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Overview of drugs and drug analysis methods

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Abstract

This paper aims to reveal the most used drug analysis techniques as well as discover the best techniques that are used to detect the poisoning materials and drugs that are used by human beings. Data were collected using a process that helps in obtaining answers and solutions to many problems and questions, helps in facilitating the decision-making and increases the quality of decisions that were taken, and also helps in improving the quality of different outputs. The most important spectrophotometric techniques that are used to detect drugs are mass selective detector technique, chemiluminescence, high-performance liquid chromatography and others. It was found that these drugs are methanol, Amphetamine/ methamphetamine, Cocaine and others. Samples taken to detect drugs in the body by spectrophotometric techniques may be Urine, blood sample, hair follicles or any other body fluids obtained from live persons or autopsy samples.

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Introduction

Many analytical procedures have been used in detecting drugs in human body fluids. Spectrophotometry is a technique used in many laboratories in order to detect the amount of chemicals used in a solution or medicine and for the absorption of light. It was invented in Japan in 1940 by Umetaro Suzuki (Burgess, 2007). It works by passing a light beam through the sample to be examined, and then each compound in the solution absorbs the light or transmits it at a specific wavelength. The goal of using this technique is to detect the presence of any chemical percentage added to the drug, such as the high chemical ratios that we find in heroin, cocaine, psychotherapy drugs and other drugs that are allowed by prescription only by a specialist doctor for the purposes of treatment and under the supervision of the doctor El-Didamony *et al.*, 2015). In addition, it is considered one of the most important medical and physical techniques used to detect these materials because of its low cost, high accuracy and inherent simplicity. This technique is also widely available in a sufficient number of quality control laboratories (Mostafa, 2010). Furthermore, there are a large number of substances that have been detected and analyzed by spectroscopic techniques, and the most important of these substances is Methanol Methanol, commonly known as methyl alcohol, is created by combining a methyl group (CH3-with a hydroxide group (-OH), resulting in the chemical formula CH3OH. It is, however, sometimes shortened as MeOH. It's also known as 'wood alcohol,' because it was once created as a by-product of wood distillation (Dalena *et al.*, 2018). There are many spectrophotometric techniques that have been used to detect methanol, and these techniques are chromatography, flow injection (FIA), fluorometry, spectrophotometry, chemiluminescence, high-performance liquid chromatography, and electrochemical techniques (Stevens, 1973).

Amphetamine and methyl amphetamine are detected gas chromatography-mass spectrometry in urine (Habib *et al.*, 2020). This technique has become widely used by police stations in order to conduct a urine analysis to detect the presence of any chemicals or narcotics inside the patient's body. This urine sample is taken and examined in the laboratory by using the technique of gas chromatography-mass spectrometry to detect the amphetamine's presence inside the body (Nathália *et al.*, 2013).

Cocaine is one of the second most dangerous drugs after heroin and leads to complete loss of mind, and cocaine is one of the drugs that lose the mind completely. For this reason, there was a need to use spectrophotometric techniques to work on detecting the abuser's human body by conducting a urine examination using Mass Selective Detector technique. The most important information that can be obtained from seized cocaine through chemical analyzes and techniques is its form, content and characterization of adulterers (Silva *et al.*, 2008, . Cocaine was invented in 1859 in German by chemist Albert Niemann. The most spectrophotometric techniques used to search for cocaine are Mass Selective Detector (GC-MS), [Mid-InfraRed (MIR), Near-InfraRed (NIR), Raman and Flame Ionization Detector (GC-FID) (Tiscione *et al.*, 2011). Many HS-GC–FID processes employ dualcolumn confirmation, which entails injecting a single sample and dividing it between two chromatographic columns of sufficiently varied polarity to vary methanol and other volatiles of interest retention and elution order (Islek, Ramadanoglu, 2017). Methanol, also known as methyl alcohol, wood alcohol, or carbinol, is the most basic alcohol. It's a light, volatile, colorless, flammable liquid with a unique odor that's comparable to ethanol but slightly sweeter. Methanol is a hazardous alcohol for animals that is commonly employed as an extraction solvent or in detergents, antifreeze, and fuel (Gupta *et al.*, 2018).

