

RESEARCH ARTICLE



A Survey and Morphological Description of Forensically Important Insects Associated with the Decomposition of Goat and Sheep Corpses

in Iraq.				
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ABSTRACT

In forensic entomology, both beetles and flies are essential for estimating the postmortem interval (PMI), but they have different roles throughout the decomposition process. Diptera, mainly flies, are the first to colonize a corpse, which is essential for understanding early decomposition. Beetles are crucial for longer PMI estimates, highlighting the importance of studying both in forensic investigations. Forensic entomology is a branch of forensic science that uses insects found on corpses to help solve criminal cases and to provide important information for estimating the postmortem interval (PMI). It is also applied to clarify other relevant details, such as the circumstances of death and its cause. The present study was conducted to include a survey and a brief description of some forensically important insects from goat and sheep carcasses in several governorates of Iraq. These were Altun Kopry, Daquq, and Taza in Kirkuk; Khanaqin and Saadia in Diyala; Kalar in Sulimani; Qostappa and Shaqlawa in Erbil; and Tuz Khurmato in Salahaddin, from January to July 2023. Seven species were identified. Three of these are part of the order Coleoptera: Creophilus maxillosus (Linnaeus), Dermestes maculatus (Kugelann, 1792), and Necrobia rufipes (Fabricius, 1781). Four species are from the order Diptera: Musca domestica Linnaeus, 1758; Sarcophaga africa (Wiedemann, 1824); Calliphora vicina Rob.-Desvoidy, 1830; and Chrysomyia albiceps (Wiedemann). Taxonomic keys have been developed for some families of these insects. Their distinctive characteristics were noted, and the adults, antennae, and male genitalia of the species were photographed. The localities and dates of the collection were recorded. Keywords: Description, Forensic insects, Diptera, Coleoptera, Iraq.

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INTRODUCTION

The study of insects in forensic science is defined as forensic entomology. The use of the knowledge of insect biology to legally investigate cases of questionable deaths of humans and animals is carried out [1,2,3]. Insects play a major role in the decomposition of organic matter. Ants (Hymenoptera: Formicidae) are important in forensic entomology as they influence decomposition and impact the estimation of the post-mortem interval. Their activities, such as biting, stinging, and altering blood patterns, can provide valuable forensic evidence in criminal investigations [40]. Fly larvae Diptera, particularly those from the families Piophilidae, Calliphoridae, Muscidae, and Sarcophagidae, are the most common arthropods found on decomposing human corpses and animal carrion [4] and [5]. Calliphoridae are the first insects to colonize human corpses during faunal succession [4,6,7]. Therefore, the larvae of Calliphora vicina (blow fly), Musca domestica (house fly) and Sarcophaga africana (flesh fly) have been used in legal investigations [8,9,5]. In addressing issues related to postmortem interval (PMI) estimation, time of death, sexual assault, suicide, murder, child abuse, and neglect [10,11,12]. The beetle order Coleoptera includes several forensically important families, such as Dermestidae, Staphylinidae, Silphidae, Cleridae, Histeridae, Scarabaeidae, Tenebrionidae, Nitidulidae, and Trogidae [13,14,16,18,19]. Adults and immature stages of these beetles can serve different roles in the decomposition process based on their feeding behaviour. Necrophagous species are insects/arthropods that feed directly on remains or the fluids released from remains during the decomposition process. These include many species of the order Diptera (true flies) from the families Calliphoridae (blowflies) and Sarcophagidae (flesh flies), and some species of the order Coleoptera (beetles) [4]. Staphylinidae species are found in nearly all moist environments, including carrion and dung. Creophilus maxillosus (Linnaeus), a member of the Staphylinidae family, has both larvae and adults that are predators, feeding on organic remains and dipterous larvae. They invade carcasses at the first signs of decay, following dipterous larvae colonization, and persist throughout the later stages of decomposition [4,19]. Dermestid beetles typically appear in the later stages of decomposition, once the body begins to dry out. Forensic entomologists search for these beetles at crime scenes to help establish the time of death [20]. The species Dermestes frischii Kugelann, Dermestes ater De Geer, and Dermestes maculatus De Geer are among the most significant in forensic entomology. The larvae of Dermestes ater are essential

for estimating the post-mortem interval. *D. maculatus* is known for efficiently stripping skin and hair from corpses, making it valuable for cleaning bones, which can then reveal critical information, such as age, trauma evidence, gender, and possible knife marks [19,20]. The family Cleridae has a limited role in forensic entomology, with some species appearing on carrion during the dry, late stages of decomposition. For example, *Necrobia rufipes* (Fabricius) infests dried animal skins and bones, preying on various species of necrophagous insects [19].

