The Accelerating Effects of Burning on Carrion Decomposition

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Abstract: In some homicide cases, the victim's body is burned. There is little data that suggests that burned organic tissue decomposes at a faster rate than unburned tissue. This experiment used chickens to test if the burning of tissue had a faster decomposing affect than unburned tissue. Decomposition rate was examined through how many insects were on the carcasses in different amounts of sunlight. It was determined that a burned carcass, where there is some sunlight, decomposes faster than an unburned carcass. This information could be used to determine the time of death of a victim that was burned after death.

Keywords: homicide, burned victims, decomposition rate

Decomposition of organic tissue is affected by several variables including temperature, soil pH, and moisture. It can also be affected by burning or charring the remains. In homicides, the burning of tissue remains is often a method used to dispose of physical evidence (Gruenthal 2012). Ariel Gruenthal (2012) documented that there are some differences in the decomposition of burnt and unburnt tissue. In the study, researchers observed that patterns of decomposition were distinctly different for the control and experimental remains (Gruenthal 2012). The control group displayed expected progression patterns, with decomposition beginning at the head, and then continuing backwards towards the neck and torso of the body (Gruenthal 2012). In contrast, the burnt body had decomposition originating at the torso and then spreading to the neck, head, and limbs (Gruenthal 2012). In addition, decomposition rates of burnt remains are likely to be slowed, in about the same way as cooked meat keeps longer than fresh meat (Spitz 2006), this is because heat denatured tissue is a less viable substrate for bacterial growth (Spitz 2006).

This study analyzes differences witnessed in the decomposition of two chicken carcasses: one left alone to serve as a control and the other severely burnt. It was hypothesized that the burning of the remains would affect insect colonization, which would influence the rates at which decomposition was occurring, and thus calculations concerning postmortem intervals.

Materials and Methods

Site location

A study of insect succession on burnt chicken remains was conducted at the TAMU Rangeland Science Facility in College Station, TX on April 11, 2013. The location was a semi-bushy area that had areas that were directly exposed to sunlight, partially shaded, and completely shaded. The study was conducted during the spring and lasted for seven days.

Chickens

Six whole chickens were thawed on April 9, 2013 at 6:00 pm. Three chickens were used as controls and the other three as experiments. After the chickens were thawed, three were put onto an outdoor grill in order to be burned using Kingsford charcoal and lighter fluid. Each chicken was allowed to blacken and char before being flipped to their opposite side to be burned and charred. The chickens were allowed to cool for ten minutes and were bagged and placed in a refrigerator. On April 11, 2013, the chickens were transported in a cooler to the TAMU Rangeland Science Facility. The chickens were placed into three different areas: in direct sunlight, partially shaded and completely shaded. The control and experiment chickens were placed side by side. The chickens were left out for seven days, covered with a metal cage to be protected from large scavengers

Collection procedure

During collection, replicates were observed and photographed for assessment in the categories: (1) decomposition state of the carcass, (2) the presence of maggot masses, (3) and the insect species present. Insects associated with carcasses were sampled through aerial sweeps and manual collection (stickytrap/forceps). Collected specimens were labeled in relation to replicate number, sampling time, and collection site. Adult flies and 2nd/3rd instars were identified based on published keys.

Results

The control chicken in group 1 showed a faster decomposition rate than the burnt chicken with the control already into the purge and skeletonization processes whereas the burnt chicken was still in bloat. However, group 2 had their burnt chicken decompose faster than their control. The burnt chicken exhibited skeletonization, whereas the control for Group 2 was still in the bloat stage. The Group 3 chickens were different than both Groups 1 and 2 due to the fact that they had nearly identical insect succession even though the burned chicken was described as completely skeletonized and the control was in the late stages of decomposition.

