

## Toxicology

*by*

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### Abstract

Law as an independent institution mainly consists of rules, statutes, presidents, etc. But sometimes, these aren't enough to attain the ultimate purpose of having a living legal system, that is to provide justice. For this purpose, law collaborates with several other disciplines like social science, psychology, philosophy, biology, and chemistry.

Toxicology, in its essence is a scientific discipline that deals mainly with chemistry, biology and medical science, which was introduced in the field of law by Mathieu Orfila in the Lafarge murder case in 1840, Tulle, France.

Before toxicology was formally introduced, justice in cases of poisoning were solved mainly on qualitative and circumstantial evidence like, who was present, who had the motive, who had the knowledge? How did the poison get there and how did it come in contact to the victim? If the suspect pleads innocent and says that he is being framed who has the strongest motive to frame the suspect? Could it be possible that the case is simply non maintainable and the death was a complete accident or natural cause or mistake of the victim himself?

Though none of these questions seem valid and legally material enough to solely determine a whole judgment, it was the best method in absence of any proper method of study of poisoning and hazardous substances. This is the gap that Toxicology was created to fill.

The scale of this challenge remains considerable in India today. National Crime Records Bureau data for 2022 record that chemical poisoning accounted for roughly a quarter of all suicides reported nationally, underscoring why a scientifically reliable method of establishing the cause and circumstances of death continues to be indispensable to the administration of criminal justice.<sup>1</sup>

The following article seeks to study what toxicology is, what are the different sub-divisions of toxicology, and why they are necessary. We also try to enhance our understanding with the help of case laws and illustrations.

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<sup>1</sup> National Crime Records Bureau, Accidental Deaths & Suicides in India 2022 (Ministry of Home Affairs 2023); Bandita Abhijita and others, 'The NCRB Suicide in India 2022 Report: Key Time Trends and Implications' (2024) 46 Indian Journal of Psychological Medicine  
<<https://pmc.ncbi.nlm.nih.gov/articles/PMC11558707/>> accessed 10 July 2026.

## Introduction

Law is a multidisciplinary and interdisciplinary subject as it studies several disciplines simultaneously (**Friedmann, 1967**). For example, *mens rea*, witness testimony, restorative justice highlights the psychological facet of law, whereas jurisprudence, theories of justice, ethics, natural law vs. positivism highlights philosophical aspect of law. Laws regarding reservation for SC, ST and women highlight sociological aspect of law. This interdisciplinary character is also reflected in India's institutional architecture for scientific investigation. The Directorate of Forensic Science Services, functioning under the Ministry of Home Affairs, coordinates a network of Central, State, and Regional Forensic Science Laboratories that assist police investigation across the country, and the Government has approved further expansion of this network under the National Forensic Infrastructure Enhancement Scheme.<sup>2</sup> Hence, it is not a surprise to find certain divisions of law that relate to science, biology and pharmacy. One such discipline that connects science to law is Toxicology, which studies how and in what circumstances a substance can be hazardous to a human body.

Toxicology is a study of harmful effects of chemical substances on human body. It studies what makes a substance toxic, at what dose, through what exposure route, and with what consequences. Paracelsus, one of the that "*the dose makes the poison*" virtually any substance can be harmful in sufficient quantity (**Klaassen, 2019**).

## Toxicology in Law

Toxicology helps in cases like health and life endangerment or murder, where chemical substances are induced instead of using weapons. Legal field interacts with various denominations of toxicology, for example:

### Forensic Toxicology

This is the most common branch of toxicology. It is used to identify drugs, alcohol and other toxic substances in the provided biological specimen like blood, hair, urine, etc. (**Levine, 2013**). for the purpose of answering legal questions.

- It discloses the cause of death, like the poison or harmful substances inside a person's body in homicide cases,
- provides chemical evidence in drug prosecution cases

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<sup>2</sup> Ministry of Home Affairs, Government of India, 'Forensic Labs' (Press Information Bureau, 2025) <<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2085688>> accessed 10 July 2026.

- determines the content of alcohol in a person's blood in case of intoxication facilitated sexual assault cases or death due to drunk driving cases
- helps determine whether a death is suicide or homicide (**Saukko & Knight, 2015**).

