

Morphological Identification of Chironomus Larvae in Jaipur District (Rajasthan) India



Microbiology

KEYWORDS : Chironomus circumdatus, Chironomidae, Blood worms, Morphological identification, Jaipur district Chironomus

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ABSTRACT

Chironomidae, also known as Chironomids, belongs to phylum Arthropoda. The Chironomidae larva is most suitable animal to test aquatic toxicity of aquatic micro-pollutants. These are the most abundant macro-invertebrates group in limnetic environments and freshwater ecosystems. Larval stages are found in almost any aquatic or semiaquatic habitat. Chironomidae undergoes through three ecdyses during the larval development. Different instars take different time to mature and varying from one species to another, while fourth instars often being longer than earlier instars. The pupal stage is relatively short; when pupa leaves exuviae on the water surface and the adult emerges. Larvae are bright red in color due to presence of hemoglobin; these are frequently known as "bloodworms". Holometabolous metamorphosis is found in this Chironomus larva. This larva bears anterior and posterior parapods and procerci well developed. Penultimate segment with 1-2 pairs of ventral tubules. 1-2 pairs of anal tubules present; striated ventromental plates are present. Median tooth of mentum not so far beyond lateral teeth; mentum bears 3 median teeth and 12 lateral teeth; mandibles with at least 2 inner teeth; antennae 4-8 segmented. Larvae were cultured in laboratory with controlled techniques. Permanent slides of these larvae were prepared using standard method. Photography of these larvae were taken by Nikon Eclipse ME-600 Microscope in CSC Laboratory, Department of Zoology, University of Rajasthan. Identification of these larvae is based on key- Identification Manual for the Larval Chironomidae (Diptera) of North and South Carolina- John H. Epler. These Chironomus species are closed to circumdatus on the basis of morphological identification.

INTRODUCTION

Utilization The Chironomidae is a large and diverse family of insects. They are commonly known as "non-biting midges." There are over 20,000 species known world-wide, including 2,000 in the Nearctic. Adult midges are relatively small (1-20 mm long), with narrow bodies and long legs. They resemble, and are often confused with, mosquitoes (Culicidae), but unlike mosquitoes, they do not bite, and have no scales on their wings. Many species rest on their hind two pairs of legs, and hold their forelegs out in front of them. In most species, adult males have plumose antennae that are much larger than the females (these are probably used to locate females) [1].

During the spring and summer males will create mating swarms which people can find quite a nuisance even though adults do not bite, or feed. Females will lay egg masses in water where the egg mass will grow and sink to the bottom. The larva stays at the bottom in silken tubes. The larva feed on organic material such as organic debris and algae [2].

The variability of environmental conditions under which Chironomids are found is more extensive than for any other group of aquatic insects [3]. The ecological amplitude is related to several morphological and behavioral adaptations found among the members of this family [4]. Such adaptations may explain the wide distribution of the group, as observed and registered worldwide [5]. According to MacDonald and Taylor [6] and Armitage et al. [7], Chironomidae go through three ecdyses during the larval development: in transitions from the first to the fourth instar. Time of different instars varies from one species to another, with fourth instars often being longer than earlier instars. The pupal stage is comparatively short; at this point larvae molt into the adult form, when pupa removes exuviae on the water surface and the adult emerges [8].

Some of the confusion in identification is due to the complexity of the taxonomy of the family. The Chironomidae have grieved a "double whammy" of sorts:

- a. Their names were confusing due to changes necessitated by the Code of Zoological Nomenclature at the time [9].

- b. There were two systems of classification, one based on adults, the other on immature stages [9].

The family is divided into 11 subfamilies, seven of which occur in North America. Two of the subfamilies, Telmatogetoninae and Podonominae, are relatively restricted in habitat; two other subfamilies, the Diamesinae and Prodiamesinae are relatively uncommon [9].

Therefore the present investigation will attempt to identify the Chironomus species of Jaipur District (Rajasthan) India. Sampling site selection based on rural, semi-urban and urban area.

MATERIAL AND METHODS

Sampling was carried out in different sites of Jaipur between Sept. and Nov.2103. Larvae were collected with the help of a net. 100 larvae were collected from each sampling site. In laboratory the larvae put under controlled factors such as temperature, nutrients, light etc. Permanent slides were prepared as below. The slides were photographed by Nikon Eclipse ME-600 Microscope in CSC Laboratory, Department of Zoology, and University of Rajasthan. These photographs of the larvae's morphological structure (mentum, antennae, and parapods) were matched with standard identification key- Identification Manual for the Larval Chironomidae (Diptera) of North and South Carolina- John H. Epler.

