Geographical and cultural trends in the use of plant-based poisons for criminal purpose.

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Abstract

Plant-based poisons, or phytotoxins, have long occupied a dual role in human societies—serving both medicinal and malicious purposes. This review explores the geographical and cultural dimensions of phytotoxins used in criminal activities, highlighting how their availability, traditional knowledge, and spiritual beliefs have facilitated their misuse across regions and eras. Toxic plants such as *Atropa belladonna*, *Aconitum ferox*, *Datura stramonium*, and *Ricinus communis* have featured prominently in cases of homicide, ritualistic poisoning, and drug-facilitated crimes. Cultural integration and indigenous practices often obscure the boundary between medicinal use and criminal intent, complicating forensic investigation in such contexts. Additionally, modern access to digital platforms has contributed to the transnational dissemination of knowledge regarding the cultivation and criminal application of these toxins, raising global security concerns. This paper aims to analyze these multifaceted trends, offering insights for forensic scientists, healthcare professionals, and policymakers to improve detection, prevention, and legal measures in the context of plant-based poisonings.

Introduction

Plant-based poisons, or phytotoxins, have played a complex and dual role in human history. While many of these compounds have been harnessed for therapeutic use in traditional and modern medicine, a darker facet of their utility lies in their application for criminal activities, particularly poisoning. Across civilizations, toxic plants such as *Atropa belladonna* (deadly nightshade), *Aconitum* spp. (monkshood), *Datura stramonium* (jimsonweed), and *Ricinus communis* (castor bean) have been exploited not just for self-medication but also for murder and assassination (Dinis-Oliveira, 2016). Unlike synthetic poisons, which require laboratory synthesis, plant-derived toxins are readily accessible in nature, often making them the preferred choice for covert criminal use, especially in regions where forensic awareness and toxicological surveillance are limited.

The geographical distribution and cultural integration of plant-based poisons significantly influence their usage in criminal contexts. For example, *Aconitum ferox*, native to the Himalayan regions of India and Nepal, has historically been used in both Ayurvedic medicine and as a homicidal agent in tribal conflicts (Poojary et al., 2010). In West Africa, the Calabar bean (*Physostigma venenosum*) was historically employed in trial-by-ordeal practices and has occasionally featured in modern poisonings (Olaleye & Akinmoladun, 2014). Similarly, the use of *Datura* in criminal activities such as drug-facilitated crimes and thefts, commonly known as “Thuggee” in colonial India, underlines how cultural familiarity with certain plants can facilitate their malicious application (Dash & Sinha, 2020).

Moreover, cultural beliefs surrounding the mystical or spiritual properties of toxic plants may contribute to their misuse. In some indigenous traditions, toxic plants are not only tools of physical harm but are also believed to exert metaphysical influence, leading to their inclusion in curses, hexes, or rituals of retribution (Balick & Cox, 2021). The line between ritual and crime is often blurred, particularly in cases where poisonings are linked to traditional healers or shamans. This entanglement of cultural context and botanical knowledge creates a complex landscape in which forensic investigators must operate, particularly in rural or culturally isolated regions.

In contemporary times, the criminal use of plant-based poisons has expanded beyond ritualistic or regional confines, partly due to increased global connectivity and internet-based information sharing. The availability of online forums and digital

literature has democratized knowledge about phytotoxins, making it easier for individuals to learn about cultivation, extraction, and application of toxic plant compounds (Osterhoudt et al., 2010). This raises significant public health and legal concerns, as traditional poisonings are now potentially replicable on a wider, even transnational scale.

The objective of this review is to explore the geographical and cultural patterns in the criminal use of plant-based poisons. By analyzing regional trends, cultural contexts, historical cases, and forensic approaches, this paper seeks to offer a multidimensional understanding of how phytotoxins are utilized maliciously around the world. Understanding these trends is essential not only for toxicologists and forensic scientists but also for policymakers, healthcare professionals, and criminologists seeking to curtail such offenses and strengthen detection and legal responses.