The public health dimension of this work is considerable. The National Crime Records Bureau's 2023 report on accidental deaths recorded poisoning as one of the principal identifiable causes of accidental death in the country, accounting for close to five per cent of such deaths nationally, a figure that illustrates the continuing relevance of forensic toxicology to both criminal investigation and public health monitoring.<sup>3</sup>

#### Cases

##### ***Mahabir Mandal v. State of Bihar (AIR 1972 SC 1331)***

On 11:00 17<sup>th</sup> September 1963, Dashrath Mandla poisoned his wife because his family refused to give him more dowry. Around 2:00 am 18<sup>th</sup> September 1963, the family took her 21 miles away to Kamarganj Ghat on the Ganges River, tied a brick-filled bag to her waist, and drowned the body in the river, which was recovered 24 hours on 19<sup>th</sup> September 1963, after 24 hours from death. The post-mortem showed greenish discoloration, congested lungs, and an empty heart (heart contracted due to rigor mortis and pumped out all the blood). The doctor who performed the post-mortem in fact ruled out death by morphine poisoning and was declared a hostile witness by the prosecution; it was the trial court that later concluded, on the basis of the surrounding circumstances, that the possibility of death by morphine injection could not be ruled out. However, the Chemical Examiner found no poison in the viscera report.

On March 7, 1972. The supreme court cited Modi's Medical Jurisprudence and Toxicology, which stated that poison may not be successfully isolated even when death is from poisoning due to evaporation, vomiting, purging, or detoxification (**Modi, 2016**). The Supreme Court convicted Mahabir and Dasrath under Section 302 IPC for murder based on circumstantial evidence including the threat, the body disposal, and medical signs suggesting poisoning, upholding district and high court conviction (***Mahabir Mandal v. State of Bihar, 1972***).

Delay in forwarding viscera samples to a forensic laboratory remains a recurring evidentiary weakness in Indian poisoning prosecutions, as the case discussed below also illustrates. A nationwide survey of forensic science laboratories conducted by Project 39A of the National Law University, Delhi, in collaboration with the Ministry of Home Affairs, found that forty per cent of sanctioned scientific posts across the laboratories surveyed were vacant, with toxicology among the divisions receiving the highest case volumes. Such staffing shortages contribute directly to the

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<sup>3</sup> National Crime Records Bureau, Accidental Deaths & Suicides in India 2023 (Ministry of Home Affairs 2024) fig 1.7 <<https://www.ncrb.gov.in/uploads/files/1ADSIPublication-2023.pdf>> accessed 10 July 2026.

kind of delay that can compromise the ability of toxicological analysis to detect volatile or rapidly metabolised poisons.<sup>4</sup>

***Budhadeb Saha v. State of West Bengal (2023 LiveLaw SC 794)***

On September 16, 2011, Tuli committed suicide by consuming poison at her matrimonial home in West Bengal. Her father Uma Shankar Shah lodged an FIR on September 19, 2011.

Before the FIR was lodged, postmortem was done on 17<sup>th</sup> September 2011. The medical officer found white froth from Tuli's mouth and nose, congested esophagus, lungs, and trachea. The stomach contained food particles with a pungent smell. The doctor opined that the pungent smell indicated poison consumption. However, there was a critical delay in sending the viscera to the Forensic Science Laboratory. The viscera were sent only on February 22, 2012, five months after the post-mortem. Due to this delay, the viscera report came back negative with no poison detected.

The supreme court on 13<sup>th</sup> September 2023, reaffirmed the principle from Mahabir Mandal that a negative viscera report alone is not conclusive proof that the victim did not die from poisoning. The Court explained that poison may not be isolated even when death is from poisoning due to evaporation, vomiting, purging, detoxification, or the delay in viscera submission. The whole family was convicted under 304B (***Budhadeb Saha v. State of West Bengal, 2023***).

**Human Performance Toxicology**

This branch of toxicology studies the effects of poison, drugs, alcohol, and other substances on human cognitive function, psychomotor performance, sensory perception, behavior, and judgment. It goes beyond the question of whether a substance was present to answer the harder and legally more significant question of whether that substance impaired a specific individual's ability to perform specific tasks at a specific time.

