OPEN ACCESS Freely available online

ISSN: 2155-9546
Journal of Aquaculture Research & Development

Research Article

Identification of Phytoplankton and Evaluation of Algal Biomass in Poultry Manure Fertilized Concrete Pond in Center for Aquaculture Research and Education, Hawassa University

Teklay Gebru Tikue*, Kassaye Balkew Workagegn, Natarajan P, Belayneh Daniel

Department of Aquaculture, Jimma University, Jimma, Ethiopia

ABSTRACT

Phytoplankton groups are the major food items of herbivores fish species and plays a key role in the productivity of water bodies. With this in mind the major phytoplankton groups available in pond water was identified from December 2020 to March 2021 in Hawassa University. A total of 20 phytoplankton groups were identified during the study period. From those which were identified four were blue green algae (*Cyanophyceae*), seven green algae (*Chlorophyceae*), six diatoms (*Bacillariophyceae*), one *Dinophyceae* and two of them were *Euglenophyceae*. Among the phytoplankton groups *Chlorophyceae* were the dominant with a percentage contributions of 56% followed by *Bacillariophyceae* (23%), *Cyanophyceae* (17%) and *Euglenophyceae* (3%) while the least was *Dinophyceae* (1%). The most frequently observed of an algal genus was *Scenedesmus*. In addition to these phytoplankton groups, three zooplankton groups were identified and those were *Copepods* (43%), *Rotifers* (31%) and *Cladocerans* (26%). Blue green algae, green algae and diatoms were the dominant phytoplankton groups identified in the pond water.

Keywords: Algae; Chlorophylla; Phytoplankton; *Scenedesmus*; Zooplankton

INTRODUCTION

Algae are most diverse groups of organisms playing key roles in ecosystem as primary producers and also as symbiosis with other organisms including bacteria [1]. They sequester carbon dioxide by photosynthesis and supply food and oxygen to the consumers of aquatic environments, and thus play key roles in biogeochemical cycles [2]. Algal biomass serves as a sustainable raw material for producing pharmaceuticals, fertilizers, biofuels and food products [3]. Algae are ideal organisms for biological monitoring. Algal diversity, density and abundance are the main indicators of the condition of aquatic ecosystems and the quality water bodies. Due to this, measurement of algal biomass is very important in many ecological and biological studies and in microalgae industry. The application of manure enhances plankton productivity however; after a certain limit may be a cause for deterioration of water quality, plankton and fish growth. The biomass of plankton groups can be reduced because of undesirable water quality and the applications of excessive amount of fertilizers [4,5]. It has been reported that an increase in plankton biomass is often associated with nutrient enrichment [6]. Planktons are sensitive to an increase or decrease in nutrients [7]. Absence of large filter feeding *Cladocerans* such as *Daphnia* species could increase phytoplankton species of a pond [8]. Maximum amount of dry manure application to earthen ponds is recommended as 50 g/m^2/week [9]. Livestock manure is a costless fertilizer that enhances the development of natural fish feeds especially phytoplankton and zooplankton. Poultry manure leads to increased biological productivity of ponds through various autotrophic (algae production) and heterotrophic (bacterial production) path ways, which results in an increased fish production [10]. Organic manures contain almost all the essential nutrient elements that stimulate the growth of plankton [11] and consequently, manure contains considerable quantities of nutrients for fish production [12].

Correspondence to: Teklay Gebru Tikue, Department of Aquaculture, Jimma University, Jimma, Ethiopia; E-mail: teklaygebru331@gmail.com

Received: 25-May-2022, Manuscript No. JARD-22-16787; **Editor assigned:** 27-May-2022, PreQC No. JARD-22-16787(PQ); **Reviewed:** 10-Jun-2022, QC No. JARD-22-16787; **Revised:** 25-Jul-2022, Manuscript No. JARD-22-16787(R); **Published:** 01-Aug-2022, DOI:10.35248/2155-9546.22.13.701

Citation: Tikue TG, Workagegn KB, Natarajan P, Daniel B (2022) Identification of Phytoplankton and Evaluation of Algal Biomass in Poultry Manure Fertilized Concrete Pond in Center for Aquaculture Research and Education, Hawassa University. J Aquac Res Dev. 13:701.

