

# The Crucial Role of Forensic Toxicology in the Administration of Criminal Justice: A Comprehensive Review

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## ABSTRACT

This research article delves into the indispensable role of toxicology in the administration of criminal justice systems worldwide. Toxicology, the study of the adverse effects of chemicals on living organisms, plays a pivotal role in criminal investigations, particularly in cases involving poisoning, drug-related offenses, and suspected impairment due to substances. This paper provides a comprehensive overview of how toxicological analyses aid law enforcement agencies, prosecutors, defense, and courts in determining the presence of toxic substances, establishing cause of death, assessing impairment levels, and ultimately, delivering justice. Through a detailed examination of case studies and legal precedents, this article highlights the significance of toxicology in ensuring fair and accurate adjudication, emphasizing the need for rigorous standards, reliable methodologies, and expert testimony in the judicial process. By elucidating the multifaceted role of toxicology in the criminal justice system, this research contributes to a deeper understanding of its impact on legal proceedings and societal perceptions of justice.

**KEYWORDS:** *Toxicology, criminal justice, forensic science, poisoning, drug-related offenses, etc*

## INTRODUCTION:

Forensic toxicology is a highly specialised branch of forensic science that necessitates knowledge in analytical chemistry, pharmacology, biochemistry, and forensic investigation. The forensic toxicologist's responsibilities include not only isolating and identifying narcotics and other poisons from tissues, but also interpreting his results for the medical examiner, coroner, or other legal authority.

Forensic toxicology is a field of research that applies toxicological concepts and knowledge to legal problems and issues. Analytical chemistry techniques are combined with toxicological principles to address questions concerning the detrimental effects of substances on humans that are relevant to legal proceedings. Analytical chemistry is the science of identifying and quantifying unknown components in a sample of matter.

In the case, *Sharad Birdhichand Sarda v. State of Maharashtra*,<sup>1</sup> The Supreme Court laid down tests in

<sup>1</sup> Sharad Birdhichand. Sarda v. State of Maharashtra, AIR 1984 SC 1622.

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order to establish proof in cases where the murder occurred due to poisoning, they are as follows:

- Whether there is a clear motive for an accused to poison the deceased;
- Whether the victim died as a result of poison that was allegedly administered.
- Whether or not the accused had poison in his possession.

It demands the pursuit of scientific discovery within the rigors of the legal system to emphasize truth (accuracy), justice (impartiality), and the public good.<sup>2</sup> This area has developed into three different disciplines, postmortem forensic toxicology, human performance forensic toxicology, and forensic urine drug testing, as a result of numerous methodological and technological advancements.<sup>3</sup> By analysing the

<sup>2</sup> John H. Trestrail III and John Harris Trestrail, *Criminal Poisoning: Investigational Guide for Law Enforcement, Toxicologists, Forensic Scientists, and Attorneys* (Springer Science & Business Media, 2007).

<sup>3</sup> Maria Luisa Soria, "The improvements in forensic toxicology and its role in the forensic process (I)," 49 *Spanish Journal of Legal Medicine* 107–17 (2023).

presence or absence of drugs and their metabolites, volatile substances like ethanol, carbon monoxide, and other gases, metals, and other toxic chemicals in human fluids and tissues, postmortem forensic toxicology assesses their potential contribution to the cause and mode of death. Behavioural toxicology, another name for human performance forensic toxicology, assesses the impact of drugs and substances, including ethanol, on human behaviour and performance by analysing their presence or absence in blood, breath, or other suitable specimens. In order to show past drug use or abuse, forensic urine drug testing detects the presence or absence of drugs and their metabolites in the urine.<sup>4</sup> In forensic toxicology, each specimen is tracked by detailed documentation, from the time of its collection to the time of its disposal, and then each positive result is confirmed by a second analytical test before being reported.<sup>5</sup>

Poisons have been around since the beginning of time. It's possible that ancient man accidentally noticed some hazardous effects in nature. He may have utilised their extracts for hunting or combat after observing the detrimental or deadly consequences that followed one of his fellow tribesmen's accidental consumptions of a plant or animal product. Written accounts from 1500 BC revealed that hemlock, opium, arrow poisons, and certain metals were employed for state executions or to poison adversaries. Poisons were utilised extensively and sophisticatedly over time. Claudius, Cleopatra, and Socrates are famous poisoning victims. Some of the basic ideas of toxicology started to take shape by the Renaissance and Age of Enlightenment.

