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DETERMINATION OF OPTIMUM HARVESTING TIME FOR PERIPHYTON PRODUCTION ON ARTIFICIAL SUBSTRATES

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ABSTRACT

The experiment was conducted in two cement made cisterns for a four-week period. Important physico-chemical water quality parameters and harvesting time in periphyton production were studied. During the study period, four groups of phytoplankton and two groups of zooplankton were observed. Among phytoplankton, Chlorophyceae was the most dominant having 62% *Chlorella* followed by Bacillariophyceae having 15% *Navicula* and 12% *Cyclotella*, Cyanophyceae having 5% *Oscillatoria* and 2% *Anabaena* and Euglenophyceae having 2% *Euglena* and 1% *Phacus.* The grand averages of periphyton mass production were 0.569 (± 0.242) mg DM/cm^2 in C-1. There was highly significant ($p<0.05$) variation ($F = 14.692$) between C-1 and C-2 in respect of periphyton production. Cistern-1 was identified as more productive due to its favourable water quality parameters, i.e., water temperature of 24.6 to 28.3 ºC, Secchi disc reading of 18 to 33 cm, dissolved oxygen of 4.67 to 9.55 mg/L, pH of 9.12 to 10.18, NO_3-N of 3.58 to 10.90 mg/L, NH_3-N of 0.26 to 0.40 mg/L, PO_4-P of 7.5 to 3.4 mg/L, conductivity 0.412 to 0.719 Ms. Third addition of substrate, that means 18-19th day was identified as the optimum harvesting time of periphyton production.

Key Words: Periphyton, Phytoplankton, Zooplankton, Chlorophyceae

INTRODUCTION

Aquatic organisms play important roles in the biological economy of a water body. Both herbivorous and carnivorous fishes directly or indirectly depend upon primary and secondary producers including phytoplankton, zooplankton, periphyton, etc. as their source of food. Periphyton, the attached algae, are the most important primary producers in the water body (Wilhm *et al.*, 1978). Periphyton is the assemblage of organisms which commonly forms upon the surfaces of submerged plants, woods, bamboos, stones and certain other objects forming a more or less continuous slimy brown coat or layer (Welch, 1948). Organisms, both plants and animals attached or clinging to stems and leaves of rooted plants or on the surface projecting above the bottom are called periphyton (Odum, 1971). Periphyton includes filamentous and other algae, diatoms and other micro

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invertebrates. They are very preferable food materials for many fishes, such as Tilapia (Trewaves, 1982 and Haque, 1996; *Labeo rohita* (Haque, 1996) and *Labeo Calbasu* (Ali, 1998). In natural productivity based aquaculture of Bangladesh, studies of periphyton have considerable importance. The objectives of the research were, i) to study the role of water quality parameters on periphyton production; ii) to identify the qualitative and quantitative production of periphyton on artificial substrates and iii) to determine the optimum harvesting time for periphyton production.

MATERIALS AND METHODS

Study area

The experiment was conducted in two cement made cisterns at the northern side of the Faculty of Fisheries, Bangladesh Agricultural University, Mymensingh, Bangladesh from 15^{th} February to 14^{th} March in 1999. Two cisterns were numbered as Cistern-1 (C-1) and Cistern-2 (C-2), respectively. The volume of the cisterns were the same, which was 3.024 m^3 and rectangular in shape (9 X 6 X 2 ft).

Cistern preparation

The bottoms of the cisterns were covered with 45 cm thick mud to fix the bamboo poles and also to create a natural ecosystem. About 0.8 m long several bamboo poles were fixed into the mud in such a way so that they remain in straight standing position emerging upper portions through water surface at 0.2 m apart from each bamboo pole. Cisterns were filled with water from adjacent pond. Each cistern was fertilized with 45g triple super phosphate (TSP), 80g urea and 1 kg of cow-dung, which was repeated every week during the four-week of experimental period. Water depth was maintained at 0.5 m regularly.

Setting of the experiment

Total 48 Perspex slides were attached with bamboo poles with the help of string in such a way so that they remained in vertical position. The slides were tagged as 1^{st}, 2^{nd}, 3^{rd} and 4^{th}week for the convenience of observation and labeled to avoid disturbances.

Analysis of water quality parameters

Physical factors: Physical factors of the two cisterns were determined with respect to the transparency and temperature of water and were recorded daily. The following physical factors were determined during the experimental period.

a. Depth, transparency and colour of water were determined by wooden scale, secchi disc and naked eyes, respectively.

b. Temperature of water was measured using Celsius Thermometer (^{o}C) between 9:00 am to 10:00 am.

