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A qualitative study of Periphytic algae attached to the surface of river boats in the Tigris River in Al Aadhamiya, Baghdad, Iraq

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ABSTRACT

A seasonal study of periphytic algae attached to the surface of river boats was conducted in Tigris river in Al Aadhamiya site for the period from October 2016 to May 2017. A total of 107 taxa of periphytic algae were identified belonging to the four classes of algae. The periphytic algae community dominated by Bacillariophyceae was (60.7%) followed by Chlorophyceae (20.5%) and Cyanophyceae (17.7%) Chrysophyceae was constituted (0.9%) of the total number. During the whole period of study filamentous taxa such as *Oscillatoria amphibian*, *Phormidium* spp., *Spirulinagigantean*, *Cladophoreglomerata* and *Melosira roeseana* remained the dominant colonizer which may be reflect the ability of this species to grow multiplies under different environmental conditions. This investigation showed that the succession of colonization species and community of periphytic algae during three seasons was developed towards the equilibrium.

Key words : *Qualitative, Periphytic, Tigris River, Baghdad*

Introduction

Periphytic algae are highly diverse organisms (Al-Hassany and Al-Bayaty, 2017) and an essential component in aquatic environment inloticsystem (Graham *et al.*, 2009), it represents main base in the aquatic food chain and the most important source of food for aquatic organisms and its ability to release oxygen as byproduct of photosynthesis processes parallel to the ability of plants on land (Bold and Wynne, 1985). Periphytic algae in fresh water may be single or multicellular with varying sizes from microalgae to visiblemacroalgae (Graham *et al.*, 2009). Algae are distinguished by their ability to absorb nutrients from the environment they are present in through the surface of their body and their ability to concentrate elements inside their cells in quantities that exceed their size several times without showing any toxic symptoms (Fritsch, 1965). Periphytic algae have the ability to adhere to surfaces submerged in water, whether surface was natural such as aquatic plants, rocks and mud or artificial such as the surface of boats, ships and concrete substrates (Al-Hussainy *et al.*, 2013). Periphytic algae resort to adhesion to surfaces as a strategy for their survival and support for their growth because the nutrient in the aquatic environment tends to aggregate and concentrate near or on solid submerged surfaces (Kasim and Mukai, 2006). Adhesion process begins with microscopic organisms such as bacteria and fungi. This process occurs within hours, followed by the formation of another biological community consisting of larger organisms that include algae and larvae of some invertebrates and crustaceans. This process takes a few days, during which algae grow and multiply in number and in-

crease than bacteria and fungi that first colonized the surface, leading to the formation of clumps of colonies compacted on these surfaces known as algal mats (Khuram *et al.*, 2014). Periphytic algae adhere to the surfaces by secreting sticky exopolymeric substances which are often polysaccharides this viscous substance is very important for these organisms as it stabilizes and attracts dissolved nutrients in the aquatic environment and facilitates the sliding movement of diatomaceous algae (Marashoglu *et al.*, 2007). This study aims to diagnose the species of periphytic algae and answer the question if the colonization process of algae attached to the boats surface in Tigris river in Aadhamiya sites hows aseasonal variation.

Materials and Methods

This study was conducted on a section of Tigris river inAl Aadhamiya site north of Baghdad cityon Al-Rusafa side (eastern side of Tigris river) which characterized by its residential areas, tourist places, river navigation and the continuous movement of boats. Tigris river in this region is affected by the used engines and the water displacement resulting from the size of the river boats, which form waves of different sizes. The location was determined by GPS device at longitudes 44° 22 28.77 E and latitudes 33° 21 24.81 N (Figure 1).

Collection of samples

Seasonal samples of periphyticalgae attached to the surface of river boats were collected in the Autumn of 2016 and Winter, Spring of 2017. Three replicates for each seasons have been collected. Method described by Fetscher *et al.* (2009) was followed to isolated periphytic algae from boat surface by use PVC delimiteris made from a 1 1/2 sewer cleanout. The diameter of cleanout is 4 cm. The edge of the cleanout should be sharp to ease insertion through algaemats and facilitate sample collection. Sample of periphytic algae were placed ina special sterile plastic container with little river water and added 3 ml of buffered formalin. Subsequently temporary and permanent slides were prepare (APHA, 2005). Light microscope were used to examineslids. Several reference were used for identification periphytic algae (Desikachary, 1959; Prescott, 1969; Patrick and Reimer, 1975; Hadi *et al.*, 1984).