The first group of chickens were both mainly colonized by flies of the family Sarcophagidae, found as 3rd instar maggots, and Piophilidae, found as adults, with nearly the same numbers of each on both the control and test chickens, even though the control was between purge and skeletonization and the burned chicken was in late bloat. Both the control and test chicken had Dermestid beetles except for the burned chicken, it had one less beetle on it than the control. One beetle of the Histeridae family was found on the control chicken. Many more beetles found on the test chicken, including six carrion beetles of the family Silphidae, three Rove beetles of the Staphylinidae family

The Group 2 chickens in the control chicken, at the back end of bloat, had P. regina 3rd instar larvae, Sarcophagid 3rd instar fly larvae, Dermestid beetles, Histerid beetles, one beetle of the Trogidae family, and one beetle of the Rhizophagidae family. The burned chicken, in its dry decay stage, only had P. regina larvae, Sarcophagid larvae, Dermestids, but also beetles of the Staphylinidae family and from the Scarabaeidae family. The control chicken in this group was the only chicken in the entire experiment to have a maggot mass of P. Regina and Sarcophagids.

The specimens collected from the Group 3 chickens varied from control to test chicken. One adult fly of the Sarcophagids was collected from the control chicken with the rest of the collected insects from the Staphylinid, Silphid, and Histerid beetles. There were a few more flies caught from the test chicken, including, one adult Lucilia cuprina, one adult Ophyra spp., and two 3rd instar Piophilid larvae. As for the beetles collected, there were much less Staphylinids, slightly less Histerids and much more Silphids than the control chicken.

Table 1. Insects found on unburned carrion.

Control Chicken					
Group Number	**Insect Species**	**# Found**	**Development Stage**	**Maggot Mass?**	**Mass Temperature °F**
1 Direct Sunlight	Sarcophagidae	12	3rd instar	No	NA
	Piophilidae	16	Adult	No	NA
	Sarcophagidae	1	Adult	No	NA
	Dermestidae	3	Adult	No	NA
	Unknown Fly	1	Adult	No	NA
	Histeridae	1	Adult	No	NA
2 Partially shaded	Trogidae	1	Adult	No	NA
	Histeridae	6	Adult	No	NA
	Phormia regina	27	3rd instar	Yes	90
	Sarcophage spp.	24	3rd instar	Yes	90
	Dermestidae	14	Adult	No	NA
	Rhizophagidae	1	Adult	No	NA
3 Completely shaded	Sarcophagidae	1	Adult	No	NA
	Staphylinidae	14	Adult	No	NA
	Siliphidae	1	Adult	No	NA
	Histeridae	12	Adult	No	NA

Table 2. Insects found on burned carrion.

Test Chicken					
Group Number	**Insect Species**	**# Found**	**Development Stage**	**Maggot Mass?**	**Mass Temperature °F**
1	Sarcophagidae	10	3rd instar	No	NA

Direct Sunlight	Piophilidae	16	Adult	No	NA
	Phormia regina	1	Adult	No	NA
	Silphidae	6	Adult	No	NA
	Staphylinidae	3	Adult	No	NA
	Dermestidae	2	Adult	No	NA
	Unknown Beetle	1	Larvae	No	NA
2 Partially Shaded	Staphylinidae	9	Adult	No	NA
	Scarabaeidae	6	Adult	No	NA
	Dermestidae	3	Adult	No	NA
	Phormia regina	3	3rd instar	No	NA
	Sarcophaga spp.	13	3rd instar	No	NA
3 Completely Shaded	*Lucilia cuprina*	1	Adult	No	NA
	Piophilidae	2	3rd instar	No	NA
	Ophyra	1	Adult	No	NA
	Staphylinidae	3	Adult	No	NA
	Siliphidae	7	Adult	No	NA
	Histeridae	9	Adult	No	NA

