Autogeny in *Culiseta longiareolata* (Culicidae: Diptera) Mosquitoes in Laboratory Conditions in Iran

Fereshteh Ghahvechi Khaligh

Urmia University of Medical Sciences

Abdollah Naghian

Urmia University of Medical Sciences

Shadiyeh Soltanbeiglou

Urmia University of Medical Sciences

Saber Gholizadeh (✉ sabergholizadeh@yahoo.com)

Urmia University of Medical Sciences <https://orcid.org/0000-0002-3255-8098>

Research note

Keywords: Culicidae, *Culiseta longiareolata*, Autogeny, Iran

Posted Date: January 29th, 2020

DOI: <https://doi.org/10.21203/rs.2.22144/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Version of Record: A version of this preprint was published at BMC Research Notes on February 19th, 2020. See the published version at <https://doi.org/10.1186/s13104-020-04942-5>.

Abstract

Objectives

Culiseta longiareolata is a cosmopolitan species and has implicated in the transmission of avian malaria, tularemia, and arboviruses. Despite the wide sprite distribution of *Cs. longiareolata* in Iran, little is known about its biology and physiology. The current research was conducted to study the autogeny behavior in this potential vector. Larval and pupa collected from Nazloo district in Urmia using standard methods during 2018. Mosquitoes were reared in cages and fed by 5% sugar for in lab condition. They were dissected in Phosphate-buffered saline (PBS) under a stereomicroscope.

Results

Two hundred thirty adults of female *Cs. longiareolata* mosquitoes were dissected. Egg rafts were observed in the ovary of 10.86 % unfed female mosquitoes. The autogeny behavior is a significant factor in the increase of population without a blood-feeding. It is necessary to study how autogenous affect mosquito-borne-diseases.

Introduction

Culicidae family has 113 genera and 3556 species [1]. They are distributing around the world [2]. In 1878, mosquitoes were the first arthropods customarily accused as intermediate hosts of vertebrate parasites, that they are the most important arthropods affecting human health [3]. Mosquitoes are the vector of different diseases such as malaria, Filariasis, yellow fever, West Nile fever, Japanese encephalitis, rift valley fever and etc [4-7].

Routinely development of eggs in blood-sucking insects are usually dependent on a blood meal [8]. Although there have some females in mosquito can develop their eggs without a blood meal [9]. Egg maturation without a previous blood meal is called autogeny [8, 10]. In some females of this group, at least the first group of eggs, and possibly the next, can be grown without blood-feeding [11, 12]. They use the last stage of larval food or feed on sugared salmon for their growth. In many species of mosquitoes, it has been seen [8]. Autogeny is necessary for some species such as megarhinini because their semiflexible proboscis is specialized for nourish on plants [11].

Culiseta longiareolata is classified in the Culicinae subfamily [13]. It was distributed in a wide range of countries such as Europe, Asia, Africa, as well as the Mediterranean sea [14]. This species is a multivoltine, thermophilic, and substantially ornithophilic [15]. It usually develops in small water bodies, and adults may enter houses sometimes attacks humans [16]; however, their primary hosts are birds [17]. This species easily distinguished from other *Culiseta* species with prominent, distinguished characters [15]. The morphological characters are white stripes and points on the legs, head, and thorax. [18]. It is a vector of avian malaria [19] [20], tularemia [17], arboviruses such as West Nile fever [21-23].

The purpose of this paper is to observe of autogenous reproduction in *Cs. longiareolata*. This result might be valuable in the survival of the vector species in the absence of a host and the vectorial capacity. The influence of autogeny on the role of the mosquito to act as a vector was not known, so it is essential to determine the basis of this autogeny.

Methods

Urmia, the center of West Azerbaijan Province, is located along the east and northern latitudes in a 70-mile-wide plain, 30 km wide and 18 km from Lake Urmia (37°39'13"N 44°52'35" E). In the current study, larvae and pupa were collected from Nazloo (37°31'59.2"N 45°02'54.5"E) during the spring and summer in 2018 with standard dipping technique [24]. The Collector name, geographic coordinates of the area with Global Positioning System (GPS), and date of capture were recorded. Mosquito samples were collected from different larval stages from their habitats. They were transferred to the medical entomology laboratory in Urmia School of public health for rearing. The laboratory temperature was set at 22-25 °C. Room lighting was provided with yellow light. They were kept for ten h in the dark and 14 h in days. Plastic containers like a cuvette were used for the maintenance of immature stages (eggs, larvae, pupae), with 45 × 25 × 5 cm dimensions. This cuvette was filled for more than half with the water of larva habitat and kept in 22-25°C. Approximately 200 or less of larvae were placed in a cuvette. After 2-3 days, the pupa was taken with the plastic sucker and placed in disposable glasses in cages (30×50×80 cm) until adult mosquitoes emerge (Fig. 1).