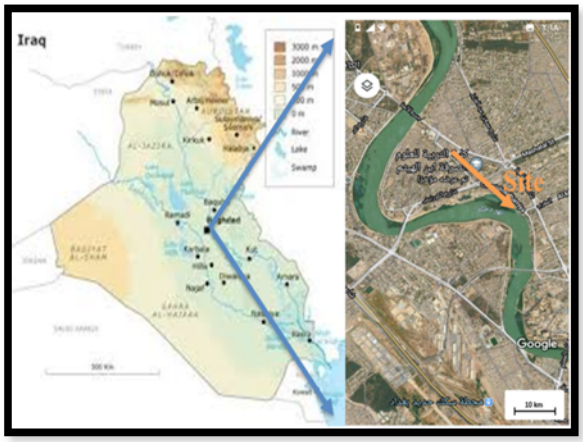

Fig. 1. Tigris River section and study area Al-Aadhamiyasite.

Results and Discussion

Periphytic algae are distribute according to the type of substrate and microenvironment that they prefer to adhere and the algae we are interested in this research were prefer to stick to the surface of river boats. The result were showed in Table 1 and Figure 2-3.

Qualitative study was recorded 107 species of Periphyton algae belonging to 48 genera During three seasons of the study. Bacillariophyceae was dominant with 65 species belonging to 25 genera Its scored % 60.7. This phenomenon is prevalent in the Iraqi internal waters (Al-Hassanyand Al-Bayaty, 2017; Hassan and Shaawiat, 2015) as well as prevalent diatom species in most bodies of water on earth (Bioloand Rodrigues, 2013; Neif *et al.*, 2014) is due to the silicon structure that diatoms possess which enable them to live and reproduce within a wide range of environmental influences.

The results showed a higher colonization rate by Pennales than Centrales order (%84.6, %15.4) respectively. It known that most of pennales diatomes prefer to live in fresh water, while central esdiatomes prefer salt water (Hunter, 2007). Tigris river is one of the freshwater rivers that hadbegun to record an increase in salinity in recent decades (Hassan, 2011; Rahi and Halihan, 2018).

The proportion of Chlorophyceae was % 20.5(22 species belong to 13 genus) while Cyanophyceae was %17.7 (19 species belong to 9 genus) we should be noted that Cyanophyceae is the less dominantthan Chlorophyceae in internal Iraqi waters (Talling, 1980). Other periphytic algae classes such as those of Chrysophyceae were not significance as only one species was recorded (Figure 1).

Table 1. Species of Periphyton algae attached to the surface of river boats in Tigris River in Al Aadhamiya site during 3 seasons.

Taxa	Autumn	Winter	Spring
Cyanophyceae			
Anabaena affinias Lemmermann	++	+	
Coelosphaerium sp	++	++	
Gloeocapsa sp.			++
Gomphosphaeriaaponina Kuetzing.		++	++
Merismopediaelegans A. Braun	+	+	+
M. marssonii Lemmermann	+	+	
Microcystisauroginosa Kuetzing	+	++	
M. elabens Breb	+	+	
Oscillatoriaacuta Bruhl and Biswas	++	+	
O. amphibia Agardh	+++	+++	+++
O. curviceps Agardh	+		+++
O. obscura Bruhl	+		+
O. raoi Detoni	++	+	+++
O. tenuis Agardh	+++		++
O. tenuis var. tergestina Rabenhorst	+		+
Phormidium sp.	+++	+++	+++
Spirulina gigantean Schmidle	+++	+++	+++
S. minue Turpin	++	+	++
S. nordstedtii Gom	++		+
Chlorophyceae			
Acanthosphaerazachriasilemm	+		+
Ankistrodesmusspiralis (Turner) Lemm.	+	++	
Chlorella sp.	++		
Coelastrummicroporum Naeg.	++	+	
Cladophorafracta (Dillw.) Ktz.	++	+	+
C. glomerata (L.) Ktz.	+++	+++	+++
C. oligoclona Ktz.(Syn.)	++	++	++
Crucigeniacrucifera (Wolle) Colins	+++	+	
Micrasterias sp.		++	+
Mougeotiaelegantula Wlttrock	+	++	
Oedogonium cardiacum (Hass.) Wittrock	++	++	
O. gracilius (Wittr.) Tiffany			++
O. mitratum Hirn.	+	+	
O. refuscens Wittr.	++	+++	
Oocystiselliptica West	+	+	
O. lacustris Chodat		+	+
O. solitaria Wittrock		+	
Pediastrumbiradiatum Meyen	++	++	
P. duplex Meyen		+	+
*Selanastrum*sp.	+	++	
Spirogyra jurgensii Ktz.	+	+	
S. singularis Nordstedt		+	
Chrysophyceae			
*Dinobryon*sp.		++	
Bacillariophyceae			
A-Centrales			
Actinocyclus granulate (Her)	+	+	
Coscinodiscuslacustris Grunow	+		
C. curvatulus Grunow	+	+	++
Cyclotellacatenata (A.Braun.) Bachmann			+
C. comensis Grunow		+	+