MATERIALS AND METHODS

Description of the study area: The experiment was conducted at the experimental site of Centre for Aquaculture Research and Education (CARE) Hawassa university and which is found in the southern part of Ethiopia at 275 km South of Addis Ababa, the capital city of Ethiopia. It is located at 7°3'7" N latitude and 38° 3'17" E longitude and situated at 1714 meter above sea level. The experiment was conducted from December 2020 to March 2021.

Algal biomass and identification of phytoplankton of pond water: Water samples for phytoplankton group identification and chlorophyll analyses were taken as described by [13] from three points of the pond on monthly basis using water column sampler (La Motte Water Sampler). These samples were pooled and preserved using 0.7% Lugol's solution for laboratory analyses later. In the laboratory, water samples for phytoplankton groups were examined under a microscope (Kruss Optronic made in Germany) at 40x and 400x magnification. Identification of phytoplankton groups was done using available keys and manuals [14]. Enumeration of phytoplankton was made following the procedures outlined in [15] and abundance of each taxon was estimated using the following formula.

C (Cells/ml)=(N × 1000 mm^3)/(A × D × F × concentration factor)

N=Number of individuals

A=Area of the field

D=Depth of the field

F=Number of fields counted

$$concentration\ factor = \frac{\text{volume of pond water filtered(ml)}}{\text{volume of concentrate(ml)}}$$

100 ml of water samples for chlorophyll analysis was filtered through a filter paper (Whatman GF/F with a pore size of 0.7 µm), using a water jet vacuum pump to get a filtrate. Filter papers containing algal samples were cut in to small pieces, 5 ml of 90% cold aceton was added in to test tubes which contain samples and kept for 24 hours in refrigerator. Then after filter papers was crushed and centrifuged at 3000 rpm for 10 minutes. 5 ml of cold aceton was added and absorbance was recorded at 665 nm and 750 nm before and after acidification using a spectrophotometer (Jenway 6305 visible spectrophotometer). From the spectrophotometer chlorophyll a (µg/l) was calculated using the following formula as used by [16].

$$\text{Chlorophyll-}a\ (\mu g/l) \quad \frac{=(Eo\ 665 - Eo\ 750) - (Ea\ 665 - Ea\ 750) * 2.43 * 11.49 * v}{V * L}$$

Where, Eo665=Absorption at 665 nm before acidification,

Eo750=Absorption at 750 nm before acidification;

Ea665=Absorption at 665 nm after acidification;

Ea750=Absorption at 750 nm after acidification;

2.43=factor to equate the reduction in absorbance to the initial concentration of chlorophyll; 11.49=absorption coefficient of chlorophyll, V=Volume of the sample filtered (l),

L=Length of the cuvette (cm) and V=Volume of the extract in ml;

RESULTS

Phytoplankton and zooplankton groups composition

The phytoplankton community was dominated by green algae followed by diatoms and blue green algae from the beginning up to the end of the experimental period. A total of 20 phytoplankton groups were identified during the study period. From those which were identified four were blue green algae (*Cyanophyceae*), seven green algae (*Chlorophyceae*), six diatoms (*Bacillariophyceae*), one *Dinophyceae* and two of them were *Euglenophyceae*. The most frequently observed an algal genus was *Scenedesmus*. Three zooplankton groups were identified and those were *Copepods*, *Rotifers* and *Cladocerans* (Table 1) and (Figures 1 and 2).

Table 1: Phytoplankton groups identified during the study period (1-5 indicates frequency of occurrence of species: 1=rare, 2=sporadic, 3=common, 4=abundant, 5=very abundant).

