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Review Article

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The First Records of Freshwater Testate Amoebae (Protozoa) for Tigris River at Baghdad City- Iraq

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Abstract This study included to describe and illustrate first records of testate amoebae fauna for Tigris River, which has massive amount of sediment at Baghdad city. The fauna of freshwater testate amoebae of Iraq are mostly unknown. Fourteen species of five families were recorded, three species for Arcellidae, three Centropyxidae , five Difflugidae, two Euglyphidae and one species for Hyalospheniidae, which will be added to the fauna of Iraqi environment. Samples were collected once every two months from four stations at Tigris River- Baghdad city in February 2016 to January 2017. The dominant species of testate amoebae depends on the chemical and physical parameters of ecosystem of the river represented by temperature, pH and food abundance.

Keywords Freshwater, Amoebae, Protozoa

Introduction

Testate amoebae as primary destructors of cellulose and lignin, take an active part in diverse biological processes in water ecosystem .They are a group of free-living protozoan having an external shell. The findings of the representatives of this group were recorded during the period of 1930-1940 [1]. They constitute a group of those amoeboid protozoa in which a single eukaryotic cell is enclosed within a shell or test (size range 25-400µm) with an oral aperture, through which filose or lobose pseudopodia protrude during locomotion or feeding [2]. They occur worldwide in wetland, freshwater habitats, standing waters, lake margins and the bio films of sewage treatment plants [3].

Testate amoebae are divided into those with lobose and those with filose pseudopodia [4]. Testate lobos amoebae are Amoebezoa [5] and include the larger species (>100µm) especially those in the families Difflugiidae, Centropyxidae, Arcellidae and Hyalospheniidae. Many species of the Difflugiids and Centropyxids have agglutinate tests or shell composed of mineral particles gathered from the environment. Many large species of Hyalospheniids (eig. those in genera *Nebela* and *Heleopera*) have tests composed of idiosomes acquired from consumption of Euglyphids as prey [6]. Testate filose amoebae by contrast are closely related to the foraminifera and cereozoa [7] and include the families Euglyphidae and Trinematidae. These contain small species (<100µm) with siliceous tests composed of idiosomes biosynthesized by the resident amoebae. Testate amoebae can be classified into ecological groups according to their requirements concerning moisture (hygrophiles, hydrophiles, xerophiles), pH (acidophiles, calciophiles), habitat preferences (sphagnophiles, soil-inhabiting, aquatic).

Materials and Methods

Description of the study stations

The Tigris River extends 49Km from Baghdad's Muthana Bridge north of Baghdad to the Diyala River south of Baghdad, which contains massive amount of sediments, leading to lower water levels along the river in Baghdad province [8]. Four stations were selected in Tigris River within the city of Baghdad and was the first station in the area of Etifiya, the second Adhameya, the third Abu-Nawas and the fourth station in Jaddareia.

Collection of Samples

Water samples were collected from four stations in the Tigris River at a rate of once every two months for the period from February 2016 to January 2017. 60 liters of water were taken by vertical hauls with 50µm mesh plankton net and concentrated to 10 ml, and in the field specimens were fixed in 4% formalin immediately after sampling .Testate amoebae were identified according to the available standard keys [9]. A depression slide was used to identify the testate amoebae at 10x to 40x magnification with a light microscope [10].

Results and Discussion

Fourteen species of five families were recorded, three species for Arcellidae, three Centropyxidae, five Difflugidae, two Euglyphidae and one species for Hyalospheniidae predominated, which will be added to the fauna of Iraqi environment.These species of testate amoebae were recorded for the first time in Tigris river. Unallocated taxonomy based the kind of shell which shows many variations and differences in shape and dimensions and components as well as the presence of spines and their numbers, the shape of the oral aperture and how many be lobed and teeth. The size of testate amoebae are ranging from 25-400 µm.

Taxonomy of testate amoebae (Patterson, 2014)

