

Toxicological analyzes and its use in forensic science

Abstract

Over the centuries, the history of drug and drug use has undergone significant changes in Forensic Sciences, in which Toxicology is used, mainly in the toxicological analyzes and methods used routinely by civil or criminal experts. Toxicology, as a multifunctional science, covers several other related areas, such as Clinical Toxicology, Social Toxicology, Environmental Toxicology and Occupational Toxicology, Toxicology applied to Doping Control, and essential Forensic Toxicology, as well as others. This article was elaborated with searches in scientific publications, bibliographical reviews, scientific journals and Forensic Science books, as well as other sources of scientific knowledge. There are currently many techniques used in the routine of Forensic Toxicology laboratories, among which the use of the following are most frequently used: Thin Layer Chromatography - CCD, Immunoassay methods, High Performance Liquid Chromatography - HPLC, Gas Chromatography - GC and Liquid or Gas Chromatography Coupled to Mass Spectrophotometry - HPLC/MS. Throughout this article, in a general and contextualized way, the relevance and importance of the toxicological analyzes and methods directed to the complex field of knowledge of Toxicology, more intensely about Forensic Toxicology, was presented as a very relevant support for the judicial authorities in the persecution criminal. In conclusion, the applicability of a toxicological routine is usually linked to some type of criminal conduct, and this science has the task of assisting justice, with technical and scientific questions, to resolve such crimes, thus preserving the prestige and trustworthiness of Forensic Toxicology in support of laws and society.

Keywords: toxicological analysis, forensic toxicology, forensic sciences, criminal expertise

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Introduction

The use of drugs and drugs is made throughout the history of mankind, and even today, and such substances can lead to the appearance of desirable or even undesirable effects on people. There is a principle widely divulged during the fourteenth century, by Paracelsus,¹ and undergoing changes at the present time, that the difference between the edicamento and the poison is in the dose. Products such as drugs, drugs, and toxic agents, which cause toxic effects on the body, have been studied by toxicology for many years, discovering new chemical findings, research in forensic science or other fields.² Doctor and alchemist Swiss-German (1493-1541), precursor gives pharmacology Modern. It is necessary to report on issues in the safety of the process of drug use. Much remembered fact, like what happened in the therapeutic disaster of hypnotic-sedative, thalidomide (Contergan®); a drug created to fight inflammation and act as a sedative for pregnant women. However, what actually happened was the appearance of thousands of cases of focomelia (malformation of limbs) in developing fetuses and deaths, this passage was covered abrasively by the national press, and more intensely in the 1960s, to the present day, whose drug is currently sold, however under the intense regulation of the National Agency of Sanitary Surveillance³ - Anvisa⁴ Toxicology is a multidisciplinary science that covers a vast area of technical-scientific knowledge, being inserted or absorbed, specifically, with several other areas of the forensic sciences, or medical sciences; because it would be very difficult, without the toxicological action with other areas, to reach the treatment, Gnostic day and cure of patients and animals that had contact with substances, toxic agents, poisons and xenobiotics (Pedroza, 2011). More categorically, Forensic Toxicology uses methods and techniques directed at the investigation of toxic agents,

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both in patients or victims of living crimes (*in vivo*), as well as in patients and victims of *post-mortem* crimes; highlighting also such science with its use directed to the control of *doping* in sports³ Such work should emphasize, in a general and contextualized way, the relevance of the analyzes and methods directed to the complex field of knowledge of toxicology, and more intensely, on Forensic Toxicology, whose direction of activities is argued in the technical -scientific assistance to the criminal investigations, in the resolution of crimes; thus showing an impartial, competent and trustworthy activity of the expert and police work, before the society.