Methanol can be found in both therapeutic and forensic settings. By using headspace-Gas chromatography/Mass Spectrometry, we were able to extract ethanol and methanol from blood. This method was designed and verified for quantitative methanol analysis by HS-GC/MS utilizing the HP5MS column. This study has several advantages, including

a readily available blood sample and a simple and quick headspace procedure. This approach was also proven to be appropriate for clinical and toxicological analysis (Cui-ting *et al.*, 2016).

The existence of distinct chemical classes of volatile chemicals was confirmed by GC-MS analysis of Urtica dioica methanolic extract. The existence of 57 chemicals (phytochemical constituents) was discovered in the GC-MS study of U. dioica leaves, which may contribute to the plant's toxic character. The phytochemical substances were identified using parameters such as peak area, retention time (RT), and molecular formula (MW) (Fürész *et al.*, 2004). Amphetamine and methamphetamine are detected in the urine using gas chromatography-mass spectrometry GC/MS. The more specific GC/MS is utilized as a confirmatory test to detect and quantify individual drug components or metabolites. Before reporting positive drug test results to employers, confirmatory testing, such as GC-MS, should be used (Braithwaite *et al.*, 1995).

Alternatively, gas chromatography may reveal urine for amphetamines or methamphetamines, benzodiazepines, barbiturates, cocaine, MDA analogs (MDA or MDMA), marijuana, opiates (morphine, codeine, 6-acetylmorphine [indicating heroin use]), hydromorphone, oxymorphone, hydrocodone,), alcohol or nicotine (Shipman *et al.*, 2013).

Gas chromatography method for detecting narcotic substances in the human body, such as amphetamine, needs 10-15 minutes to detect toxic substances in the body, and it may appear through the pop sample that was made on the person who abused, and this technique reveals what approximately fourteen types of toxic drugs in the body (Miranda *et al.*, 2007). Plagioclase-olivine Inclusions (POI) test is applied to indicate the actual drug users and to detect t the percentage of concentration of each drug in the body of each person. Mass spectrometry liquid chromatography-tandem mass spectrometry MS-LC-MS, high-performance liquid of chromatography (HPLC) and capillary electrophoresis (CE) are also used to detect amphetamine and misamphetamin (Sim *et al.*, 2019) In addition, plagioclase-olivine inclusions (POI) was also detected in drug users urine using MS-LC-MS, HPLC and CE (Silva *et al.*, 2008).

This study focused on drugs and their detection methods and the advantages of each method of analysis.

Detection of the presence of amphetamine and methamphetamine in urine

There is a statistical study conducted in Mexico to detect the presence of amphetamine and methamphetamine in urine through the use of spectrophotometric techniques, including manufacturer's instruction with EMIT Dade Behring technique used in criminal investigations and the drug control unit more. This statistical study was conducted on approximately 121 truck drivers on federal highways, their ages ranged from 18-65 years all randomly. Sampling was carried out following the guidelines and principles for workplace of the testing drug at the Mexican Secretariat of Transport and Communications. This method was used by the sample of those drivers in order to detect five types of alcohol and drugs they may have. These five drugs are (Ag-tetrahydrocannabinol, amphetamines, amphetamines, cocaine and opiates, and this study focused only on positive samples of amphetamine users of truck drivers and ignored the types Other drugs were taken and work was done to obtain empty urine samples from the laboratory staff. The method that was used in that study and was applied to the sample for the detection of methamphetamine and amphetamine in urine is a good method because it reduced the cost of the analytical procedure, used one liquid using conventional solvents, and locked the amphetamines as HCI salt and it was an accurate, easy and fast method (Miranda *et al.*, 2007).