Phylum:Amoebozoa Luhe,1913
Class:Lobosia Carpenter,1861
Order:Arcellidae Kent, 1880
1- **Family**:Arcellacea Ehrenberg,1843
Genus:*Arcella*. Ehrenberg,1832
Species:1- *Arcella discodies* Ehrenberg,1872
2- *Arcella dentate* Ehrenberg,1838.
3- *Arcella* sp .
2- **Family**:Centropyxidae Jung,1942
Genus:*Centropyxis*. Stein,1859
Species: 1- *Centropyxis aculeata* Ehrenberg,1838
2- *Centropyxis ecornis* Ehrenberg,1841.
3- *Centropyxis* sp
3- **Family**:Difflugidae Awerintzew, 1906
Genus:*Difflugia*.
Species: 1- *Difflugia acumiata* Ehrenberg, 1838
2- *Difflugia australis* Playfair, 1918
3- *D. mammillaris* Penard, 1893
4- *D. schizocamlis* Stepanek, 1952
5-*Difflugia* sp. Leclere, 1815
4- **Family**:Euglyphidae Wallich, 1864
1- **Genus**:*Euglypha*. Ehrenberg, 1841.
Species*: Euglypha* sp. Dujardin, 1841
2- **Genus**:*Scutiglypha*.
Species*: Scutiglypha* sp.Ehrenberg, 1841
5-**Family**: Hyalospheniidae Schulze, 1877
Genus: *Nebela*. Ehrenberg, 1848.
Species*: Nebela* sp. Penard, 1902

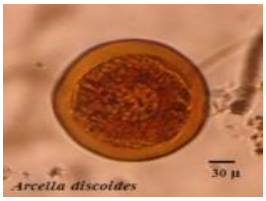
***Arcella* sp**.

Species with a more or less circular shell, aperture central, invaginated in many species surrounded by a tubes circle of pores. Test completely organic , composed of box- like building units arranged in a single layer and cemented together resulting in an areola surface. Young shells are colorless, older become brown, due to iron and manganese storage into the builbing units. Most species are binucleate, have several contractile vacuoles. The diameter of the shell varies between 25-300 µm. Species of *Arcella* can be found in all freshwater biotopes.

Wet and dry mosses and with a few species in soils. Some species are characteristic for specific habitats dry mosses and wet Sphangum. Most of them are mainly herbivores (algae, fungi and bacteria).

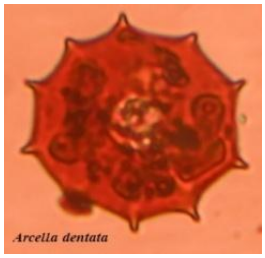
Arcella discoides Ehrenberg, 1843

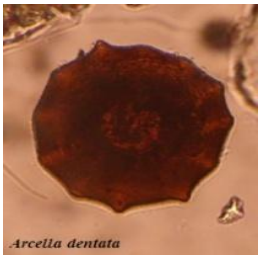
Shell generally circular in apical view, plano-convex in lateral view, sometimes arched; diameter about three to four times the height; without a distinct rim or border.Two nuclei or more. Aperture circular, invaginated, bordered by a shallow lips usually surrounded by a ring of numerous small pores. Ratio diameter aperture/shell usually 0.30-0.45. Height of the shell about 1/3 that of the diameter. Shell yellow or brown, shell diameter 70-157 µm, aperture diameter 21-52 µm . It is common in pond water.



***Arcella dentata* Ehrenberg, 1838**

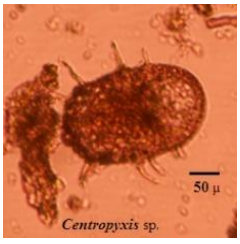
Shell circular and dentate in front view, crown-like in profile, diameter more than twice the height, aperture circular, large, colorless to brown, fifteen to seventeen spines, with teeth or dentate border. The ventral side turned to the substratum, resembles an inverted funnel, with circular aperture in the center. The opposite, dorsal side is dish-shaped with flattened vertex, and bears 7-20 spines or ridges, the spines are bent dorsally and more or less evenly spaced around the circumference in a single row. The shell is about 120 µm in diameter (107-133 µm) and about 50 micron height (41-58 µm). Habitat bogs and swamps, Sphagnum.





***Centropyxis* sp.** Stein, 18

Centropyxis is a genus with a discoid, flattened shell, some what beret-shaped. At the posterior end or all around the periphery some spines may be present. Within population individuals may have zero to thirteen spines, the shell surface is smoother, dorsally with more or less mineral particles or diatoms, cemented together by an organic materials, ventrally polished-looking due to more cement and much smaller grains in the shell. Some species are common in freshwater habitats and sphagnum, but most species are found in drier mosses and humus.



Centropyxis aculeate (Ehrenberg, 1838)

Shell 92-178 µm in diameter, variable in contour and size , cap-shapes, yellow or brown, ovoid or circular and usually with about four or more lateral spines, in dorsal view spherical and tapering towards the aperture, shell surface rough, except for a smooth region around the aperture, often covered with quartz grains and /or diatom frustules, aperture invaginated, oval and sub-terminal. Live in sphagnum, other mosses in the ooze of ditches and lakes.