Methodology

The development of the article focused on the search for scientific articles, bibliographic reviews, scientific journals and Forensic, Forensic and Forensic Toxicology, in order to carry out a theoretical subject matter. Within the scope of the article, which will be based, solely and exclusively, on theoretical research on the topic addressed. A bibliographic survey was carried out, using descriptor: Toxicological Analysis, Forensic Toxicology, Forensic Sciences, in the indexes Scielo Scientific Electronic Library Online (Scielo), Bibliographic database of the network of Libraries of the State University Paulista "Júlio de Mesquita Filho" - Unesp (Athena), Virtual Health Library (vhl,2009), International Literature on Health Sciences (Medline), WHO Library Information System (Wholis), Latin American and Caribbean Literature on Health Sciences (lilacs) and Toxicology Data Network (Toxnet). Brazilian Society of Toxicology (Sbtox), Regional Medicine Library (Bireme), Virtual Thematic Network of Pharmacology and Toxicology (Bibliomed and Farmatox), from 2000 to 2013 in Portuguese, Spanish and Portuguese. English as selection criteria, articles with data and bibliographies dealing with toxicological methods and analyzes, their use in Forensic Sciences and other specific information related to the subject were considered.

Then, an anthytic reading was made to sort the information and identify the object of study.

Referential theoretical

Brief history of toxicology and exposure of toxic body

The origin of the word Toxicology is defined as the study of toxics; is a science aimed at understanding the toxic agents, their occurrence, existence, their interactions and mechanisms of action occurring in the toxicological process.⁵ Toxicology encompasses several areas, one distinct from the others, yet each of them has specialized professionals, with different scientific backgrounds, and there is a pooling of knowledge and better qualified professionals.⁶ The crime of poisoning was committed even in antiquity, as in the case where the Roman Empress Agrippina, who poisoned her companion using arsenic to marry her own uncle.⁷ Much remembered fact, such as what happened in the therapeutic disaster of hypnotic-sedative, thalidomide (Contergan®); a drug created to fight inflammation and act as a sedative for pregnant women. However, what actually happened was the appearance of several cases of focomelia (malformation of limbs) in developing fetuses and deaths, such passage was covered abrasively through the press national, and more intensely in the 1960s, to the present day, whose medication is currently sold, however under the intense regulation of the National Health Surveillance Agency – Anvisa.⁸ The word *Toxikon* has Greek origin and means venom of the arrows. The arrowheads were inserted into biological material contaminated with poisons, such as pieces of corpses or substances of vegetable origin, with the intention of accelerating the death of the animals during the hunting. *Logos*, in Greek, originally meant the written or spoken word - the Word. But, from the ideas of Greek philosophers like Heraclitus, it came to have a broader meaning. It then becomes a philosophical concept translated as reason, as much as the capacity for individual rationalization or as a *cosmic principle of the Order and Belize*. Plants that caused inflammation were used for this, causing paralysis of the cardiac or skeletal striated muscles, or respiration. In summary, Toxicology is the study of toxic effects harmful to the body, caused by chemical compounds.⁹

Main areas of toxicology

The distinction between the various areas of Toxicology happens fundamentally in the way that the toxic agent reaches the organism, or according to the chemical nature of the agent. In summary, in a dynamic approach of,² we can cite the great new areas of Toxicology, each with its peculiarities presented below:

Among the most useful areas within Toxicology, it is known that Forensic Toxicology carries out the study and investigation of the toxic effects caused by an agent, usually chemical, in biological materials removed from corpses and in the living periciando. It has close links in the scientific support for the research of the chemical agent, to which it is directly connected with crimes such as homicide, robbery, suicides, traffic accidents, work accidents, among others. Within the medical area, Toxicology of Medicines, promotes the search and research of new drugs and drugs to treat patients affected by certain pathologies, which conventional medicines can no longer combat with efficiency, for example, bacterial resistance antimicrobial agents currently available on the market, and also in the search for new chemical substances or active prevent diseases, always paying attention to this science, for responsible and conscious use of medicines, as these can cause harmful effects to health. Appearing in evident prominence in the current society, Environmental Toxicology, acts in the scenario of investigation of the chemical interactions between the ambient

environment and the environmental chemical contaminants in direct or indirect contact with humans or animals. Occupational Toxicology, which promotes the study of the action of toxic agents produced in the workplace, with the exposed professional and the factors impacting on their health during the occupational period. Also, it is not of less importance the Social Toxicology, being this a science that acts in the sense to understand the relation of the use of drugs by the people to the drug chosen and how it is consumed by the user, also showing how it happens to the familiar acceptance and the society.

