Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2019; 8(1): 155-158
Received: 06-11-2018
Accepted: 08-12-2018

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Zooplanktonic fauna in relation to physico-chemical characteristics in Lake Pichhola, Udaipur, Rajasthan, India

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Abstract
Zooplanktons are small animals that float freely in surface water, column of water bodies and whose distribution is primarily determined by water waves and current. Zooplanktons of Indian freshwaters have been studied by various researchers. Rapid development in recent years has led to an increased demand for water and it does depend on ground water. The freshwater zooplankton consists mainly of 4 major groups *i.e.* Protozoa, Rotifera and two orders of Crustacea *viz*., Cladocera and Copepoda. The physico-chemical parameters of lake Pichhola were fairly moderate. The average water quality parameters of the lake during the study period were, air temperature-28.30ºC, water temperature-25.07ºC, Depth of visibility-85.56 cm., pH-7.68, EC-0.45 mS/cm^{-1}, dissolved oxygen-5.95 mg l^{-1}, free CO_2-17.08 mg l^{-1}, Total dissolved solids-296.83 mg l^{-1}, carbonates-33.74 mg l^{-1}, bicarbonates-136.67 mg l^{-1}, total alkalinity-156.13 mg l^{-1}, orthophosphates-0.14 mg l^{-1}, nitrate-nitrogen-0.60 mg l^{-1}, GPP-0.39 g C m^3 h^{-1}, NPP-0.24 g C m^3 h^{-1}, CR-0.15 g C m^3 h^{-1}.

Keywords: Physico-chemical parameters, Zooplankton, Lake Pichhola, Eutrophic

Introduction
Physico-chemical features of any water body grossly influence the trophic status of that water body. These parameters influence the primary productivity (phytoplankton and zooplankton productivity) and in turn the growth of the fish. In general, the growth of a fish is influenced by the quality and quantity of food material available and consumed. Thus, any variation in quality and quantity of food materials will affect the growth rate of the fish. The qualitative and quantitative variations of natural food materials in a water body are influenced by several abiotic and biotic factors. A comparative study of plankton and productivity of certain Udaipur waters in comparison to the selected waters of Rajasthan have been carried out by Sharma (1980) [13]. Zooplanktons of Indian freshwaters have been studied by various researchers. Sharma *et al.*, (2012) [7, 15] studied the zooplanktonic fauna and its relation to Physico-chemical characteristics in Madar Tank, Udaipur, Rajasthan, India and observed that the presence of a number of zooplanktons also indicate that Madar Tank is little organically rich water body. In this tank he reported some zooplanktons are related to oligotrophic water bodies whereas some are related to eutrophic water bodies and some of them are showing their special preference to mesotrophic environment. Balai *et al.*, (2014) [4] studied the seasonal variations of zooplankton and selected physico-chemical parameters were studied in Jaisamand lake, a large man-made reservoir in Udaipur (Rajasthan). In the study period, 51 species of zooplankton - 17 species of Rotifera, 18 species of Cladocera, 5 species of Ostracoda and 4 species of Copepoda were observed. Among zooplankton, Rotifera was (727 No.l^{-1}) observed as the dominant group throughout the study period and the highest count was recorded in the summer or pre-monsoon period while low incidence was observed in winter season. Zooplankton community is also correlated with certain physico-chemical parameters. Bhavan *et al.*, (2015) [5] studied the diversity of zooplankton was correlated with physico-chemical characteristics of a perennial lake at Sulur, Coimbatore, India. A total of 34 zooplankton species was identified. Sharma *et al.*, (2015) [16] conducted an ecological study have so as to study diversity of zooplankton and macrobenthic invertebrates in two perennial ponds of Jammu region (Jakh pond and Dilli ponds) in all give number species of zooplankton were identified from Dilli pond whereas 25 species from Jahk pond *viz.*, protozoan, rotifer, cladoceran, copepods and ostracods. Pawar (2016) [11] studied the zooplankton diversity and seasonal variation in Majalgaon reservoir. A total of 23 species were found in this reservoir.