Plagioclase-olivine inclusions

Plagioclase-olivine Inclusions (POI) test was taken from real 93 drug users that their urine samples were taken by police stations in Yeongnam District and the local prosecutor's office.

The Agilent 1260 Infinity HPLC system (Santa Clara, USA, CA) is used in that work, and it comprised binary pump, autosampler, vacuum degasser and column oven. ChiroSil SCA() (4.6 mm 150 mm, 5 m), . ChiroSil RCA (+) (4.6 mm 150 mm, 5 m) and Supelco Astec Chirobiotic V2 were employed to separate the enantiomers (Sim *et al.*, 2019).

Narcotic substances detection

The Agilent 1260 Infinity HPLC system is also used narcotic substances detection. The results of narcotic substances detection indicated that 93 actual drug users were detected, and it was revealed through the aforementioned methods, and the percentage of concentration of each of these drugs in the body of each person was revealed as described in Table (1) below from (Sim *et al.*, 2019). Table 1 shows the percentage of concentration of each of the narcotic substances inside the body of the individuals from whom urine samples were taken. In addition, the linearity is used to describe the determination of coefficient for the curve of calibration. In this study, the calibration curve's coefficient of determination (r2) was 0.999 for the analyses with a weight coefficient of 1/x2, demonstrating satisfactory linearity across the calibration range. 2.57.5 ng/mL and 25 ng/mL were determined to be the LOD and LLOQ, respectively as shown in table above. On the other hand, lower limit of qualification clarified as the less rate on the curve of calibration with precision (percentage), accuracy (percentage bias), within (20%), less than (20%) (Sim *et al.*, 2019).

Table 1. Shows the results of the detection of narcotic substances using HPLC system (Santa Clara, USA, CA) (from Sim *et al.*, 2019).

Compound	Range of Concentration	Slope	LLOQ (ng/ml)	LOD (ng/ml)
d-AP	25-1000	0.0087 0.0002	25	7.5
l-AP	25-1000	0.0087 0.0001	25	7.5
d-MA	25-1000	0.0040 0.0001	25	2.5
l-MA	25-1000	0.0040 0.0001	25	3.4

LOD: Limit of detection, *LLOQ:* Lower limit of qualification.

Cocaine Drug and its relation to spectrophotometric techniques

Detecting the concentration of cocaine in the body is one of the important things to detect in criminal matters in the police because the detection can indicate the percentage of drugs in the body, in addition to the fact that large doses of cocaine may lead to death. There are a number of photometric techniques used to detect heroin in the body and these techniques are gas chromatography, mass selective detector with detector of flame ionization. These techniques used are very costly techniques and are not used in all police stations. Therefore, different techniques for spectrophotometry such as cobalt thiocyanate were used as a complex detector (Miranda *et al.*, 2007).

Two phases emerge from this reaction: the top pink layer has an excess of cobalt thiocyanate solution, whereas the bottom (blue) layer has the complex cocaine-cobalt thiocyanate. A sequential-injection valve in a reaction chamber inserts samples and reagents between two air bubbles. A fiber optic sensor connected to the chamber collected the absorption at 630 nm. The quantification and detection limits were respectively 98 mg L(-1) and 29.4 mg L(-1). For the containing of solutions (n=10), 400 mg L(-1), the relative standard deviation was 4.9 percent, with stable baselines. At 12 determinations per hour, the analytical throughput was impressive (Fiorentin *et al.*, 2017).

Review analysis

The spectrophotometry techniques are a standard and inexpensive method that has a key role in measuring the amount of chemicals in the body and solution, in addition to measuring the absorption of light. This is done by passing the beam through a sample and

absorbing all types of light. The compounds in the solution (Burgess, 2007; Mostafa, 2020).

There are many methods of spectrophotometry used to detect toxic substances and drugs inside the human body, and these methods are the mass selective detector technique, mass spectrometry, mass spectrometry-gas chromatography, high-performance chromatography liquid, chromatography liquid-tandem mass spectrometry, capillary electrophoresis (CE), flow injection (FIA), fluorometry, chemiluminescence and other methods (El-Didamony *et al.*, 2015; Dalena *et al.*, 2018; Stevens *et al.*, 1973).