Stages of exhibition

In the peculiarities of Toxicology, it is of great importance to speak of the phases of exposure, when the toxic agent comes into contact with the organism, therefore with specific cellular receptors, being inserted in this context of exposure and manifestation of the clinical symptoms, resulting of the toxic action of the agent, it is possible to emphasize the four main phases that the toxic agent happens to interact with the organism and vice versa: Exposure Phase, Toxic kinetic Phase, Toxic dynamic Phase and Clinical Phase. Beginning with the Exposure Phase, which represents the occurrence of contact between the toxic agent and the organism; there is also the Toxic kinetic Phase, in which the chemical kinetics of the toxicant necessarily passes through the processes of absorption, distribution, storage and disposal, biotransformation and excretion, thus causing the availability of the toxic agent to the body. Already in the Toxic dynamics Phase, where it is shown in a direct or indirect way, the damages that were caused to the organism, due to the fact that there has been interaction between toxic agent and the most varied types of cellular receptors; Finally, the Clinical Phase, which is evidenced by signs and symptoms, shows the toxic effects of the above-mentioned interactions on the organism, a phase in which the clinician, doctor or pharmacist can demonstrate when the individual presents a specific clinical picture of intoxication.¹⁰

Forensic toxicology applied to doping

When referring to the context of Pharmacological Toxicology, there is also a use for toxicological analysis in *Doping* Control, where, with the creation of the International Olympic Committee (IOC) in the 1960s, a Committee composed of medical professionals and toxicologists, they placed criteria to determine whether or not the athlete consumed a banned substance before the competitions, and the athlete has recourse and ample defence to the contestations raised and to prove his innocence. It is a relevant factor that Toxicology a Forense can guarantee, with techniques and methods used, the isomeric process in sports competitions, or that demonstrates or not the presence of substances not authorized by the IOC, meaning that all athletes participate of equality under the legal parameters.²⁻¹⁰

Toxic agents and matrices biological

The events within Forensic Toxicology culminating in suicide-type crimes, homicide, traffic accidents in which the driver was under the influence of psychoactive substances or alcohol, crimes in which the victim was sedated (rape), fatalities due to accidents work in which the victim has used narcotic substances must correlate directly or indirectly with the toxic agents present in biological matrices such as gastric contents, blood, vitreous humour and liver. Such matrices have a high degree of complexity in their chemical structures, these proteins, lipids, carbohydrates, nucleic acids and other inorganic or organic compounds being linked; thus making the toxicological analyzes of tissues and fluids much more relevant and complex than with other matrices,² with the composition of these substances

and the physiological process of death of the organism. There are a number of factors that must be taken into account in order to prove and succeed in the investigation, isolation and identification of the toxic agent linked to crime, being sequenced in an orderly manner in three main phases - Preanalytic Phase, Analytical Phase and Post-analytical Phase. The first, Pre-analytical Phase, where the collection, identification and transport of the biological matrix takes place, in which phase the Chain of Custody of the material, which ensures memory of all phases of the process, is secondly the Analytical Phase, in that the analysis of the biological matrix happens using appropriate methods and techniques with each type of chemical reactions known. Finally, there is the third Phase, Post-analytical, where interpretation of the results obtained in the previous phases occurs. All three phases are of fundamental importance in the process of formulating evidence in criminal situations, since the freedom or innocence of the accused depends strictly on a well-processed and flawless expertise.² The use of organoleptic analysis is also a considerable factor in the toxicological analysis of the suspected sample, although it is not considered an analytical technique. It ends up directing the professional performing the analysis to the possible profile of the chemical agent ingested by the victim. For example, visual station of drug tablet (Viagra® or Rohypnol®) or rodenticides (Aldicarb - Temik®), the organoleptic perception occurring one - pre-triage ml that directs the conventional agent confirmation tests.¹¹

