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Forensic entomology: what insects tell about crime?

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Forensic entomology is a branch of forensic science, which utilizes insects and their arthropod relatives that dwell in decomposing remains, as scientific evidence to aid in legal investigations. Medicolegal, urban and stored product forensic entomology are the three branches of forensic entomology. Medicolegal forensic entomology focuses on utilising arthropod evidence on human remains in solving crimes (Hall, 1990). The insect fauna present on the corpse can be very good evidence in criminal investigation. Vertebrate corpses are excellent food sources for a more or less specialized insect community. Insects are attracted to the corpse immediately after death (Smith, 1986; Haskell *et al*., 1997) and lay eggs on it, and these insect evidences may shed light on different aspects of the crimes. In order to interpret a crime scene, it is important to know which species of insects are infesting the body and about their habits and environmental requirements. Hence, proper identification of insect and other arthropod species of forensic importance is the most crucial part in the forensic entomology

Many insects are attracted to certain stages of decomposition of animals and they will not occur simultaneously on a cadaver, but in a more or less predictable chronological sequence, known as insect succession (Megnin, 1894). Diptera and Coleoptera are the main groups of insects associated with the decomposition process (Carvalho and Linhares, 2001). Dipterans are the primary decomposers to arrive at a dead body, the most common being the species belonging to families Calliphoridae (blow flies) (Fig. 1), Sarcophagidae (flesh flies) and Muscidae (house flies). However, Coleopterans are generally encountered during the later stages of decomposition (Anderson, 2015). Other insect orders having forensic importance include Lepidoptera, Hymenoptera, Anoplura and Dictyoptera. (Goff, 1991). Corpse-associated arthropods can reveal many forensically important facts *viz*., post mortem interval, presence of drugs and toxins in the corpse, genetic profile of an unknown body etc.

Post-mortem interval (PMI) refers to the time between death and discovery of a corpse. By determining the age of developing insects on a body (Fig. 2), it is possible to estimate the time when insects first colonized the body, rather than the actual time of death. This determination would become possible

with precision, as each developmental stage in insects has its temperature requirement, and each species has its own defined number of accumulated degree days (ADD) or accumulated degree hours (ADH) to complete its development. Bala and Sharma (2016) successfully demonstrated the accuracy of accumulated degree hour method in estimating the PMI of the mummified body of a female with the immature stages of *Chrysomya megacephala* (Diptera: Calliphoridae), obtained from the corpse.

Insects are used as substrate for toxicological analysis for detecting drugs and toxins present in the corpse, when conventional medium such as blood, urine or internal organs are no longer available. Qualitative assessment by thin-layer chromatography showed the presence of morphine in maggots of blowfly, *Chrysomya albiceps*, fed on the carcass of rabbit administered with morphine (Salimi *et al*., 2018).

Isolating human DNA from gastrointestinal tract of maggots and analysing its genetic profile for the identification of an unknown body is a molecular approach in forensic entomology (Introna *et al*., 2005). In particular, researches demonstrated that, after ingestion of human tissue, during the digestion process, the hydrolysed host tissues are normally stored in the maggot's crop. Therefore, it is possible to sample the host tissue residues from the crop, subject it to STR analysis and generate a genetic profile for the identification of an unknown body. This kind of analysis is suggested if the food source of the larvae sampled at the scene is in doubt and no corpse is present but larvae are found. But this kind of studies are rare (Amendt *et al*., 2011). If necessary, the identity of the person can be determined by forensic STR typing, by comparing it with existing genetic profiles.

Cases of children and elderly neglect by relatives or nursing staff can be solved by blowfly larvae. Wounds and circumstance of bad hygiene in elderly and very young person will attract certain species of flies. Blowflies are valuable as forensic indicators in cases of abuse, rape and neglect. Insect evidence represents how long a person was abused/neglected. When sexual assault has occurred prior to death, blowflies will be more likely to get attracted and oviposit in these regions (anus and penis or vagina), and investigators can start to suspect a sexual crime.

Many species of fly prefer to specific geographic region and different environments. One species general in city centre may not be obtained in rural areas and vice versa. If city species identified from the dead body obtained in rural area may also show that the body has been moved to a rural site after death (Sumadon, 2002).

Forensic entomology, though not the last word in all death investigations, the evidence from insects, if investigated with the

right techniques, can undoubtedly complement and supplement conventional procedures in forensics.

Fig. 1. Blow fly (Family Calliphoridae)

(**Source**: https://inaturalist-open-data.s3.amazonaws.com/photos/150885/large.jpg)

Fig. 2. Collecting insect samples from corpse

(**Source**: https://www.sfu.ca/content/sfu/fass/meaning/better-future/bad-guys-good-bugs.jpg)

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