

Pathological Implications of Anthomyiid Flies (Diptera, Anthomyiidae) in Iraq: A Study on Their Role in Bacterial Disease Transmission

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ABSTRACT

Objective: This study aimed to evaluate the impact of laboratory accreditation on enhancing patient safety and improving the quality of healthcare services by ensuring high standards in diagnostic testing. **Methods:** We employed a quantitative approach using SPSS software to analyze data from accredited and non-accredited laboratories. The analysis included descriptive statistics, correlation coefficients, chi-square tests, and regression analyses to explore the relationship between accreditation and various quality metrics in laboratory performance. **Results:** The findings underscore the critical role of accreditation in promoting uniformity, accuracy, and reliability in diagnostic processes. Accredited laboratories demonstrated reduced risk, fewer errors, and compliance with stringent healthcare regulations. Statistical analyses revealed significant positive correlations between laboratory accreditation and enhanced patient safety measures, as well as higher quality care outcomes. The study highlighted that accredited laboratories are better equipped with robust quality control procedures, qualified personnel, and standardized operational protocols, all contributing to improved diagnostic precision and patient care. **Conclusion:** Laboratory accreditation has a substantial impact on the healthcare system, significantly enhancing patient safety and care quality. The study not only reinforces the importance of accreditation in building trust among healthcare providers and patients but also illustrates how it fosters a culture of continuous improvement and adaptability to new challenges in healthcare. The implications of these findings advocate for broader adoption of accreditation standards to ensure optimal treatment outcomes and bolster confidence in healthcare services.

Keywords: Diptera, Anthomyiidae, New Record, Chelisia, Lasioomma, Botanophila

INTRODUCTION

The name for this order comes from the fact that its members have two pairs of wings: the first located on the mid thorax (mesothorax) and the hind wings (the second pair) have mutated into two balance pins known as (halteres), which work as a balance organ during flying, situated on metathorax. The presence of a single pair of wings is what distinguishes it from other insects [1-4].

Classification

Diptera: an order belongs to the class: Insecta of the phylum: Arthropoda. It is a big order of insects.

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta (Hexapoda)

Subclass: Pterygota

Division: Endopterygota

Order: Diptera

The division of diptera into families depends on the habitat and habits of the insect, whether it is a larva or an adult. Among the many large families that fall taxonomically under the Diptera list is: Anthomyiidae, locally called (root maggot flies) the subject of the current study, as shown below:

Kingdom: Animalia

Phylum: Arthropoda

Class: Insecta (Hexapoda)

Subclass: Pterygota

Division: Endopterygota

Order: Diptera

Sub Order: Brachycera

Division: Cyclorrhapha

Series: Schizophora

Section: Myodaria

Subsection: Calyptrate

Superfamily: Muscoidea

Family: Anthomyiidae

It is a very large and wide family, includes approximately more than 2000 species in the world, most of those species from Europe and regions of North America [5-8]. It is one of the dipteran Calyptrate families, which are taxonomically difficult, as well as changing nomenclature and division [9-12].

Anthomyiidae were previously listed as belonging to the family of Muscidae, but has now been separated from the latter as an independent family [13, 14]. Most of the Anthomyiidae larvae depend on plants for their nutrition, and since they invade the roots of plants, hence the name of the family "root larvae". Some species of the family

feed on animal waste, and other species prey on insects, it often preys on other dipterans or prey on flies from the same family, Some species are also leaf miners, some larvae are parasitic [15, 16].

Diagnostic Characteristics

The Anthomyiidae family is characterized by several taxonomic characteristics, and these characteristics apply to most members of the family and distinguish them from other families, these characteristics are: they are small to medium sized; similar in shape to house flies but slightly smaller, their color is pale gray or black, light yellow and silver, compound eyes are usually close together in males (holoptic) and separate or spaced in females (dichoptic), arista *aris* pubescent or plumose, most often pubescent, interfrontal setae *if* are present, Anepimeron *anepm* and proepisternal *prepst* are bare, usually notopleuron *ntpl* contains two strong setae, transverse suture *ts* is present and complete, Costa *c* without spinules on ventral surface, The cross-vein *m-m* is either oblique or straight, and is most likely oblique, the anal vein *Al* reaches or close to the edge of the wing in most genera, The scutellum most likely contains fine setulae ventrally and strong setae dorsally [17-22].