Of the chemistry and toxicology applied to the criminal

Within Forensic Sciences, according to Passagli,² there are two specialized areas that arouse a degree of importance for the criminal expert and other professionals of the criminal justice system; the first, Forensic Toxicology, combines method if analyzes of Analytical Chemistry; the second, General Toxicology, used in several other forensic or non-forensic functions, such as Clinical Toxicology. One of the primary functions of Forensic Toxicology is to assist *post-mortem*¹¹ investigations, depending on the case being analyzed, to establish causes and circumstances of deaths. However in clinical toxicology studies and elucidates mechanisms of toxicity, mainly *in alive*. The use of scientific data search is performed by methods chosen prior to the start of forensic toxicological analyzes, which must be explained by the expert who will demonstrate reproducibility of the test in the investigation. What happens in practice is the expert using protocols of procedures, the use of experimental controls and intense biblioclical search performed prior to the experiment (Limberger et al., 2010). At the beginning of the 20th century, the most restricted toxicologist was the researcher on the origin of the toxic agent found in the crime with death, however, currently in the area of toxicology it shelters *post-mortem examinations*, public health issues such as falsification or adulteration in drugs, accidents with substances chemical in undoing in pasta, cases of wrongful or caused accidents by the will of the agent and also *in vivo* skills.² The Criminal Expertise develops its daily work in order to reduce any doubt regarding the true authorship of the crimes committed; In the future, the sudden and sudden resolution of the crime is increased, especially when the solution is received by the population. However, the criminal investigation follows its routine and the methods are used in a coordinated and intelligent way; in most national forensic toxicology laboratories, methods are performed manually, because of the lack of available resources and lack of government research investment.²

From the analysis and techniques applied to forensic toxicology

It is important to always try to find the high degree of sensitivity in the selective and specific analyzes, allowing the expert to issue unquestionable and irrefutable results, since the reports, in a routine, are used as evidence in the aid to justice, to medical reports, among others, and may end with the conviction or acquittal of a person to be served.¹² With the increase of urban violence, forensic analysis, for quantification of alcohol has been growing in equal proportion. A well-executed forensic autopsy has an unquestionable contribution to justice, gaining enormous attribution to the applicability of reliable and sensitive analytical techniques, to be used in favour of justice, generating economic benefits in favour of the State, knowing where the option of methods or techniques and with lower costs is essential (Herbella et al., 2003). The detection of drug use can be done routinely by hair analysis, not only in forensic science, but also in clinical toxicology or in medicine.¹³ It is a simple process to collect samples of hair, non-invasive, and difficult to tamper. There is no special storage and transport conditions, as the hair samples are stable for a long period of time. In addition to providing long-term information on drug use (the method may vary by hair size), it may complement other biological matrices (urine or blood).¹⁴ Nowadays, in the scenario of the Brazilian Toxicology Science, several techniques are found for toxicological purposes, being able to begin with simple methods to the most sophisticated, thus acquiring credibility and trust of the society, when dealing with the technical quality directed to the forensic toxicology directed the investigations of crimes.² Forensic Toxicology, which is directed at providing support in the investigation and resolution of crimes, based on technical-scientific support and with the main objective of finding and quantifying the toxic products likely to be present in criminal situations.¹⁵

