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Research Article

Capillary Electrophoresis with UV Detection to Determine Cocaine on Circulated Banknotes

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A new methodology employing capillary electrophoresis with UV detection (CE-UV) was developed, validated, and applied to determine the presence of cocaine on Brazilian banknotes. Some of the banknotes analyzed were obtained directly from general circulation (well used) while others were collected from Automated Teller Machines (ATMs) (relatively new). The background electrolyte optimized using Peakmaster 5.1 software was composed of 60 mmol L^{-1} TRIS(hydroxymethyl)aminomethane and 20 mmol L^{-1} 2-hydroxyisobutyric acid, at pH 8.4. The separation time achieved for cocaine was only 2.5 minutes. The figures of merit obtained in the evaluation of the proposed method were good linearity ($r > 0.999$) in the concentration range of 0.8–8.0 mg L^{-1} and acceptable limits of detection and quantification (0.2 mg L^{-1} and 0.8 mg L^{-1}, resp.). The relative standard deviations of the instrumental precision, repeatability (intraday), and intermediate precision (interday) were less than 4.5% (peak area). The accuracy evaluated through comparing the cocaine results for the banknotes determined by the proposed CE-UV method and using an LC-MS/MS method showed no significant difference between the methods (95% confidence level). In the analysis of the samples cocaine was detected on 93% of the circulating banknotes in amounts ranging from 11.5 μg to 2761.9 μg per note.

1. Introduction

Since the 1980s it has been known that banknotes in North America and Europe are contaminated with cocaine residues. This results from the sale and consumption of this drug, because many cocaine users use a wrapped banknote as a kind of straw to inhale the drug. The presence of traces of this drug on banknotes is often used as forensic evidence to establish a connection between a suspect and illicit drugs [1]. Other explanations for the presence of cocaine on banknotes have been proposed, including contamination due to handling during drug dealing, the transfer from a contaminated note to "clean" ones during counting in financial institutions, and also banknotes coming into contact with one another within the ATM [2, 3].

To ensure the determination of cocaine with precision and accuracy, it is necessary to quantitatively extract the drug from the banknotes. In studies reported in the literature, the extraction technique most commonly employed involves the use of organic solvents and a dilute aqueous acid. For the analysis of US dollar banknotes, the solvents chloroform [4, 5], acetonitrile [6], and ethanol [7] have been used, together with procedures involving vortex agitation and centrifugation, followed by heating and evaporation under nitrogen flow. Methanol was used in three similar studies conducted on euro banknotes [8–10]. Dilute acids have also been used to extract cocaine from banknotes, for example, hydrochloric acid for the extraction of the drug from US dollars [11, 12] and acetic acid in a study on Chinese banknotes [13].

In general, there are two factors that must be considered in relation to the analysis of cocaine on banknotes. Firstly, the use of gas and liquid chromatography in tandem with mass spectrometry, which has enabled the development of highly sensitive, selective, and reproducible methodologies [1, 4, 6, 8–10, 14, 15]. Secondly, the application of screening techniques such as ion mobility spectrometry (IMS) [15–17] or thermal desorption coupled with mass spectrometry (TD-MS)^2

[3, 15, 18–21], which have contributed greatly to reducing the total analysis time and the sample preparation.

Capillary electrophoresis is a separation technique that shows potential in terms of quantification and screening with fast methods of separation. However, the only method reported in the literature employing capillary electrophoresis for the determination of cocaine on banknotes is electrochemiluminescence detection (CE-ECL), as proposed by Xu and colleagues in 2006 [13]. To increase the sensitivity of the method, an online preconcentration technique called field-amplified sample stacking (FASS) was employed, and under the optimum conditions a detection limit of 0.018 mg L^{-1} was obtained. The authors reported the possibility of determining whether or not banknotes were contaminated with illicit drugs. However, they focused on the potential for the application of the CE-ECL/FASS technique by spiking the banknotes with standard solutions of cocaine and heroin. These drugs were then determined after careful washing of the banknotes and a short separation time (around 6 min) was achieved [13].