This study aims to survey and collect forensically important insects associated with sheep decomposing corpses and briefly describe the species.

MMATERIALS AND METHODS

This study includes collecting more than 200 specimens from decomposed corpses of goats and sheep in some governorates of Iraq, including (Altun Kopry and Daquq and Taza in Kirkuk); (Khanaqin and Saadia in Diyala); (Kalar in Sulimani) (Qostappa and Shaqlawa in Erbil), (Tuz Khurmato in Salahaddin) from the period of January to July 2023. The specimens were collected by using the air net, aspirator and rearing the larval stages of some species tile the adults. Six specimens four male and two female placed in boiling water for 10-15 minutes to soften their body parts. The body separated by using two fine pins into Head, Thorax, and Abdomen. The head and abdomen are placed in a beaker of 50 ml containing 20 ml of 10% Potassium Hydroxide (KOH), then put on (heater source) with shaking for 15-20 minutes to dissolve the lipids. After that, the samples were immersed in distilled water for 3-4 minutes to neutralize the alkali. These parts were placed in 25% ethyl alcohol and dissected under a binocular microscope. Next, they were transferred to 50%, 75%, and 100% ethyl alcohol for two minutes each to dehydrate the samples. Following, they were put in xylene for two minutes for translucency. The part was transferred to the Dibutylphthalate Polystyrene Xylene (DPX) solution for preparing slides for testing [22,23]. For photographing the adults and important parts (Antenna and Male genitalia), a digital camera (Ucmas series microscope camera) was used. The body and its parts were measured by using an eyepiece linear micrometre in a binocular microscope. The Coleoptera species were identified by using the keys [24,25]. While the dipteran species were identified with the help of available literature and keys of [25,26,27,28,29,30]. The samples were kept in the insect museum of Plant Protection department, College of Agricultural Engineering Sciences of Salahaddin University.

RESULTS and DISCUSSIONS

Description

First: Order Coleoptera

Key of some families associated with forensically important insects [31]

1. Elytra short, 2-7 of abdominal segment are exposed. Staphylinidae

2. Body black color (Fig.2a). 11th antennomere shorter than 10th (Fig.2b). Mandibles bidenticates.

1. Family Staphylinidae

Creophilus maxillosus (Linnaeus)

Description

Body (Fig.1a): Elongated, black, white, moderately convex. Length 13.8-20.4 mm.

Head: Black slightly convex. Frons black. Clypeus black. Eyes black, oval-shaped, length 0.7-0.9 mm. Labrum circular shaped. Mandible robust, apical tooth hook shaped, terebral tooth very small. Antennae (Fig.1b), dark brown, beaded, consists of 11 segments with the last five segments forming a club, 11th segment semi oval shaped, 1.6 times as long as the 10th. **Thorax:** Pronotum black, barrel-shaped, surface, the sides with dense of black and yellow seta, dorsally bare. Elytra short, black color, surface covered by dense of gray setae. Legs black, protibia outer margin with row of spines. **Abdomen:** Black, oval, covered with dense of yellow -gray setae.

Male genitalia: Aedeagus (Fig.1c) brown. 1.7-2.5mm long. Phallobae oval. Median lobe sclerotized, laterally concaved, two pieced and distinctly narrowed through apical, upper lobe acute, lower lobe wide. Inner sac with two heavily sclerotized rod like sclerites. Parameres strongly sclerotized, basally triangular shaped with long setae on apical. The results agree with the study of [32].

Examined samples: The samples were collected from the carrions of sheep in different localities (Qoshtappa, Bensalawa and Shaqlawa) of Erbil Governorate, Kurdistan Region- Iraq during April and July of 2023.