The most important concept in human performance toxicology is the distinction between:

**Presence** — a substance is detectable in the body

**Impairment** — a substance has degraded a person's functional capacity

These are not the same thing, and the law in most jurisdictions requires proof of impairment, not merely presence (**Huestis & Smith, 2018**). A person may test positive for cannabis metabolites days after last use with no functional impairment whatsoever. A person may be profoundly impaired at a blood alcohol concentration below the legal per se limit due to individual factors.

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<sup>4</sup> Tanvi Kanchan, 'Large Vacancies, Underutilised Budgets In India's Forensic Science System' (IndiaSpend, 19 August 2023) <<https://www.indiaspend.com/police-judicial-reforms/large-vacancies-underutilised-budgets-in-indias-forensic-science-system-873773>> accessed 10 July 2026.

Human performance toxicology provides the scientific framework for navigating these distinctions in court.

The scale of alcohol-impaired driving in India gives this branch of toxicology particular practical importance. Ministry of Road Transport and Highways data analysed for 2023 attribute more than three thousand road deaths nationally to drunken driving, a figure that keeps forensic determinations of impairment central to recurring criminal litigation on Indian roads.<sup>5</sup>

#### Cases

##### ***Selvi & Ors. v. State of Karnataka & Anr. Criminal Appeal No. 1267 of 2004***

The narco-analysis test uses sodium pentothal, which is intravenously injected into the subject. The subject then enters a state of hypnosis with all inhibitions shed, and responds to all questions put without knowing that they are incriminating themselves. The Brain Electrical Activation Profile (BEAP) employs electrodes attached to the scalp to record the electrical waves emitting from the subject's brain, which are then recorded to be presented as evidence in the court.

The issue was whether the forcible use of scientific techniques like narco-analysis, polygraph tests, or brain mapping would amount to self-incrimination, and thus violate Article 20(3) of the Constitution, which protects an accused from being compelled to be a witness against themselves.

On May 5, 2010, the court ruled against the involuntary use of these techniques. The involuntary use of narco-analysis, test, and brain-mapping tests was declared unconstitutional. If done without individual consent, and the results alone cannot be used as direct evidence in court (***Selvi v. State of Karnataka, 2010***).

Concerns about the reliability and voluntariness of narco-analysis had, in fact, been anticipated before the Supreme Court's ruling. The National Human Rights Commission had already published Guidelines for the Administration of Polygraph Tests in January 2000, requiring recorded consent before a judicial magistrate and access to legal counsel, and the Court in *Selvi* held that these guidelines must be strictly followed for narco-analysis and brain-mapping tests as well.<sup>6</sup>

##### ***Mr. Nikhil Wagle & Ors. v. The State of Maharashtra & Ors. 2016(1) ALL MR 862***

This PIL was filed following a surge in drunken driving incidents and road accidents in Maharashtra involving multiple high-profile fatal accidents caused by alcohol-impaired drivers.

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<sup>5</sup> 'The Data Behind India's Road Carnage: Fatalities Soar 80% in Two Decades Despite Only 10% Rise in Accidents' Down To Earth (7 November 2025) <<https://www.downtoearth.org.in/governance/the-data-behind-indias-road-carnage-fatalities-soar-80-in-two-decades-despite-only-10-rise-in-accidents>> accessed 10 July 2026.

<sup>6</sup> 'Guidelines Issued by NHRC Regarding Polygraph Test' (GA IAS, 2024) <<https://gurusashramias.com/polygraph-test/>> accessed 10 July 2026.

The petitioners sought the court's intervention to fix lapses in how breathalyzer and blood alcohol tests were being administered by police under Sections 185, 203, and 204 of the Motor Vehicles Act, 1988.

The Supreme Court had previously noted: "Drunken driving has become a menace to our society. Everyday drunken driving accidents take several human lives. Alcohol consumption impairs consciousness and vision, and it becomes impossible to judge accurately how far the objects are. When depth perception deteriorates, eye muscles lose their precision causing inability to focus on objects. In short, alcohol leads to loss of coordination, poor judgment, slowing down of reflexes, and distortion of vision."