After describing the main techniques used in the laboratory of Forensic Toxicology are of interest to understand at what time these will be used. Considering the variety of known substances, most of them may be involved in situations of intoxication.⁸ Argued by the publication of Anvisa¹³ and the Central Laboratory of Technical Police of the State of Bahia (Bandeira, 2008), seven groups of substances of forensic interest, involving the publication: stimulants, opiates, system depressants Central Nervous System (CNS), volatile agents, cannabinoids, hallucinogens and poisons. It is said in the literature that the definition of the word poison is such: any substance that causes harmful effects to a living organism, especially when administered accidentally or intentionally (Hodgson, 2004). Within the stimulant group are Cocaine, Amphetamine and Methamphetamine, Caffeine and Nicotine. For Opiates, we highlight Morphine, Methadone and Heroin. Barbiturates and Benzodiazepines are part of the group of CNS depressants; therefore the volatile ones are alcohols and inhalants such as Chloroform, Dichloromethane and Acetone.¹³ It is determined to the class of Tetra hydro cannabinol (THC) cannabinoids and hallucinogens are composed of LSD, Ecstasy and some hallucinogenic plants and fungi (Giovannelli, Garrido, 2011). Finally, within the classification of the poisons, they emerge the Carbon Monoxide, Cyanide and pesticides, as Organ chlorines, Organophosphates and Carbonates. And in the daily toxicological routine it is verified that all the groups can be analyzed from the three main forensic techniques - colorimetric tests, immunoassays and chromatography. However, the types of colorimetric tests vary for each group of substance. This depends on the composition of the substance, so the reagent must be specific to show colour change after the interaction.¹³ In the case of immunoassays, the most commonly used tests are immunocromatographic, immunofluorescence (except for cannabinoids) and ELISA. In light of that substance, the antibody used will be specific. With the implementation of chromatography

techniques, which are one of the most sophisticated and accurate in the forensic scenario, it is noted that Gas Chromatography (GC) and High Performance Liquid Chromatography (HPLC) can be defined to detect and quantify the presence of all seven groups cited. If we talk about Thin-layer Chromatography (TLC), its use is excluded in cases of analysis of CNS and volatile depressants.¹³ There are a number of stages through which the research methodologies pass: screening confirmation, quantification and interpretation. It starts with a general test (detecting a large number of substances, providing a negative screening of cases), and only in the post-screening phase, confirmatory methods are used (allowing the confirmation and presence of a suspected substance as well as identify and / or quantify it) (Osselton, 2004). The methods of toxicological analysis vary from conventional non-instrumental methods, colorimetric or volumetric methods, to more innovative methods, involving cutting-edge science, for which appropriate technology is used, which can be simple and coupled, such as spectro photometric techniques (e.g.: molecular absorption spectrophotometry - UV-Vis, infrared - IR or atomic absorption - AAS), chromatography (e.g. gas chromatography - GC and HPLC), immunochemistry (e.g. Elisa, immunoassays with polarized fluorescence - FPIA or Radioimmunoassay-RIA), and mass spectrometry - MS (Osselton, 2004). In the technological age, with new daily discoveries, the exposure of man to several toxic agents is common and even daily, about 80,000, with an increase of approximately 7000 / year, capable of causing important health disorders, including causing death, being in the an important public health problem, especially in the occupational area.¹⁴

To do so, it is necessary that criminal expertise has defined and included, increasingly inserted their techniques, within what could be called a community of forensic science, including international exchanges. Currently, the pretension is very far from the practical reality, there is a great lapse in the methodologies applied to toxicology and also conceptual between Brazilian forensic science and international forensic science when it comes to fostering forensic research (Giovanelli, Garrido, 2011). Within the field of science, innovative forensic methods and techniques are increasingly being sought, and toxicology has evolved with the knowledge acquired over the years. Toxicology is today the science that studies the adverse effects of chemical substances, such as drugs, drugs and toxicants on living or dead organisms - *in vivo* or *post-mortem*.² With regard to forensic science, a more precise toxicological investigation of fluids or biological tissues is necessary to better clarify homicidal or suicidal deaths through intoxication, driving motor vehicles under the influence of alcohol and psychoactive substances, sedation in case of rape, correlation between shooting deaths and trafficking through the detection of drugs of abuse in samples of the victim.¹⁵