Table 1. *Continued ...*

Taxa	Autumn	Winter	Spring
C. operculata (Ag.) Kützing	+	+	++
Melosira granulate (Ehr.) Ralfs	+	++	+
M. lineata (Dillw.) Ag.		+	
M. roeseana Rabenhorst	+++	+++	+++
M. varainsAgardh		+	++
B-Pennales			
Achnantheseffinies Grunow	++	+	+++
A.delicatula (Ktz.) Grunow	+	+	+++
Amphiporapaludosa W. Smith	+		+
Anomoeoneisexilis (Kütz.) Cleve	+	+	+
Bacillariaparadoxa Gmeline	+++	+++	+++
Centronellareichelteii Voiget			+
Caloneis amphisbaena (Bory.) Cleve	++		+
Cocconeishetroidea Hantzsch	+	++	+
C. pellucida Hantzsch	+	+	++
C. rugose Sov.	++	+	+
Cymatopleurasolea (Breb.) W.Smith	++		
C.soleavar.apiculata (W.Smith) Raifs	+	+	+
Cymbellaaffinis Kützing	+	+	+++
C.cistula (Hemp.) Grunow	++		
C. cymbeformis (Kütz.) Van.Heurck	+	+	+
C.gracilis (Rabh.) Cleve	++	+	++
Denticulatenuis Kützing	+	++	
Diatomaanceps (Ehr.) Grunow	+	+	+
D.vulgare Bory	++		+
Diploneiselliptica (Kütz.) Cleve	+		
D. puella (Schum.) Cleve	++	+	
Fragilariacapucina Desmazieres	+++	+++	+++
Gomphonemaacuminatum Ehrenberg		+	
G. acuminatumvar.turris (Ehr)Cleve		+	++
G. olivaceumLangby	+		+
G. paravalum (Kütz.) Grunow	+	+	++
*G. ventricosu*m Gregory	+	+	++
Gyrosigmaacuminatum (Kütz.) Rabenhorst		+	+
Hantzschiaamphioxys (Ehr.) Grunow			++
Naviculaanglica Ralfs	+	+	+++
N. cryptocephale Kuetzing	++		+
N. cuspidata (Ktz.) Kuetzing		+	
N. exilissima Grunow	++	+	++
N. gracilis Ehrenberg	++	++	
N. graschopfii Hust	++	+++	+
N. pygmaea Kuetzing		+	
N. radiosa Kützing	++	++	
N. rhycocephala Kuetzing	+	+	
N.spicula Cleve	+	+	++
Nitzschiaacicularis(Ktz.) W.Smith		+	
N. acuta Hantzsch	+++	++	++
N. amphibian Grunow	+	+	
N. apiculate (Greg.) Grunow	+	++	++
N. closterium (Ehr.)	+	+	+
N. commutata Grunow	+		+
N. gracilis Hantzsch	++	+	
N. palea (Kütz.) W.Smith	+++		+

Table 1. *Continued ...*

Taxa	Autumn	Winter	Spring
Pinnularia leptosome Grunow		+	
Surirellalinearis W. Smith	+++	+++	++
S. ovalis Berbisson	++	+	
Synedraacus Kuetzing	+	++	
S. capitate Ehrenberg	+	++	
S. fasciculate (Ag.) Kuetzing	+++	+++	+++
S. pulchella (Ralfs) Kuetzing	+	+	
S. ulna (Nitz.) Ehrenberg	+	+	++

Periphytic algae adherence began with taxa whose growth is closely associated with each other which might be filaments or single cell have the ability to excrete mucilaginous compounds that reinforce algae to the host surface (Cronkand Mitsch, 1 994). Succession of periphytic algae species generally started with Bacillariophyceae followed by Chlorophyceae and peakwith Cyanophyceae class (Rodusky and Anderson, 2013).