COLLECTION OF SAMPLES

The Chironomus larvae samples were collected from three different geographical localities in vicinity of Jaipur. These are following sites-

1. Village-Vimalpura, Tehsil-Chomu, Dist.-Jaipur (Sept. 2013)
2. JECRC University Campus, Sitapura, Jaipur (Oct. 2013)
3. Village-Maniyavas, Mansarovar, Jaipur (Nov.2013)



Photos during sampling at JECRC University campus



Sampling at Vimalpura

Sampling at Maniyavas

Figure 2.1 Sampling Photographs

SLIDES PREPARATION

After collection, larvae were kept in a tray and feed by organic material present in soil and fish protein powder. Permanent slides were prepared accord to the following steps:

10% KOH (6-14 Hrs.)

Water (5 Min.)

Glacial acetic acid (10 Min.)

Absolute Alcohol (10Min.)

Fix the slide with Canada balsam

PHOTOGRAPHY OF SLIDES

Photography of slides has done with Nikon Eclipse ME-600 Microscope by using objective lens 40X and 100X (oil emersion).



Figure 2.2 Photography of slides at Department of Zoology, University of Rajasthan

RESULTS AND DISCUSSION

Many species superficially look like mosquitoes, but they lack the wing scales and elongated mouthparts of the Culicidae. Chironomid larvae bear a sclerotized, non-retractile head capsule, with opposing mandibles, on a narrow, cylindrical body. There is one pair of unjointed anterior parapods ("prolegs") on the first body segment, one pair of unjointed posterior parapods on the last body segment, which also bears a pair of setae-bearing procerci, and 1-2 pairs of anal tubules. Some terrestrial Chironomids and others living in specialized environments have lost one or both pairs of parapods. There are usually no spiracles, except in some members of the subfamily Podonominae. There are four larval instars (the larvae shed its skin four times before pupating).

Chironomus larva takes 28-30 days in complete development from first instar to adult. Setal fringe is not present, penultimate segment sometimes with 1-2 pairs of ventral tubules; antepenultimate segment sometimes with lateral tubules.

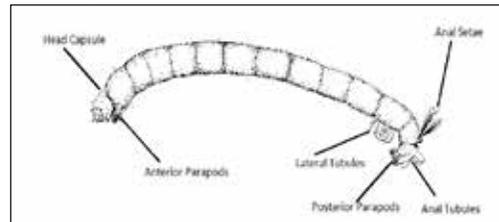


Figure 3.1 Chironomus External Structure (Schematic)

COMPARISON OF TEST SPECIES TO KEYS

Median tooth of mentum not projecting far beyond lateral teeth; pecten epipharyngis a broad multitoothed comb; 1 or 2 pairs of ventral tubules.....Chironomus

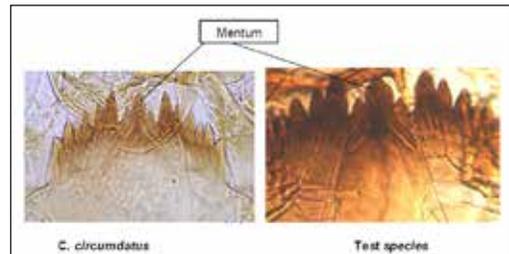


Figure 3.1 Comparison of mentum

- Striated ventromental plates are present; no beard present beneath ventromental platesChironominae
- Ventromental plates squat, separated by at least the width of the 3 median teeth; larvae in transportable cases.....Chironominae
- Ventromental plates separated medially by at least the width of the median tooth/teeth of the mentum Chironominae

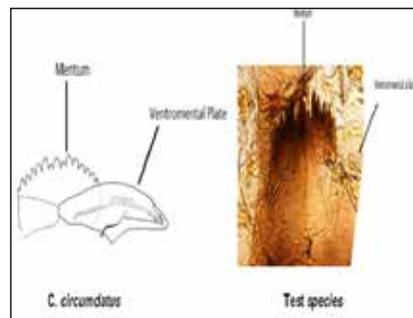


Figure 3.2 Comparison of ventromental plates

- Mandibles with at least 2 inner teeth or notches indicating teeth..... *Chironomus*
- Mandible with basal row of rapidly arranged striae front clypeal apotome with 1 median labral sclerite anterior to it.....*Chironomus*

