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Entomotoxicology as a tool for forensic investigations

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Abstract
Entomotoxicology is a rapidly developing field in forensic investigations that combines the disciplines of forensic entomology and toxicology. This paper reviews the application of entomotoxicology as a tool for forensic investigations and highlights its potential in providing valuable information on the presence and effects of drugs or toxins in insects found at a crime scene. The analysis of insect evidence in forensic investigations has long been used to estimate the time of death and other important factors. However, the incorporation of toxicology into this analysis can provide critical information on the presence and effects of drugs or toxins in the body. Entomotoxicology has the potential to be a valuable tool in forensic investigations, particularly in cases involving drug-related deaths or poisonings. By studying the presence and distribution of drugs or toxins in insect tissue, entomotoxicology can provide information on the timing and pattern of drug use. The use of entomotoxicology in forensic investigations is not without challenges. Factors such as post-mortem redistribution and contamination of the crime scene can impact the reliability of the results. There is also a need for standardized protocols and validation studies to ensure the accuracy and reliability of the results.

Keywords: Entomotoxicology, toxins, forensic investigation

Introduction
The number of drug related deaths worldwide has increased. These deaths are frequently only discovered years later, and it is not unusual for the body to be severely decomposed or reduced to skeletonised.
Entomotoxicology, which merges the fields of forensic entomology with toxicology, is a fast growing area in forensic investigations. Entomotoxicology examines the poisons present in insects that consume carrion, primarily flies and beetles. The analysis of insect evidence in forensic investigations has long been used to estimate the time of death and other important factors. However, the incorporation of toxicology into this analysis can provide critical information on the presence and effects of drugs or toxins in the body [1].
Entomotoxicology involves the study of the presence and effects of drugs or toxins in insects found at a crime scene. By studying the presence and distribution of drugs or toxins in insect tissue, the time and pattern of drug usage can be revealed through entomotoxicology. This information can be useful in cases of drug-related deaths, poisonings, or other criminal investigations involving the use of drugs or toxins [2].
Entomotoxicology has significant potential as a tool for forensic investigations, but it is not without challenges. Factors such as post-mortem redistribution and contamination of the crime scene can impact the reliability of the results. Standardized procedures and validation studies are also required to make sure that the outcomes are accurate and reliable [3].
Despite these challenges, the use of entomotoxicology in forensic investigations is becoming increasingly important. This paper reviews the application of entomotoxicology as a tool for forensic investigations and discusses its potential in providing valuable information on the presence and effects of drugs or toxins in insects found at a crime scene.

Need of the study
The study of entomotoxicology is necessary to provide valuable information for forensic investigations, particularly in cases involving drug-related deaths or poisonings. Insects found at a crime scene can provide critical evidence on the time and location of death, and the study of insect evidence has long been used in forensic investigations.

The incorporation of toxicology into the analysis of insect evidence can provide additional information on the presence and effects of drugs or toxins in the body. This information can be useful in cases of drug- related deaths, poisonings, or other criminal investigations involving the use of drugs or toxins [4].

The need for the study of entomotoxicology is further emphasized by the challenges associated with traditional toxicological analyses. These challenges include issues with post-mortem redistribution, degradation of toxicants, and issues with sample collection and storage.

Therefore, the development and refinement of techniques used in entomotoxicology are necessary to ensure the accuracy and reliability of the results. The need for standardized protocols and validation studies is also essential to ensure the effective application of entomological evidence in criminal investigations [5].

Types of Entomotoxicology

Entomotoxicology is the study of insect-derived toxins and their effects on humans, animals, and the environment. There are several types of entomotoxicology, which include [6].

Medical entomotoxicology: This branch of entomotoxicology deals with the study of insect venom and its effects on humans. Medical entomotoxicology includes the identification and characterization of venomous insects, the development of antidotes, and the treatment of venomous bites and stings.

Forensic entomotoxicology: Forensic entomotoxicology is concerned with the use of insect-derived toxins in criminal investigations. It involves the analysis of insect venom and toxins as evidence in cases involving suspected poisoning, homicide, or other criminal acts [7].

Agricultural entomotoxicology: This branch of entomotoxicology focuses on the use of insecticides to control pests in agricultural settings. It includes the study of the toxicity of insecticides on target and non-target organisms, the development of new insecticides, and the management of insecticide resistance.