Literature review

1. Phytochemical Fingerprinting of Phytotoxins in Forensic Science (2025)

This study explores the integration of phytochemistry into forensic science, emphasizing phytochemical fingerprinting as a method to detect plant-derived toxins. Utilizing advanced techniques like Ultra-High-Performance Liquid Chromatography (UHPLC) and High-Resolution Mass Spectrometry (HRMS), the research highlights how unique phytochemical profiles serve as distinctive markers in forensic investigations. Real-world case studies demonstrate the critical role of plant toxins in legal proceedings. The study also discusses challenges in postmortem detection due to decomposition and the need for specialized methods. Overall, it positions phytochemical fingerprinting as a promising tool to enhance the precision of forensic analyses. SpringerLink

2. Emerging Global Trends and Development in Forensic Toxicology: A Review (2024)

This review article examines the evolution of forensic toxicology, highlighting the transition from traditional methods to advanced analytical techniques like liquid chromatography-tandem mass spectrometry (LC-MS/MS) and gas chromatography-tandem mass spectrometry (GC-MS/MS). The study discusses the challenges faced by the field, including the lack of reliable analytical techniques and trained personnel. It also emphasizes the importance of bibliometric analysis in understanding research trends and identifying gaps. The review underscores the need for interdisciplinary collaboration and continuous technological advancement to address complex forensic toxicology cases effectively. ScienceDirect

3. Alternative Matrices in Forensic Toxicology: A Critical Review (2021)

This article explores the use of alternative biological matrices, such as hair, nails, and breast milk, in forensic toxicology. It discusses how these matrices can provide valuable information about long-term exposure to toxins, including plant-based poisons. The review highlights the advantages and limitations of each matrix, emphasizing the need for standardized protocols and further research. It also addresses the ethical considerations and potential applications in various forensic scenarios, including cases involving infants and breastfeeding mothers. SpringerLink

4. Potential Significance of Medicinal Plants in Forensic Analysis: A Review (2021)

This review focuses on the role of medicinal plants in forensic investigations, particularly those producing toxic secondary metabolites like alkaloids and glycosides. It discusses how plants such as Conium, Cicuta, and Datura have been used in homicidal and suicidal cases. The article emphasizes the importance of understanding plant toxicology in forensic contexts and suggests that plant-based evidence can be crucial in crime scene investigations. It also calls for the development of comprehensive databases and analytical methods to identify plant toxins accurately. PMC

5. Systematic Toxicological Analysis in Forensic and Clinical Laboratories: A Challenging Task of Analytical Chemistry (2024)

This article addresses the complexities of systematic toxicological analysis in forensic and clinical settings. It highlights the challenges in detecting plant-based toxins due to their diverse chemical structures and the potential for degradation. The study discusses advanced analytical techniques, including liquid chromatography-mass spectrometry (LC-MS) and DNA barcoding, as tools to improve the identification of plant toxins. It emphasizes the need for comprehensive analytical methods and interdisciplinary collaboration to enhance the reliability of toxicological analyses. SpringerLink

6. The Chemistry and Biology of Plant Poisons and Their Forensic Significance (2023)

This chapter delves into the chemical and biological aspects of plant poisons, focusing on secondary metabolites like alkaloids, glycosides, and proteins. It discusses how these compounds serve as defense mechanisms for plants but pose significant risks to humans. The study explores the forensic implications of plant toxins, including their use in criminal activities and the challenges in detection. It also emphasizes the importance of understanding plant metabolism and environmental factors that influence toxin production. ScienceDirect

7. Biomarkers and Their Potential for Detecting Livestock Plant Poisonings in Western North America (2023)

This article reviews the use of biomarkers to detect plant poisonings in livestock, focusing on species prevalent in Western North America. It discusses how biomarkers can aid in the rapid diagnosis of poisoning cases, thereby preventing further animal deaths. The study highlights various plants, such as larkspur and water hemlock, and the specific biomarkers associated with their toxins. It also explores non-invasive sampling techniques and the factors affecting biomarker concentrations, emphasizing the importance of timely and accurate detection in veterinary forensic investigations. Frontiers

8. A Systematic Review of Natural Toxins Occurrence in Plant Commodities Used for Plant-Based Meat Alternatives Production (2022)

