H97 Ecology of Decomposition: A Chemical and Biological Profile of the Maggot Mass

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After attending this presentation, attendees will understand the chemical and biological factors that influence maggot mass ecology and its potential use as a forensic tool.

This presentation will impact the forensic science community by exploring a new microenvironment and establishing a more accurate and reliable method to estimate the postmortem interval based on possibly predictable characteristics of maggot masses.

Carrion decomposition is largely attributed to microorganism and insect activity. These two pathways of nutrient renewal have traditionally been considered as separate mechanisms of decomposition and studied as such; however, recent research has shown that interactions between insects and microorganisms culminate in the formation of maggot masses. Yet maggot masses associated with carcass decomposition harbor a microenvironment that has not been fully analyzed. In this study, a preliminary chemical and bacterial profile of the maggot mass is provided using a swine model (*Sus scrofa domesticus*). More specifically, this is the first comprehensive view into the bacterial microbiome of the maggot mass through sequencing the V4 region of the 16S rRNA gene. To provide further description of the microbiome, culture techniques were utilized to establish what constituents of this community can be easily observed in the laboratory. In doing so, the goal is to understand the ecology of the maggot mass so that it can be used to its full forensic value.

Three swine carcasses were decomposed in a tropical savanna ecosystem in Palolo Valley, Oahu, HI. Swine were killed via electrocution and placed at the site one hour postmortem. Microbial samples were collected when the maggot masses became established (74h postmortem). The maggot mass was swabbed twice daily from 74h-128h postmortem for sequencing and culture. Simultaneously, the skin was swabbed near the maggot masses for culture. Additionally, the pH, oxidation-reduction potential, and the temperature of the maggot masses were measured. Swabs for culture were immediately transferred to the laboratory and streaked onto standard nutrient agar and incubated at 22°C for isolation. Once isolated, bacterial samples were identified via Matrix-Assisted Laser Desorption/ Ionization-Time of Flight (MALDI-TOF). Swabs for sequencing were transferred to the laboratory and stored at -20°C until the survey was complete, then sequenced.

The maggot masses exhibited obvious chemical trends. From 74h to 104h postmortem the pH became more alkaline (6.4 ± 0.5 to 7.4 ± 0.2). At 104h to 122h postmortem, the pH became more acidic, decreasing from 7.4 ± 0.2 to 6.7 ± 0.1. During the final day of the study, the pH regained alkalinity and rose to 7.6 ± 0.1. Oxidation-reduction potential increased from -283milliVolts (mV) to -78mV indicating a highly reducing environment. The temperature remained relatively constant, averaging at 35.6°C within the maggot masses and generally higher than the environmental temperature averaging at 26.8°C. Microbial data will be presented but a diverse bacterial community dominated by Proteobacteria (specifically Gammaproteobacteria), Firmicutes, and Bacteroidetes is anticipated. This community is expected to change over time as decomposition progresses, putrefactive bacteria migrate, insects oviposit on the carcass, and resources become depleted.

The results show that the chemistry of the maggot mass changes during decomposition. The shift in pH is similar to previous studies and probably occurs when macromolecules are broken down into smaller amino acid constituents. As those amino acids were further broken down into inorganic compounds such as ammonia and incorporated into the environment, the maggot masses regained alkalinity, increasing the pH. This noticeable trend in the maggot mass pH has great potential as a forensic tool as a postmortem interval estimator. The oxidation-reduction potential indicated a highly reducing environment that corresponds with sulfur reduction. From this measurement, the presence of sulfur-reducing bacteria is expected, possibly verifying the assumption that phylum Proteobacteria is a part of this maggot mass community. Finally, the maggot mass temperature being higher than environmental temperature indicates that the bacterial community might include thermotrophic taxa. These data provide novel insight into the ecology of the bacterial community. More tests, specifically in different seasons and climates, are needed to verify if these trends are consistent and predictable.

Microbiome, Postmortem Microbiology, Taphonomy

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