It is important at this time to highlight the relevance and availability of analytical methodologies that are highly selective, sensitive and capable of quantifying the toxic substances that may be found in crime scenes. These methods can also be extended to the diagnosis of poisoning in different toxicological areas; (Giovanelli, Garrido, 2011). The main objective of the toxicological sciences is to present its truth and unambiguous and reliable potential of information extracted on the analyzes and methods applied both *in vivo* and *post mortem*. Also based on the study of Bicho,¹⁶ some other techniques are applied, less frequently, as spectrophotometry. Others are still being improved and implanted in laboratories; however they present relevant results, in this case capillary electrophoresis.¹⁷ Being a new technique, it explores a biological matrix that has also received greater importance recently, hair.¹⁸ With new techniques and its introduction in the scientific

market, such as High Performance Liquid or Gas Chromatography coupled with Mass Spectrophotometry - HPLC/MS, a high specificity and sensitivity is achieved in toxicological analyzes related to forensic sciences. In previous years, quantification of chemical substances in biological tissues was not possible, however, with researches such as the identification of toxic analyses in hair samples, and as studies of the Headspace technique - a technique used by gas chromatography used in research of volatiles in biological matrices, causing these, results updated, making possible not only detection of agent toxic, but also quantify toxics in minimal quantities in the samples analyzed.¹⁹

The screening techniques show high sensitivity and low specificity, since the confirmatory methods are of high specificity. However, when the results of the analysis are considered positive, the data of the screening and confirmation should be positive according to predetermined and internationally accepted criteria (Fassina et al., 2007). It is appropriate for the Toxicology expert to point out which technique is most appropriate for the analysis, based on criteria such as: sensitivity, applicability, precision, accuracy and selectivity of the technique, as well as the availability and cost of the analysis.¹⁸ However there are many options of techniques and methods available currently. The toxicological analyzes, in cases of death, are fundamental before the law. Regarding forensic toxicology, the analyzes are directed to the use in the detection and identification of toxic agents for medical-legal purposes.¹⁰ The gains of society and, in general, the use of toxicological investigations are notable, and they have made great efforts to begin and insert analytical procedures in a reliable way in forensic application, as support in decision making on the effect/cause/effect relationship between a particular substance and an observed adverse or undesired effect, so in Toxicology it is necessary to have a specific and highly sensitive analysis on the analyzed biological matrices (Klaassen; Watkins III, 2001). The use of toxicological analyzes has been directed, with good frequency of use, by several segments of society, obtaining excellent results to verify the use of drugs in the work environment, sports competitions, assistance and follow-up of users recovery in establishments for treatment of chemical dependents and forensic purposes both *in vivo* and *post-mortem*.¹¹ The difficulty in analyzing the biological matrices is proportional to the variability of the types of materials that can be analyzed. There is a certain amount of interferons in the materials that are sent for analysis.¹² Unlike other services involving legal and even technical-expert medicine; a single case for toxicology often presents five different analytical procedures, hereafter referred to as analytical marches. A standard case contains viscera and blood (contents of the stomach, liver, and stomach), from which research is sought: drug treatment, blood alcohol testing and possibly the analysis of carbon monoxide in the blood, thus constituting six different analytical marches. Basically, an analytical gait is composed of three stages: 1-grinding (except in the case of blood), 2-extraction of drugs from biological material (matrix) with the aid of organic solvents, and finally, the drug in the analyzed sample, which is performed at two levels.¹⁵ In the first one, the screening consists of the verification of the presence of some potentially active substance in the sample and the second that is the identification of the drug that is the specific and confirmatory analysis. It is added to this analysis the gait relative to the alcohol analysis that undergoes a completely different procedure, which does not require extraction, and has its detection and quantification performed by a distinct methodology, as well as the analysis of carbon monoxide.¹⁵