This systematic review investigates the presence of natural toxins in plant commodities used for producing plant-based meat alternatives. It highlights concerns about the potential health risks associated with consuming these products, particularly due to the presence of compounds like lectins and cyanogenic glycosides. The study emphasizes the need for rigorous safety assessments and monitoring to ensure consumer safety. It also calls for further research into processing methods that can reduce toxin levels in plant-based food products. PubMed

9. Forensic Study of Indian Toxicological Plants as Botanical Weapons: A Review (2020)

This review focuses on the use of toxic plants in India as botanical weapons in criminal activities. It discusses various plant species known for their toxic properties, such as Datura and Aconitum, and their historical and contemporary applications in homicides and suicides. The study emphasizes the importance of forensic awareness and the development of analytical techniques to detect plant-based toxins. It also highlights the need for public education to prevent misuse and accidental poisonings.

10. Deliberate Self-Poisoning Due to Plant Toxins: Verdant Footprints of the Past into the Present (2021)

This article examines cases of deliberate self-poisoning using plant toxins, focusing on the sociocultural factors influencing such acts. It discusses common toxic plants involved in self-poisoning incidents and the clinical presentations observed. The study emphasizes the importance of early recognition and management of plant toxin exposures in clinical settings. It also calls for public health initiatives to raise awareness about the dangers of plant-based self-poisoning and the need for mental health support systems.

11. Phytochemical Fingerprinting of Phytotoxins as a Cutting-Edge Approach for Unveiling Nature's Secrets in Forensic Science (2025)

This study explores the integration of phytochemistry into forensic science, emphasizing phytochemical fingerprinting as a method to detect plant-derived toxins. Utilizing advanced techniques like Ultra-High-Performance Liquid Chromatography (UHPLC) and High-Resolution Mass Spectrometry (HRMS), the research highlights how unique phytochemical profiles serve as distinctive markers in forensic investigations. Real-world case studies demonstrate the critical role of plant toxins in legal proceedings. The study also discusses challenges in postmortem detection due to decomposition and the need for specialized methods. Overall, it positions phytochemical fingerprinting as a promising tool to enhance the precision of forensic analyses. SpringerLink

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16. The Chemistry and Biology of Plant Poisons and Their Forensic Significance (2023)

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Methodology

The methodology section of this review paper will outline the research design, data collection methods, and analysis techniques used to investigate the geographical and cultural trends in the use of plant-based poisons for criminal purposes. The approach is based on a qualitative review of existing literature, historical records, case studies, and ethnobotanical research. This section will explain the different sources of information utilized and how the data was analyzed to identify patterns in the use of plant-based toxins across different regions and cultures.

Literature Review and Selection Criteria

The primary source of data for this review is academic articles, books, and case studies that document the use of plant-based poisons across various cultures. The research involved reviewing both historical and contemporary literature, focusing on peer-reviewed journals, books from ethnobotanists, and legal studies that examine criminal applications of plants. In selecting articles for review, several inclusion criteria were applied:

1. The study must specifically discuss plant-based poisons, excluding non-plant-based substances.
2. The study should focus on cultural or geographical patterns of plant poisoning, examining both traditional use and criminal misuse.
3. The literature should provide evidence of how plant poisons have been utilized or misused, ideally with reference to specific cases or incidents.

Data was drawn from academic sources published between 2000 and 2021, ensuring a broad yet current overview of the field. Older works were included if they were seminal studies or particularly relevant to the understanding of historical trends.

Case Study Approach

The case study approach was central to understanding how plant-based poisons have been used for criminal purposes. Various historical and contemporary case studies were analyzed, including:

- **Indigenous practices** in regions like South America and Africa, where plant toxins like *Strychnos toxifera* (curare) and *Physostigma venenosum* (Calabar bean) were used both for medicinal and criminal purposes.
- **Modern criminal applications** in urban settings, where toxic plants such as *Atropa belladonna* and *Aconitum* have been used for assassination, poisoning, and other illicit activities.
- **Legal cases** and forensic reports that document poisoning incidents, shedding light on how the misuse of plant-based toxins is handled in criminal investigations.

These case studies helped contextualize the findings of ethnobotanical studies and legal research by illustrating the real-world consequences of plant toxin misuse.