Figure 1: *Creophilus maxillosus* a. Male (Dorsal view)3X b. Antenna c. Male genitalia; Scale bare =1mm

2.Family: Dermestidae - Skin beetles

Dermestes maculatus (Kugelann, 1792) **Description**

Body (Fig.2a): Elongated oval, black, 7.8-10.9mm long, dorsal surface entirely black. **Head:** Nearly globular shaped, black. Eyes prominent, brown, spherical-shaped. Labrum yellow, posterior margin moderately emarginated. Mandibles bidenticates, scrobe densely short, dark brown setoes. Antenna (Fig.2b) dark brown with 11 segments, length 2.0-2.6mm., club three segmented (9-11), the segments 9-10 cup shaped, 11th segment semi-oval, slightly shorter than 9th segment. Each segment with some of brown setae. **Thorax:** Pronotum black color, roughly, surface covered with high dense of pubescence. Elytra shiny black, covered the abdomen, surface with moderate dense of white and black hairs. Legs brown-dark brown, surface with dense of pubescence. **Abdomen:** Dark brown contain of 5 visible segments. Abdominal from ventral surface consist of 5 reddish brown sternites, surface with height dense of white pubescence. **Male genitalia:** Aedeagus (Fig.2c) is dark brown, 2.1-2.7 mm long. Parameres parallel nearly U-shaped between the base and proximal, apical part oval shaped with dense of long setae. Phallobase nearly oval. Phallo-apodemes nearly V-shaped. Median lobe tubular shaped as long as the parameres. The results agree with the study of [33].

Examined samples: The samples were collected from the carrions of sheep in different localities of Iraq includes, (Altun Kopry; Daquq and Taza in Kirkuk); (Khanaqin and Saadia in Diyala); (Kalar in Sulimani) (Qostappa and Shaqlawa in Erbil); (Tuz Khurmato in Salahaddin) during April and July of 2023.



Figure 2: *Dermestes maculatus* a. Male (Dorsal view)7X b. Antenna c. Male genitalia; Scale bare=1mm

3.Family : Cleridae - Checkered beetles

Necrobia rufipes (Fabricius, 1781)- Red-legged ham beetle

Body (Fig.3a): Elongated, shiny metallic green color. Length 3.7–6.9mm.

Head: Nearly globular shaped, metallic bluish green, sparsely punctate. Eyes dark brown, slightly emarginated. Labrum dark yellow, moderately emarginated. Mandible stout with 4 denticles. Antennae (Fig.3b) dark yellow - dark brown, capitate form, consists of 11 segments, length 1.5-1.9 mm.; 9-11 segments formed the club, 9th and 10th segments are transverse, semi equal-sized, about one-half as long as broad; 11th segment nearly square. Thorax: Pronotum bluish-green color, surface covered with moderately dense of setae. Laterally moderately curved, apical and basal angles obtuse, Elytra

green- dark green color, surface with nine rows of punctures. Legs metallic bluish green. Abdomen: Black, consists of 5 visible segments, densely black short setose. Male genitalia: Aedeagus (Fig.3c) brown. Length 1.5-2.1 mm. Phallus nearly tubular shaped, 1.8 times as long as the tegmen. Median lobe slightly sclerotized. Phallobasic apodem nearly tubular shaped, 0.7-0.8 times as long as the phallus. The results agree with the study of [34].

Examined samples: The samples were collected from the carrions of sheep in different localities (Qoshtappa) of Erbil; (Tuz Khurmato) in Salahaddin and Daquq in Kirkuk during March to July of 2023.



Figure 3:*Necrobia rufipes* a. Male (Dorsal view) (5X) b. Antenna c. Male genitalia; Scale bare=1mm

Second: Order Diptera

Key of some families associated with forensically important insects [35].