Group	Species	Relative abundance
Cyanophyceae (Blue green algae)	*Anabaena* species	3
	Cylindrospermopsis	1
	Aphanizomenon	4
	Microcystis	1
Chlorophyceae (Green algae)	*Scenedesmus*	5
	Actinastrum species	1
	Coelastrum	2
	Zygnema	1

	Ankyra	2
	Cosmarium species	3
Bacillariophyceae (Diatoms)	*Pediastrum*	4
	Cymbella	3
	Navicula	4
	Syndra	2
Dinophyceae	*Cyclotella*	2
	Nitzschia	3
	Surirella	1
	Peridinium	2
Euglenophyceae	*Euglena*	2
	Phacus	1
	Copepods	2
	Rotifers	2
	Cladocerans	3

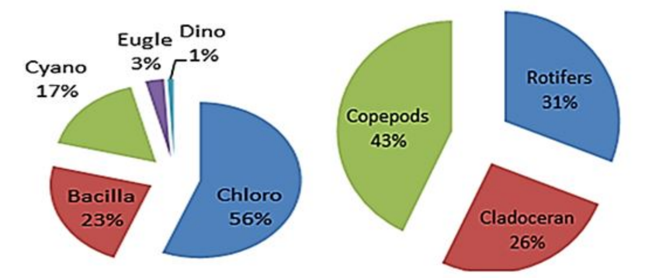

Figure 1: Percentage contribution of phytoplankton and zooplankton groups to the total counts (Cyano= Cyanophyceae, Eugle=Euglenophyceae, Dino=Dinophyceae, Chloro=Chlorophyceae, Bacilla=Bacillariophyceae).

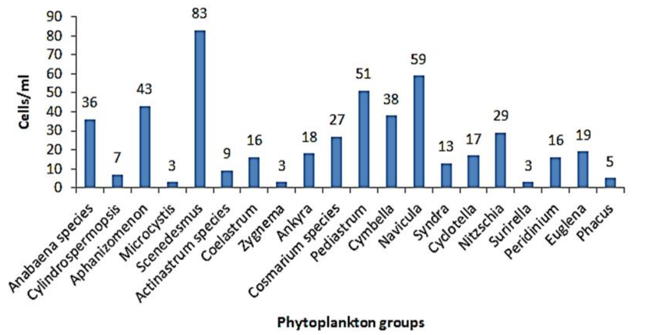

Figure 2: Phytoplankton abundance of pond water.

DISCUSSION

Phytoplankton groups composition and phytoplankton biomass

The result of the present study of chlorophyll a was from 58.4-64.3 μg/l. High amount of chlorophyll a were recorded in pond fertilized with chicken manure which favors good growth of phytoplankton in fish ponds. The current chlorophyll a value is greater than the value reported by [17] who recorded chlorophyll a value from 18.2 ± 2 to 23.4 ± 3.9 μg/l. The reason for the difference in chlorophyll a may be due to the difference in phytoplankton abundance. Therefore, in the current study there is higher phytoplankton abundance than the report of. The chlorophyll a value recorded in the present experiment is in agreement with the works of [16] who reported a chlorophyll a value of 59.22 ± 9.54 μg/l. Furthermore, the chlorophyll a value of the current study is within the recommended range by [18] who reported that productive aquaculture ponds often have chlorophyll a concentration of 50 μg/l-200 μg/l. These showed that poultry droppings are most suitable for phytoplankton production based on its nutrient composition which stimulates optimal production of natural food in an aquatic system [19]. Among the phytoplankton species *Scenedesmus* was the dominant and this may be due to the higher nutrient level of the chicken manure. Nutrients extracted from chicken manure accelerate growth of microalga *Scenedesmus* and it can efficiently utilize the available nitrogen and phosphorus in the manure to support a high growth and biomass production [20]. The reason for the occurrence of diverse phytoplankton groups could be due to the absence of large filter feeding *Cladocerans* such as *Daphnia* species [8]. On the other hand, absence of large *Daphnia* species could favor the diversity of rotifers. This was inconsistent with the works of [17] who reported the percentage contribution of rotifers in pond waters was more than 70% of the total zooplankton groups.

CONCLUSION

In the current study high amount of chlorophyll a was recorded which indicates that there was plenty of phytoplankton biomass needed for pond productivity and for fish feed, these phytoplankton was grown as a result of poultry manure application. Green algae, diatoms and blue green algae were the dominant food items of the fish in the integrated aquaculture system. Similarly, these algae were the dominant algal groups found in the pond. Particularly, *Scenedusmus* was the most abundant phytoplankton species found both in the pond and in the stomach content of the fish. In addition to these, *Dinophyceae* and Euglenophyceae were found in a limited amount in the pond water.