Material and Methods

Study Area: Lake Pichhola is situated in Udaipur district of Rajasthan at Latitude 24°58'N and Longitude 73°68'E. The water spread of the lake is 6.96 km^2 with the length of 4 km and the maximum depth of 8.5 m. towards the central western part. The maximum width of the lake is 3 km. Lake Pichhola commands a total catchment area of about 12,700 sq kms.

Collection of water samples: During the study period, quadruplicate surface water samples from adjoining area within a vicinity of 5 meters of four selected sampling stations were collected using a plastic bucket. The water sample were stored in one litre plastic sample collection bottles with air tight cap for analysis of certain parameters in the laboratory of the Department of Aquatic Environment, College of Fisheries. Whereas, some of the parameters were assessed in the field itself, as mentioned under the "Water quality analyses".

Collection and analysis of Zooplankton samples: Zooplankton samples were collected along with the sampling of water. For the sample collection, an appropriate quantity of water sample (*i.e*. 50 liters) was filtered through bolting silk(mesh size 55 µ)and plankton thus obtained were preserved in 4% neutralized formaline for further quantitative and qualitative analysis. For quantitative analysis of plankton, 1 ml subsample was taken in Sedgwick Rafter plankton counting cell with the help of plankton pipette and counted under microscope. The total number of plankton counted in each sample was multiplied with dilution factor and results were expressed as Cell ml^{-1} and No l^{-1} respectively for phytoplankton and zooplankton, APHA (1989) [2]. The qualitative analysis of phytoplankton and zooplankton was done following the standard methods of Edmondson (1965) [6], Needham and Needham (1962) [10] and Adoni (1985) [1].

Fig 1: Location map of study area (Lake Pichhola)

Results and Discussion

Observations pertaining to different physic parameters and primary production of Lake Pichhola given in the Table 1.

Temperature: During the present study the air and water temperature were comparable and ranged between 22.03 ºC to 37.40 ºC - air temperature and 20.23 ºC to 30.33 ºC - water temperature at all four stations. Similar range of air and water temperature is commonly found prevailing in and around water bodies of arid and semi-arid regions of Rajasthan (Rajkumar, 2005 and Balai, 2007) [12, 3]. The statistical computation indicated that water temperature had positive significant relationship with phosphate.

Depth of Visibility: The variation in depth of visibility ranged from a minimum of 75.00 cm. to maximum 94.00 cm. The statistical computation indicated positive significant correlationship of water clarity with nitrate, phosphate and conductivity.

pH value: The pH value of water was moderately alkaline and varied from 7.38 to 8.23during the present study. The statistical computation indicated positive significant correlationship of pH with conductivity, TDS, visibility, phosphate, and temperature. In general the solubility and availability of nutrients is affected by oxygen content of water and therefore the productivity of aquatic ecosystem.

Dissolved Oxygen: The dissolved oxygen concentration of lake Pichhola ranged from 5.28 to 6.63 mg l^{-1} with average value of 5.95 mg l^{-1}. Similar values of dissolved oxygen were also noted by Nandan and Magar (2007) [9], Tamot *et al.* (2007) [17] and Mishra *et al.* (2016) [8] in different water bodies of the India. Dissolved oxygen showed a positive correlation with GPP, NPP and CR.

Total Alkalinity: During the present study, total alkalinity ranged from 141.25 to 172.25 mg l^{-}. Total alkalinity depicted positive correlation with air and water temperature, depth of visibility, pH, electrical conductivity, free CO_2, total dissolved solids, carbonates, bicarbonates, orthophosphates, nitrate-nitrogen, GPP, CR, TPP and TZP. Similar relationships were also found by Sharma *et al.* (2011) [14] and Sharma *et al.* (2012) [7, 15]. An increase in total alkalinity may be related with increase in pH as suggested30.