"The science of poisons" is the conventional definition of toxicology. Toxicology is more precisely the study of the chemical and physical characteristics of poisons, how they affect the body or behaviour of living things, how to analyse them qualitatively and quantitatively in biological and nonbiological materials, and how to create protocols for treating poisoning. Any substance that can result in illness or death when consumed in large enough quantities is considered a poison (or toxicant). The word "sufficient quantity" is crucial. The physician Paracelsus (1493–1541), who lived in the sixteenth century and was well-versed in the dose–response connection, noted that all chemicals are poisons and

that none are not. The appropriate dosage distinguishes between a poison and a cure. Paracelsus discovered that the toxicity of a plant or animal toxin was actually caused by certain compounds. Additionally, he provided evidence that the body's reaction to those substances was dose-dependent. His research showed that while bigger dosages of a chemical could be dangerous, smaller doses might be safe or helpful.<sup>6</sup> Today, this is referred to as the dose-response relationship, which is a crucial toxicological concept. For instance, the human body routinely absorbs minute amounts of cyanide, arsenic, lead, and dichlorodiphenyltrichloroethane (DDT) by ingestion from food or inhalation of environmental contaminants. Toxicants are present, but not in sufficient concentrations to have noticeable negative consequences. Conversely, even something as seemingly harmless as pure water can result in an electrolyte imbalance that can be fatal if consumed in large enough quantities. The mechanism of action of a medicine and a toxin is frequently the same. In order to achieve the intended therapeutic effect, a drug is given at doses that change physiological function. If administered in greater than therapeutic quantities, a drug may produce toxic (harmful) effects. Thus, toxicology is a quantitative discipline that seeks to identify the amount of a substance that, in particular exposure situations will cause deleterious effects in a particular animal or patient.<sup>7</sup>

### SCOPE OF TOXICOLOGY IN FORENSIC INVESTIGATIONS

The combination of science and detective work in toxicology is amazing. Understanding how chemicals affect our bodies and their presence helps to ensure justice, direct medical interventions, and promote a safer society. Toxicology also sheds light on the intricate relationships that exist between substances and biological systems, which is crucial information for the development of new drugs, the preservation of the environment, and public health initiatives.

Every chemical has a tale to tell in the body, whether it be an illicit drug, a common home product, or a prescription drug. With their specialised skills, toxicologists and forensic professionals decipher these tales, bridging the gap between an effect that is witnessed and its underlying cause.

Understanding the significance of this topic as a researcher can lead to a fascinating and influential world. It offers a rewarding career where one's skills

<sup>4</sup> Dr K. V. K. Santhy, "*The Realm of Forensic Toxicology in Criminal Justice System of India*" (Rochester, NY, 2023).

<sup>5</sup> Michele L. Merves and Bruce A. Goldberger, "Chapter 13 - Forensic Toxicology," in N. S. Miller (ed.), *Principles of Addictions and the Law 193–201* (Academic Press, San Diego, 2010).

<sup>6</sup> Heesun Chung and Sanggil Choe, "Overview of Forensic Toxicology, Yesterday, Today and in the Future," *23 Current Pharmaceutical Design* 5429–36 (2017).

<sup>7</sup> Loralie J. Langman and Bhushan M. Kapur, "Toxicology: Then and now," *39 Clinical Biochemistry* 498–510 (2006).

may save lives, shape policies, and open the door for safer, more informed societies, beyond just the excitement of solving mysteries.<sup>8</sup>

### TOXICOLOGY IN CRIMINAL CASES

Critical evidence for criminal investigations and court cases is provided by toxicological studies. It facilitates the determination of whether a substance was involved in an offence, such as drug-induced assaults, poisonings, driving while intoxicated, or overdose deaths. Roman law dates back to 82 B.C., when a legislative act was passed that addressed the use of poisons as well as the crime of poisoning. It is documented that Agrippina and her son Nero conducted extensive research on human subjects in experimental toxicology and used their findings to poison a number of well-known figures. Poisons were used for the next millennium, although toxicological research made no significant advances during that time. There are several records of emperors and other powerful sovereigns dying from poisoning. With the Renaissance in Italy poisoning became a fine art.<sup>9</sup>