Ethnobotanical and Cultural Analysis

A significant portion of the methodology involved understanding how plant-based poisons are culturally embedded. Ethnobotanical research was used to explore how certain cultures have integrated toxic plants into their rituals, beliefs, and everyday life, and how these practices overlap with criminal behavior. Through this analysis, the paper aimed to identify cultural patterns that influence the use of plants for criminal purposes. For example, *Datura stramonium* has long been used in India and other parts of Asia for both ritualistic and criminal uses, such as incapacitating victims for robbery or murder.

Understanding these cultural trends required a cross-disciplinary approach, bringing together perspectives from anthropology, criminology, toxicology, and botany. This allowed for a more holistic understanding of the factors influencing the use of plant toxins in criminal activities.

Data Synthesis and Pattern Recognition

Once the data was collected, the synthesis process focused on identifying recurring patterns across geographical regions and cultures. A comparative analysis was conducted to assess how plant-based poisons are used in different parts of the world, highlighting common themes such as the prevalence of certain plants, the method of poisoning, and the socio-political context in which the poisonings occur. For example, in African cultures, the use of *Physostigma venenosum* in traditional trials and criminal poisonings is well-documented, while in Europe, plants like *Atropa belladonna* have been more associated with political assassinations.

Pattern recognition also involved investigating the sociocultural and legal frameworks surrounding plant poisonings. This included an analysis of how criminal justice systems in different countries handle poisoning cases and the challenges faced in detecting and prosecuting poisonings caused by plant-based toxins. In some regions, legal systems may have a history of incorporating traditional knowledge of plants into their judicial processes, while in others, the lack of forensic resources may allow such crimes to go undetected.

Limitations

While this methodology provides a thorough review of existing literature, there are several limitations to consider. First, the reliance on secondary data means that some information may be biased or incomplete, especially in regions where documentation of plant-based poisons is scarce. Additionally, the cultural specificity of some studies limits the generalizability of findings. Finally, the study focuses primarily on qualitative data, which may not fully capture the quantitative aspects of plant toxin misuse, such as incidence rates or the geographical spread of poisoning cases.

Despite these limitations, the methodology provides a comprehensive framework for understanding the complex interactions between plants, culture, and crime, and it contributes valuable insights into the geographical and cultural trends in the use of plant-based poisons for criminal purposes.

Results and Discussion

The results and discussion section of this review paper synthesizes the findings from the literature on the use of plant-based poisons for criminal purposes, identifying key trends, cultural patterns, and the implications of these practices. This section will provide a detailed analysis of how plant-based poisons have been used across different geographical regions, explore the role of culture and traditions in facilitating or mitigating such crimes, and discuss the challenges in detecting and addressing these criminal activities. The discussion will also touch on the ethical concerns surrounding the use of ethnobotanical knowledge for harmful purposes and suggest areas for future research.

Geographical Distribution of Plant-Based Poisons

One of the most significant findings in this review is the widespread use of plant-based poisons across different geographical regions. The use of plant toxins is not confined to a specific region or culture but occurs globally, with certain plants being more prevalent in specific areas due to local biodiversity, climate, and cultural practices.

In **South America**, for example, plants such as *Strychnos toxifera* (curare) and *Thevetia peruviana* (yellow oleander) are well-known for their toxic properties. Curare, historically used by indigenous tribes for hunting, has also been implicated in criminal poisonings. The alkaloids in curare, which affect the neuromuscular system, can cause paralysis and death. Similarly, *Thevetia peruviana*, found in many tropical regions, contains toxins that can lead to cardiac arrest, making it a

dangerous plant for criminal use. The accessibility of these plants in rural areas, combined with traditional knowledge of their properties, increases the risk of misuse for malicious purposes.

In **West Africa**, the Calabar bean (*Physostigma venenosum*) has long been used in both ritual and criminal settings. The bean contains physostigmine, a powerful acetylcholinesterase inhibitor that can lead to respiratory failure and death. Historically, the Calabar bean was used in trials to determine guilt or innocence, with suspects forced to ingest the toxin and judged based on their reaction. This practice, while intended as a form of divine judgment, also made the bean a potential tool for poisoning. Today, the use of the Calabar bean in criminal activities remains a concern, with documented cases of poisoning in both rural and urban settings.

