Identification of a forensically and medically important blowfly: A case study of adult *Calliphora vicina* (Robineau-Desvoidy) in Turkey

Halide Nihal Acikgoz¹, Duygu Divrak², Meriem Taleb³

ABSTRACT

Background: Blowflies are a group of species which belong to Calliphoridae family, and they often colonize human and animal corpses. Being the first species to settle on cadavers, they have become of great forensic importance. They lay their eggs on corpses and play a crucial role in the decomposition process. Many species of blowflies appear globally while some of them live in certain regions. *Calliphora vicina* (Robineau-Desvoidy, 1830) (Diptera, Calliphoridae) is a species which is common in Turkey as well as in the rest of the world.

Aim: The aim of this study is to summarize the morphological features of *C. vicina* adults from Turkey so that they can easily be used by non-specialists including the police and forensic teams.

Material and Methods: The specimens were collected using liver traps. The flies colonizing the traps were killed by thiamethoxam. The dead specimens were collected, identified, and photographed. However, morphological features of the adult species were evaluated using different keys.

Results: The key was created for the purpose of easy identification of this fly in Turkey.

Conclusion: *Calliphora vicina* is cosmopolitan. In this study, there was no significant difference in the morphological characteristics of *C. vicina* species between specimens from Turkey and those from Europe.

KEY WORDS: Forensic sciences, forensic entomology, *Calliphora vicina*, identification, Turkey

INTRODUCTION

*Calliphora vicina* (Robineau-Desvoidy) (*C. erythrocephala* Meigen) is globally distributed and can be found in natural environments even though it is a synanthropic species [1]. It plays a very important role in the biological cycle of corpses in nature [2]. Therefore, it is one of the most commonly used blowflies in the determination of post-mortem interval (PMI). This fly is usually closely associated to man. The importance of this fly cannot be overemphasized because it is the causative agent of human and animal myiasis [3-5]. In the cases of advanced decomposition, when no tissues or body fluids are available, *C. vicina* and other Calliphoridae can serve as alternate specimens for toxicological analysis.

Identification of *C. vicina* using morphological features and knowing the criteria used for its diagnosis allow an easier, faster, and accurate PMI estimation. In addition, it contributes to solving forensic cases. *C. vicina* is one of the several species with the common name of blue bottle fly because of the metallic blue-gray coloration of its thorax and abdomen [5]. The fly is large and usually ranges from 10 to 14 mm long. The head of the fly is black in color, with the lower part of the bucca or “cheeks,” which is often red or yellow [1]. However, its maggots
are extremely common on human corpses throughout the U.S. and Europe in temperate regions [1,6]. This species primarily favors shady situations and urban habitats, where it is often the dominant species on human cadavers. C. vicina is more commonly seen around suburban and urban homes in warm and sunny spring mornings laying in patches of sunlight. This fly is sometimes seen in residential houses, which is one reason why it may seem more common in forensic case studies [1,7].

C. vicina has been used in a variety of criminal investigations [7]. Subsequently, the adult flies lick blooms, ripe fruits, and honeydew produced by scale insects and aphids, fermented sap, and fruit juices. They also lay on feces, vomited material, and cadavers or wounded animals. From there, they fly to foodstuffs to feed, thereby contaminating them with micro-organisms present on their body surface, their feces, and regurgitated fluid [8]. In addition, much has been written about the biology of this species, including rearing rates of immature forms at various constant temperatures [7,9-15]. Therefore, this makes it a very useful species for the determination of PMI.

Climatic factors, such as temperature, are also known to influence egg laying and development of instar larvae. In warmer weather, the life cycle span is shorter; while in cooler temperatures, the life cycle is longer. This fly has a lower threshold temperature for flight activity than other blowflies; hence, this allows a greater prevalence during colder periods [5]. Small C. vicina adults lay fewer eggs than larger ones; however, the egg size is not compromised [16]. This trend is expected to occur with other closely related Calliphorids [7].

The maggots feed on decaying organic matter, mainly animal carrion. Adult Calliphoridae females lay eggs on fresh cadavers and immediately after death under favorable conditions. Therefore, the ability of blowflies to locate and colonize corpses represents a key characteristic used in forensic investigations to estimate the PMI. Having a good understanding of the duration between the three instars, pupa stage, and post-feeding larval dispersal can be very useful in the determination of a reasonable PMI in a criminal case [5].

In this context, the aim of this study is to introduce C. vicina adults which are widely distributed in Turkey. Therefore, it forms the basis of morphological features key which is easily used and understood by non-specialists. The target population of this study includes not only crime scene investigation (CSI) teams and forensic pathologists or coroners, but also individual researchers.