Electrical Conductivity: The electrical conductivity, which represents the total ionic load of water. The electrical conductance of lake Pichhola was found to be ranged from 0.39 to 0.49 mS cm^{-1} (average EC 0.45 mS cm^{-1}). The electrical conductance showed positive significant relationship with visibility, pH, total dissolved solids, carbonates, bicarbonates, orthophosphates, nitrate-nitrogen, total alkalinity, CR, TPP and TZP. Similar positive relationship was also seen in Udaipur lakes by Sharma *et al.* (2012) [7, 15] and Mishra *et al.* (2012) [7].

Total Dissolve Solid: In the present study, TDS ranged ranged from 257.63 to 327.95 mg l^{-1} with an average value of 296.83 mg l^{-1}. TDS shows a positive relationship with visibility, pH, electrical conductivity, carbonates, bicarbonates, total alkalinity, orthophosphates, nitrate-nitrogen, CR, TPP and TZP.

Phosphate: Phosphorus is one of the important nutrients governing overall algal growth. It plays a pivotal role in productivity of water bodies. During the present study phosphate ranged ranged between 0.11 to 0.16 mg l^{-1} during the study period. The comparative low level of phosphate indicated that water free from effluent contamination31. Orthophosphate showed positive relationship with air and water temperature, depth of visibility, pH, electrical conductivity, free CO_2, total dissolved solids, carbonates, bicarbonates, total alkalinity, nitrate-nitrogen, GPP, CR, TPP and TZP.

Nitrate: Nitrate is one of the most stable forms of nitrogen, which enhances the growth of plankton, their density, and primary production. In the present study, the value of nitrate-nitrogen in lake Pichhola, varied from 0.44 to 0.71 mg l^{-1} with an average value of 0.60 mg l^{-1}. The statistical computation indicated a positive correlation of nitrate with visibility, pH, electrical conductivity, free CO_2, total dissolved solids, carbonates, bicarbonates, total alkalinity, orthophosphates, CR, TPP and TZP.

Gross primary production: During the present study, gross primary production has been estimated by light and dark bottles methods. The overall values gross primary production at all stations ranged between 0.36 to 0.45 g C m^{-3} h^{-1} with an average value of 0.39 g C m^{-3} h^{-1}. The higher primary productivity found in the present study may be assigned to high concentration of nutrients, higher temperature and higher photosynthesis during the pre-summer and late monsoon months. As per this classification, lake Pichhola comes in eutrophic category. The statistical relationship of GPP was found positive with air and water temperature, free CO_2, dissolved oxygen, carbonates, total alkalinity, orthophosphates, NPP, CR and TPP.

Observation of Zooplanktons

Among the zooplankton, total 32 species belonging to four major groups *i.e.* Rotifera, Cladocera, Copepoda and Protozoa, were recorded (Table 2). Out of these 32 genera, 11 were from Rotifers (34.37%), 9 from Cladocerans (28.12%), 7 from Copepoda (21.87%) and 5 belonged to Protozoa (15.62%).

The observed scenario of zooplankton dominance at four stations studied in lake Pichhola is as under:

Station A: Copepoda > Rotifera > Cladocera > Protozoa.
Station B & D: Rotifera > Cladocera > Copepoda > Protozoa.
Station C: Cladocera > Rotifera > Copepoda > Protozoa.

Table 1: Annual average values of physico-chemical characteristics and primary productivity at four stations of lake Pichhola, Udaipur