Evidence of the widespread acceptance of political poisoning in Italy dates back to the Council of Ten in Venice, which met there between the years 1400 and 1500. Pope Alexander VI. and his son Casar Borgia used poisoning to kill multiple people. Between 1495 and 1503, at least five cardinals were poisoned to appease Pope Alexander VI, who himself poisoned in 1503. His butler had given him the poisoned wine meant for one of his victims. Poisoning was not unknown in England at this time, and in 1531 a statute enacted by Henry VIII mandated the boiling to death of poisoners. Criminal poisoning was quite widespread up until the eighteenth century, and it's likely that arsenic and corrosive concoctions were used.<sup>10</sup> The methods of detecting poison depended primarily on the conditions around administration. The postmortem appearances in cases of poisoning appear to have been poorly understood, and importance was attributed to symptoms such as lividity, incombustibility of the heart, etc.,<sup>11</sup> which we now know is not indicative of poison-related death. Toxicology, like medicine, did not make significant

advances until the introduction of modern chemistry and its application in the laboratory to the solving of analytical problems associated with toxicology. It has been argued that the only sure evidence of poisoning is the identification by analysis of the poison in the body.<sup>12</sup>

### RECOMMENDED SPECIMENS COLLECTED IN POST-MORTEM CASES<sup>13</sup>

Type of death case	Recommended specimens
Suicides, motor vehicle crashes, and industrial accidents	Blood, urine, vitreous humour, liver
Homicides and/or suspicious	Blood, urine, vitreous humour, gastric contents, bile, liver, hair
Drug-related	Blood, urine, vitreous humour, gastric contents, bile, liver, hair
Volatile substance abuse	Blood, urine, vitreous humour, lung fluid or tied-off lung, liver
Heavy metal poisoning and exposure to other poisons	Blood, urine, vitreous humour, liver, hair, kidney

### HOW FORENSIC TOXICOLOGISTS AID MEDICAL EXAMINERS?

Because it is the medical examiner's legal obligation to certify that the cause and mode of death are consistent with medical and scientific facts in all cases of sudden and unexplained death, extensive toxicological analyses are required for a thorough inquiry. In drug-induced and drug-related deaths, some evidence of the foreign chemical or its specific poisonous impact must be found in the deceased's body, or there is no positive proof of their involvement in the terminal episode.<sup>14</sup>

The tissue concentrations, combined with an estimate of the total amount of drug remaining in the stomach at the time of death, not only provide information about the expected level of toxicity, but they can also help the medical examiner determine intent, i.e., accidental vs. suicidal. The toxicologist should be encouraged to conduct "body distribution studies," especially for newer medications and poisons about which little is known. The medical examiner and toxicologist are in a unique position to investigate the

<sup>8</sup> "Exploring Toxicology in Forensic Investigations: Detecting Drugs, Poisons, and their Role in Justice" *TMU* available at: <https://www.tmu.ac.in/blog/role-of-toxicology-in-the-forensic-investigations-of-drugs-and-poison> (last visited May 12, 2024).

<sup>9</sup> Shreenya Sharma, "Forensic Toxicology and Indian Laws" *Legal Desire Media and Insights*, 2020 available at: <https://legaldesire.com/forensic-toxicology-and-indian-laws/> (last visited May 12, 2024).

<sup>10</sup> Kalipatnapu N. Rao, *Forensic Toxicology: Medico-Legal Case Studies* (CRC Press, 2012).

<sup>11</sup> Philip S Guzelian et al., "Evidence-based toxicology: a comprehensive framework for causation," 24 *Human & Experimental Toxicology* 161–201 (2005).

<sup>12</sup> William Willcox, "Toxicology and Crime," 1 *The Police Journal* 98–104 (1928).

<sup>13</sup> "Toxicology: How It's Done," available at: <https://www.forensicsciencesimplified.org/tox/how.html> (last visited May 12, 2024).

<sup>14</sup> Eugene C Dinovo, "Forensic Toxicology in Death Investigation."



distribution and metabolism of pharmaceuticals in human situations when the substances have been consumed in significant quantities. Such cases cannot be repeated by the scientific community, and much useful information is irreversibly lost when they are not thoroughly investigated. These comprehensive toxicological studies provide the forensic toxicologist with competence in interpreting tissue concentrations, which is critical for the medical examiner. The recent development of instruments capable of measuring sub-nanogram concentrations, together with body distribution studies and thorough study by other members of the medical examiner's team, has increased our understanding of earlier issue areas. For example, until roughly a decade ago, urine and bile were considered the best specimens for laboratory investigations of intravenous narcotism deaths. As a result, in many cases, the laboratory provided no evidence to the medical examiner since the specimens did not contain a measurable amount of morphine. Body distribution studies, together with case narratives, have transformed this notion. In cases where death occurs quickly after intravenous treatment, large levels of morphine are discovered in the blood, brain, and lungs. We frequently discover that if the victim was drug-free previous to injection, there is no measurable concentration in the bile or urine. As previously noted, Johnston, Goldbaum, and Whelton (1969) concluded from distribution experiments that morphine concentrations in the kidney exceeding 0.2 mg/100 ml are associated with a short survival time. And Garriott and Sturmer (1973) recently correlated blood morphine concentrations and distinct pathology with survival time.<sup>15</sup>