In addition, there were another techniques used to determine the amphetamine enantiomers and methamphetamine in human urine and these techniques are mass spectrometry liquid chromatography-tandem mass spectrometry, high-performance liquid chromatography and capillary electrophoresis (CE) (Sim *et al.*, 2019).

Numerous studies have been conducted to detect drugs in the human body, and the most important types of drugs that have been studied are heroin, cocaine, ethanol, cardiovascular disease drugs, thiamine, Amphetamine/methamphetamine, marijuana and other drugs (Burgess, 2007; El-Didamony *et al.*, 2015; Mostafa, 2020; Dalena *et al.*, 2018; Stevens, 1973; Habib *et al.* 2020).

There are a large number of laboratory tests that have been used to detect amphetamine, cocaine and other narcotic substances in the body and these tests are blood test, urine test and hair follicle test. There have been many discussions about these tests, and all the discussions and studies that I have read have made it clear to me that the urine test is one of the best types of tests because urine preserves the substances in the urine and it is difficult to change them (Miranda *et al.*, 2007; Fiorentin *et al.*, 2017).

The method used to assess the levels of methamphetamine, amphetamine, and 4-hydroxyamphetamine in the urine is a valuable addition to an already well-established field (Mostafa, 2020; Stevens, 1973; Nathália *et al.*, 2013). This method differs from other amphetamine technique because the use of a single extraction of liquid with the conventional solvents.

That is reduced the analytical procedure's cost and made it simple to do it; (ii) the trapping of the amphetamines as their HCI salt is an appealing solution to the problem of the volatile nature of these analyses, and this step facilitates solvent evaporation at 50 with minimal amphetamine loss; and (iii) the trapping (Burgess, 2007; Nathália *et al.*2013; Miranda *et al.*, 2007).

The spectrophotometric for detecting cocaine were thoroughly examined and proved to be appropriate for evaluating cocaine and/or crack cocaine users, according to cocaine drug. Therefore, BZE concentrations in urine were higher than those seen in plasma of real samples, showing chronic users' propensity to accumulate in matrices with a broad detection window (Miranda *et al.*, 2007; Sim *et al.*, 2019; Fiorentin *et al.*, 2017).

Conclusion

Many techniques are used in medical and forensic laboratories in order to detect the amount of chemicals or drug used in a solution or medicine. There is a large number of spectrophotometric techniques to detect narcotic drugs in the body such as heroin, ethanol, amphetamine and marijuana, and to detect other drugs such as heart disease drugs [1-5]. The most important techniques used now are flow injection (FIA), fluorometry, chemiluminescence and other expensive techniques, which are Mass Selective Detector, gas chromatography-mass spectrometry. These techniques are used in laboratories and police offices in order to detect criminals or drunks to detect any chemicals, narcotics or drugs inside their bodies in order to take the appropriate decision regarding them. Finally, the above-mentioned spectrophotometric techniques are suitable and accurate in detecting the presence of drugs and their concentrations in human body fluids and tissues.

References

Braithwaite RA, Jarvie DR, Minty PS, Simpson D, Widdop B. 1995. Screening for drugs of abuse. I: Opiates, amphetamines and cocaine. Annal Clinical Biochemistry **32,** 123-153.

Burgess C. 2007. Chapter 1. The basics of spectrophotometric measurement. Techniques and Instrumentation in Analytical Chemistry. Techniques and Instrumentation in Analytical Chemistry **27,** 1-19.

Cui-ting L, Zhang M, Yan P. 2016. Qualitative and Quantitative Analysis of Volatile Components of Zhengtian Pills Using Gas Chromatography-Mass Spectrometry and Ultra-High Performance Liquid Chromatography. Journal of Analytical Methods in Chemistry, 1206391.