Distribution

The family is found in general throughout the countries, and in particular it is usually found in places with moderate climates, Holarctic region, and also in the Palaearctic region [17, 23]. Anthomyiids flies vary in their presence, they are abundant on agricultural crops, fields, farms, near water, and wet places and they are also found in deserts [24, 25].

Many of them feed on flower nectar and pollen. According to my experience in collecting samples for this study, it is very clear to me that Anthomyiidae individuals are found almost everywhere; they are found close to most agricultural crops, such as cabbage, cucumbers, onions, garlic, eggplant, okra, beans, peas, peppers, squash, and tomatoes, as well as fruits such as apples, grapes, watermelon, and many others. There is also what is considered important pests that cause huge losses to crops. Such as genus *Delia* Robineau-Desvoidy, which is considered one of the most important agricultural pests [1, 3, 7].

Economic Importance

Anthomyiid flies are widespread in all parts of the world. They are found, as mentioned above, on field plants, and they are also close to weeds and bushes. Therefore, Anthomyiidae have great economic importance, represented by the role that some species play on all field crops that cause extensive damage, other species also adopt the behavior of parasites, but until now the extent of the economic losses of these pests has not been accurately determined [19, 26]. The genus *Delia*, which includes several species, for example *Delia antiqua*, which is considered an important pest on onion plants, as it feeds on it and causes severe damage, and [14].

The same applies to other types of *Delia*, such as: *Delia platura* seed corn pest Which feed on corn and other vegetables as well, such as garlic, onions, and many others [10, 20]. Other species of Anthomyiidae, such as *Pegomya hyoscamii*, whose larvae are leaf miners on beet and spinach [14, 20, 22]. The genus of *Phorbia* is also

a pest on some field plants and crops [20, 22] *Egle* is crop pest in many places of world [19, 20, 27].

Also the species, *Botanophila seneciella* recorded in Australia and Europe, as a natural enemy to reduce the Poisonous bushes and weeds [20]. There are also, as we mentioned some species that are parasites, such as *Acridomia* and *Acyglossa*, which are parasites on grasshoppers [14, 28].

Studies Related to Anthomyiidae

Anthomaede are often considered very important agricultural pests, as they usually depend for their nutrition on good quantities of plants and their tissues. Among them are those that attack crops such as turnip, corn, spinach, and many other crops. As for the genus *Delia*, whose species are considered important pests on onion crops (*Delia antiqua*), wheat (*Delia coarctata*), and turnips (*Delia floralis*).

In addition to being pests, some adult of anthomyiidae act as pollinators when they feed on the nectar of flowers, [14, 24]. In this study [29] mentioned two species of *Pegomya* for the first time, [30] found *Delia alliaria* also for the first time. [31] found *Delia antiqua* (Meigen, 1826) from plants, and [5] also mentioned species of the genus *Pegomya*. All of the above authors recorded these species as pests on plants [8, 11, 12, 26] also recorded clear infections and big damage to onion, garlic and spring onion by *Delia antique*, [7] found *Delia floralis* as a big pest on cruciferous plants, and also [7, 8, 16] recorded *Pegomya hyoscamii* and its larvae as a pest on spinach, [16, 27] found in his study species of *Phorbia* as a pest on germinating crops. In the current work, three genera belonging to the family (Anthomyiidae - Diptera) were recorded for the first time in Iraq [32, 33]. The purpose of this study is to identify the diagnostic characteristics of Anthomyiidae, with the registration of three of its genera for the first time in Iraq.

MATERIALS AND METHODS

Specimens

17 samples of adult flies of Anthomyiidae family were collected from different places in Iraq for four months (February, March, April and May) of 2023; using the sweeping net and the aerial net using the correct method of using the net by passing it at the required speed between grass, bushes and agricultural crops [34, 35] After that, the contents of the fishing net are emptied into transparent plastic bags, closed and placed in the freezer for a whole night, then the bags are taken out of the freezer, their contents are emptied, anthomyiid flies specimens are isolated, fixed by using special insect pins and placing them in insect boxes [31].