These cages were covered with finely textured cloth. Adults were feed on impregnated cotton with 5% sugar. The cotton was streaked into a glucose solution every day. The cotton was replaced with a new sugar solution every three days to prevent the growth of fungi. They were identified to species level using the morphological key [25]. Then, newly emerged males and females of *Cs. longiareolata* were transferred to new cages for mating and dissection in PBS to obtain eggs under the stereomicroscope. The test was repeated three times.

Results

About 230 female adults were used in the mating experiments in three replications (Fig. 2A). About 15-21 days after emerging, the abdomen of mosquitoes was bulk. 10.86 percent of adults female were produced eggs without a blood-feeding. Each gravid mosquitoes incubated in a separate cage for egg-laying. Three days after incubation in a cage, eggs were laid on a cup of water (Fig. 2B). Eggs were transferred into new plastic containers. The color of eggs was grey immediately after laying, 1-2 days later, the color was changed to black or dark brown. The first instar of the larva has emerged within 3-5 days (Fig. 2C and 2D).

Discussion

There are many studies related to Culicidae identification, distribution, insecticide resistance and vector control in Iran [7, 26-32]. *An. sacharovi* experience gonotrophic dissociation during autumn and winter in northern Iran [30]. An-autogeny was reported in *Cx. pipiens* in central parts of the country [33]. There are no reports related to the autogeny in *Cs. longiareolata* in Iran; therefore, the current study is reported autogeny in *Cs. Longiareolata* for the first time in the country.

Autogenous species have higher nutritional requirements than an-autogenous to develop egg batch [34]. Also, temperature, environmental factors, geographical variation [35], seasonality [36], and food availability [37] help mosquitoes to become autogenous species. For example, when larvae fed on the animal matter may be more likely to be autogenous and also produce more eggs in *Cs. longiareolata* because of the high protein content [38]. On the other hand, some populations of *Cs. longiareolata* are autogenous [39]; however, all laboratory populations were an-autogenous [40, 41]. The autogeny rate was low (10/86%) in *Cs. longiareolata* collected from Urmia, Iran. The larva was reared in water obtained from larval habitat near a dairy, without any other nutrient additive. Autogenous female's body size of field-collected samples of *Cs. longiareolata* was larger than an-autogenous specimens. Probably, the larval habitat nutrients could be a significant factor in autogeny in *Cs. longiareolata* in northwestern Iran. However, the determination of physicochemical characters of larval habitat water may be helped in a better understanding of *Cs. Longiareolata* Autogeny.

It is hypothesized that autogeny can affect different parameters of pathogen transmission, such as increasing the vector population and reducing the pathogen incubation period [42]. On the other hand, autogeny is an excellent survival mechanism for a particular mosquito species [9, 42, 43]. The present study showed a more extended survival period in females fed on a 5% sugar solution. The high survival rate increases their ability to the transmission of possible pathogens. However, autogenous species could transmit arboviruses pathogens horizontally than an-autogenous populations [34].

Conclusion

Culiseta longiaerolata is one of the potential vectors for some of these vector-borne diseases such as avian malaria, bird flu, avian smallpox, malta fever. Urmia city is an excellent destination for many migratory birds because of its lakes and islands. The presence of reservoirs (birds) potential vectors, including *Cs. longiaerolata* provide conditions for establishing the transmission of infectious diseases. However, their role of autogeny on the transfer of infectious diseases need to be studied.

Limitations

The major concern within this study is the examination of autogeny on specimens that emerged from the field-collected larva. Because of our limitation in the insectary, we could not follow autogeny in the next generation. The current study was conducted on specimens collected from the Nazloo region in Urmia district, however, the test of autogeny on samples in large areas from multiple regions in the country is recommended.

Declarations

Acknowledgments

This project was provided by Medical Entomology Laboratory, School of Public Health, Urmia University of Medical Sciences, Urmia, Iran.

