Effects of Ethanol Exposure on Decomposition and Insect Colonization

Savannah Ewing, Michael Koch In Jung Lee, Amanda Pena, Seth Stroupe
Texas A&M University - College Station

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Abstract: In the field of forensic entomology, various factors go into account during the determination of a post mortem interval. These variables arise from different scenarios that affect insect colonization and decomposition. One scenario, involves the use of alcohol, due to its availability in the market and the effects it has on different species of insects. This leads researchers to believe that alcohol does indeed change the pattern of decomposition in test subjects containing alcohol. By using chickens, it was observed that after a week of exposure both the specimen containing the alcohol, as well as the control chicken, decomposed at nearly the same rate. This result could be explained by close proximity of the two specimens.

Keywords: Forensic entomology, alcohol, PMI, colonization

Death investigations rely on various techniques to determine the post- mortem interval (PMI) of a subject, drawing from a wide range of fields and disciplines to obtain accurate results. Forensic entomology is one of the most useful disciplines in determining PMI, due to information gathered from insect colonization of the subject. Insect colonization follows a temporally dependent pattern based on the state of decomposition. This aspect is generally affected by various fluctuations in temperature, exposure, and bodily disturbance, all of which have been studied extensively in forensic entomology literature.

However, the physical condition of a subject at the time of death, has the potential to affect the decomposition process, particularly if some sort of chemical is present on or in the body. A chemical of interest for forensic investigations involving human subjects, is alcohol, due to its availability and has been known to cause sudden death. Research concerning the effects of drinking alcohol on forensically significant arthropods appears scarce, since multiple searches in EBSCOHost databases produced few relevant results. However, studies do exist that discuss the effects of other types of alcohol on flies and beetles.

Flies have been recorded to have differing reactions to ethanol on the basis of sex. Male *Drosophila melanogaster* have a higher tolerance for ethanol in terms of resisting ethanol sedation when compared to female flies, while females have less ethanol hyperactivity than males (Devineni and Heberlein 2012). This variation may indicate the mating and subsequent colonization activities of flies on a body exposed to high amounts of alcohol will be delayed. In addition, particularly those produced by specific flowering plants (Vuts et al. 2010). This suggests that the presence of alcohol on or near a victim may lead to beetles being observed earlier than expected at a crime scene.

Given this information, it is likely that the presence of drinking alcohol will have some sort of effects on human decomposition and insect colonization. However, due to monetary, spatial, and legal limitations,

chickens and 200-proof ethyl alcohol was used as proxies in this experiment. Our null hypothesis states that soaking a chicken in 200-proof ethyl alcohol for 24 hours will have no significant effect on either decomposition or arthropod colonization; the alternate hypothesis states that these conditions will slow decomposition and delay arthropod colonization.

Materials and Methods

The null hypothesis for this experiment stated that soaking a chicken in 200-proof ethyl alcohol for 24 hours would have no significant effect on either the rate of decomposition or arthropod colonization. The alternative hypothesis stated that soaking the chicken in 200-proof alcohol would slow decomposition as well as the colonization by arthropods. In order to test these hypothesis, two chickens were used: one soaked in 200-proof alcohol, and the other was a control chicken with no alcohol. Chickens were then thawed out on the day that they were placed out in test field. Both test chickens were placed out on the field on the same day at the same time.

Both chickens were laid out laterally on their right sides under the same metal wire cage. Another groups control test chickens were placed under the same cage a few feet away.

Collection took place the following week at approximately the same time of day that the test chickens were placed in the testing field. Photos were taken of the subjects, and a few adult fly specimens were collected. All collected adults were placed in vials filled with ethanol for storage until they could be identified. Close proximity of the two test subjects made determination of which subjects were colonized by particular species. Maggot masses were identified and collected, and the temperature of the masses was also recorded using a thermometer. Maggots were then collected from each mass and blanched with hot water to ease identification. Beetles were collected form the test chickens as well and later identified.

Results

The species data collected from each of the matched pairs of chickens in the experiment lead to the assumption that no significant change in rate occurred between the test subject and the control subject. The close proximity of the test subjects to one another, made identifying and determining the presence of a certain species on a single test subject. All of the collected specimens were caught either between test subjects, or in the near air proximity above the test subjects, rendering identification useless. The only useful specimens collected were the identifiable 3rd instar fly larvae.

The maggots were found underneath the wings, and other feather covered areas of the chickens. Both test and control subjects had *Cochliomyia macellaria* (Townsend 1915) and *Phormia regina* (Meigen 1826) larvae, along with *Sarcophagidae* (Maquart 1834) family larvae. Due to the stage of decay, these maggots were expected to be present on the subjects, rendering any hypothesis conclusions null.

The five degree temperature difference between the test and control chicken was likely due to the inclusion of *Lucillia* (Robineau-Desvoidy 1830) species on them, meaning that they comprised enough mass to have increased the temperature of the mass by five degrees.

DISCUSSION: The experiment tested the effect of pure ethanol on insect and arthropod colonization patterns on a medium sized chicken carcass. According to primary literature, alcohol should have slowed the normal succession of colonization, while normal patterns of should have been observed on the control chicken. However, after one week of exposure, little difference was distinguished between the test and control subjects.

The test and control chickens were generally in the same state of decay (active purge) at the time of collection. During the collection of flies and beetles from the carcasses, in most cases, it was difficult or impossible to determine which species of ether came from which carcass: test or control. The most common species found on the chickens were *Cochlyomya macellaria, Sarcophagidae spp,* and *Phormia regina.* Several species of the family *Lucillia* were also found only on the test chicken, not the control. However, due to the difficulty in rearing *Lucillia*, little can be deduced from their behavior. The colonization and pattern of decomposition were similar on carcasses leading to the conclusion that alcohol had little to no effect on rates of colonization, particularly when the temporal separation between the chicken sample deposition was taken into consideration.

Discussion

The hypothesis that soaking chicken in 200 proof ethyl alcohol for 24 hours will slow decomposition and delay arthropod colonization of the chicken was supported for only one out of four groups. It was determined that the lack of beetle activity on the treated chicken constituted a delay in arthropod colonization. However, group's 1, 2, and 4 reported finding beetles on their test chicken. Group's 2 and 4 reported no difference in the decomposition rate between the test and control chickens. Group 2's results most closely matched what Tabor et al. (2005) found in their study since no major differences were found. Group 1 did report that their test chicken was not as far along in the decomposition process as their control chicken, but a significant delay in insect colonization was not found.

This study, along with the other studies cited, show the importance of understanding factors that affect PMI estimations. Investigators should keep in mind these factors in order to determine a PMI estimation with the least amount of error. Further research is still needed on the specific effects of alcohol on decomposition rates and insect succession to further reduce inaccuracy in PMI estimations.

References Cited

Devienni, A. V., U.H. Heberlein. 2012. Acute ethanol responses in Drosophila are sexually dimorphic. Proceedings of the National Academy of Sciences 109:21087-21092

Vuts, J., Szarukan, M. Subchev, T. Toshova, M. Toth. 2010. Improving the floral attractant to lure Epicomentis hirta Poda (Coleoptera: Scarabidae, Cetiniinae). Journal of Pest Science 83:15-20