REFERENCES

1. Loram J, Trapido-Rosenthal H, Douglas A. Functional significance of genetically different symbiotic algae Symposium in a coral reef symbiosis. Mole Ecol. 2007;16(22):4849-4857.
2. Mario G, John, B, John A. CO_2 concentrating mechanisms in algae: Mechanisms, Environmental Modulation and Evolution. Annual Rev Plant Biol. 2005;56:99-131.
3. Sorrachat T, Manita M, Jeeraporn P, Lapatrada M, Yuwadee P. Edible algae in Northern Thailand. Chiang Mai Sci. 2012;39(11):119-127.
4. Lin C, Teichert-Coddington D, Green B, Veverica K. Fertilization regimes dynamics of pond aquaculture. CRC Press, Boca Raton. 1997; 73–107.
5. Azim M, Verdegem M, Khatoon H, Wahab M, Van Dam A, Beveridge C. A comparison of fertilization, feeding and three periphyton substrates for increasing fish production in freshwater pond aquaculture in Bangladesh. Aquaculture. 2002;212(1-4):227-243.
6. Smith V. Eutrophication of freshwater and coastal marine ecosystem: A global problem. Environ Sci Pollut Res Int. 2003;10(2):126-139.
7. Mlelwa T. Growth performance and economic benefit of Nile tilapia (*O. niloticus)* and Chinese cabbage *(Brassica rapachinensis)* in aquaculture integration. Sokoine University of Agriculture. Morogoro, Tanzania. MSc Thesis. 1-74
8. Sarma SS, Nandini SS, Gulati RD. Life history strategies of Cladocerans: comparison of tropical and temperate taxa. Hydrobiology. 2005;542(1):315-333.
9. Nyandat B. Analysis of feeds and fertilizers for sustainable aquaculture development in Kenya. Study and analysis of feeds and fertilizers, Rome, Italy. FAO.423-436.
10. Oribhabor B, Ansa E. Organic waste reclamation, recycling and re-use in integrated fish farming in the Niger Delta. J App Sci Environ Mana. 2006;10(3):47-53.
11. Ansa E, Jiya J. Effect of pig manure on the growth of *O. niloticus under integrated fish cum-pig faming system*. J Aqua sci. 2002;17(2):85-87.
12. Gabriel U, Akinrotimi O, Bekibele D, Anyanwu P, Onunkwo D. Economic benefit and ecological efficiency of integrated fish farming in Nigeria. Sci Res Essays. 2007;2(8):302-308.
13. Boyd C, Tucker C. Water quality and pond soil analyses for aquaculture. Alabama Agricultural Experiment Station, Auburn University, Alabama, USA.1992:188.
14. John D, Whitton B, Brook A. The freshwater algae flora of the British Isles: An identification guide to freshwater and terrestrial algae. Cambridge University Press, Cambridge, United Kingdom. 2002;1-702.
15. Hötzel G, Croome R. A phytoplankton methods manual for Australian freshwaters. Land and Water Resources Research and Development Corporation, Australia.1999;1-58.
16. Shoko A, Getabu A, Mwayuli G, Mgaya Y. Growth performance yields and economic benefits of O. *niloticus* and *Kales (Brassica oleracea)* cultured under vegetable-fish culture integration. Tanzan J Sci. 37:37-48.
17. Abelneh Y, Adamneh D, Zenebe T. Effects of feed additives (premix) on growth performance of O. *niloticus* (L, 1758) in concrete pond Sebeta, Ethiopia. J Afr Stud Dev. 2015 ;5:16-36.
18. Boyd C. Water quality for pond aquaculture, research and development series No.43. International Centre for Aquaculture and Aquatic Environments, Alabama Agricultural Experiment Station, Auburn University, Alabama.1998.
19. Wurtz W. Organic fertilizer in culture ponds. Kentucky state University Cooperative Extension programme. World Aquaculture. 2009;35(2):64-65.
20. Han X, Rusconi N, Ali P, Pagkatipunan K, Chen F. Nutrients extracted from chicken manure accelerate growth of microalga Scenedesmus obliquus HTB1. Green Sustain Chem. 2017;7:101-113.