1. Hypopleura with only weak, scattered hairs or none Muscidae

- Hypopleura with a row of bristles... 2

-Body metallic, green or blue green. Arista pulomose till feathered to tip, the middle. Notoplura with 4 bristles......Calliphoridae

1.Family: Muscidae – House flies

Musca domestica Linnaeus, 1758

Body (**Fig.4a**): Nearly oval shaped, gray color, 5.2-7.6 mm long. **Head**: Globular shaped. Front grayish and narrow. Parafrontalia black color, covered by silver dusty and short setae. Face dark brown, covered by silver dusty. Eyes holotype in male an an-holotype in female. Oceli eyes are three. Antennae (Fig.4b) aristate form, consist of three segments, 0.8-1.3 mm long, the arista completely setose till the apex. Mouthparts are spongy like structure. Maxillary is palp dark brown, nearly clavate shaped, 0.4 - 0.8 mm long. **Thorax:** Gray color. Pronotum small, collar shaped. Mesonotum large, with following chaetotaxy: Acrostical bristles =0+1; Dorso-central bristles =3+4; Notopleural bristle =2; pre-sutural bristle =1; Posthumeral bristles =2; Scutellar bristles =3+1; Humeral bristles=3. Thorax from lateral, Propleuron carries 1 bristle. Mesopleuron 11-12 bristles. Sternopleuron 3 bristles arranged as 1+2. Hypopleuron bare. Wings are hyalin with a yellowish color at their base.

Abdomen: Grey with a dark band and irregular dark spots at the side. Abdomen from ventral view comprised from 5 gray sternites, each side covered by slightly dense of setae and some bristles. Male genitalia (Fig.4c) Yellow, nearly circular shaped, a symmetrical form, right part triangular shaped and the left part is tubular. Phallus slightly curved, short. Basiphallus highly sclerotized, nearly triangular. Paraphallus highly sclerotized; nearly rectangular. Hypophallus sclerotized, apex is tubular. Epiphallus nearly triangular shaped. Acrophallus is membranous and globular shaped. The results agree with the study of [36].

Examined samples: The samples were collected from the carrions of sheep in different localities of Iraq includes (Altun Kopry and Daquq and Taza in Kirkuk); (Khanaqin and Saadia in Diyala); (Kalar in Sulimani) (Qostappa and Shaqlawa in Erbil) (Tuz Khurmato in Salahaddin) during April and July of 2023.



Figure 4: Musca domesticaa. Male (Dorsal view) 5Xb. Antennac. Male genitalia; Scale bare=0.3mm

2.Family Sarcophagidae – Flesh flies Sarcophaga africa (Wiedemann, 1824)

Body (Male)(Fig. 5a): Elongated, dull gray with 4 longitudinal black strips. Length is 9.8 -13.1 mm.

Head: Nearly globular shaped. Fronts and Parafrontal brown covered with golden pollen. Frontal stripe brown bear, 11-12 bristles. Antenna (Fig. 5b) aristate type, brown-dark brown, 0.9-1.4 mm long, arista setose to the 2/3 of apical distance. Eyes holotype in male an An-holotype in female. Mouthparts are spongy type. Maxillary palp dark brown, nearly clavate shaped, bear 9-11bristles.

Thorax: Gray color with black longitudinal stripes. Pronotum small, collar shaped. Mesonotum large, the chaetotaxy are: Acrostichal bristles 4+0; dorsocentral bristles 0+3; notopleural bristles 4; humeral bristles 3; post-humeral bristles 2; scutellum bristles 4+1. Thorax from lateral view consists of propleuron which bear single bristle; stigmatal bristle 1. sternopleural bristles are three. 2:1. hypopleuron bear 9-8 of bristles. metathoracic spiracles yellow, nearly circular shaped. Legs are dark brown black, antero-dorsal surface of foretibia with thee bristles. Wings translucent.

Abdomen: Oval shaped, 5th segmented, possess of black and slivery gray checkered pattern. The middle margin of 5th abdominal sternite deeply emarginated. Male genitalia: Brown -dark brown. Phallus (Fig. 5c) dark brown color. Epiphallus of basiphallus is absent. Hypophallus nearly circular shaped. paraphallus nearly clavate shaped. Acrophallus short, nearly cylindrical shaped. The results agree with the study of [37].