On January 7, 2016, the Bombay High Court ruled that an offence under Section 185 of the Motor Vehicles Act can never be proved unless it is proved that the driver of a motor vehicle had alcohol in their blood exceeding 30 mg per 100 ml. A person cannot be sent for a laboratory test unless they are first arrested. If a breath test can't be conducted, the conduct of a blood test at the earliest becomes necessary (*Nikhil Wagle v. State of Maharashtra*, 2016).

***Benny Mon v. State of Kerala 2025: KER:22425 | 2025 LiveLaw (Ker) 189***

The petitioner in this case was a motorcyclist charged under Section 279 (rash driving) of the IPC and Section 185 of the Motor Vehicles Act. He challenged the legality of the breathalyzer test result produced against him, arguing that procedural safeguards had not been followed. The court quashed proceedings under Section 185 due to procedural lapses by law enforcement.

The Kerala High Court, on March 18, 2025, ruled that if a person is arrested for drunken driving under Section 185 of the Motor Vehicles Act, they must be subjected to a medical examination. Also, the original printout obtained from the breathalyzer equipment after a test under Section 203 of the Motor Vehicles Act is admissible as evidence to establish drunken driving under Section 185 of the Act. A typewritten copy prepared by the police after the test is not admissible as evidence in court (*Benny Mon v. State of Kerala*, 2025)

**Doping Control Toxicology**

Doping control toxicology is the specialized analytical and interpretive discipline concerned with detecting, identifying, and quantifying prohibited performance-enhancing substances and methods in athletes, operating within the parallel legal framework of international sports law. It is the scientific enforcement arm of the global anti-doping system.

The World Anti-Doping Agency (WADA) was established in 1999 following the 1998 Tour de France doping scandal, WADA is the international independent agency responsible for promoting, coordinating, and monitoring the fight against doping in sport. It operates under the authority of the World Anti-Doping Code — the foundational legal instrument of global anti-doping (**World Anti-Doping Agency, 2021**).

India's own experience illustrates the scale of the enforcement challenge that doping control toxicology addresses. Since the National Anti-Doping Agency began testing athletes in 2009, it has tested more than forty thousand samples, with over twelve hundred athletes found to have committed anti-doping rule violations, a record that has repeatedly placed India among the countries with the highest number of violations reported to the World Anti-Doping Agency.<sup>7</sup>

### **Cases**

#### ***Landis v. USADA, CAS 2007/A/1394***

Landis's urine sample from Stage 17 of the 2006 Tour de France showed an elevated testosterone-to-epitestosterone (T/E) ratio.

The B sample, analyzed using IRMS, confirmed the presence of synthetic (exogenous) testosterone.

USADA initiated disciplinary proceedings against Landis under the Code, asserting the AAF as conclusive evidence of an ADRV.

USADA's American Arbitration Association panel (first instance) → Court of Arbitration for Sport (appeal). Landis's defense was not a denial of presence but a challenge to the validity of the laboratory's IRMS process and documentation. He contested the *evidentiary foundation* of Article 2.1 violation rather than disputing presence itself once both panels found the lab's procedures compliant.

Both the arbitration panel and CAS upheld the AAF as valid; Landis was stripped of his 2006 Tour de France title and sanctioned with a two-year suspension (***Landis v. USADA, 2008***).

#### ***United States Anti-Doping Agency v. Lance Armstrong, USADA Reasoned Decision, 2012***

Lance Armstrong won seven consecutive Tour de France titles between 1999 and 2005 while riding for the U.S. Postal Service and later Discovery Channel cycling teams

Suspicious and allegations of doping followed Armstrong throughout his career, with former teammates and journalists raising questions for years

In 2010, former teammate Floyd Landis publicly alleged systematic doping within the USPS team, triggering a federal criminal investigation

A U.S. federal grand jury investigation into Armstrong and the USPS team began but was closed in February 2012 without criminal charges being filed

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<sup>7</sup> S Star, 'The Quest for Harmonisation in Anti-Doping: An Indian Perspective' (2022) International Sports Law Journal <<https://pmc.ncbi.nlm.nih.gov/articles/PMC9131978/>> accessed 10 July 2026.