In **India**, the use of *Datura stramonium* (jimson weed) is widespread. This plant, which is known for its hallucinogenic and toxic properties, has been employed in both traditional medicine and criminal activities. In the context of crime, *Datura* is often used to incapacitate victims, rendering them unconscious and vulnerable to theft or assault. The plant's use in ritualistic practices adds another layer of complexity, as it is sometimes consumed in small doses for spiritual or religious purposes, which complicates efforts to regulate or control its misuse.

In **Europe**, plants like *Atropa belladonna* and *Aconitum* have a long history of use in criminal activities, particularly in political contexts. During the Renaissance and early modern period, these plants were often employed to poison political rivals or enemies. *Atropa belladonna* contains tropane alkaloids, which cause delirium, hallucinations, and death, while *Aconitum* (aconite) is a potent neurotoxin that affects the heart and nervous system. Both plants were favored for their ability to cause death without leaving clear signs of poisoning, making them ideal tools for covert assassinations. The continued availability of these plants in modern times, especially in herbal markets and online forums, has raised concerns about their potential for use in modern criminal cases.

Cultural Significance and Traditional Use of Plant Poisons

Cultural beliefs and practices play a significant role in the use of plant-based poisons, often complicating the line between legitimate medicinal use and criminal application. In many cultures, plants with toxic properties are deeply embedded in traditional medicine and spiritual practices. For instance, *Datura* and *Aconitum* are used in some cultures for their psychoactive effects, often in rituals meant to induce trance-like states or communicate with the divine. While these plants have legitimate medicinal uses, their toxicity also makes them susceptible to misuse in criminal activities.

In **West Africa**, the Calabar bean was historically used in a form of trial called the "Calabar ordeal," where suspects were forced to ingest the bean's toxin to prove their innocence. While this practice has been largely abandoned, the knowledge of the plant's toxicity continues to be passed down through generations. In some cases, individuals with malicious intent use this knowledge to poison their victims, knowing that the effects of the toxin can mimic natural death, making detection difficult.

In **India**, the use of *Datura* in religious and spiritual rituals complicates its role in criminal activities. The plant is considered sacred in certain Hindu practices, and its hallucinogenic properties are sometimes used in ceremonies to induce altered states of consciousness. However, the same properties that make it useful for these purposes also make it a tool for criminal poisonings. The use of *Datura* in criminal activities often goes unreported or undetected, as it is considered a "common" plant and is sometimes overlooked by law enforcement and health authorities.

The intersection of culture, tradition, and criminality highlights the complexity of plant-based poisonings. While some plants have a long history of legitimate use in traditional medicine and rituals, their toxicity makes them vulnerable to abuse. This cultural acceptance of certain plants for ritualistic purposes can make it difficult to distinguish between traditional use and criminal behavior, especially in regions where botanical knowledge is deeply embedded in the local culture.

Challenges in Detection and Forensic Analysis

One of the major challenges in addressing criminal poisonings involving plant-based toxins is the difficulty in detecting these poisons in the body. Many plant toxins, such as those found in *Atropa belladonna* and *Aconitum*, do not leave obvious traces in the body, making it challenging for forensic scientists to confirm the cause of death. Moreover, some plant toxins, like ricin from *Ricinus communis*, can cause symptoms similar to other forms of poisoning, such as foodborne illnesses, further complicating diagnosis.

In addition, the widespread availability of toxic plants, especially in rural areas and through online markets, has made it easier for individuals to access these substances. While forensic science has made significant strides in detecting plant toxins, the lack of specialized toxicology training in some regions remains a significant barrier. For example, in parts of Africa and Asia, where plant-based poisons are often used in criminal activities, the ability to test for specific toxins may be limited, leading to misdiagnosis or failure to identify the true cause of death.

Ethical Considerations

The use of ethnobotanical knowledge for criminal purposes raises significant ethical concerns. Traditional knowledge of plants, which has been passed down through generations, is intended to serve beneficial purposes, such as medicine and ritual. However, the misuse of this knowledge for harmful purposes highlights the ethical dilemma of how to regulate and protect indigenous knowledge from exploitation. There is a fine line between cultural practices that use plants for spiritual or medicinal purposes and their malicious application in crimes. The challenge lies in balancing the preservation of cultural traditions with the need to prevent harmful use of toxic plants in criminal activities.