Chemical factors: Water samples were collected in 250 ml of black bottles from each cistern by hand from just below the surface and were carried to the Water Quality Laboratory for chemical analysis. To minimize the hourly fluctuations the following chemical analysis of water were done in the laboratory in between 9:00 am and 10:00 am.

- **a. Dissolved Oxygen (DO):** DO was measured by a DO Meter (YSI, Model 58, USA) from the samples collected in black bottles with care to avoid any air bubbles inside the bottles.
- **b. Water pH:** The pH of water was determined by a portable pH Meter (Jenway, Model 302, UK).
- **c. Nitrate-Nitrogen (NO_3-N):** To determine nitrate-nitrogen (NO_3-N), 100 ml of collected water sample was filtered through high quality glass microfibre filter paper (Whatman GF/C) with the help of vacuum pressure air pump. Then NO_3-N was determined by a HACH Kit (Model DR/2000, a direct reading spectrophotometer) using Nitraver-5 (nitrate reagent HACH Kit 14034-46 USA).
- **d. Ammonia-Nitrogen (NH_3-N):** NH_3-N was determined with the help of a direct reading spectrophotometer known as HACH Kit (Model DR/2000). Rochelle salt and Nessler reagent (USA) were required as chemical reagents.
- **e. Phosphate-Phosphorus (PO4-P):** 100 ml of collected water sample was filtered through high quality glass microfibre filter paper (Whatman GF/C) with the help of vacuum pressure air pump. Then PO4-P was determined by a HACH Kit (Model DR/2000) using Pellow Phosver-3.
- f. **Conductivity of water:** Water samples of both cisterns were collected in 250 ml black bottles and poured in glass beaker. Then conductivity was measured by Conductivity Meter (Jenway, Model 4200).

Method of periphyton study

Sample collection and measurement: Among 48 Perspex slides three slides were used for quantitative study and one slide for qualitative study on 3, 5, 7, 10, 12, 15, 17, 19, 22, 24, 27 and 30 days from each cistern. The slides were very carefully removed from both cisterns without disturbing the remaining slides.

Quantitative estimation: Immediately after collection of Perspex slides periphyton were scrapped by a sharp knife and transferred to pre-weighed (BDH Balance; precision 0.0001g) pieces of aluminum foil and dried at 105ºC for 24 hours. After that dried periphyton with foil were weighed and then biomass was estimated by subtracting with the weight of pre-weighted foil.

Qualitative analysis: Periphyton grown on Perspex slides were collected into the laboratory and scrapped carefully by sharp knife. Then the collected periphyton was diluted into distilled water and was observed under microscope for identification. Periphyton was identified upto genus level according to Smith (1950), Needham and

Needham (1962), Ward and Whipple (1959), Pennak (1953), Belcher and Swale (1978), APHA (1992) and Bellinger (1992).

Statistical analysis

Statistical analysis (DMRT, ANOVA, Correlations) were performed using a statistical package called Statgraphics version 7.0 in a computer (SAMTRON-LOW Radiation) following method of Zar (1984).

RESULTS

Analysis of water quality parameters

Important physical and chemical water quality parameters were studied and the results (Table 1, Table 1a and Table 2) are shown below.

Table 1. Weekly variations (± SE) in the values of water quality parameters in two cisterns during the study period

Parameters	Cistern No.	Weekly average values				F- values
		1st week	2nd week	3rd week	4th week	
Temperature (°C)	C-1	24.95^{a}(±0.157)	26.12^{b}(±0.324)	26.14^{b}(±0.208)	28.07^{c}(±0.092)	36.87*
	C-2	24.57^{a}(±0.201)	26.1^{b}(±0.317)	26.05^{b}(±0.220)	27.64^{c}(±0.313)	34.02*
Secchidisc Reading (cm)	C-1	28.85^{c}(±1.010)	26.37^{bc}(±0.50)	23.28^{ab}(±1.426)	22.14^{a}(±1.143)	8.02*
	C-2	21.42^{b}(±2.08)	14.73^{a}(±0.203)	14.02^{a}(±0.29)	13.71^{a}(±0.68)	0.80NS
DO (mg/L)	C-1	7.81^{b}(±0.356)	7.5^{ab}(±)	6.43^{b} (±0.643)	6.67^{ab}(±0.27)	2.744 NS
	C-2	7.56^{b}(±0.434)	1.17^{b}(±0.484)	6.34^{b}(±0.739)	4.09^{a}(±0.105)	10.00*
pH	C-1	9.99^{b}(±0.025)	10.02^{b}(±0.045)	9.81^{b}(±0.117)	9.44^{a}(±0.089)	11.52*
	C-2	10.08^{c}(±0.019)	10.03^{c}(±0.069)	9.78^{b}(±0.126)	9.43^{a}(±0.082)	5.29*