The aim of this paper was to develop a new methodology employing the CE-UV technique to determine cocaine and its application in the analysis of banknote samples. The optimization of the background electrolyte was performed using the Peakmaster 5.1 software. The proposed method was validated and the results for the cocaine concentration were compared using the LC-MS/MS method. The cocaine concentration was determined for several samples of Brazilian banknotes obtained directly from general circulation (well-used notes) and from ATMs (relatively new notes).

2. Materials and Methods

2.1. Chemicals and Reagents. All reagents and chemicals were of analytical reagent grade. Cocaine (1.0 mg mL^{-1} in acetonitrile) was obtained from Cerilliant Corporation (Round Rock, TX, USA), and propranolol hydrochloride (internal standard (I.S.)) was purchased from Sigma-Aldrich (São Paulo, SP, Brazil). TRIS(hydroxymethyl)aminomethane (TRIS), 2-hydroxyisobutyric acid (HIBA), and formic acid were obtained from Sigma-Aldrich (São Paulo, SP, Brazil). Deionized water (Milli-Q deionizer, Millipore, Bedford, MA, USA) was used to prepare the background electrolyte (BGE). Acetonitrile and methanol (both of HPLC grade) were purchased from Tédia Brazil (Rio de Janeiro, RJ, Brazil).

2.2. CE Instrumentation. All experiments were performed on an Agilent Technologies 7100 system (Palo Alto, CA, USA), equipped with a UV diode array detector. Data acquisition was performed with HP ChemStation software, version B.04.03. The cocaine was detected at 200 nm and propranolol at 215 nm, respectively. The capillary chamber was set at 20°C for all the experiments.

2.3. CE Separation. Electrophoretic measurements were performed on an uncoated fused-silica capillary (48.5 cm × 75 μm i.d. × 375 μm o.d.), which was obtained from Polymicro (Phoenix, AZ, USA). Prior to their first use, the capillaries were conditioned with 1 mol L^{-1} NaOH and deionized water for 40 min, respectively. Daily, capillaries were conditioned with 1 mol L^{-1} NaOH, deionized water, and BGE (separation buffer) for 5 min, consecutively. The optimized BGE was composed of 20 mmol L^{-1} HIBA and 60 mmol L^{-1} TRIS, pH 8.4. The capillary was flushed for 30 s with BGE between runs. Standard solutions and samples were introduced from the capillary inlet end (length to the detector: 40 cm) and injected hydrodynamically at 50 mbar for 10 s (50 mbar = 4996.2 Pa). Separation was performed applying a positive voltage of +25 kV.

2.4. LC-MS/MS Analysis. LC-MS/MS analysis was performed on a high-performance liquid chromatography (HPLC 1200 series) system (Agilent Technologies, Waldbronn, Germany). Separation was performed in a Synergi Polar-RP column (ether-linked phenyl) (150 mm, 2.0 mm, and 4 μm particle size) obtained from Phenomenex, and an isocratic mode was applied. The runs were performed using a mobile phase as follows: 50% of solvent A (H_2O + 0.1% formic acid) and 50% of solvent B (95 : 5 methanol/H_2O). The flow rate was set at 350 μL min^{-1}. In all instances, the injection volume was 10 μL and the column temperature was set to 40°C. The LC system was coupled to a hybrid triple-quadrupole/linear ion trap mass spectrometer (Q Trap 3200, Applied Biosystems/MDS Sciex, Concord, Canada). Analyst version 1.5.1 software was used for the LC-MS/MS system control and data analysis. The mass spectrometer was tuned to the negative and positive modes by infusing a polypropylene glycol solution. The experiments were performed using the TurboIonSpray source (electrospray (ESI)) in positive ion mode. The capillary needle was maintained at 4500 V. MS/MS parameters were as follows: curtain gas, 10 psi; temperature, 500°C; nebulizer gas, 50 psi; auxiliary gas 2, 50 psi; and collision gas, medium. The mass spectrometer parameters used to detect cocaine were parent ion 304.20 Da, quantitative ion 182.10 Da, declustering potential 46 eV, entrance potential 4.5 eV, collision cell entrance potential 16 eV, collision energy 29 eV, and collision cell exit potential 4 eV. The cocaine was monitored using scan type Q1 Multiple Ions. The mass spectrometer was optimized with the direct infusion of a solution containing 1 mg L^{-1} of cocaine.