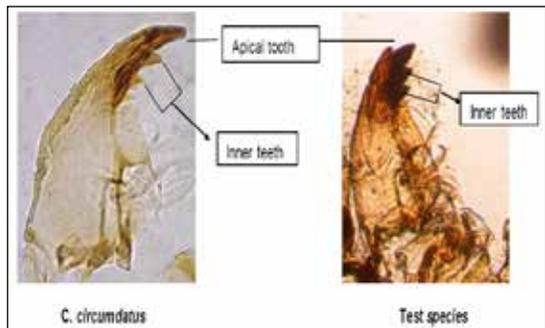


Figure 3.3 Comparison of teeth

- Antennae 4-8 segmented, rarely reduced

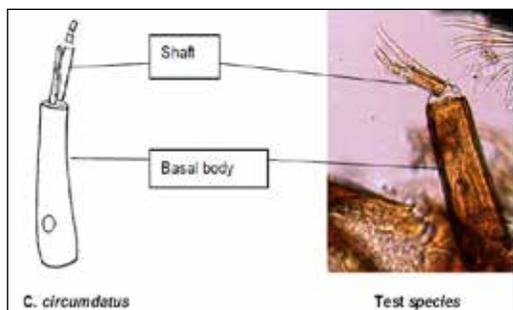


Figure 3.4 Comparison of antennae

- Penultimate body segment with 1-2 pairs of anal tubules.
- Anal setae present.
- 1 pair of posterior parapods present.

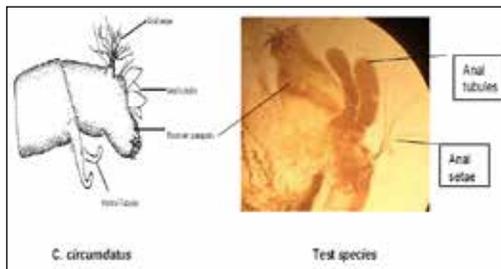


Figure 3.5 Comparison of penultimate organ

- One pair of plumose antennae present.
- One pair of wings present.

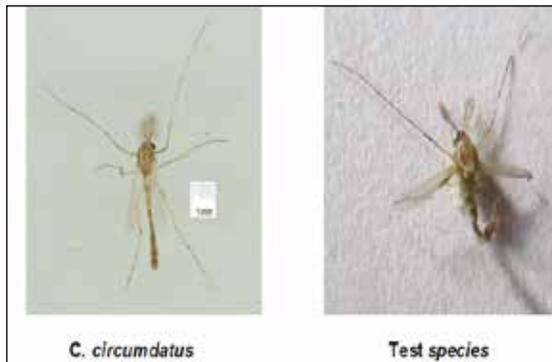


Figure 3.6 Comparison of adult Chironomus

This identification is based on morphology of the larvae. After comparison and matching of characteristics to the key (Identification Manual for the Larval Chironomidae (Diptera) of North and South Carolina- John H. Epler) we can conclude that species of Chironomus larvae of Jaipur District is c.f. *C. circumdatus*.

REFERENCE

1. Coffman, W., L. Ferrington Jr. (1996), Chironomidae. R Merritt, K Cummins, Eds. "An Introduction to the Aquatic Insects of North America", Dubuque, Iowa, USA: Kendall/Hunt Publishing Company, 591-754. | | 2. Evans, Arthur V. (2007), "Flies: Order Diptera". Field Guide to Insects and Spiders of North America", Sterling Publishing Co., Inc., 235 ISBN 978-1-4027-4153-1. | | 3. Merritt R.W., Cummins K.W. and Berg M.B (2008), "An Introduction to the Aquatic Insects of North America", 4th ed., Dubuque, Kendall Hunt, 1-772. | | 4. Ferrington Jr. L.C. (2008), "Global diversity of non-biting midges (Chironomidae: Insecta-Diptera) in freshwater, Hydrobiologia", 595, 447-455. | | 5. MacDonald E.E. and Taylor B.R. (2006), "Incidence of mentum deformities in midge larvae (Diptera: Chironomidae) from Northern Nova Scotia, Canada, Hydrobiologia", 563, 277-287.) | | 6. Armitage P.D., Cranston P.S. and Pinder L.C.V. (1995), "The Chironomidae biology and ecology of non-biting midges", 1st ed., London: Chapman & Hall, 538. | | 7. Tokeshi M. (1995), "Life cycles and population dynamics In (Armitage, P.D., Cranston, P.S. and Pinder, L.C.V.) (Eds), The Chironomidae: Biology and Ecology of Non biting Midges", London: Chapman & Hall, 225-250. | | 8. Daughton C.G. and Ternes T.A. (1999), "Pharmaceuticals and personal care products in the environment: Agents of subtle change? Environmental Health Perspectives", 107, 907-938. | | 9. Epler John H. (2001), "Identification Manual for the Larval Chironomidae (Diptera) of North and South Carolina", 1-526. |