Parameters	Station A	Station B	Station C	Station D	Overall Avg.
Air temperature °C	28.03	28.53	28.31	28.29	28.29
Water temperature °C	25.38	24.55	25.33	25.02	25.07
Depth of visibility (cm)	87.88	86.75	81.92	85.68	85.56
pH	7.67	7.49	7.84	7.72	7.68
EC (mS cm^{-1})	0.42	0.39	0.50	0.48	0.45
Dissolved oxygen (mg l^{-1})	6.00	6.08	5.71	6.02	5.95
Free CO_2 (mg l^{-1})	-	14.33	17.92	14.60	15.62
Total dissolved Solid (mg l^{-1})	277.38	252.62	334.51	322.80	296.83
Carbonates (mg l^{-1})	28.58	36.47	-	37.86	34.30
Bicarbonates (mg l^{-1})	130.50	140.67	137.17	138.33	136.67
Total alkalinity (mg l^{-1})	159.08	168.02	137.17	160.42	156.17
Orthophosphates (mg l^{-1})	0.06	0.06	0.25	0.18	0.14
Nitrate-nitrogen (mg l^{-1})	0.53	0.52	0.83	0.54	0.61
Primary productivity (g C m^{-3} h^{-1})					
Gross primary productivity	0.37	0.36	0.43	0.40	0.39
Net primary productivity	0.23	0.23	0.24	0.26	0.24
Community respiration	0.15	0.13	0.17	0.14	0.15

Table 2: Annual average values of zooplankton (No l^{-1}) at four stations of lake Pichhola, Udaipur

Major groups	Station A	Station B	Station C	Station D	Overall Avg.
Rotifera					
Filinia longiseta	1.67	-	1.91	1.60	1.73
Keratella sp.	1.75	2.75	1.64	1.83	1.99
Trichocera sp.	1.60	2.40	-	1.60	1.87
Testudinella sp.	1.50	-	1.27	1.64	1.47
Hexarthra sp.	1.40	2.17	1.33	1.73	1.66
Rotaria sp.	1.33	2.36	1.45	1.70	1.71
Polyarthra sp.	1.40	-	1.40	1.41	1.40
Brachionus sp.	2.00	2.83	1.89	-	2.24
Monostyla sp.	1.33	2.00	1.33	1.50	1.54
Platyias sp.	-	-	1.50	1.25	1.38
Notholca sp.	-	-	-	1.29	1.29
Total	13.98	14.51	13.73	14.13	14.09
Cladocera					
Daphnia sp.	2.09	2.50	2.42	1.73	2.19
Moina sp.	1.50	2.08	2.09	1.67	1.84
Bosmina sp.	1.55	2.33	1.92	1.70	1.88
Sida sp.	1.50	-	1.30	-	1.40
Macrothrix sp.	1.56	-	1.50	1.56	1.54
Diaphanosoma sp.	-	1.64	1.38	-	1.51
Simocephalus sp.	-	1.75	1.44	-	1.60
Chydorus sp.	1.36	-	1.67	-	1.52
Alonella sp.	1.64	1.60	1.67	1.29	1.55
Total	11.19	11.90	15.38	7.94	11.60
Copepoda					

Diaptomus sp.	1.50	1.91	2.10	2.09	1.90
Cyclops sp.	2.18	2.42	2.25	2.50	2.34
Canthocampus sp.	1.50	1.63	1.70	-	1.61
Nauplius larvae	1.45	1.42	1.60	1.64	1.53
Mesocyclops sp.	1.25	-	1.22	1.60	1.36
Halicyclops sp.	1.50	-	1.11	-	1.31
Eucyclops sp.	1.20	1.67	-	1.50	1.46
Total	10.59	9.03	9.98	9.33	9.73
Protozoa					
Amoeba sp.	1.50	1.80	1.50	1.56	1.59
Arcella sp.	1.44	-	1.00	1.73	1.39
Didinium sp.	1.40	-	1.40	1.75	1.52
Paramecium sp.	1.27	1.75	1.50	-	1.51
Vorticella sp.	1.25	1.75	1.14	1.90	1.51
Total	6.87	5.30	6.54	6.93	6.41

Conclusion

It is clear that on the basis of water quality parameters, observations on productivity and lake plankton it is appropriate to place this water body somewhere between "mild eutrophic-to-eutrophic water". Indeed, much of the available nutrient resources are gainfully utilized by the primary producers and thus this is the good example of effective channelization of nutrients into higher producers *i.e.* fish production. In view of this it is appropriate to further channelize this energy trapped in the form of primary producers (macrophytes and phytoplankton) and available secondary producers i.e. zooplankton for the production of suitable fish species.