Conclusion and Future Research Directions

This review highlights the complex relationship between culture, geography, and the use of plant-based poisons for criminal purposes. While certain plants are used for legitimate cultural and medicinal purposes, their toxic properties make them susceptible to misuse in criminal activities. The study emphasizes the importance of understanding the cultural significance of plants and the role that traditional knowledge plays in both healing and harming. Future research should focus on improving forensic techniques for detecting plant toxins and increasing awareness in communities where these plants are prevalent. Additionally, ethical discussions surrounding the regulation of ethnobotanical knowledge should be a priority, ensuring that traditional knowledge is protected from exploitation while preventing its misuse for criminal purposes.

As plant-based poisons continue to be used in both traditional and criminal settings, the need for interdisciplinary collaboration between ethnobotanists, toxicologists, and law enforcement agencies becomes even more critical. Understanding the cultural, social, and biological factors behind the use of these toxins will be key to mitigating the risks associated with their abuse in the future.

Conclusion

The use of plant-based poisons for criminal purposes is a complex and multifaceted issue that involves a combination of cultural, geographical, and scientific factors. This review has explored the geographical distribution of these poisons, the cultural significance and traditional uses of toxic plants, the challenges in detecting plant-based poisonings, and the ethical concerns surrounding their misuse. It has become evident that while many plant toxins have a legitimate place in traditional medicine and rituals, they are also vulnerable to exploitation for criminal activities.

One of the key findings of this review is the wide geographical spread of plant-based poisons across different regions of the world. In South America, Africa, and Asia, plant toxins such as *Strychnos toxifera* (curare), *Physostigma venenosum* (Calabar bean), and *Datura stramonium* (jimson weed) have been traditionally used both for medicinal and criminal

purposes. These plants, which were once limited to specific cultural contexts, have found their way into the criminal arsenals of individuals looking to harm or incapacitate others. In some cases, plant poisons are used in political assassinations, while in other contexts, they are used to facilitate theft, revenge, or other criminal acts.

The cultural significance of plant-based poisons is another critical aspect that must be considered. Many toxic plants, such as *Datura* and *Aconitum*, have deep roots in spiritual or ritualistic practices, often used to induce altered states of consciousness or to communicate with the divine. This connection to culture and tradition complicates the issue, as these plants are seen as part of a broader social and religious context. The dual nature of these plants—as both beneficial and harmful—presents challenges for regulation and control, particularly in regions where they are considered sacred or medicinal.

Furthermore, detecting and analyzing plant-based poisons in forensic settings remains a significant challenge. Many plant toxins do not leave obvious traces in the body, and the symptoms of poisoning can mimic those of other medical conditions, making it difficult for law enforcement and medical professionals to identify the cause of death. The widespread availability of these plants, coupled with insufficient forensic resources in certain regions, increases the difficulty in investigating plant-based poisonings effectively. The lack of awareness and training in toxicology further exacerbates the issue, highlighting the need for better detection methods and more specialized knowledge in the field of forensic science.

Ethical concerns also play a significant role in the ongoing debate about the use of plant-based poisons. Traditional knowledge of these plants, passed down through generations, is an invaluable cultural resource. However, the use of this knowledge for harmful purposes raises important ethical questions. How can societies protect their traditional knowledge while preventing its misuse for criminal activities? Balancing the preservation of cultural practices with the need to protect individuals from harm is a complex challenge that requires ongoing dialogue between ethnobotanists, policymakers, and law enforcement agencies.

In conclusion, while plant-based poisons have a long history of use in both beneficial and harmful contexts, their criminal application presents significant risks. Future research should focus on improving forensic techniques for detecting plant toxins, as well as developing strategies for public education and awareness. Additionally, more attention should be given to the ethical implications of regulating traditional plant knowledge, ensuring that it is used responsibly and ethically. As plant-based poisons continue to be used in criminal activities, interdisciplinary collaboration will be essential to address the challenges posed by their misuse. Effective regulation, improved detection methods, and heightened awareness can help mitigate the risks associated with plant-based poisoning and protect individuals and communities from harm.

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