Sample Examination

Insect samples were examined using a dissecting microscope (Am Scope) to study insect parts such as mouthparts, antennae, wings, and thorax area, samples were photographed using a portable digital microscope, With the use of taxonomic keys to diagnose the family and its genera, such as: [19, 25]. In addition to compare with identified specimens kept in the laboratories of "The Iraq Natural History Museum" / Baghdad—Iraq. Synonyms for each genus have been added depending on [7].

Table 1: Abbreviations

Descriptive Character	Abbreviation
Anal Vein	<i>Al</i>
Frontal Seta	<i>Fr</i>
Interfrontal Seta	<i>If</i>
Arista	<i>Ar</i>
Orbital Seta	<i>Orb</i>
Vibrissa	<i>Vi</i>
Palpus	<i>Plp</i>
Notopleural Setae	<i>Nipl</i>
Premmentum	<i>Premnt</i>
Anepimeron	<i>Anepm</i>
Anepisternum	<i>Anepst</i>
Meron	<i>Mr</i>
Proepisternum	<i>Prepst</i>
Costal Spinules	<i>c spl</i>
Anteroventral Seta	<i>Av</i>
Posteroventral Seta	<i>Pv</i>
Posterior Seta	<i>Ps</i>
Ventral Seta	<i>Vs</i>

Results AND Discussions

Results obtained for this study are three genera belonging to the Anthomyiidae family that were collected from different places in Iraq: *Chelisia Rondani*, 1856, *Lasiomma Stein*, 1916 and *Botanophila* Liroy, 1864

Genus *Chelisia* Rondani, 1856

Synonym of *Anthomyia* Meigen, 1803

Materials examined (1♂) and (7♀♀) the specimens collected from Baghdad Province - Bismayah City 33°11'42"N 44°35'56"E, Saladin Province - Tikrit 34° 6187204 N 43° 6567219 E and Wasit Province-Prenej 32 53 50.5"N, 45 03 54.1"E. Distribution: China [33], Nearctic and Palaearctic region [29], United State of America – California [17].

Diagnosis

The genus *Chelisia*: In males, the eyes are close together (holoptic) and in females; are separated or set apart (dichoptic), interfrontal setae *if* absent in both sexes, vibrissae present, arista *ar* not plumose, Complete, well-developed mouthparts protrude more outward in males, pulpus *p/p* slender, anepimeron and proepisternal bare, katepisternal bristles are arranged in the shape of an equilateral triangle, The anal vein (*A1*) reaches away from the end of the wing (fig.1), and the pale color, cross vein m-m is oblique (fig.2), darkening slightly and narrowing at the base in male. scutellum with one pair of long apical setae [8, 29].

Genus *Lasiomma* Stein, 1916

Synonyms : *Acrostilpna* Ringdahl, 1929

: *Crinurina* Karl, 1928

: *Macrophorbia* Malloch, 1920

: *Opsolasia*

: *Sinohylemya* Hsue, 1980

Materials examined (3♂) and (3♀) the specimens collected from Saladin Province - Tikrit 34.6187204 N 43.6567219 E. Distribution: China [33], Korea [19], Japan [8] Nearctic and Palaearctic region [36], Holarctic, Afrotropics and Neotropics.

Diagnosis

The genus *Lasiomma*: holoptic in male and dichoptic in females (figs. 4,7), interfrontal and orbital setae present, arista pubescent, scutellum with fine hairs ventrally, anepimeron and proepisternal bare, (*A1*) reaches to the end of the wing, costa not fading at R4+5, M1 parallel with R4+5 mostly, fore tibia with apical posteroventral (*pv*) seta, mid tibia with one or two anteroventral (*av*) setae, hind tibiae with more than 3 posterodorsal setae. (figs.5,6)

Genus *Botanophila* Liroy, 1864

Synonymy : *Aegeria* Agassiz, 1846

: *Aegeria* Macquart, 1835

: *Monochrotogaster* Ringdahl, 1932

: *Pseudomyopina* Ringdahl, 1933

: *Xanthocnemis* Karl, 1943

Materials examined (3♂♂) and (1♀) the specimens collected from Saladin Province (Tikrit, Ishaqi) 34.6187204 N 43.6567219 E ; 34.0475291 N 44.0294362 E. Distribution: China 39, Korea [19, 25] Japan [8], Nearctic and Palaearctic region [36]