Abbreviations

Phosphate-buffered saline (PBS)

Global Positioning System (GPS)

Ethics approval and consent to participate

Not applicable

Consent for publication

Not applicable

Availability of data and materials

Data supporting this article are included in the article.

Funding

Not applicable

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

Conceived and designed the experiments: SG and FGK.

Performed the experiments: FGK, AN, and SS.

Analyzed the data: SG and FGK.

Contributed reagents/materials/analysis tools: SG, FGK, and AN.

Wrote the paper: SG, FGK, AN, and SS.

All authors read and approved the final manuscript.

References

1. Mosquito Taxonomic Inventory
2. Lane RP, Crosskey RW: *Medical insects and arachnids*. Springer Science & Business Media; 2012.
3. Mullen GR, Durden LA: *Medical and veterinary entomology*. Academic press; 2009.
4. Azari-Hamidian SJJoVE: Checklist of Iranian mosquitoes (Diptera: Culicidae). 2007, 32:235-242.
5. Onchuru TO, Ajamma YU, Burugu M, Kaltenpoth M, Masiga D, Villinger JJIJoTIS: Chemical parameters and bacterial communities associated with larval habitats of Anopheles, Culex and Aedes mosquitoes (Diptera: Culicidae) in Western Kenya. 2016, 36:146-160.
6. Saidi S, Tesh R, Javadian E, Nadim AJIJoPH: The prevalence of human infection with West Nile virus in Iran. 1976, 5:8-13.
7. Gholizadeh S, Djadid ND, Nouroozi B, Bekmohammadi M: Molecular phylogenetic analysis of Anopheles and Cella subgenus anophelines (Diptera: Culicidae) in temperate and tropical regions of Iran. *Acta Trop* 2013, 126:63-74.
8. Gaugler R: *Medical Entomology for students*. Oxford University Press; 2016.
9. Laurence BJJoIP: Autogeny in Aedes (Finlaya) togoi Theobald (Diptera, Culicidae). 1964, 10:319-331.
10. Levin MLJEid: *Medical entomology for students*. 2014, 20:1428.
11. O'Meara GF, Krasnick GJJJome: Dietary and genetic control of the expression of autogenous reproduction in Aedes atropalpus (Coq.)(Diptera: Culicidae). 1970, 7:328-334.
12. Roubaud EJCAS, Paris: Cycle autogene d'attente et generations hivernales suractives inapparentes chez le moustique commun, Culex pipiens L. 1929, 188:735-738.
13. Marquardt WH: *Biology of disease vectors*. Elsevier; 2004.
14. O'Connor J: *Adults, Larvae and Pupae of British Mosquitoes (Culicidae). A Key*. JSTOR; 1989.
15. Kampen H, Kronefeld M, Zielke D, Werner DJJEMCA: Three rarely encountered and one new Culiseta species (Diptera: Culicidae) in Germany. 2013, 31:36-39.
16. Maslov AVE: Krovososushchie komary podtriby Culisetina (Diptera, Culicidae) mirovoi fauny. 1967.
17. Maslov AVE, Ward RA, Rao P: *Blood-sucking mosquitoes of the subtribe Culisetina (Diptera, Culicidae) in world fauna*. Citeseer; 1989.
18. Becker N, Petrić D, Boase C, Lane J, Zgomba M, Dahl C, Kaiser A: *Mosquitoes and their control*. Springer; 2003.
19. Schoener E, Uebleis SS, Butter J, Nawratil M, Cuk C, Flechl E, Kothmayer M, Obwaller AG, Zechmeister T, Rubel FJMj: Avian Plasmodium in Eastern Austrian mosquitoes. 2017, 16:389.
20. Huff CGJEp: Susceptibility of mosquitoes to avian malaria. 1965, 16:107-132.
21. Bisanzio D, Giacobini M, Bertolotti L, Mosca A, Balbo L, Kitron U, Vazquez-Prokopec GMJP, vectors: Spatio-temporal patterns of distribution of West Nile virus vectors in eastern Piedmont Region, Italy. 2011, 4:230.