Centropyxis ecornis (Ehrenberg, 1841)

Shell of large size, usually more than 200 µm, usually circular or largely elliptical, mostly irregular in outline, in lateral view the dorsal region is spherical and tapers from the mid-body position to the apertural lip, shell rough, covered with quartz sand grains, embedded in an organic cement, color usually grey, sometimes brownish, depending upon the density of the xenosomes, aperture invaginated, oval or circular, irregular lobed, not very much eccentric, with a thick apertural rim. Live in freshwater, in sediments and among water plants and mosses.

Difflugia **sp**. (LeClerc, 181)

Species with an agglutinated shell, with terminal, round, lobed or teethed aperture, some with necklace but never with internal diaphragma. The pseudopodia are broad and with rounded ends (are lobos). A shell always composed of mineral particles or diatome in a structured or sheet-like organic cement. Many Difflugia select and arrange the building material according to size and shape to construct a species specific shell. The nucleus is mostly ovular in some species vesicular. Several freshwater species have green symbionts. Many species are common in freshwater sediments or between water plants others live in dry mosses and soil.

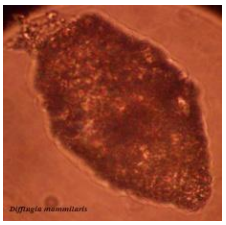
Difflugia acuminata **Ehrenberg, 1838**

Testae amoebae, lorica is brown, cylindrical with a pointer or acuminate aboral region. The surface is rough and covered with quartz particles and occasionally with fragments of diatoms. The aperture is circular and often covered with a thin layer of organic cement which gives it a smooth utline.

Length of shell 100-300 microns, breadth of shell 35-95 microns, diameter of aperture 36 microns.

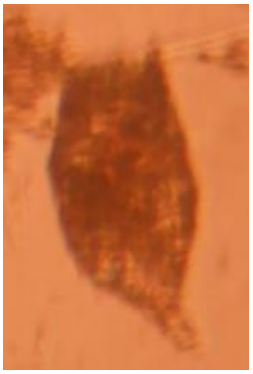
Difflugia mammillaris Penard, 1893

Shell ovoid, elongate, swollen or arched in the mid-region but tapering at both extremities, to give a rounded protuberane aborally and gradually near the aperture to give a slightly pronounced neck. Aperture circular, composed of small particles, in side view usually oblique. Aboral spine usually non-entral. Nucleus spherical with central nucleolus. Nucleolus with some lacunae. Length 90-130 micron , lives in freshwater, different water types. Common species in sediments and detritus.



Difflugia australis Playfair, 1918

Shell transparent, colorless or light yellow-brown,ovoid, spherical or pyriform usually with one prominent spine, positioned centrally.The aboral horn was either present or absent. Shell composed of thin siliceous plates overlaid by diatom frustules, whih are united by an organic cement. Length 57-133 micron, lives in *Sphagnum* pools, Rare.

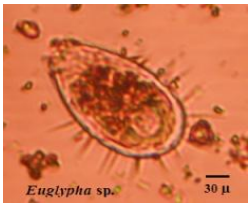


D. shizocaulis Stepanck, 1952

The shell is Oval to pyramid, the presence of irregular bump branching divergent from the area of the mouth, the limbs are irregular in length. The shell is made of from small pieces to large of flat quartz, the nucleus spindle shape. Its dimensions range from 175-332 micron and lives in the freshwater environment and sediments.

Euglypha acanthophora Ehrenberg, 1841

The shell length is 50-75µm, width 25-40. Shell ovoid, elliptic in transverse section. Aperture (15-22µm) circular, 8 to11 aperture idiosomes. Idiosomes thickened, on the anterior end rounded with on median tooth, and 3 pairs of lateral teeth. Nucleus with a central nucleolus. Lives in freshwater .

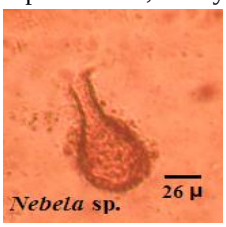


***Scutiglypha* sp.** Ehrenberg, 1841

Shell dimensions 55-84 µm thick oval length to width ratio 1-4 relatively small, length to width ratio 69 in 48 micron, containing 3-4 rows of oral plates, the first row of oral plates is a medial form. The shape of the shell in the round cross section consists of 100-120 silicon plates there are alternately overlapping and in long rows. The oral cavity is a circular endothelium with a final dental line, the body panels give a wide shape. There are 4-5 spines on the posterior end.

***Nebela* sp**. Leidy, 1875

Shell thin ,ovate or pyriform with circular or oval platelets of uniform or various sizes, highly irregular, endoplasm with oil globules, nucleus posterior, body dose not fill the shell and is connected with the latter by many ectoplasmic strands as fundus end, pseudopodia blunt, varely branched, freshwater.



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