Finding alcohol and other drugs that may have impaired mental functioning or caused other psychic disturbances might assist to explain a range of traumatic deaths, including automotive accidents, industrial accidents, drowning, and, in certain cases, homicide. In addition to the forensic toxicologist's assistance in explaining suicides and accidental fatalities, the medical examiner will value his negative or therapeutic concentration findings. As a result, in our drug-addicted society, the prevalence of drug-related and induced mortality is high and increasing. The forensic toxicologist can aid the coroner or medical examiner in his search for the cause and manner of death by his knowledge and expertise in a difficult scientific specialty and by his technical capacity to find evidence showing the role

<sup>15</sup> Gerald Long, "Recommendations to Guide Determining Cause of Death in Toxicity Studies," *32 Toxicologic Pathology* 269–70 (2004).

that the ubiquitous drugs of our society play in unexplained deaths.<sup>16</sup>

## FORENSIC TOXICOLOGY IN LEGAL PROCEEDINGS

Forensic toxicologists provide expert testimony in legal proceedings, presenting their findings and interpretations to judges and juries. Their expertise helps elucidate complex scientific concepts and ensures the fair administration of justice. In both criminal investigations and legal trials, forensics has become essential.<sup>17</sup> Toxicology is still frequently used to gather sufficient evidence that could be used to disprove convictions, familiarise or bolster witness testimony. The case involving Nicholas Odze, a 4-year-old boy who passed away strangely, is the first one involving the use of toxicology. According to the boy's mother Bernabe Raisa's official declaration, the boy passed away shortly after receiving a prescription for Lunesta. When she noticed that he couldn't fall asleep, his mother gave him such a medication. Following the incident, toxicology investigations and tests revealed the presence of several substances in the child's system, including eszopiclone, oxycodone, and ibuprofen. The competent authorities were unable to bring any charges against the boy's parents as a result of these findings and reports. The results of the investigations also showed that the child had not suffered any kind of internal trauma or harm. Consequently, this case demonstrates how toxicology is a vital discipline that can aid juries and judges in reaching an accepted judgement much more quickly.

*The Janie Lou Gibbs case*<sup>18</sup> was the second unresolved case that was finally solved thanks to toxicology. This woman was suspected of plotting and carrying out the murders of her husband, one of her grandkids, and three of her sons. Gibbs would ultimately deliver some soup laced with arsenic following an unsuccessful effort to poison her husband with rat poison. Gibbs used chemicals in all of these killings, and she gave the local church the insurance payouts from the victims' deaths. Robert, one of Gibbs' sons, would subsequently be subjected to certain toxicological testing by the family doctor. When the bodies of the other deceased family members were exhumed, forensic toxicologists discovered that each one had perished from poison-

<sup>16</sup> Ritesh G. Menezes and Francis N. Monteiro, "Forensic Autopsy" *StatPearls* (StatPearls Publishing, Treasure Island (FL), 2024).

<sup>17</sup> Balvant S Khajja, Mukesh Sharma, Rajveer Singh and Girish K Mathur, *Forensic Study of Indian Toxicology Plants as Botanical Weapon A Review*, Volume 1 Issue 4, *Journal of Environmental and Analytical Toxicology*, pg.1, pg.2 (2011).

<sup>18</sup> *Gibbs vs State* 235 Ga. 480 (1975).

related homicide. Such discoveries would allow the court to arrest and declare Gibbs guilty of the three victims' deaths.

**Tandoor murder case (1995)**<sup>19</sup> Delhi- The culprits attempted to hide a shooting homicide by setting the dead body on fire in the first criminal case in India to be solved with the use of forensics. However, the real cause of death was discovered after a thorough and smart forensic investigation. The victim was shot by the victim's spouse, Sushil Sharma, and then placed in a tandoor in the incident at hand. After killing his wife, Sharma drove her body to the Bagiya restaurant where he attempted to burn her in a tandoor with the assistance of the manager, Keshav Kumar. Sharma's gun and blood-stained clothing were found by police, who then sent them to the forensic lab on Lodhi Road. They also collected blood from Sahni's parents, Jaswant Kaur and Harbhajan Singh, and sent it for a DNA test. The blood samples that the doctor saved while doing the post-mortem and the blood stains on two leads removed from the deceased Naina's skull and neck are both of the "B" blood group, according to the lab report. The DNA result stated that the tests "show beyond a reasonable doubt that the charred body is that of Naina Sahni who is the biological offspring of Mr. Harbhajan Singh and Jaswant Kaur," confirming that the body was Sahni's. Finally, Mr. Sushil Sharma was determined to be guilty using forensic evidence.