22. Hubálek Z, Halouzka JJ: West Nile fever—a reemerging mosquito-borne viral disease in Europe. 1999, 5:643.
23. Romi R, Pontuale G, Ciufolini M, Fiorentini G, Marchi A, Nicoletti L, Cocchi M, Tamburro AJM, Entomology V: Potential vectors of West Nile virus following an equine disease outbreak in Italy. 2004, 18:14-19.
24. Focks DA: A review of entomological sampling methods and indicators for dengue vectors. World Health Organization; 2004.
25. Azari-Hamidian S, Harbach REJZ: Keys to the adult females and fourth-instar larvae of the mosquitoes of Iran (Diptera: Culicidae). 2009, 2078:1-33.
26. Manouchehri A, Janbakhsh B, Rohani FJMN: Studies on the resistance of *Anopheles stephensi* to malathion in Bandar Abbas, Iran. 1976, 36:320-322.
27. Vatandoost H, Hanafi-Bojd AAJAPjotm: Indication of pyrethroid resistance in the main malaria vector, *Anopheles stephensi* from Iran. 2012, 5:722-726.
28. Azari-Hamidian S: Checklist of Iranian mosquitoes (Diptera: Culicidae). *Journal of Vector Ecology* 2007, 32:235-242.
29. Khoshdel-Nezamiha F, Vatandoost H, Azari-Hamidian S, Bavani MM, Dabiri F, Entezar-Mahdi R, Chavshin ARJJoa-bd: Fauna and larval habitats of mosquitoes (Diptera: Culicidae) of West Azerbaijan Province, northwestern Iran. 2014, 8:163.
30. Djadid ND, Gholizadeh S, Tafsiri E, Romi R, Gordeev M, Zakeri SJMJ: Molecular identification of Palearctic members of *Anopheles maculipennis* in northern Iran. 2007, 6:6.
31. Azari-Hamidian S, Norouzi B, Harbach RE: A detailed review of the mosquitoes (Diptera: Culicidae) of Iran and their medical and veterinary importance. *Acta Trop* 2019, 194:106-122.
32. Asadi Saatlou Z, Sedaghat MM, Taghilou B, Gholizadeh S: Identification of novel Glutathione S-Transferases epsilon 2 mutation in *Anopheles maculipennis* s.s. (Diptera: Culicidae). *Heliyon* 2019, 5:e02262.
33. Dehghan H, Moosa-Kazemi SH, Sadraei J, Soleimani HJJoa-bd: The ecological aspects of *Culex pipiens* (Diptera: Culicidae) in central Iran. 2014, 8:35.
34. Reisen WK, Milby MMJJotAmca: Studies on autogeny in *Culex tarsalis*: 3. Life table attributes of autogenous and anautogenous strains under laboratory conditions. 1987, 3:619-625.
35. O'MEARA GFJIJoIR: Variable expressions of autogeny in three mosquito species. 1979, 1:253-261.
36. Spadoni R, Nelson R, Reeves WJAotEsoA: Seasonal occurrence, egg production, and blood-feeding activity of autogenous *Culex tarsalis*. 1974, 67:895-902.
37. Kay B, Edman J, Mottram PJJotAMCA: Autogeny in *Culex annulirostris* from Australia. 1986, 2:11-13.
38. Polis GA, Myers CA, Holt RDJAroe, systematics: The ecology and evolution of intraguild predation: potential competitors that eat each other. 1989, 20:297-330.
39. Haramis L: Larval nutrition, adult body size, and the biology of *Aedes triseriatus*. 1985.

40. Al-Jaran TK, Katbeh-Bader AMJAI: Laboratory studies on the biology of *Culiseta longiareolata* (Macquart)(Diptera: Culicidae). 2001, 23:11-22.
41. Van Pletzen R, Van Der Linde TDKJBoER: Studies on the biology of *Culiseta longiareolata* (Macquart)(Diptera: Culicidae). 1981, 71:71-79.
42. Hugo L, Kay B, Ryan PJJome: Autogeny in *Ochlerotatus vigilax* (Diptera: Culicidae) from Southeast Queensland, Australia. 2003, 40:897-902.
43. Tsuji N, Okazawa T, Yamamura NJJome: Autogenous and anautogenous mosquitoes: a mathematical analysis of reproductive strategies. 1990, 27:446-453.

Figures

Figure 1

Field collected *Cs. longiareolata* mosquito rearing in lab condition.

Figure 2

A) Eggs in the ovary of dissected autogenous *Cs. longiareolata* mosquitoes. B) Laied eggs with autogenous *Cs. Longiareolata* mosquito. C) Egg sells. D) The first larval instar of *Cs. Longiareolata* emerged from autogenous mosquitoes.