Dalena F, Senatore A, Marino A, Gordano A, Basile M, Basile A. 2018. Methanol Production and Applications: An Overview, Science and Engineering, 3-28, 104139506.

El-Didamony AM, Saad MZ, Saleem NO. 2015. Spectrophotometric determination of some analgesic drugs in pharmaceutical formulations using N-bromosuccinimide as an oxidant. Journal of the Association of Arab Universities for Basic and Applied Sciences **17,** 43-50.

Fiorentin TR, D'Avila FB, Eloisa Comiran E, 2017. Simultaneous determination of cocaine/crack and its metabolites in oral fluid, urine and plasma by liquid chromatography-mass spectrometry and its application in drug users. Journal of Pharmacology Toxicol Methods **86,** 60-66.

Fiorentin TR, D'Avila FB, Comiran E. 2017. Simultaneous determination of cocaine/crack and its metabolites in oral fluid, urine and plasma by liquid chroF.B.matography-mass spectrometry and its application in drug users. Journal of Pharmacological and Toxicological Methods 86, 60-66.

Fürész J, Kocsis G, Gachályi A, Karvaly G, Boldis O. 2004. Mass Selective Detection of Amphetamine, Methamphetamine, and Related Compounds in Urine. Journal of Chromatographic Science **42(5),** 259–262.

Gupta DD, Das AK, Bipul, Kalita CH, Gupta DD, Hui PK, Tag H. 2018. Gas Chromatography-Mass Spectrometry of Methanol Extract of *Urtica dioica* L. from Arunachal Pradesh, India. Journal of Basic and Applied Plant Sciences **1(2),** 111-118.

Habib A, Nargis A, 2020. Analysis of amphetaminic drug compounds in urine by headspace-dielectric barrier discharge ionization-mass spectrometry. Arabian Journal of Chemistry **13(1),** 2162-2170.

Islek DS, Ramadanoglu S. 2017. Headspace-gas chromatography/mass spectrometry analysis of methanol in blood. Med-Science **6(2),** 372-374.

Miranda GE, Sordo M, Salazar AM. 2007. Determination of Amphetamine, Methamphetamine, and Hydroxyamphetamine Derivatives in Urine by Gas Chromatography-Mass Spectrometry and Its Relation to CYP2D6 Phenotype of Drug Users. Journal of Analytical Toxicology **31(1),** 31-36.

Mostafa A. 2020. Spectrophotometric and Multivariate Calibration Techniques for Simultaneous Determination of Different Drugs in Pharmaceutical Formulations and Human Urine: Evaluation of Greenness Profile. Journal of Analytical Methods in Chemistry, 8873003.

Nathália VS. Rodrigue Cardoso EM, Marcus VO, Andrade 2013. Analysis of seized cocaine samples by using chemometric methods and FTIR spectroscopy. Journal of the Brazilian Chemical Society **24,** 3.

Shipman R, Conti T, Tighe T, Buel E. 2013. Forensic Drug Identification by Gas Chromatography – Infrared Spectroscopy. National Institute of Justice,

242698.

Silva MJ, dos Anjos EV, Honorato RS. 2008. Spectrophotometric cocaine determination in a biphasic medium employing flow-batch sequential injection analysis. Analytica Chimica Acta **629(1-2),** 98-103.

Sim Y.E., Jun K., Young J. 2019. Determination of methamphetamine and amphetamine enantiomers in human urine by chiral stationary phase liquid chromatography-tandem mass spectrometry. Analytical Science and Technology **32(5),** 163-172.

Stevens HM. 1973. Spectrophotometric method for screening urine samples for amines, including amphetamine and methylamphetamine. Journal of the Forensic Science Society **13(2),** 119-125.

Tiscione NB, Alford I, Yeatman DT. 2011. Ethanol Analysis by Headspace Gas Chromatography with Simultaneous Flame-Ionization and Mass Spectrometry Detection. Journal of Analytical Toxicology **35(7),** 501-11.