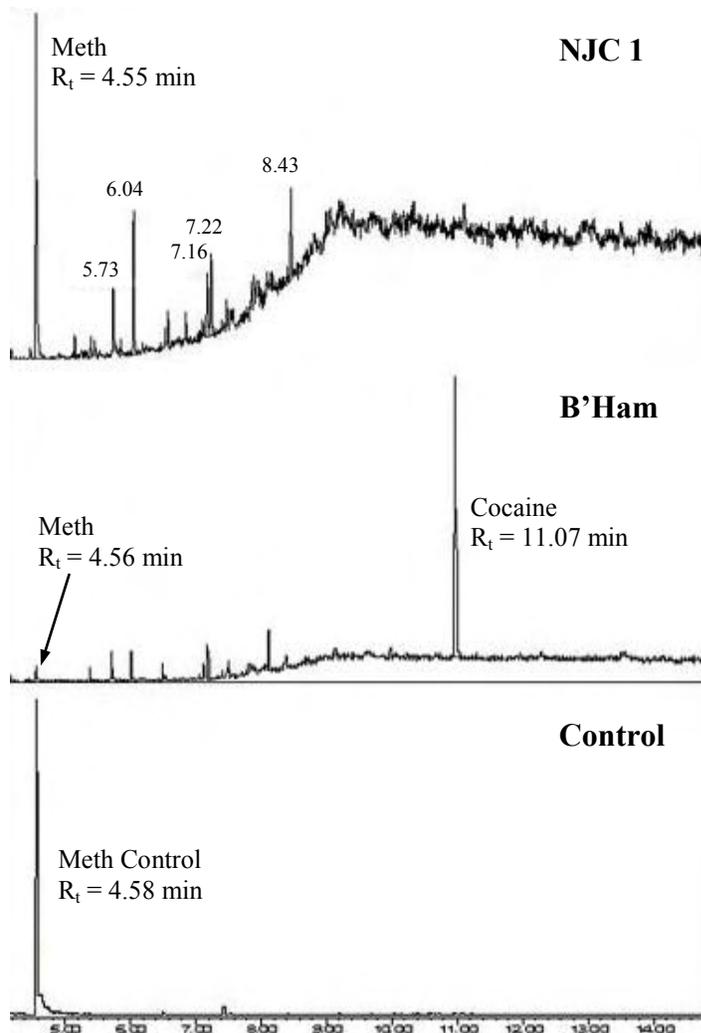


Figure 1 - Gas chromatograms of extracts showing cocaine and/or methamphetamine from USD1s.

Table 1 - Number and % of Drug Contaminated Currency.

Set	Number of Positive Samples			% Contaminated With Methamphetamine
	Methamphetamine Only	Cocaine Only	Methamphetamine & Cocaine	
NJC 1	9	0	8	85
NCJ 2	0	13	5	25
B'Ham	0	14	2	10
BES	3	6	8	55
Grant	3	7	4	35

The extraction method developed by Negruz *et al.* was utilized [6]. Each bill was crumpled and placed into a 20 mL vial. Ten mL of 0.1 M HCl were added, and the vial was capped and agitated on an orbital shaker (150 cycles/min) for between 30 min and overnight. The resulting solution was transferred to a 20 mL vial, basified to pH 12 with 2 M NaOH, and extracted with 1 mL of CHCl₃.

The isolated extracts were analyzed using an Agilent 6890 gas chromatograph equipped with a DB-5 MS column (30 m × 0.25 mm, 0.25 μm film thickness), interfaced with an Agilent 5973 MSD. Helium was used as the carrier gas at a constant flow of 1.0 mL/min. The injector temperature was 260°C and the split ratio was 15:1. The GC temperature program started at 70°C (no hold), ramped at 20°C/min to 250°C (6 min hold).

Cocaine and methamphetamine standards were obtained from Sigma Aldrich. All other chemicals were chromatographic or HPLC grade. The retention time of the methamphetamine standard was 4.578 ± 0.05 min, and the fragment ions of *m/z* 58, 91, and 134 were used for confirmation. The retention time of the cocaine standard was 11.135 ± 0.06 min, and the fragment ions of *m/z* of 82, 182, and 303 were used for confirmation. Representative chromatograms are shown in Figure 1; in addition to methamphetamine and cocaine, several common contaminants are labeled, including a possible nicotine metabolite (5.73 min), acetaminophen (6.04 min), diethyl-toluamide (familiarily known as DEET, 7.16 min), diethyl phthalate (7.22 min), and 1,2-diphenoxyethane (8.43 min). DEET is the most commonly used insect repellent, while diethyl phthalate and 1,2-diphenoxyethane are used in production of various polymers. All of these contaminants were identified by comparison with the NIST mass spectra library [7] and were not confirmed. The chromatograms were not quantitated.

Results and Discussion

USD1s were originally chosen (in 2008) for this study both to reduce expense and because they are reportedly less likely to be contaminated with cocaine from trafficking versus any other denomination except for \$100 bills [3]. Thus, in our opinion the results presented herein are more reflective of handling by cocaine and/or methamphetamine consumers, enabling local trends to be more easily identified and monitored.