2.5. Analytical Curves. For the CE analysis, a working solution of a cocaine standard was prepared by dilution of the 1000 mg L^{-1} stock solution to 10 mg L^{-1} in acetonitrile. The I.S. stock solution of propranolol hydrochloride was prepared by dissolving 20 mg in 10 mL of acetonitrile. The I.S. was added at 2.0 mg L^{-1} to the standard and sample solutions. Calibration curves were obtained after preparing individual standards in concentrations from 0.8 to 8 mg L^{-1}. All solutions were stored at 4°C in a refrigerator.

For the LC-MS/MS analysis, the analytical curves were prepared in deionized water in the application range from 10 μg L^{-1} to 100 μg L^{-1}.

2.6. Banknote Samples. This study analyzed 46 Brazilian banknotes of R$ 2.00 denomination collected in the city of

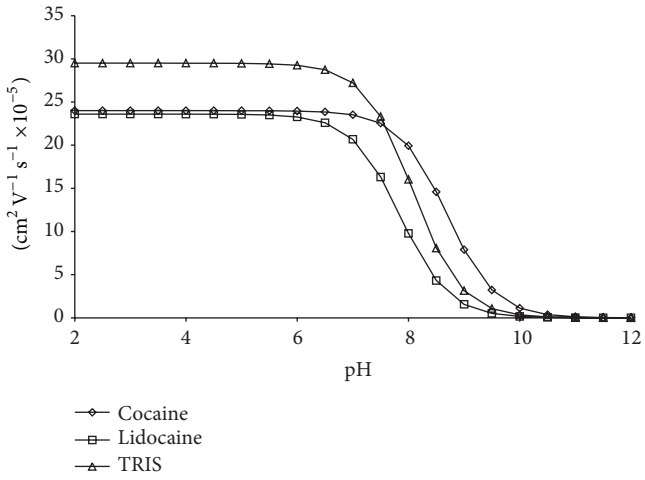

Figure 1: Curves of effective mobility versus pH for cocaine, lidocaine, and TRIS.

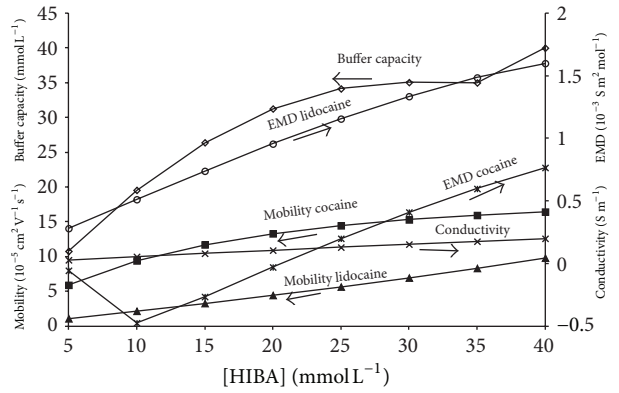

Figure 2: Optimization of BGE composition using Peakmaster 5.1 software with fixed TRIS concentration of 60 mmol L^{-1} and varying concentration of HIBA (5–40 mmol L^{-1}).