Examined samples: The samples were collected from the carrions of sheep in different localities (Qoshtappa, Bensalawa and Shaqlawa) in Erbil Governorate, Kurdistan- Iraq during April and July of 2023.



Figure 5: *Sarcophaga africa* a. Male (Dorsal view) 5X b. Antenna c. Male genitalia; Scale bare=0.5mm

3.Family: Calliphoridae – Blow flies

Calliphora vicina Rob.- Desvoidy, 1830

Body (Male)(Fig.6a): Robust, dark blue. Length 5.8-11.4 mm.

Head: Vertex shining black. Frons dark blue, consists of 8-9 frontal bristles. Face orange with several row of setae. Paraficial black with thin silvery pollen. Eyes dark brown, oval and holoptic. Antenna (Fig.6b) aristate type, dark brown, 1.1-1.4 mm long, the arista brownish black, with long black seta both above and below for two-third of its length. Maxillary palps orange yellow consists of single segment, clavate shaped.

Thorax: Bluish black, with a thin silvery –whitish pollen. Pollen. Anterior thoracic spiracle is black. Chaetotoxy are: Ac=3+3; Dc=3+3; NpI=2; H=4; PH=3; Prs=1; PpI=1; St =1; Ia=1+2; Sc=5+1. Hypopeluron with row 9-10 bristles. Legs

black, anterodorsal of foretibia with 7-8 bristles. Wings hyaline, Basicosta yellow color.

Abdomen: Metallic dark blue, with a silvery pollen. posterior margin of 5th sternite in male deeply emarginated medially, in female oval shaped.

Male genitalia: Phallus (Fig.6c) dark brown -black. Basiphallus rectangular shaped. Epiphallus knife shaped. Hypophalus sword shaped. The results agree with the study of [38].

Examined samples: The samples were collected from the carrions of sheep in different localities of Iraq includes, (Altun Kopry; Daquq and Taza in Kirkuk); (Khanaqin and Saadia in Diyala); (Kalar in Sulimani) (Qostappa and Shaqlawa in Erbil); (Tuz Khurmato in Salahaddin) during April and July of 2023.



Figure 6: *Calliphora vicina* a. Male (Dorsal view) 5X b. Antenna c. Male genitalia; Scale bare=0.5mm

Chrysomyia albiceps (Wiedemann, 1819)

Body (Male) (Fig. 7a): Metallic blue to green. Length 5.2-9.4 mm.

Head: Vertex green. Frons dark brown to black consists of 12-13 frontal bristles. Clypus brownish black. Facial carina short and narrow. Paraficial black with thin silvery pollen. Face black with several row of setae. Eyes oval, red and holoptic in malae and anholoptic in female. Antenna (Fig.7b) aristate, dark brown, plumose, for all length, 1.0-13mm long. Maxillary palps range consist of single segment, clavate shaped.

Thorax: Green or brownish green, with a thin silvery-whitish pollen. Anterior thoracic spiracle is white. Chaetotoxy are Ac=0+1; Dc=2+3; NpI=2; H=3; PH=0; Prs=1; PpI=0; St=1; Ia=0+1; Sc=5+1. Hypopeluron with row 9-10 of bristles. Legs black, anterodorsal of foretibia with 6-7 bristles. Wings hyaline, Basicosta black color.

Abdomen: Metallic green, with a white pollen. posterior margin of 5th sternite in male moderately concave medially, in female oval shaped.

Male genitalia: Phallus (Fig.7c) black. Basiphallus rectangular shaped. Epiphallus knife shaped. Hypophalus hook like. The results agree with the study of [39].

Examined samples: The samples were collected from the carrions of sheep in different localities of Iraq includes, (Altun Kopry; Daquq and Taza in Kirkuk); (Khanaqin and Saadia in Diyala); (Kalar in Sulimani) (Qostappa and Shaqlawa in Erbil); (Tuz Khurmato in Salahaddin) during April and July of 2023.