USADA continued its own independent investigation after the federal case closed, treating the matter as a doping violation under the World Anti-Doping Code rather than a criminal matter

Throughout the investigation, numerous former teammates and team staff were approached by USADA and chose to break what USADA called the "Code of Silence" (*omertà*), agreeing to provide sworn testimony

By late May 2012, USADA concluded it had sufficient evidence to formally charge Armstrong, team director Johan Bruyneel, team doctors Pedro Celaya, Luis Garcia del Moral, and Michele Ferrari, and trainer José "Pepe" Martí

USADA sent Armstrong a formal charging letter notifying him of the anti-doping rule violations alleged against him

Armstrong responded by filing a lawsuit in federal court seeking to block USADA's proceedings entirely, arguing USADA lacked jurisdiction over him and that authority instead rested with the UCI (International Cycling Union)

Armstrong also argued in his lawsuit that USADA's arbitration procedures were unconstitutional and violated his due process rights

The federal court (Judge Sam Sparks) dismissed Armstrong's first complaint, criticizing it for containing excessive irrelevant material

Armstrong filed an amended complaint on July 10, 2012, repeating his jurisdictional and constitutional objections

The court again ruled against Armstrong, holding that USADA's arbitration rules were sufficiently robust to satisfy due process, that his jurisdictional challenges had to be raised in arbitration rather than in court, and that he had validly agreed to arbitrate with USADA

The UCI stripped Armstrong of all seven of his Tour de France titles (1999–2005) and removed his other results from August 1998 onward from the official record

In January 2013, Armstrong publicly admitted to having used performance-enhancing drugs throughout his career in a televised interview with Oprah Winfrey, confirming the substance of USADA's findings

Armstrong subsequently faced and settled several related civil lawsuits, including claims brought by the U.S. government and sponsors seeking to recover funds paid to him based on his denials of doping (**United States Anti-Doping Agency, 2012**)

Multiple ADRVs under Articles 2.1, 2.2, 2.6, and 2.8 of WADA:

- Article 2.1 — Presence of prohibited substances (EPO, in retrospectively tested samples)



- Article 2.2 — Use of prohibited substances and methods (blood doping/transfusions)
- Article 2.6 — Possession of prohibited substances/methods
- Article 2.8 — Administration/trafficking — assisting or facilitating doping by others on the team

***World Anti-Doping Agency (WADA) v. Alberto Contador Velasco & RFEC, CAS 2011/A/2386***

Alberto Contador won his third Tour de France title in 2010, riding for the Astana team alongside teammate Lance Armstrong

On July 21, 2010, the second rest day of the 2010 Tour de France, Contador submitted to a routine anti-doping control in Pau, France

On July 25, 2010, Contador went on to win the 2010 Tour de France overall

The sample collected from Contador during this control was found to contain 50 picograms per milliliter of clenbuterol

Although the positive test dated July 21, 2010, the matter was not made public until September 30, 2010

Contador announced he had been informed of the positive finding and vowed to fight the charge, claiming the clenbuterol came from contaminated Spanish beef he had eaten on the rest day

Contador was provisionally suspended by the UCI pending the outcome of disciplinary proceedings before the Spanish Cycling Federation (RFEC)

On November 26, 2010, Contador was heard by the RFEC's anti-doping disciplinary committee (CNCDD)

On January 26, 2011, the RFEC initially handed Contador a one-year ban, which he had the right to appeal

On February 15, 2011, the RFEC reversed course and cleared Contador of the clenbuterol charges entirely, accepting his contaminated-meat explanation, and he became free to race again

On March 24, 2011, the UCI announced it would appeal RFEC's clearance decision to the Court of Arbitration for Sport (CAS)

On March 30, 2011, WADA also lodged its own appeal with CAS against the RFEC's decision to clear Contador

On September 28, 2011, WADA published its 2012 prohibited list and confirmed clenbuterol would remain banned at any detectable level, quashing rumors that a minimum threshold would be introduced

The CAS hearing was ultimately scheduled for November 21–24, 2011, in Lausanne, Switzerland

The hearing itself was marked by controversy, including a reported threat by WADA's lawyers to walk out after the panel declined to permit an anti-doping expert to testify to the theory that Contador may have undergone a blood transfusion on July 20

During the proceedings, Contador's defense argued that clenbuterol contamination in livestock is essentially unheard of in Spain due to strict EU and Spanish regulation, citing data showing no non-compliant samples for clenbuterol found in tens of thousands of tested animals across Europe

The UCI and WADA countered that a doping scenario — including the possibility of a blood transfusion — was statistically more probable than meat contamination.