Environmental entomotoxicology: This area of entomotoxicology deals with the impact of insect-derived toxins on the environment. It includes the study of the effects of insecticides on non-target organisms, the development of environmentally friendly insecticides, and the management of insecticide residues in the environment [8].

Entomotoxicology is a multi-disciplinary field that involves the collaboration of entomologists, toxicologists, chemists, and other experts to understand the complex interactions between insects and their toxins and their effects on human health and the environment.

Samples used in entomotoxicology, and its analysis and preservation

Samples used in entomotoxicology can vary depending on the specific research question, but some common samples include [9]:

Insect venom or saliva: Venom or saliva can be collected from live or dead insects for analysis. The collection can be performed using a variety of techniques, such as electrical stimulation, milking, or dissection [10].

Tissues or fluids from animals: Samples from animals that have been exposed to insect toxins or venom can be collected and analyzed to determine the effects of the toxin on the animal's physiology. These samples can include blood, urine, or tissue samples.

Insecticide residues: Samples of soil, water, or plant tissue can be collected and analyzed to detect residues of insecticides that have been applied to the environment.

Insects and other arthropods: Dead insects or arthropods can be collected from the environment and analyzed for the presence of toxins.

The analysis and preservation of samples in entomotoxicology require careful handling to ensure accurate and reliable results. Common methods for sample analysis and preservation include:

Sample preparation: Samples may need to be processed before analysis, such as homogenization or extraction, to extract the target compounds.

Separation techniques: Various separation techniques can be used to isolate the target compounds, including liquid chromatography, gas chromatography, and mass spectrometry.

Preservation: Samples should be preserved using appropriate techniques to avoid degradation or contamination. For example, samples can be frozen or stored in a preservative solution.

Quality control: It is essential to include appropriate controls to ensure the accuracy and reliability of the results. This can include blank samples, reference standards, or replicate analyses.

The analysis and preservation of samples in entomotoxicology require careful attention to detail to ensure accurate and reliable results.

Limitation

Entomotoxicology, like any scientific discipline, has certain limitations that must be considered when interpreting its results. Some of the limitations of entomotoxicology include:

Limited knowledge of insect venom and toxins: While there is a growing body of research on insect venom and toxins, much remains unknown about their composition and effects on humans, animals, and the environment. This can make it difficult to accurately assess their potential risks and benefits.

Ethical concerns: The collection and use of live insects or animals for research purposes raise ethical concerns. Researchers must ensure that their methods are humane and comply with animal welfare guidelines.

Sample variability: The composition of insect venom and toxins can vary between species, individuals, and geographic locations. This can make it challenging to draw broad conclusions from a limited set of samples.

Limited availability of analytical techniques: Analyzing insect venom and toxins can be technically challenging, and specialized equipment or expertise may be required. This can limit the accessibility of the research to some researchers or institutions.

Potential for misinterpretation: The complex interactions between insects and their toxins can make it difficult to accurately interpret the results of entomotoxicological research. Careful consideration and appropriate controls must be used to avoid misinterpretation or false conclusions. Entomotoxicology has the potential to provide valuable insights into the composition and effects of insect venom and toxins. However, researchers must be aware of the discipline's limitations and use appropriate methods and controls to ensure the accuracy and reliability of their results.

Conclusion

Entomotoxicology is a relatively new subfield of forensic entomology that focuses on the use of insects to detect and analyze toxins in the environment. This discipline has become increasingly important in forensic investigations, as it allows investigators to identify toxic substances that may have been used in criminal activities or that may have contributed to a victim's death. By examining the insects that are present at a crime scene, entomotoxicologists can determine if toxic substances were present in the area and if so, which ones. They can also use insects to determine the time of exposure to the toxin and the level of exposure. This information can be used to help identify suspects or to provide evidence in court.

One of the major advantages of entomotoxicology is its ability to detect toxins that may have broken down or been metabolized by other organisms, making them difficult to identify through other methods. Insects are also highly sensitive to toxins, and their response to these substances can provide valuable information about the toxicity of a particular compound. There are also some limitations to entomotoxicology. For example, the insects that are present at a crime scene may not be able to detect all types of toxins, and the presence of other environmental factors can complicate the analysis. In addition, there are ethical concerns associated with the use of insects in toxicology research, and it is important to ensure that insects are treated with respect and care throughout the process.

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