Florianópolis, in Santa Catarina State: 30 obtained directly from general circulation and 16 from ATMs. These banknotes were circulating samples and they were not spiked with cocaine standard. The samples were placed in a centrifuge tube (one note in each tube) containing 10 mL of acetonitrile, and extraction of cocaine was performed by sonication for 8 min. This procedure was based on research reported by Jenkins in 2001 [6]. Before injection into the CE equipment, the samples were placed in vials in a proportion of 9 : 1 (cash note extract/I.S.).

3. Results and Discussion

3.1. CE Method Development. To optimize the background electrolyte for cocaine determination using capillary zone electrophoresis, curves of the effective mobility versus pH for cocaine and lidocaine were constructed. Lidocaine is used as an additive for cocaine adulteration [22] and, in preliminary tests, it was found on banknote extracts. Lidocaine has structural characteristics similar to those of cocaine and may compromise the selectivity of the method. Thus, it was considered as an analyte in developing the method by simulation, although an evaluation to obtain the figures of merit was not carried out. The curves were constructed using (1), where $\mu_{\text{eff},A}$ is the effective mobility and $\mu_{\text{act},A}$ is the apparent mobility:

$$\mu_{\text{eff},A^-} = \frac{\mu_{\text{act},A^-}}{1 + 10^{\text{pKa-pH}}}. \quad (1)$$

Figure 1 shows the pH range (from 6 to 10) which provided the most effective separation of the analytes, considering that the choice of coion as well as the counterion of the running buffer aimed to achieve a good buffering capacity and reduce the Joule effect, the electromigration dispersion (EMD), and the adsorption in the capillary. In this pH range, the analytes are in the cationic form and the capillary wall is strongly negative. Thus, the use of a base containing an amino group, such as TRIS, in the BGE, may be applied in order to reduce the adsorption of the analytes in capillary. Considering that the pKa of TRIS is 8.15 and at around this pH value the maximum difference between the μ_{eff} of the analytes is obtained, this was chosen as the coion for the BGE. Besides providing a BGE with a good buffering capacity, TRIS presents other attractive features including low UV absorption and μ_{eff}, similar to those of the analytes, which minimizes the widening of the bands caused by EMD. HIBA was chosen as the counterion due to the low UV absorption. Furthermore, like TRIS, HIBA is a solid, allowing the BGE preparation to be carried out weighing the required amounts of both, which facilitates the process.

The TRIS and HIBA concentrations were optimized using Peakmaster 5.1 software. For this, the TRIS concentration was fixed at 60 mmol L^{-1} and the HIBA concentration was varied (5 to 40 mmol L^{-1}). The parameters EMD, conductivity, and buffer capacity were evaluated and the results obtained are shown in Figure 2. According to the analysis of the curves for each parameter, the optimum composition of the BGE was 60 mmol L^{-1} TRIS and 20 mmol L^{-1} HIBA, at pH 8.43. With this composition the EMD for cocaine is close to zero (0.03), which generates high peak symmetry. The buffering capacity is around 31 mmol L^{-1}, which makes the method robust, and the conductivity is low (0.106 S/m), which does not raise the current power, contributing to the absence of the Joule effect. The mobility of the electroosmotic flow (EOF) was obtained experimentally for the simulation.

Figure 3(a) shows the simulated electropherogram for the optimized BGE composition, and Figure 3(b) shows the experimental electropherogram of a banknote extract. A good agreement can be observed between the two electropherograms, showing that the simulation was an important tool in method development.

Propranolol was selected as the IS for this method due to its chromophore properties, generating a response in the UV detector and its pKa (9.45) [23], which permits a high ionization and high μ_{eff}, at the pH of the optimized BGE (8.43) contributing to fast separation. Lastly, the high separation pH of the BGE provides a strong positive EOF (toward the cathode) and thus the migration time decreases

