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DETERMINATION OF PSYCHOACTIVE SUBSTANCES IN HAIR TO ASSESS THE CONSUMPTION PROFILE IN THE MARÉ REGION

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Introduction

Maré, a complex of "favelas" in the northern part of Rio de Janeiro, is home to over 140,000 people in 16 communities and faces significant social challenges. The lack of basic services, such as health, education and sanitation, results in high school-dropout rates and difficulties in accessing medical treatment. Violence is a critical problem in this conflict-ridden region, which is frequently involved in clashes between criminal factions and security forces. This atmosphere of insecurity interrupts essential services and increase social vulnerabilities. In addition, the lack of effective public policies contributes to a high number of deaths and encourages drug use, leading to a cycle of vulnerability in the community [1].

Psychoactive substances are chemical compounds that, when ingested or administered, alter the functioning of the central nervous system, impacting a person's mental state, perception, mood, behavior, and cognitive functions. These substances are classified into three main categories: depressants (alcohol, benzodiazepines, barbiturates, and opioids), stimulants (cocaine, crack, and amphetamines), and hallucinogens (marijuana and ecstasy) [2].

Toxicological analysis is essential for identifying and understanding exposure to toxic substances and is widely applied in forensic investigations. In recent years, hair has gained prominence as a valuable alternative for these analyses, offering significant advantages, such as enabling the assessment of drug exposure over several months, compared to blood and urine samples [3,4].

This study aims to evaluate the consumption profile using matrices collected from unclaimed corpses originated from the Maré region, in partnership with the Afrânio Peixoto Forensic Medical Institute, affiliated with the Rio de Janeiro State Civil Police Department, and the Contraprova Laboratory.

Material and Methods

Hair samples were collected from 22 individuals according to the guidelines of the Brazilian Society of Toxicology (SBTOX) [3] and analyzed at Contraprova Laboratory utilizing an ISO/IEC 17.025 certified LC-ESI-MS methodology. For screening analysis, the following analytes were monitored: amphetamine (ANF), morphine (MOR), 6-monoacetylmorphine (6-MAM), codeine (COD), methylenedioxy-amphetamine (MDA), methamphetamine (MET), mazindol (MZD), fenproporex (FPX), 3,4-methylene-dioxyamphetamine (MDMA), cocaine (COC), and Δ-9-tetrahydrocannabinol (THC). A previously prepared deuterated internal standard solution containing ANF-d6, MOR-d3, COD-d6, MDA-d5, MET-d9, MDMA-d5, COC-d3, and THC-d3 was used for both the calibrators and the samples.

After identifying the root and tip of the hair strand for proper segmentation, 10 to 20 mg were weighed and placed in a microtube. After decontamination, the samples were dried, pulverized using a Bead Mill Homogenizer (Omni International), extracted with methanol/sonication, and centrifuged. The sample preparation followed the protocol used at the Contraprova Laboratory[3,4].

The analysis was performed using liquid chromatography coupled to a triple quadrupole mass spectrometer (LC-MS/MS), equipped with an electrospray ionization (ESI) source operating in positive ionization mode. Data were acquired using Multiple Reaction Monitoring (MRM). Calibration curves for each analyte were obtained using the least squares method. The samples underwent screening analysis, and those that tested positive for one or more analytes were sent for confirmatory analysis, also performed by LC-MS/MS. In addition to the screening of the drugs, the confirmatory analysis included the biotransformation products of cocaine (benzoyl-ecgonine (BZE), norcocaine (NCOC), and cocaethylene (CE)) and THC (11-nor-tetrahydrocannabinol-9-carboxylic acid (THC-COOH)).

Results and Discussion

The analysis of hair samples from a population aged between 11 and 83 years, composed of 59% men and 41% women, yielded important preliminary findings. From the 22 samples analyzed, 13 were reactive for THC, 16 for COC, 1 for COD, and 1 for MDA, while only one sample showed no reactivity. Among the positive samples, 8 reacted for both THC and COC, while one sample tested positive simultaneously for THC, COC, and CE. Cut-off values were established according to the NIT-DICLA-069 standard. Among the samples positive for COC, 15 were confirmed with concentrations ranging from 1.4 to 50.1 ng/mg. Of the 13 samples positive for THC, only 3 were confirmed, with concentrations between 0.07 and 0.75 ng/mg. The samples that tested positive for COD and MDA, however, were not confirmed. The lack of confirmation indicates that the concentrations of these substances were below the cutoff value established by the standards. This occurs because substances like COC and THC are generally more available and frequently consumed in regions where the socio-economic context limits purchasing power and directs demand toward cheaper drugs.

Additionally, the presence of BZE confirmed the use of cocaine in all samples positive for COC, with 63% also reactive for CE. This interaction is significant from a forensic perspective, as the presence of CE and elevated levels of BZE are a reliable indicator that COC use occurred alongside alcohol consumption. The combination of COC and alcohol increases the risk of acute toxicity and adverse effects, including cardiovascular and neurological complications.

Conclusion

Despite these preliminary results, toxicological hair analysis proved promising, providing valuable data on chronic and multiple substance use patterns. It is important to note that hair as a matrix is not yet routinely analyzed in the forensic context by the State Civil Police, underscoring the methodological innovation and the potential to expand investigative capabilities in forensic science.

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