To start colonization substrate adaptation is essential to ensure an attachment between algae and its host (Hameed, 2003). Appearance of an organic film consist of bacteria, fungal hypha, organic molecules and detrital particles on submerged substrate will started during a short time (Tippett, 2007). Many research suggested that organic film should cover substrate before bio attachment (Al-Hussainy *et al.,* 2013). Because the studied area in Tigris river receives untreated sewage so organic material is easy obtained fromwater (Hassan, 2011). Primary colonizers are usually unicellular and small motile forms of periphtic algae which have the capacity to pressed tightly on the surface and forming the shape of the cortex or preserve within the mucilaginous layer (Hameed, 2003). The lower stratum ofalgae are typically consist of multicellular and slowly moving forms (Tippett, 2007). During the whole period of study filamentous taxa such as *Oscillatoria amphibian, Phormidium* spp, *Spirulina gigantean, Cladophore glomerata* and *Melosira roeseana* remained the dominant colonizer this might reflect the capability of this species to grow and multiply under different climatic variables.

During this study a high numerical density wasillustrated forstalked taxa *Gomphonema* spp., *Cymbella* spp. and the motile taxa such as *Navicula* spp. and *Nitzschia* spp. which showed a preference for adhesion to the *Cladophora* filaments that attached to the surface of the river boats. This texture of algal filaments helped to provide a favorable and stable environment for these taxa to adherence and continue to be abundant

The current study reported an increase in the density for genera *Bacillaria paradoxa*, *Fragilaria capucina* and *Synedra fasciculate* which was accompanied by an attachment of other classes of algae like green and blue –green algae.

During three seasons of the study periphytic community developed towards the equilibrium de-

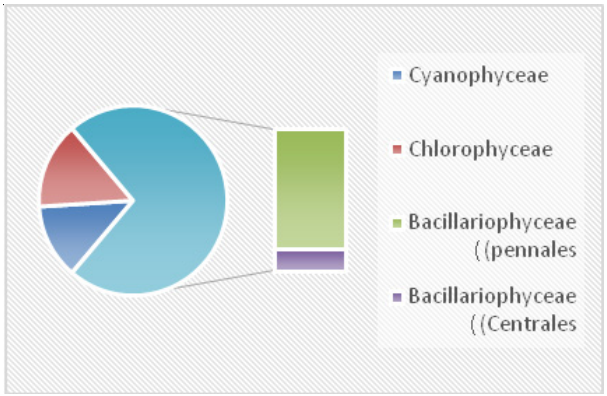

Fig. 2. Percentage of classes of Periphytic algae attached to the surface of river boats in Tigris river in Al Aadhamiya sit.

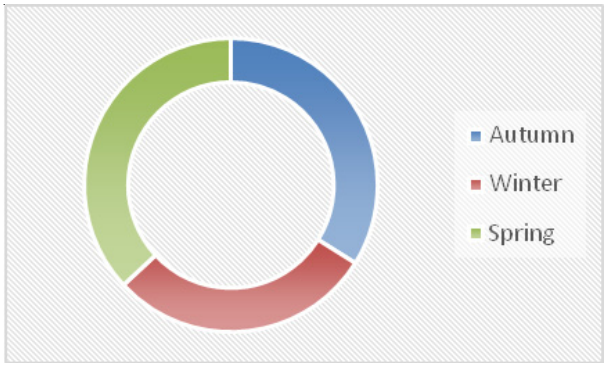

Fig. 3. Number of species of Periphytic algae attached to the surface of river boats in Tigris river in Al Aadhamiya site during three seasons of the study.

spite the climatic fluctuations during Autumn, Winter and Spring seasons. This investigation showed that colonization of abundant species during three different seasons was much stable and balanced in terms of genus presence and the density of the dominant species Figure 3.

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