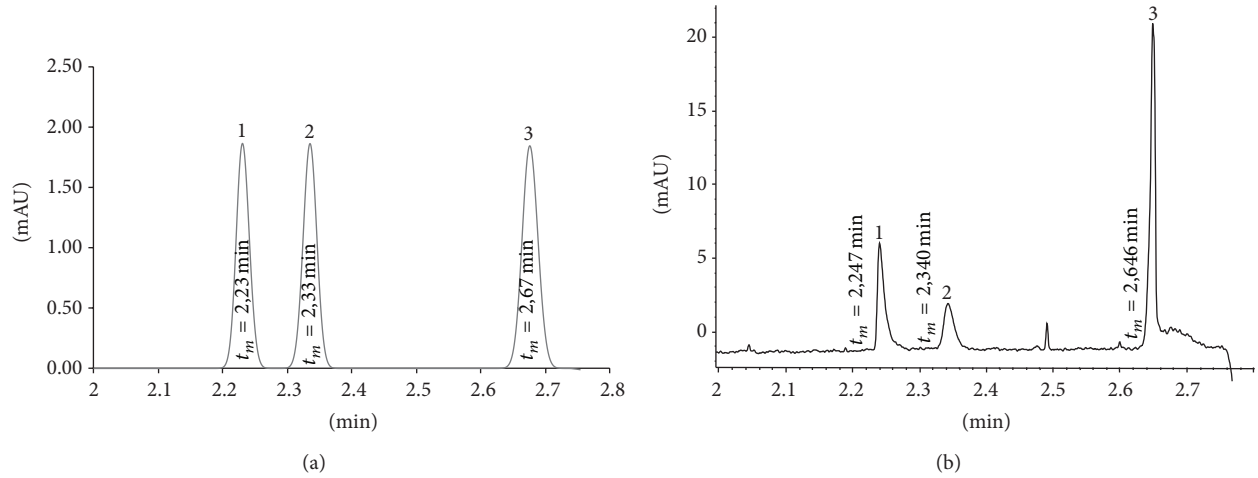

Figure 3: Comparison between (a) simulated and (b) experimental electropherograms of a banknote extracted under the optimized conditions. Legend of the peaks: 1: propranolol (I.S.), 2: cocaine, 3: lidocaine. Experimental conditions: capillary 48.5 cm (length to the detector 40 cm); BGE composed of 20 mmol L^{-1} HIBA and 60 mmol L^{-1} TRIS at pH 8.4; injection using 50 mbar for 10 s; voltage +25 kV.

in the coelectroosmotic mode as well as in the total analysis time.

3.2. Increasing the Detectability of CE. To find traces of cocaine from an extract of a banknote, the injection time was varied to increase the detectability. Several papers in the literature demonstrate the effectiveness of acetonitrile in different stacking procedures [24, 25]. Therefore, the standard was prepared in acetonitrile and injected, increasing the injection time. Using acetonitrile, it was possible to apply a 10 s injection time while maintaining good peak efficiency for the cocaine determination, with a high signal to noise ratio. The monitoring wavelength also affects the cocaine signal. Based on the UV spectrum of the compound, which is shown in Figure 4, the best signal for the detection was 200 nm.

3.3. Method Validation. In order to evaluate the proposed method for the determination of cocaine in paper currency samples, the following validation parameters were evaluated: selectivity, linearity, repeatability (instrumental and intraday), intermediate precision, limit of detection (LOD), limit of quantification (LOQ), and accuracy.

3.3.1. Selectivity. Selectivity was evaluated by the method of standard addition, comparing the analytical curve obtained with additions of cocaine standards to 3 different banknote extracts with a calibration curve obtained without the presence of the banknote extract. Observing the slopes of the standard addition (0.321 ± 0.003; $R^2 = 0.9995$) and external calibration (0.323 ± 0.012; $R^2 = 0.9992$) curves, they were found to be parallel and no matrix interference was observed. The proximity between the determination coefficients indicates that the method is suitably selective for determination of cocaine on banknote extracts.

To demonstrate the selectivity of the method, Figure 4 compares three electropherograms: (a) paper currency extract free of the analyte of interest, (b) banknote extract blank with cocaine standard added at a concentration of 4 mg L^{-1}, (c) extract of a circulating banknote. It was verified that the compound detected in the banknote extract is cocaine because no interfering compound was eluted at the migration time of cocaine.