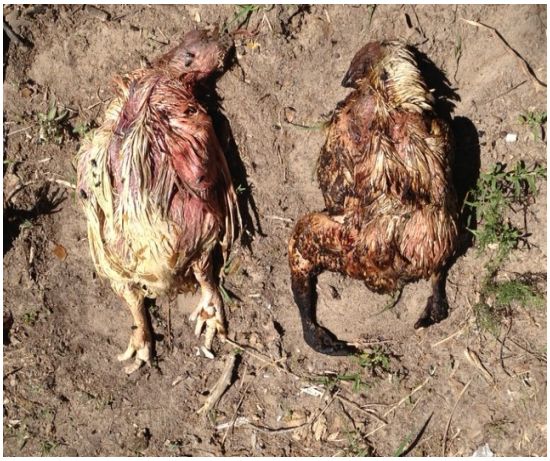

Figure 1. Top view of Test (Right) Chicken o

Figure 2. Side view from bottom of Control (Left) and Test (Right) Chicken on Day 0

Figure 3. Top view of Control (Left) and Test (Right) Chicken at the time of insect collection

Discussion

The hypothesis was confirmed in the fact that the colonization of insects was affected by being burned, however the reduction of decomposition due to the change in the succession patterns of insects was only apparent in one out of three groups of chickens. Group 1 showed that the control chicken was at the end of purge and the start of skeletonization while the burned chicken was still in bloat. The succession pattern of insects was similar for both, but there was a small difference in the Dermestids, which show up in late decomposition; this fact indicates that the control chicken had been decomposing more quickly. Also, there were many more carnivorous, maggot-feeding beetles (Silphids and Staphylinids) collected off of the burned chicken, than the ones collected off of the control. These carnivorous beetles show up when there are many maggots to prey on, which means they will be more present during bloat and early purge (Byrd and Castner 2010). The control chicken was in this stage. Therefore, the burned chicken was at an earlier stage of decomposition than the control.

The reason for Group 2 having a faster decomposition rate for the burned remains than the control may have been due to the chicken not being burnt enough combined with the issue that the skin of the abdomen of said burnt chicken ruptured, providing, (1) an unburned substrate, and (2) a much larger, more suitable substrate for colonization than provided by the non-ruptured control chickens. Beetles that feed on dry remains and show up at the end of decay and the beginning of skeletonization, such as ones from the families, Trogidae, Scarabaeidae, and Dermestidae. These beetles were prevalent on the remains of the burned chicken but were not found on the control, there were many more Dermestids on the control than on the test chicken. This could be that the Trogids and Scarabs outcompeted the Dermestids quickly after they arrived on the burned remains. This all means that the burnt chicken decomposed faster since there were many more dry-stage beetles on it than the control. Another point is that there was a maggot mass of Calliphorid and Sarcophagid maggots, which showed up mainly at the bloated stage of

decomposition, along with carnivorous beetles from Staphylinidae and Histeridae, which showed up shortly after the maggots, on the control chicken, which was at the bloat stage, but not on the burnt chicken. This further proves that the burned chicken decomposed much faster since there was still a maggot mass on the control chicken.

Both of the chickens from Group 3 showed similar insect succession for both the control and test Chickens. They both had similar numbers of flies, despite the few Piophilid maggots, and similar amounts of carnivorous beetles on both carcasses. It was odd that there were no dry-remain beetles found since one chicken was skeletonized and the other very close to that point. It could be possible that there was no colonization by these beetles, but Dermestids prefer darker areas and this chicken was in complete shade (Byrd and Castner 2010). It could have been a human error of incorrect identification. It is, however, possible that the burned chicken had decomposed slightly faster than the control due to the colonization by the Piophilid maggots and incidence of the adult Ophyra. Both of these flies can be found in active or dry decay but will colonize after Calliphorids and Sarcophagids (Byrd and Castner 2010). Since the control had a Sarcophagid collected from it, there is a slight chance that the control is earlier in decomposition than the burnt chicken due to this.

This information could be used in forensic cases that involve burned organic tissue. In order to improve this experiment, one could replace the chickens with pigs. Pigs are evolutionary more closely related to humans than birds, this could insure more accurate results in the rate of decomposition of burned victims. If the time of decomposition is known, then the time of death could be known, which is vital to a homicide case.

References

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