**Murder of Sister Abhaya in Kerala in 1995 that the Sister Abhaya Case**<sup>20</sup> concerns the passing of a Knanaya Roman Catholic nun who was discovered dead in an Indian town of Kottayam's water well on March 27, 1992. She belonged to the women's St. Joseph's Congregation in the Knanaya Catholic diocese of Kottayam, Kerala, India, and was 19 years old when she passed away. She awoke from her sleep at around 4 am on the day of her death to prepare for her exam, and she then went downstairs to the hostel's kitchen to collect water from the refrigerator. Later, in the convent/hostel complex, her body was discovered in the well outside the kitchen. The case was solved using scientific investigation techniques like polygraph exams, brain mapping/brain fingerprinting, and narco-analysis. In August 2007, as part of its inquiry, the CBI tested for narcoanalysis. Two church fathers were subsequently detained with the aid of these.

**Aarushi talwar murder case (2007)**,<sup>21</sup> Noida Aarushi Talwar, the 14-year-old daughter of a prosperous

dental couple, was discovered dead with her throat cut in her parent's Noida, Delhi, house in 2008. Hemraj, the home servant, was discovered dead alongside the girl. In this instance, DNA was taken from the blood-stained garments and fingerprints were used to identify the suspect. On the glasses at the residence at the time of the murder, many fingerprints were also discovered. On the basis of CBI suspicions, Aarushi's father underwent a number of narcoanalysis tests; however, because there was no supporting evidence, he was found not guilty. The Court has not yet rendered a decision in this matter. The case included discussion of whether drug testing might be used as evidence in court.

**Anant Chintaman Lagu v. state of Bombay**,<sup>22</sup> The prosecution must prove three things in a case of poisoning, according to the court:

1. that the death was brought on by poison;
2. that the accused had access to the poison; and
3. that the accused had a chance to provide the poison to the victim.

The court may be able to conclude that the accused gave the dead the poison, which caused his death, if these facts are shown and there was a purpose.

## CONCLUSION

Forensic science is a vast field that uses many different scientific disciplines to create evidence that can be used in court. This could be related to a legal proceeding or a police investigation. Drug use has become such a serious societal issue that it is widely acknowledged that chemical testing of biological samples from individuals is the most objective method for determining drug usage. Drug testing based on forensic science is becoming more widespread in the criminal justice system. Toxicological analysis is thus a means of determining the severity of a drug's or a group of medications' effects on a human being. Toxicological data are used to determine the reason and circumstances surrounding a person's death, which is the most serious type of impairment. Every year, a frightening number of people's bodies are discovered in places that make no sense, such as their own beds, strangers' beds, squats, and open fields. The discovery of empty pill bottles, alcohol bottles, or drug-taking equipment at the scene of a death may indicate that drugs or alcohol played a role in the victim's demise. The Forensics Labs receives several cases from coroners and law enforcement organisations for toxicological analysis. Suspicious deaths at healthcare institutions may be more difficult to examine because to the difficulties in interpreting excessive doses of a

<sup>19</sup> State vs Sushil Sharma 2007 CriLJ 4008.

<sup>20</sup> CBI vs Father Thomas Kottor & ors SC No. 1114/2022.

<sup>21</sup> Nupur Talwar vs State of Uttar Pradesh (CRL) NO. 45 of 2012.

<sup>22</sup> Anant Chintaman Lagu vs State of Bombay 1960 AIR 500.

prescribed drug in someone who has developed tolerance to its effects. Toxicological data is frequently used to measure or explain performance impairment, which can aid in determining whether or not a driver has been under the influence of ethanol (alcohol) and/or drugs. Furthermore, drug and alcohol tests may be used to assess whether the suspect's or victim's actions, behaviour, or attitude would have changed if they had been impaired. Toxicology has a wide range of real-world applications, including protecting people and animals from harmful substances and improving pesticides, chemotherapeutic treatments, and other medications.

Since the turn of the century, forensic toxicology has experienced remarkable technological and conceptual growth. Although it has a long way to go before it can completely replace other methods of investigation, forensic toxicology is widely relied on because of the vital role it has played in bringing justice and solving crimes. Despite these limits, the court and the general public rely on the findings of forensic examinations and reports. Because crime shows itself in a variety of ways as society evolves and becomes more sophisticated, forensic toxicology study is growing. In light of this, it is vital to undertake a study utilising modern scientific techniques. The science of forensic toxicology satisfies this societal need.