3.3.2. Linearity, Accuracy, and Precision. The other figures of merit listed above are presented in Table 1. Linearity was evaluated by considering the correlation coefficient (r). An r value equal to or higher than 0.999 is considered evidence of an ideal data fit to the linear regression curve, performed through the least squares fitting technique [26, 27]. Another way to verify the linearity is applying the *a priori* linearity hypothesis test. The test was carried out by comparing $F_{\text{calculated}}$ and F_{critical}; if $F_{\text{calculated}} \leq F_{\text{critical}}$, the null hypothesis was not rejected, indicating that the linear model can be considered satisfactory for application [27]. In this case, $F_{\text{calculated}}$ was higher than F_{critical} and thus the regression is significant for the linear model applied ($F_{\text{calculated}} = 3181.30$ and $F_{\text{critical}} = 4.60$). Another F test was carried out to verify the lack of fit of the linear model, and the results show no lack of fit with the linear model applied, since $F_{\text{calculated}}$ was lower than F_{critical} ($F_{\text{calculated}} = 0.00014$ and $F_{\text{critical}} = 3.6$, with a 95% confidence interval).

Instrumental precision, intraday precision, and intermediate precision were evaluated in the proposed method for cocaine determination (Table 1). Instrumental precision ($n = 10$) was determined through the injection of the same banknote extract 10 times. Values for the repeatability of the migration time and peak area ratios were 2.2 and 0.3 RSD%, respectively. The intraday precision ($n = 6$) was determined through the preparation of 6 replicates of a cocaine standard at a concentration of 1 mg L^{-1}, added to an internal standard at 2 mg L^{-1} and injected on the same day. The values for the repeatability of the migration time and peak area ratios were 2.2 and 3.0 RSD%, respectively.

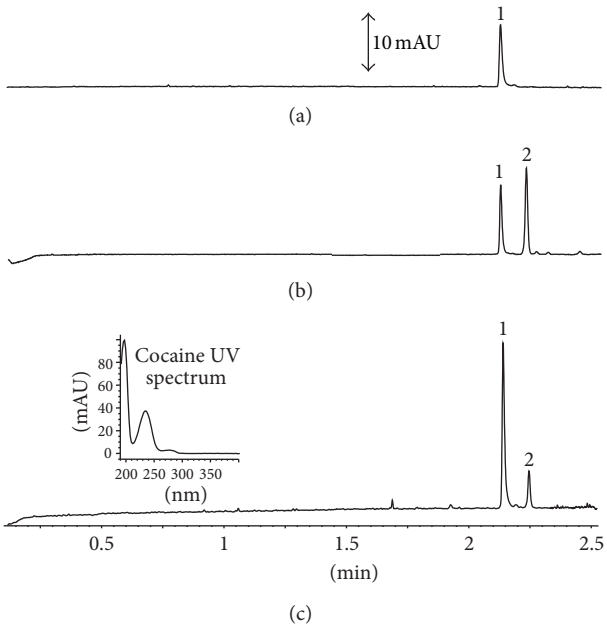

Figure 4: Illustration of the selectivity of the method: (a) banknote extract free of the analyte of interest; (b) banknote extract blank with cocaine standard added at concentration of 4 mg L^{-1}; (c) extract of a banknote in circulation. Legend for the peaks: 1: propranolol (I.S.), 2: cocaine. Experimental conditions: capillary 48.5 cm (length to the detector 40 cm); BGE composed of 20 mmol L^{-1} HIBA and 60 mmol L^{-1} TRIS at pH 8.4; injection using 50 mbar for 10 s; voltage 25 kV.

Intermediate precision was verified by preparing daily three cocaine standards at concentrations of 1, 2, and 3 mg L^{-1}, added to the I.S. (2 mg L^{-1}) and injected in duplicate on three consecutive days, $n = 9$. For the peak area ratio, the results obtained for the three concentrations were 0.3, 4.5, and 3.4 RSD%, respectively.