Because the violation was established, the burden shifted to Contador to prove, on the balance of probabilities, how the prohibited substance came to be in his system to have any period of ineligibility reduced or eliminated

After confirming none of the parties wished to change the composition of the panel, CAS proceeded to issue its decision

On February 6, 2012, CAS announced it had upheld the joint appeal by the UCI and WADA, overturning the RFEC's earlier decision to clear Contador

CAS found that both the meat-contamination theory and the blood-transfusion theory were "possible" but "equally unlikely," and held there were no established facts that would elevate the meat-contamination explanation to something that occurred on a balance of probabilities

CAS specifically noted that Spain, unlike certain countries outside Europe, was not known to have a clenbuterol meat-contamination problem, and no comparable cases involving Spanish meat were known

Contador was sanctioned with a two-year ban

He was stripped of his 2010 Tour de France title, and Andy Schleck was elevated to champion in his place, while Michele Scarponi was declared the winner of the 2011 Giro d'Italia that Contador had won while the case was pending

The ban meant Contador lost all race results dating back to and including the 2010 Tour de France

CAS backdated the ban, making him eligible to return to competition on August 6, 2012 — meaning he would miss the 2012 Giro d'Italia, Tour de France, and London Olympics, but remained eligible for the Spanish Vuelta starting August 18

CAS reserved its ruling on a separate UCI request to fine Contador €2.4 million (approximately \$3.25 million)

Contador became only the second Tour de France champion in history to be disqualified and stripped of victory specifically for doping (**United States Anti-Doping Agency, 2012**)

## Conclusion

Toxicology is a discipline that mainly finds its roots in the field of science, particularly biology and chemistry. Yet, it plays a very crucial role in the field of law and justice. It facilitates investigation, tells what substance, how and when, entered the body of the victim. It helps determine whether the act is punishable, who is to be held responsible, and the gravity of the actual and possible damage caused.

Though toxicological evidence is widely inadmissible in a judicial court independently, it surely facilitates the investigation and forms very strong supporting evidence, backed by other evidence such as timelines of events, statements of witnesses and suspects and other subjective factors that can't be precisely estimated by scientific means (**Saferstein, 2018**).

Also, like any other living institution like law itself, toxicology in law is also under constant criticism. For example, as addressed earlier, the Narco-test of accused suspects, which leads them to self-incrimination, is often questioned as being unconstitutional. Court also said it can't be sustained as stand-alone evidence against any accused (**Selvi v. State of Karnataka, 2010**).

Despite all this, it still plays a crucial job in cases relating to murder or suicide by poisoning. Because certain substances which are only poisonous in a certain quantity can be easily overlooked by investigators. Certain substances dissolve into blood and can't be traced after a certain period, and their symptoms can be easily misunderstood as those of other causes of death such as heart attack.

This is the reason why such a field requires a whole separate dedicated discipline, distinct from medical science.

India's response to these evidentiary demands has included sustained investment in forensic infrastructure, including schemes to strengthen DNA and cyber-forensic capacity in State forensic science laboratories and to expand the network of Central Forensic Science Laboratories, alongside a new requirement that a forensic expert visit the crime scene for offences carrying a sentence of seven years or more. Whether this expansion can keep pace with the resulting increase in caseload will determine how effectively toxicological evidence can continue to support the criminal justice system in the years ahead.<sup>8</sup>

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<sup>8</sup> Ministry of Home Affairs, Government of India, 'Forensic Labs' (Press Information Bureau, 2025) <<https://www.pib.gov.in/PressReleasePage.aspx?PRID=2085688>> accessed 10 July 2026.

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