Diagnosis

The genus *Botanophila* consists of approximately 70 species [9, 22] holoptic in male and dichoptic in females, (*if*) and (*ors*), present, arista pubescent, scutellum with fine hairs ventrally and with pair of apical scutellar seta on dorsal surface, Presutural acrostichal setae fine and weak, *A1* traceable to wing margin, costa not fading at R4+5, M1 parallel with R4+5 mostly. Mid tibia with 1 (*ad*) and apical (*pd*) seta, hind tibia with 3 long (*ad*) and 3 (*av*) setae. (figs. 9,10)

Key to genera

1. *A1* does not reach, or far from the end of the wing 2. *A1* traceable to wing margin 3.

2. Katepisternal setae arranged in a nearly equilateral triangle *Chelisia* Rondani, 1856. (fig.3). Katepisternal setae not arranged in a nearly equilateral triangle 4. 3. Mid tibia with 1 -2 anteroventral (*av*) setae, hind tibiae with more than (3) posterodorsal setae *Lasiomma* Stein, 1916 (fig.8). Mid tibia with 1 (*ad*) and apical (*pd*) seta, hind tibia with 3 long (*ad*) and 3 (*av*) setae *Botanophila* Liroy, 1864 (fig. 10)

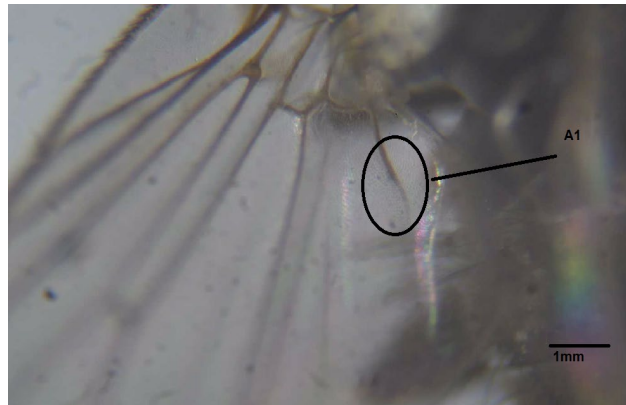


FIGURE 1: Chelisia, Black Line: Anal Vein

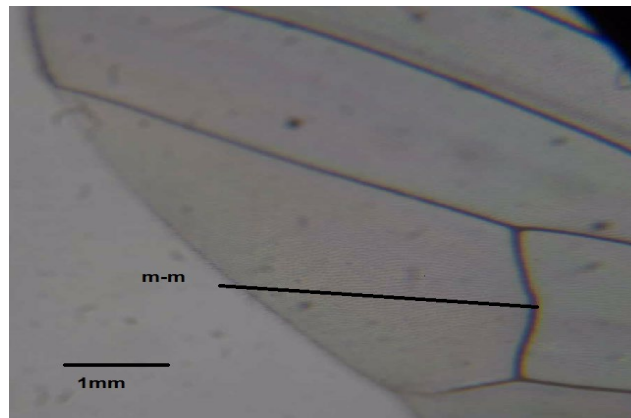


FIGURE 2: Chelisia, Black Line: Cross Vein m-m

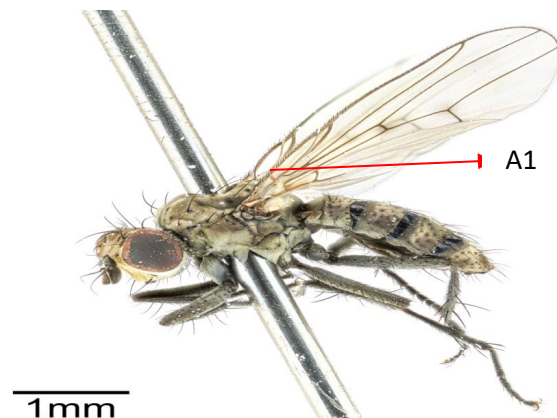


FIGURE 3: Chelisia Genus (Adult) Lateral View, Red Arrow: Anal Vein



FIGURE 4: Lasiomma Genus (Head) Frontal View Femal

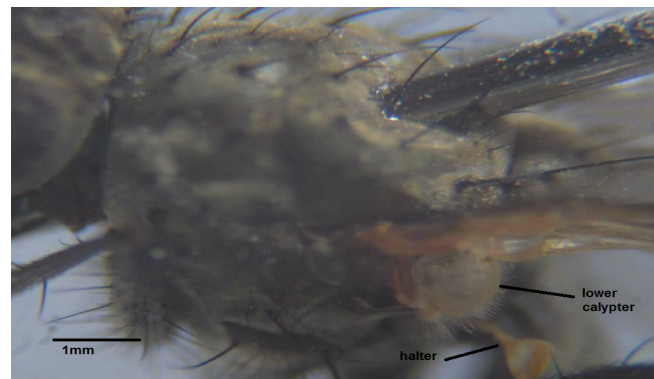


Figure 5: Lasiomma Genus (Head) Lateral View Femal

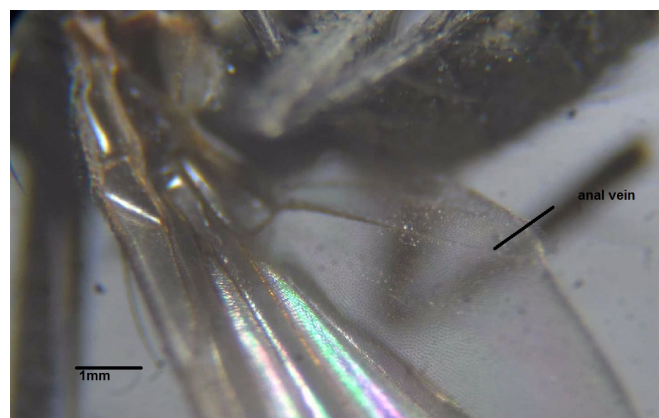


FIGURE 6: Lasiomma Genus (Wing)



FIGURE 7: Lasiomma Genus (Head) Male



FIGURE 8: Lasiomma Genus (Adult)

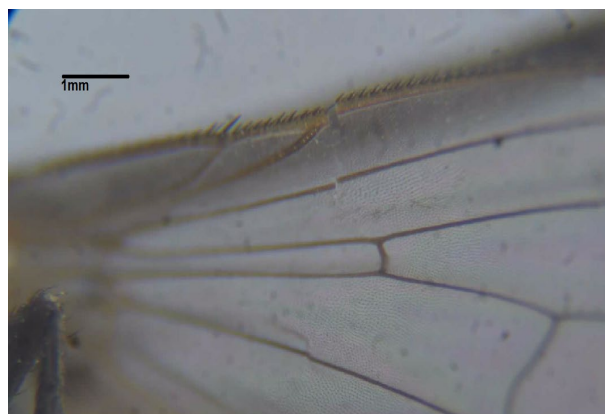


Figure 9: *Botanophila* Genus (Wing)



Figure 10: *Botanophila* Genus (Adult)

Acknowledgements

In fact, in this type of studies; authors suffer from some difficulties associated with the work, such as the difficulty of collecting and isolating samples, the small size of the insect and therefore the difficulty of dealing with it in the laboratory, the lack of references and local taxonomic keys in Iraq, as this family has not previously been studied except very little, it has been mentioned. In displaying references. Regardless of all the suffering and difficulties, I would like to extend my sincere thanks and appreciation to everyone who participated in providing a helping hand and offering assistance to complete this clear work, especially the head and members of the Department of Insects and Invertebrates at the Natural History Research Center and Museum - University of Baghdad.

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Conclusions

The current work included identifying the family of root maggot flies from a taxonomic standpoint, as well as the diagnostic characteristics through which the family can be distinguished from other families of the order Diptera, as the flies of this family are important from an economic and medical standpoint, and taxonomic studies about them are very few in Iraq. So, we hope to focus on them in the future; also focus on studying this family taxonomically, economically and medically, we recommend that more taxonomic studies be conducted on the species of this Anthomyiidae family using taxonomic keys and genetic analysis technology due to the difficulty in diagnosing species of this family due to their similarity to species from the same family and from other families.

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