**MATERIALS AND METHODS**

This study was conducted in the garden of Forensic Sciences Institute, Ankara University (39°56′02.66″N, 32°53′06.91″E). Therefore, the altitude of the campus is 850 m.

**Design of the Traps**

Traps were prepared as shown in Figure 1. Two plastic water bottles of 500 ml were cut below their necks. The upper part of each bottle was reversed and inserted into the lower part. Then, a hole which is large enough for a fly to go inside was created on each side of the bottles. Two pieces of fresh beef liver, each which weighed 200 g, were set in eight traps. Furthermore, 2 g of thiamethoxam (10 WG, Distributed by Novartis, Switzerland) was placed in a bottle cap next to the baits. Acetate sheets were placed above the traps to prevent rain from flowing into them. Hence, the flies colonizing the traps were killed by thiamethoxam. The dead specimens were collected, identified, and photographed. Identification was performed under Leica S8APO trinocular stereozoom research microscope at Forensic Entomology/Forensic Biology Laboratory at the Forensic Sciences Institute, University of Ankara, using the keys described by Smith (1986)[17] and Szpila (2012) [18].

**RESULTS**

The aim of this study is to provide guidance for unspecialized CSI teams and forensic physicians. This would help them in performing examinations in crime scenes in Turkey. This is done by easily identifying C. vicina adults and establishing a key for the morphological features of this species. Therefore, general characteristics of morphological structures of the species were presented in a way that even an untrained person interested in forensic entomology could understand them easily.

In general, the body of adult Calliphoridae is divided into three equal parts, i.e., the head, thorax, and the abdomen. C. vicina species are metallic blue-black blowflies of about 10-12 mm in length [Figure 2]. These flies live in urban areas and are the first to reach corpses. The main identification features used in identifying C. vicina are illustrated in Figures 3-6.

**DISCUSSION**

C. vicina is widely distributed worldwide. It is found in Spain [2], Germany [19], Italy [20], the USA [21], Algeria, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Pakistan, Saudi Arabia, Syria, and Yemen [22]. In addition, it is found in nearly all parts of Turkey: Ankara, Elazig, Hatay, Izmir, Konya,

![Figure 1: Design of the traps](image-url)

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Acikgoz, et al.: Adult Calliphora vicina (Rob-Desvoidy) in Turkey
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Figure 2: General morphology of Calliphora vicina adults. These blowfly species are 10-12 mm long and appear metallic blue-black.

Figure 3: Antennae and aristae of Calliphora vicina. Three-segmented antenna found on C. vicina where the third segment bears a protruding hair called an arista.

Figure 4: Orange color of the anterior thoracic spiracle. Yellow to orange gena or cheeks.

Figure 5: Basicosta of Calliphora vicina. Basicosta is one of the two plaques in the region where the wing that is connected with the body typically looks like an epaulet. In C. vicina, it is generally orange or yellowish-brown in color.

Figure 6: Lower and upper calypters. Dark lower calypter setose above.

and Sanliurfa [23-28]. It is seen oftentimes on corpses by CSI in homicide cases. Since forensic entomologists do not attend crime scenes in Turkey and in most other countries [29,30], specimens are collected by CSI teams. Some of the members of these teams report observing black blowflies over corpses during personal communications. However, they neglect the collection of these flies on corpses for not being green in color. Until recently, this important evidence has provided critical information in solving forensic cases which have been disregarded and removed during the washing of corpses [31]. Currently, there is an increasing awareness of the importance of blowflies by the dint of scientific studies results [31-36]. Furthermore, there is still a problem which needs to be solved at present. Entomological specimens are not collected carefully and properly in crime scenes and morgues. In addition, they are not sent to laboratories appropriately. They are not even mentioned in crime scene records [30]. Thus, this is due to the absence of forensic entomologists at crime scenes and the lack of knowledge regarding the collection of entomological evidence by police and gendarmerie. Therefore, we intend to
highlight the importance of collecting blowflies whether they are metallic green or black in color.

As for morphological differences, there was no significant difference between the morphological characteristics of C. vicina species from Turkey and those from Europe. Hence, this is considered as an advantage for Turkish researchers.

The contribution of this study to the available literature from Europe was not to introduce species of blowflies but to add to the development in forensic entomology and CSI practice in Turkey.

To the best of our knowledge, this is the first study performed to reveal the forensic importance of morphological identification of C. vicina in Turkey. The results of this study will increase awareness in the identification of this blowfly by CSI teams in Turkey. Due to the far-reaching influence of this study, PMI will be determined faster and more easily. However, this plays a significant role in solving forensic cases. The results of this study will have a positive impact on public opinions about teaching forensic entomology and solving forensic cases in Turkey. In addition, it will decrease forensic investigations costs in the long-term. Therefore, it can be suggested that the entomological evidence should not be disregarded any longer.

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REFERENCES