The 2012 results are summarized in Table 1. In NJC 1, nine of the 20 bills were positive for methamphetamine alone, none were positive for cocaine alone, and eight were co-

contaminated with both cocaine and methamphetamine. In NJC 2, none were positive for methamphetamine alone, 13 were positive for cocaine alone, and five were co-contaminated. In B'Ham, none were positive for methamphetamine alone, 14 were positive for cocaine alone, and two were co-contaminated. In BES, three were positive for methamphetamine alone, six were positive for cocaine alone, and eight were co-contaminated. In Grant, three were positive for methamphetamine alone, seven were positive for cocaine alone, and four were co-contaminated. In total, 42% of the bills collected to date in 2012 tested positive for methamphetamine.

The chromatograms from previously conducted analyses (i.e., 2008 – 2011) were then re-examined to see if methamphetamine had actually been present on those bills but not recognized at the time. None of the chromatograms from any of the earlier analyses that were conducted using the conditions detailed in the Experimental section were positive for methamphetamine. However, one set of 10 bills collected in Birmingham in October, 2011 that had been analyzed using an alternate splitless GC method (for maximum sensitivity) did have three bills display ultra-trace-level peaks for methamphetamine. Based on these results, the contamination of USD1s with methamphetamine is a recent development in the Birmingham area.

Cocaine contamination of currency is international in scope, and has been thoroughly documented. There have been several mechanisms proposed for this contamination, including adsorption to the paper fibers, and absorption/dissolution in the various dyes that are imprinted on the paper and/or in the human sweat components and skin oils that become laced into the paper from normal handling of the bills. At the present time, the only identifiable trend is that most currency will test positive for cocaine in countries where cocaine abuse is widespread, and test negative in countries where such abuse is uncommon. According to Ebejer *et al.*, it is currently not possible to correlate cocaine contamination with rural versus urban populations, percentage of convicted drug offenders in the area, proximity to a port of entry, geographical region, or socio-economic standing [8].

Contamination of currency with other drugs of abuse has been previously reported, although with less frequency and lower abundance versus cocaine. Heroin, morphine, O⁶-monoacetylmorphine, methamphetamine, phencyclidine, tetrahydrocannabinol, and 3,4-methylenedioxymethamphetamine have all been reported on currency [2,5,9-13].

Table 2 - Percent methamphetamine contamination by federal reserve banks for the Bessemer and Grant bills.

Federal Reserve Bank	Number of Bills	% of Bills	Methamphetamine Positives	Cocaine Positives	% Total Methamphetamine Contaminated
Atlanta	11	27.5	5	8	27.8
Boston	3	7.5	0	1	0.0
Chicago	4	10	1	3	5.6
Cleveland	2	5	0	1	0.0
Dallas	2	5	2	2	11.1
Kansas City	1	2.5	1	0	5.6
Minneapolis	0	0	0	0	0.0
New York	5	12.5	4	3	22.2
Philadelphia	1	2.5	0	1	0.0
Richmond	5	12.5	3	3	16.7
San Francisco	4	10	2	2	11.1
Saint Louis	2	5	0	1	0.0

In 2001, Jenkins reported that 3 of 50 USD1s analyzed for drugs were positive for methamphetamine [2]; the bills in this study were collected from five different U.S. cities. Also in 2002, Nath *et al.* examined 80 bills from convenience stores in San Francisco and determined that methamphetamine could be detected on bank notes and that screening currency was indicated [11]. In 2010, Veitenheimer analyzed bundles of 1, 5, 10, 20, 50, and 100 dollar bills (10 bills per bundle) collected in 35 different cities for cocaine, codeine, heroin, MDMA, methamphetamine, and morphine. Nine of the bundles (4.3%) tested positive for methamphetamine [12]. And in 2011, Wimmer *et al.* identified methamphetamine on 53 of 64 Euros of mixed denominations; however, the average contamination per bill was only 7 ng, lower than cocaine (106 ng), benzoylecgonine (43 ng), heroin (41 ng), O⁶-monoacetylmorphine (15.5 ng), morphine (16.5 ng), and MDMA (9 ng). Interestingly, all 64 of the Euros analyzed in this study were contaminated with cocaine [13].

As an additional measure of the randomness of the sample, the percentage of methamphetamine contaminated bills versus Federal Reserve Bank source was calculated for the Bessemer and Grant sets (Table 2). Although Birmingham is in the Atlanta Federal Reserve District, 11 of the 12 Federal Reserves were represented in the two selected sets; only the Minneapolis Federal Reserve was not encountered. Of the bills collected in BES and Grant, 27.5% were from the Atlanta Reserve Bank and 27.85% of the bills that tested positive for methamphetamine were from the Atlanta Reserve. Although the contribution from each individual Federal Reserve Bank is too small to assign any significance to them, collectively these values indicate that the location of issue is not a factor in the percentage of bills that are contaminated with methamphetamine.

Conclusions

Methamphetamine was detected on currency for the first time in the Birmingham metropolitan area. Forty-two percent of the bills collected to date in 2012 were contaminated with methamphetamine, more than has been previously reported for any drug other than cocaine in the United States. The high percentage of contamination detected in this study, and its sudden appearance, indicates a significant change in the pattern of drug contamination of currency around Birmingham, probably reflecting higher methamphetamine abuse in the local populace. This conclusion is in agreement with and complements the findings reported in the National Substance Abuse Index, which states that methamphetamine abuse currently exceeds that of cocaine throughout the state of Alabama [14].

By the time that contamination of currency with cocaine was detected, it was already widespread. The results of this study suggest that it is possible to track significant changes in methamphetamine abuse in a specific region over time. Future studies may lead to insights into the geographical and economic factors that influence methamphetamine abuse (if any). Determining the actual mechanisms for the absorption and/or adsorption of methamphetamine to currency is potentially an important area of future research.

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