For any toxic chemical substance, there must be a safe condition for the health of the professional who handles it, since the chemical

substances (all) are toxic under certain exposure conditions. Ethical conditions are one of the factors that restrict assisted human exposure to hazardous controlled substances, leading to the use of clinical and epidemiological data to know the toxicity of certain chemicals in the safety assessment of use.² The use of psychotropic drugs in modern society is increasingly present, such drugs acting in the Central Nervous System (CNS); and may modify mood, conscience, thoughts and feelings, such drugs, natural or synthetic chemicals, unleashing serious social problems when used illicitly, being closely linked to the increase in violence and crime (Kalina, 2001).²⁰

When it comes to the crime of drug trafficking²¹, it happens that all rapid tests performed by the agents on the seized substances need to be confirmed, later in the toxicology laboratory, thus demonstrating an endorsement of unreliable scientific evidence; (amphetamines, antidepressants, cocaine, nicotine and caffeine), psychodysleptics or psychedelic hallucinogens (marijuana, hashish, LSD, mescaline, pheniclidine, colas, benzene), ether and belladonna) and psycholeptics or depressants (opium, morphine, heroin, methadone, benzodiazepines, carbonates, metaqualone and secobarbital).¹⁶ Many substances give different colours when put in contact with certain chemical reagents; in however, not always The reaction in colouring this characteristic occurs once for the substances to undergo toxicological analysis (analyse), often occurring to the appearance of the same coloration for several analyses in the test (Duarte, 2009). Forensic toxicology analyzes of parts of human tissue and body fluids are carried out in search of minute amounts of pure drug or its metabolites, these compounds can be found in very small concentrations ($\mu\text{g/ml}$ or ng/ml), being very important (DALE and BECKER, 2007). In order to obtain a successful criminal investigation, the prevention of the contamination of samples collected during the judicial inspection of the locale during the necropsy. The pioneering steps of Toxicology in Forensic Sciences are a deserved achievement by all professionals who act directly or indirectly with scientific research and practices, gaining an increasing quality in services rendered to society.²

Survey of data by SENAD and use of drugs by the Brazilian population

In a publication prepared by the National Anti-Drug Secretariat²¹, in the year 2002, through Cebid - Brazilian Information Center on Psychoactive Drugs, in the publication of results referring to the first household survey on drug use in Brazil; 8,589 people of both sexes, aged 12-65, were interviewed, living in 170 cities with more than 200,000 inhabitants. This survey showed that 19.4% of the interviewees had used some type of drug, except tobacco and alcohol, at least once in their life, about 7% had used marijuana, 5.8% used solvent or inhalant, and 2.3% reported having snorted cocaine; 3.3% would have used benzodiazepines and 1.5% amphetamines.²⁰ Consisting also in the study that 45.4% of the people interviewed stated that it is easy to buy drugs in Brazil, 15% had spotted someone buying or dealing drugs and 4% of which passed the interview had been approached by traffickers; also indicating this survey that 35% of the interviewees had not finished elementary school or were illiterate.^{20,21} The professionals involved in the control and prevention of the use of licit drugs and toxicological analysis²² to show and prove exposure to cocaine²³ and to alcohol, and also c atom form in diagnose the poisoning, monitoring of use in drugs in schools and evaluating the effectiveness of treatment of dependents in rehabilitation.²² One issue that draws toxicology attention to public health problems with the increasing use of thousands of new molecules in medical treatments has clashed with another major increase, the growing need for health services, demonstrated in forms and quantities depending on the countries. This increase in consumption, as a consequence of economic

development, social security and pressure on manufacturers, has not, however, been uniform throughout the world. (Starkey et al., 1994). World pharmaceutical spending in 1985 was around \$ 100 billion. Taking into account that Globalization gives priority to the sharing of ills and aggravating factors to health, not the sharing of profits for the so-called developing countries; the possibility of an occasion to the diseases induced by chemical-pharmaceutical substances as a result of excessive use of unnecessary treatments (Starkey et al., 1994). The importance of toxicology in the area of criminal investigations will often be focused on cases of homicide and drug trafficking. The first one stems from many autopsies carried out on victims of violent death, with the search for toxic agents in the urine, blood, viscera and gastric contents, being followed strictly by legal medicine, from which the investigation of the crime is saved when compared to drugs, drugs or poisons (seized from suspects).¹⁷