LOD and LOQ values were calculated based on the following equations: LOD = $(3 \times s)/S$, LOQ = $(10 \times s)/S$, where s is the standard deviation of the intercept and S is the standard deviation of slope. The LOD and LOQ determined for both the sample and standard using the CE-UV method were close to 0.2 and 0.8, respectively.

Finally, the accuracy was obtained through comparing the CE-UV and LC-MS/MS methods, and the results are shown in Table 2. Ten banknote extracts chosen randomly from the samples that contained cocaine above the LOQ were injected in duplicate on the same day into the two instruments, taking into account that, before the injection into the LC-MS/MS, the banknote extracts were diluted 100-fold with deionized water. Thus, a statistical test was carried out, and the result obtained applying the paired-samples t-test was a P value of 0.576. As the P value was higher than 0.05 and $t_{calculated}$ (0.580) was less than $t_{critical}$ (2.26), no significant difference between the CE-UV and LC-MS/MS methodologies was evidenced (95% confidence interval).

3.4. Analysis of Cocaine in Banknotes. The proposed method using CE-UV was employed to determine the presence of cocaine on 46 Brazilian banknotes: 30 obtained directly from general circulation and 16 from ATMs. Thus, this is a sample of banknotes in circulation rather than banknotes spiked with a cocaine standard (Table 3).

Table 1: Some figures of merit for the CE-UV method applied to the determination of cocaine on banknotes.

Parameter	Value
Linearity—slope (L mg^{-1})	0.32 ± 0.003
Linearity—intercept	−0.003 ± 0.015
Linearity—correlation coefficient (r)	0.9997
Instrumental precision (RSD%); peak area; $n = 10$	0.3
Instrumental precision (RSD%); migration time; $n = 10$	2.2
Intraday precision (RSD%); migration time; $n = 6$	2.2
Intraday precision (RSD%); peak area; $n = 6$	3.0
Interday precision (RSD%); peak area; (1 mg L^{-1}); $n = 3$	0.3
Interday precision (RSD%); peak area; (2 mg L^{-1}); $n = 3$	4.5
Interday precision (RSD%); peak area; (3 mg L^{-1}); $n = 3$	3.4
LOD (mg L^{-1}) for standard	0.2
LOQ (mg L^{-1}) for standard	0.8

From 30 banknotes obtained directly from general circulation, cocaine was detected on 28 samples (93%), with levels being above the LOQ, in amounts ranging from 11.5 μg to 2761.9 μg per note. Regarding the group of notes collected from ATMs, these were practically new, having been subjected to minimal handling, which explains the low values found: out of 16 notes two had negative results for the presence of cocaine (below the LOD), two contained only traces of the drug (below the LOQ), and twelve presented cocaine levels above the LOQ, ranging from 9.1 μg to 264.8 μg per note.

About the cocaine quantities in banknotes, some researches reported in the literature demonstrated similar results in the analysis of euro banknotes such as Esteve-Turrillas et al. (2005) who developed a nondestructive method for cocaine determination in banknotes by CG-MS/MS. The results obtained in the analysis of 16 Euro banknotes of different nominal values showed contamination in all banknotes measured in the range between 1.25 and 889 μg per note [8]. In another study, Wimmer and Schneider (2011) developed and validated a method for simultaneous quantification of illicit drugs on Euro banknotes, using an LC-MS/MS. The authors determinated a median amount/note of 106 ng to cocaine [10]. These values described in euro banknote are very low in comparison with Brazilian banknotes determined by the present method by CE-UV.

Table 2: Accuracy of CE-UV and LC-MS/MS methods.

