



Original communication

## Modification of postmortem wounds by *Dermestes maculatus* (Coleoptera: Dermestidae) activity: A preliminary study

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### ABSTRACT

The purpose of this analysis was to evaluate the effects of insect activity on hacking trauma which was inflicted with a small cleaver and a razor blade under controlled conditions. Three pig hooves were each subjected to a blow with a small cleaver and a cut with a razor blade prior to insect exposure. We used *Dermestes maculatus* DeGeer 1774 species. These beetles made principally depressions and destruction on both wounds, and bites were observed on the edges of the wounds. As time passed and insects fed and refuge, chop marks were deformed and disappeared, taking this less than a month. Thus, *D. maculatus* could mask postmortem wounds and probably premortem wounds, and so the cause of death.

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## 1. Introduction

Human or animal remains can suffer alterations after death which can result from different factors such as physical variables; environmental conditions; the stage of the corpse; the proliferation of seaweed, fungi, and plants; and the activity of scavenger animals, among others.<sup>1</sup> Insects are an important group involved in carrion consumption and are thus of forensic interest. Care must be taken during examination to determine if insect artifacts have taken place on other superficial antemortem injuries,<sup>2,3</sup> resulting in the modification of wounds and/or loss of identifying features,<sup>4–6</sup> for instance a gunshot wound or even more nail abrasions in the neck after manual strangulation.<sup>4</sup> Also, insect activity can simulate vital lesions.<sup>5–7</sup> Moreover, injuries can be confused with postmortem injuries caused by aggressors.<sup>5</sup>

Stabbings, one of the most frequent ways of committing homicide, is by inflicting injuries with a sharp cutting or stabbing

weapon; and cutting of the wrists and throat with hesitation scars, is one of the most common suicide methods.<sup>8–12</sup> Sometimes the pattern can change.<sup>9,13</sup> The weapons that have been usually used in stabbings are knives and blades.<sup>9,13–16</sup>

By studying the wound itself, it may be possible to determine the instrument used to inflict the injury and to establish whether the particular attack was fatal.<sup>17,18</sup> For example, a neat wound indicates the use of a sharp object, such as a knife, whereas ragged wounds would suggest that a blunter instrument was used. The direction of cuts can be examined to determine whether they were made by the victim or by someone else.<sup>10,19–21</sup> The motion of the sharp object can be ascertained depending on whether a cut (the incision is wider than it is deep) or stab (the incision is deeper than it is wide) mark is left.

Although Coleoptera is an important order in forensic entomology, few studies were performed to study the taphonomic activity of beetles on cadaveric tissues. They showed that beetles (Cleridae, Dermestidae, Tenebrionidae and Scarabaeidae) could cause marks on cadaver tissues and other artifacts.<sup>5,6,22,23</sup>

Taking into account all the above-mentioned, the aim of this study was to conduct research into the effects that *Dermestes maculatus* can produce on postmortem wounds on animal tissue.

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## 2. Materials and methods

To perform this study, adults of *D. maculatus* were selected from a culture established in 2010.<sup>24</sup> Sixteen adults were placed inside a 22 cm deep × 10 cm diameter glass container filled with 3 cm of sand. The neck of the container was greased with mineral oil and the opening was covered with a piece of voile mesh secured with a rubber band to prevent insects from escaping. Protection and a water source were provided by introducing a piece of cotton wet with distilled water and pieces of soft wood. A pig trotter without cuts was used as control (Fig. 1a) and to evaluate the changes that postmortem wounds can suffer, other pig trotter was first cut with a small cleaver (wound 1), and then in a different place, with a razor blade (wound 2) (Fig. 1a, b). Fig. 1 b and c inserts show the weapons used to make the wounds. These were approximately of 10 cm long each one and the wound 1 was deeper than wound 2. Three replicates were carried out. The trotters were photographed for control purposes and then placed in the containers with insects. Containers were maintained in an OBSAR incubator at  $24 \pm 0.1$  °C,  $55.4\% \pm 2\%$  relative humidity and 12:12 h day/night cycle. Insect activity was observed and photographed every 4 days for 1 month and a half. Photographs were taken with a NIKON COOLPIX 150 (Nikon, Argentina).

## 3. Results and discussion

We observed that during the first days, beetles fed on other parts of the trotters, especially of soft tissues, leaving marks in those areas. The marks made by beetles can be differentiated of postmortem wounds made by blunt objects, because knives with single cutting edges such as kitchen knives cause wounds that have clean or smooth cut edges, a clearly pointed edge, with the opposite edge being squared off or split, the absence of abraded margins of the wound and there is little damage to the adjacent

tissues.<sup>9,10,12,19,20,25</sup> These characteristics matched with the wounds inflicted in the pig trotters in our study.

Casts have been attempted on soft tissue cut marks with some success.<sup>26</sup> Some works have examined the force necessary to penetrate the soft tissues involving stabbing and considering how the different aspects of knife geometry influence sharpness, and the mechanism of knife penetration into the skin.<sup>8,11</sup> Pounder and Reeder<sup>17</sup> made stab wounds in porcine cartilage with different types of knives and analysed the injuries produced by them. Until now there were no studies under controlled conditions which described insect activity effects on postmortem wounds. After 8 days beetles made depressions in wounds 1 and 2 of different trotters. At day 10, wound 1 presented destruction; two days after appeared more depressions and destruction in wounds 1 and 2 (Fig. 1d, e). We also observed in less number, holes (in wound 1 at day 17 and in wound 2 at day 26), (Fig. 1f) a combination of hole and depression (at days 17, 20 and 30), and gnawing (at days 17, 20, 23). A total of 13 marks plus destruction and gnawing were found (1 hole, 9 depressions, and 3 depressions combined with holes).

Another feature that we detected was that the wounds 1 and 2 were deformed as time passed due to decomposition and insect activity. The borders were widened and acquired ragged form due to the bites (Fig. 1d, e). The marks observed in this study were first described in Zanetti et al.<sup>22</sup> When the insect activity deformed the inflicted wounds (changed their original form), these could not be discriminated from that made only by the beetles. This could be something similar to that observed by Campobasso et al.<sup>3</sup> with ants bites, which can mimic antemortem injuries or can be easily misinterpreted as patterned abrasion due to the imprinted effect of a blunt or offending object; or also due to brush or chemical burns.<sup>7,27,28</sup>

This work provided helpful information about how *D. maculatus* could change and mask postmortem wounds and probably pre-mortem wounds, and so the cause of death; and when lesions could appear (chronology), to forensic pathologists and entomologists.



**Fig. 1.** Marks caused by *D. maculatus* activity. a) Control. b) Small cleaver cut. c) Razor blade cut. d) Depressions and destruction in wound 1. e) Depressions and destruction in wound 2. f) Hole.

**Conflict of interest**

The authors declare that they have no competing interests.

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None declared.

**Ethical approval**

None.

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