Legal aspects related to forensic toxicology

On the other hand, both the concentration of the narcotic product and its adulterations may lead to distorted or difficult to interpret results. These facts, and also the attribution of technical-legal capacity to analyze the product, to the Laboratory of Scientific Police, lead to the need to comply with legal formalities (article 62 of Decree Law no. 15/95, of 22 January), justifying not only the confirmation of the narcotic, but also with its necessary validation, as proof.²⁰ All existing field tests have only the purpose of presumptive identification of the presence of suspect substances, and should not be considered as definitive evidence (Soares et al., 1998). In order not to create a considerably high demand for lack of forensic services, in the change of the expert means, one must start from a coordination integrated by the Federal Government with the participation of bodies that perform national standardization of techniques, aiming at the establishment of standardization of examinations,²⁴ protocols of procedures and the promotion of the teaching and research of forensic science in Brazil. The expert practices in Brazil are closely related to the centralized approach in the decision-making of a technical-scientific decision, used these, in the modernity and homogeneity of the Brazilian expertise. This would make it possible to understand comparatively the real faults and deficiencies in each of the states (Giov Anelli, Garrido, 2011). In order to finalize the reasoning, it is fundamental to strengthen institutions that give legitimacy and technical and scientific support to judicial decisions, in which case there is a possibility of confronting violence, thus increasing efficiency and effectiveness when dealing with the area of Criminal Expertise and in judicial decisions.²⁵ In addition, it is important to note that there is a lack of trust on the part of the judiciary and especially the society that uses the public security services and also the authorities requesting expert assistance in the attempt to solve criminal offenses.²⁶ It is brought up the idea that currently the performance of the scientific expertise, is still serving as a regulatory part in the judicial sphere, as opposed to serving only the proof of crimes that intensively increase the statistics of cases of violence in society.²⁷

Final considerations

In the course of crimes, several traces may be produced, and these crimes can only be solved by analyzing the material evidence left or discovered along the criminal trial; routine occurrence occurs in the toxicological²⁸ analyzes of biological materials such as urine, blood, vitreous humour, saliva, stomach contents, viscera, sperm, vaginal contents, among others. The most varied techniques used in the investigation of toxic agents include: Immune chromatography, Immunofluorescence, Elisa, Thin Layer Chromatography, Gas Chromatography, Liquid Chromatography, and in the scope of Forensic Toxicology, even in Brazil.²⁹ Of higher sophistication

- Capillary Electrophoresis, High Performance Liquid or Gas Chromatography coupled to Mass Spectrophotometry.³⁰ The use of toxicological analyzes is highly impartial, when the criminal experts make available to the judge in labour, sports, civil or criminal proceedings,³¹ and the magistrate accepts or denies, in whole or in part, the expert's report. The relevance of the analyzes and methods,³² directed to the complex field of knowledge of Forensic Toxicology, was approached in a broad and contextualized way, which is of unquestionable utility in the technical-scientific support to the criminal investigations,³³ in the resolution of crimes; thus showing an impartial, competent and trustworthy activity of expert and police work,³⁴ before the population. Therefore, research indicates that the use of both licit and illicit drugs is closely associated with the large-scale increase in violence and crime, and it is understandable³⁵ to have institutions with technical-centric competence, closely linked to the quality and efficiency of the services provided by experts or experts to society, especially in Forensic Toxicology,³⁶ where such science mostly comes from providing informative elements that can either acquit or convict someone.

Conclusion

We can conclude with this article, the applicability of a toxicological routine is usually linked to sound and kind of criminal conduct, with such a task of science to assist justice, with technical-scientific questions, to resolve such disputes criminal, thus conserving the prestige and credibility of Forensic Toxicology in supporting laws and society.

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Conflict of interest

The author declares that there is no conflict of interest.

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