Sample	Cocaine (μg/note) CE-UV	Cocaine (μg/note) LC-MS/MS
2[a]	25.4 ± 2.7	23.3 ± 0.5
11[a]	19.2 ± 0.4	20.7 ± 0.2
12[a]	23.5 ± 0.5	26.9 ± 0.3
18[a]	113.9 ± 1.5	129.8 ± 0.3
21[a]	178.3 ± 2.6	173.9 ± 3.4
8[b]	11.4 ± 1.2	9.0 ± 0.7
9[b]	13.2 ± 1.4	11.5 ± 1.2
12[b]	9.3 ± 0.7	7.8 ± 0.4
13[b]	18.2 ± 1.2	14.8 ± 1.8
14[b]	12.0 ± 0.6	13.4 ± 1.0

[a]Banknotes obtained from general circulation.

[b]Banknotes obtained in ATMs.

[c]t-test for paired samples, $t_{calculated} = 0.58 < t_{critical} = 2.26$; no significant difference was observed, 95% confidence interval.

The LOD obtained for this method is not very low compared to that reported for previous studies using GC-MS or LC-MS/MS [1, 4, 6, 8–10, 14, 15] techniques or the methodology proposed by Xu et al., 2006 (i.e., CE-ECL). Nonetheless, the value of 0.2 mg L^{-1} appears to be acceptable for the determination of cocaine on Brazilian banknote extracts, since the quantities (Table 3) found on the notes are much higher than this LOD value. Furthermore, the method proposed herein has the advantage of a simple sample procedure consisting of acetonitrile extraction and sonication. In addition, this methodology allows the determination of cocaine in less than 2.5 min, increasing the analytical frequency, and has lower costs associated with reagents and solvents.

4. Concluding Remarks

A simple extraction procedure was applied and an efficient CE-UV method was developed and validated for the determination of cocaine on Brazilian banknotes in circulation. This optimized CE-UV method showed good analytical parameters, such as acceptable reproducibility and repeatability for the samples. In relation to the accuracy, no significance difference was found on comparing LC-MS/MS with the proposed CE-UV method. In addition, samples can be analyzed with low solvent and reactant consumption. Although it is not possible to differentiate between banknotes which are directly linked to the consumption and sale of cocaine and those which have suffered cross-contamination, this method allowed quantitative differences to be identified between relatively new and well-used banknotes. By optimizing the background electrolyte using simulation software, a simple extraction with an organic solvent, without a preconcentration procedure, and with a fast separation time (2.5 min) was obtained. From 30 banknotes obtained directly from general circulation, cocaine was detected on 28 samples (93%). Regarding the group of notes collected from ATMs, these were practically new, having been subjected to minimal handling, which explains the low values found. The results of this study highlight CE-UV as a promising technique as an alternative to GC or LC for the determination of cocaine on banknotes, which may be used to identify the presence of this drug in the forensic analysis of this type of sample.

Table 3: Amount of cocaine content on Brazilian banknotes determined by CE-UV method.

Sample	Cocaine (μg/note)
1[a]	74.8
2[a]	25.4
3[a]	225.4
4[a]	63.3
5[a]	45.7
6[a]	776.0
7[a]	34.6
8[a]	43.6
9[a]	413.1
10[a]	11.5
11[a]	19.2
12[a]	23.5
14[a]	14.1
15[a]	53.2
16[a]	24.3
17[a]	38.4
18[a]	113.9
20[a]	230.5
21[a]	178.3
22[a]	70.6
23[a]	28.5
24[a]	15.6
25[a]	17.7
26[a]	18.5
27[a]	56.2
28[a]	90.0
29[a]	2761.9
30[a]	918.6
1[b]	14.3
2[b]	264.8
3[b]	15.8
4[b]	10.8
5[b]	14.2
6[b]	22.8
7[b]	9.1
8[b]	11.4
9[b]	13.2
12[b]	9.3
13[b]	18.2
14[b]	12.0

[a]Banknotes obtained from general circulation; [b]banknotes obtained from ATMs.

Conflict of Interests

The authors declare no conflict of interests.

Acknowledgments

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