Mycology- An Emerging Tool in Forensic Investigations

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Abstract

Microbial forensics may be defined as a scientific discipline bridging two branches of science, microbiology and forensic science to track and analyze the crimes. It includes a vast scope of forensic science clubbed with microbiology. This field is emerging day by day through out the world. Microbial forensics deals with myriad organisms, including viruses, bacteria, fungi, parasites and the toxins some of these organisms produce. "Microbial Forensics" becomes an ideal requirement in India. It includes but not limited to analysis of microbes or their toxins and materials used to prepare, store and deliver the toxin or pathogen. It is found that human decomposition starts within 4 to 5 minutes after death has occurred. This process of decomposition is called autolysis – or self-digestion. A microbial clock has also been developed to calculate postmortem interval(PI), in which mouse corpses were placed on soil and decomposition monitored for 48 days. The sizes of fungal colonies found on skin or other materials, had been used to estimate times of death or deposition which gave positive and successful results.

Key Words: Microbes, fungi, Post mortem interval,

Introduction

Microbial forensics, a branch of science that involves the multi-disciplinary techniques which helps in tracing the evidences, detecting the crime with the help of microbes i.e., fungus, bacteria etc. Microbial forensics may be defined as a scientific discipline bridging microbiology and forensic science dedicated to track and analyze bio crime. It includes a vast scope of forensic science clubbed with microbiology. This field is emerging day by day through out the world. Microbial forensics deals with myriad organisms, including viruses, bacteria, fungi, parasites, and the toxins some of these organisms produce. Largely built on science and technology developed and used for other fields and purposes, transposed to forensic applications. This new branch is essential for the modern world where the technology possessed by the criminal or a terrorist could be disastrous. "Microbial Forensics" becomes an ideal requirement in India. It includes but not limited to analysis of microbes or their toxins and materials used to prepare, store and deliver the toxin or pathogen. Traditional forensic evidence (e.g., fingerprints, trace evidence, digital, materials) is also still an important part of attribution that should not be ignored.

It requires that scientific investigators safely and properly address the probative classic evidence while also studying the biological agent as evidence.

Mycology can contribute to a variety of forensic investigations

- Determination of postmortem intervals (time since death)
- Providing trace evidence
- Linking people and objects with places.

Human body decomposition

It is found that human decomposition starts within 4 to 5 minutes after death has occurred. This process of decomposition is called autolysis – or self-digestion. As decomposition starts, the level of O_2 in cells of human body decreases while, CO_2 in the blood increases, pH also decreases and wastes accumulate which toxify the cells. But not only self digestion is responsible for decomposition some microbes are also responsible for decomposing human body that process is known as putrefaction. Putrefaction is the destruction of the soft tissues of body by the action of micro-organisms like bacteria, fungi and protozoa which results in the catabolism of tissues into gases, liquids and simple molecules. The process progresses into distension of tissues due to the formation of various gases like hydrogen sulfide, carbon dioxide, methane, ammonia, sulfur dioxide and hydrogen, especially in the bowels.

Microbes in decomposition

All fungus in dust or soil typically provide large numbers of microbial taxa and there is some evidence that the analysis of these taxa can also be used to identify the geographic origin of dust or soil samples of crime scene. Many fungal taxa are restricted in their niche area and are only found in particular ecosystem types(1). Many fungal taxa produce spores that are tolerant of dessication and other environmental stresses they can persist in samples for prolonged periods of time. The potential advantages of fungal analyses for biogeoprinting, their utility remains more potential than realized (2). Microbes proved to be an elegant tool in tackling bio-crimes. There is continuing interest in the possibilities of using fungi and prokaryotes (bacteria) associated with human decomposition to indicate postmortem interval (PMI).

Postmortem interval

Use of fungi and bacteria made it possible to evaluate/calculate postmortem interval (PMI) from human body decomposition(3). A microbial clock has also been developed to calculate postmortem interval, in which mouse corpses were placed on soil and decomposition monitored for 48 days. The sizes of fungal colonies found on skin or other materials, had been used to estimate times of death or deposition which gave positive and successful results. Many criminal cases have been solved by estimating postmortem interval with the help of fungi (4, 5). It is gradually becoming more widely appreciated that mycology (the study of fungi) contributes greatly to the provision of intelligence, and to the resolution of evidence in various kinds of criminal and civil forensic investigations. Direct observations on human cadavers buried in soil in Russia demonstrated that soil fungi were able to grow through the skin and clothes by the second week after burial(6,7). Fungi involved were autochthonous (belonging to that place), and corresponded to those recovered directly from the burial places (Candida, Penicillium, Mucor etc.)(8). Forensic pathologists are often unaware that such growths may be of evidential value and, may clean them from the cadaver without consideration. Comparing fungal colony sizes is of particular value if the fungi can be isolated into culture. They need to be grown in appropriate conditions which mimic, as closely as possible, those prevailing at the place where the body was found. It is not essential to identify any fungus – of critical importance is the response of the species obtained from the body to an experimental temperature range.

Conclusion

Use of fungal data in a broad spectrum of forensic situations or mycology has much to contribute to the investigation of both criminal & civil cases (in the latter, particularly for insurance fraud). The applications discussed here are not suggestions of possibilities yet to be explored, but ones which have been used in actual cases and tested in the Courts. In order to realize the potential, however, it will be necessary for investigating officers to become more aware of the possibilities provided by spores and whole fungi, and to recognize situations where mycological evidence might provide critical evidence. There is a need for those involved in all aspects of forensic medicine (especially pathology and toxicology), to be aware of the evidential value of fungi, especially with respect to trace evidence, timing of events. They may provide important evidence which might otherwise be missed. In order to avoid valuable information being overlooked, there is a need for investigating officers, and those involved in forensic medicine, especially pathologists and toxicologists, to be aware of the evidential value of fungi.

References:

References are available on request at editor@healtalkht.com