Acknowledgement

We are thankful to Prof. L. L. Sharma, Ex Dean College of Fisheries, Udaipur For their support to complete the work.

References

1. Adoni AD. Workbook on limnology. Pratibha Publishers, 1985, 216.
2. APHA. Standard methods for the examination of water and wastewater 20th Edition. American Public Health Association (APHA), Washington, D.C, 1989.
3. Balai VK. Current fish and planktonic biodiversity in the Jaisamand reservoir Udaipur, (Rajasthan) Ph.D. (Limnology) Thesis, Maharana Pratap University of Agriculture and Technology, Udaipur, 2007.
4. Balai VK, Sharma LL, Ujjania NC. Diversity and seasonal variations of zooplankton in Jaisamand lake, Udaipur, India. Indian Journal of Animal Research. 2014; 48(5):432-437.
5. Bhavan SP, Selvi A, Manickam N, Srinivasan V, Santhanam P, Vijayan P. Diversity of Zooplankton in a Perennial Lakeat Sulur, Coimbatore, India. International Journal of Extensive Research. 2015; 5:31-44.
6. Edmondson WT. Freshwater Biology.4th edition, John Wiley and Sons Inc. New York, 1965.
7. Mishra V, Sharma SK, Sharma BK, Upadhyay B, Choubey S. Phytoplankton, Primary Productivity and Certain Physico-Chemical Parameters of Goverdhan Sagar lake of Udaipur, Rajasthan Universal Journal of Environmental Research and Technology. 2012; 2:569-574.
8. Mishra V, Surnar SR, Sharma SK. Some limnological aspects of Goverdhan Sagar Lake of Udaipur, Rajasthan to suggest its fisheries management. International Journal of Science, Environment and Technology. 2016; 5:2943-2948.
9. Nandan SN, Magar UR. Limnological studies of Girna Dam of Nashik with relation to algae. Proceedings of DAE-BRNS National Symposium on Limnology, Udaipur (Rajasthan), 19-21 Feb, 2007, 274-277.
10. Needham JG, Needham PR. A Guide to Study of Fresh Water Biology. Holden Bay, San Fransicso, U.S.A. 1962, 108.
11. Pawar RT. Zooplankton diversity and seasonal variation of Majalgaon reservoir, Maharashtra state, India. International journal of environmental sciences, 2016, 6.
12. Rajkumar. Some Aspects of Fish Biology and Fisheries Potential in Relation to Current Water Quality Status of Daya Reservoir, Udaipur, (Rajasthan) Ph.D. (Limnology) Thesis, Maharana Pratap University of Agriculture and Technology, Udaipur, 2005.
13. Sharma LL. Some limnological aspects of Udaipur waters in comparison to selected waters of Rajasthan. Ph.D. Thesis, University of Udaipur, Udaipur, 1980.
14. Sharma R, Sharma V, Sharma MS, Verma BK, Modi R, Singh KG. Studies on limnological characteristic, planktonic diversity and fishes (species) in Lake Pichhola, Udaipur, Rajasthan (India). Universal Journal of Environmental Research and Technology. 2011; 1:274-285.
15. Sharma V, Verma BK, Sharma MS. Zooplanktonic fauna in relation to physico-chemical characteristics in Madar Tank, Udaipur, Rajasthan (India). International Research Journal of Environment Sciences. 2012; 1:5-10.
16. Sharma KK, Sarbjeet K, Antal N. Diversity of zooplankton and macro benthic invertebrates in two perennial ponds of Jammu region. Journal of Global Biosciences. 2015; 4:1328-1392.
17. Tamot P, Mishra R, Saxena A. Limnology of Halali reservoir with reference to cage aquaculture for enhanced fish production. Proceedings of DAE-BRNS National Symposium on Limnology, Udaipur (Rajasthan), 19-21 February, 2007, 316-320.