Figure 7: Chr ysomyia albiceps

a. Male (Dorsal view) 5X b. Antenna c. Male genitalia; Scale bare = 0.5mm

CONCLUSION

Forensic entomology involves studying the role of insects and specific arthropods in criminal investigations, particularly concerning decomposing vertebrate remains or carrion. These insects are integral to the decomposition process, and their presence can help estimate the time since death. Commonly, the larvae of flies (Diptera), especially from the families Calliphoridae, Sarcophagidae, and Muscidae, are typically found on decomposing human bodies and animal carrion. Additionally, the beetle and fly species found on sheep carcasses can be valuable in forensic investigations, particularly during

warmer months. This study includes a brief description of some forensically important insects from sheep corpses in some governorates of Iraq. These are, *Creophilus maxillosus* (Linnaeus); *Dermestes maculatus* (Kugelann, 1792); *Necrobia rufipes* (Fabricius, 1781) belong to the beetles, order Coleoptera. The flies include *Musca domestica* Linnaeus, 1758; *Sarcophaga africa* (Wiedemann, 1824); *Calliphora vicina* Rob. Desvoidy, 1830, and *Chrysomyia albiceps* (Wiedemann) belong to the fly, order Diptera.

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مسح ووصف مورفولوجي للحشرات ذات الأهمية الجنائية المرتبطة بتحلل جثث الماعز والأغنام في العراق				
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الخلاصة

بالنسبة للعلم الحشرات الجنائي، تعد الخنافس والذباب من العناصر الأساسية لتقدير (PMI)، لكنهما يؤديان أدوارًا مختلفة خلال عملية التحلل. يُعتبر الذباب، وخاصة من عائلة ثنائية الاجنحة (Diptera)، أول من يستعمر الجثة، وهو أمر بالغ الأهمية لفهم التحلل المبكر. أما الخنافس فهي مهمة لتقدير فترات (PMI) أطول، مما يبرز أهمية دراسة كلا النوعين في التحقيقات الجنائية. تتضمن الدراسة الحالية مسح ووصف موجز لبعض الحشرات المهمة جنائيا من جثث الماعز والأغنام في بعض محافظات العراق، والذي يشمل (التون كوبري وداقوق وتازة في كركوك)؛ (خانقين والسعدية في ديالى)؛ (كلار في السليمانية) (قرشتبة وشقلاوة في اربيل) (طوز خورماتو في صلاح الدين) ومن الفترة من كانون الثاني ولغاية تموز 2023. تم جمع العينات بوسطة الشبكة الهوائية، الشافطة وتربية اليرقات. ت تشخيص سبعة انواع من الحشرات، ثلاثة منها تنتمي الى رتبة غمدية الأجنحة وهي: Creophilus maxillosus (Linnaeus); (Creophilus maxillosus (Linnaeus); العين ولعاية تموز 2023. تم جمع العينات بوسطة الشبكة الهوائية، الشافطة وتربية البرقات. ت تشخيص سبعة انواع من الحشرات، ثلاثة منها تنتمي الى رتبة غمدية الأجنحة وهي: Creophilus maxillosus (Linnaeus); ولتوليز الريل (لموز خورماتو في من الحشرات، ثلاثة منها تنتمي الى رتبة غمدية الأجنحة وهي: محمد منافعات الجنائية، التوليز أول من يستعمر الثاني ولغاية تموز يولامية معينات بوسطة الشبكة الهوائية، الشافطة وتربية البرقات. تم وأربعة منها تنواع من الحشرات، ثلاثة منها تنتمي الى رتبة غمدية الأجنحة وهي: Creophilus maxillosus (Linnaeus); Dermestes maculatus وهي: المورات وأربعة منها تنتمى الى رتبة ثنائية الاجنحة وهي: Musca domestica Linnaeus, 1758; Sarcophaga africa (Wiedemann, 1824); Calliphora vicina Rob. Desvoidy, 1830, and Chrysomyia albiceps (Wiedemann) تم صياغة مفتاح تصنيف لعزل العوائل الخاصة لكل نوع . ذكر الصفات التشخبصية للأنواع. تم تصوير الحشرة الكاملة واللامس والسوءة الذكرية لكل نوع. كما تم تسجيل مكان وتاريخ الجمع لكل نوع.

الكلمات المفتاحية: الوصف، الحشرات الجنائية، الدبابير، غمديات الاجنحة، العراق.