NS = Not Significant at 5% Level; * Significant at 5% level

Table 1a. Weekly values of other water quality parameters in two cisterns during the study period

Parameters	Cistern No.	Weekly values			
		1st week	2nd week	3rd week	4th week
NO_3 - N (mg/L)	C-1	6.60	10.90	3.58	5.00
	C-2	2.40	5.70	3.30	4.80
NH_3 - N (mg/L)	C-1	0.30	0.26	0.40	0.33
	C-2	0.86	1.32	1.73	0.92
PO_4 - P (mg/L)	C-1	7.50	6.21	4.60	3.40
	C-2	0.86	4.30	3.50	3.10
Conductivity (Ms)	C-1	0.452	0.704	0.412	0.719
	C-2	0.280	0.298	0.607	0.678

Table 2. Range and average values (± SE) of water quality parameters in two cisterns during the study period

Parameters	Cistern-1		Cistern-2		F-value
	Range	Average (± SE)	Range	Average (± SE)	
Temperature (°C)	28.3-24.6	26.32 (±0.237)	24.00-28.00	26.125 (±0.232)	Week variation= 62.15 Cistern variation = 0.955 NS
DO (mg/L)	4.67-9.55	7.13 (±0.224)	3.80-9.89	6.175 (±0.352)	Week variation= 7.921 Cistern variation = 7.286*
pH	9.12-10.18	9.81 (±0.057)	9.12-10.33	9.825 (±0.062)	Week variation= 25.15 Cistern variation = 0.063 NS
Secchi disc Reading (cm)	18.00-33.00	25.16 (±0.716)	12.00-31.00	15.95 (±0.081)	Week variation = 17.563 Cistern variation = 141.094*
NO_3 - N (mg/L)	3.58-10.90	6.52 (±1.584)	2.40-5.70	4.05 (±0.739)	Week variation = 9.846 Cistern variation = 13.924*
NH_3 - N (mg/L)	0.26-0.40	0.322 (±0.290)	0.86-1.73	1.20 (±0.202)	Week variation = 4.613 Cistern variation = 81.536*
PO_4 - P (mg/L)	7.50-3.40	5.42 (±0.899)	5.50-3.10	4.10 (±0.529)	Week variation = 47.001 Cistern variation = 40.47*
Conductivity (Ms)	0.420-0.719	0.571 (±0.810)	0.280-0.678	0.465 (±0.103)	Week variation = 4.345 Cistern variation = 2.613 NS

NS = Not Significant at 5% Level; * Significant at 5% level

Air temperature: During the study period, the weekly variations of air temperature ranged from 23 to 26.7°C. The lowest temperature was recorded in the 1st week (15 February) and the highest in the 4th week (8 March) of the study period.

Water temperature: The values of water temperature ranged from 24.6 to 28.3°C with the mean value of 26.32 (± 0.237)°C in C-1 and 24 to 28°C with the mean value of 26.12 (± 0.232)°C in C-2. There was no significant ($P<0.05$) difference between C-1 and C-2 ($F=0.955$). The maximum water temperatures of 28.3 and 28°C and the minimum temperatures of 24.6 and 24°C were recorded in the 4th week (14 March) and the 1st week (15 February) in C-1 and C-2, respectively.

Secchi disc reading (cm): The values of Secchi disc reading ranged from 18 to 33 cm in C-1 and 12 to 31 cm in C-2. The average values were 25.16 (± 0.716) and 15.95 (± 0.08) in C-1 and C-2, respectively. There was a highly significant ($P<0.05$) difference ($F=141.094$) between C-1 and C-2 in respect of transparency. The maximum values of 33 cm and 31 cm and the minimum values of 18 cm and 12 cm were recorded in C-1 and C-2 in the 1st week (15 February) and in the 4th week (14 March) of the study period, respectively.

Dissolved Oxygen (DO): The values of DO ranged from 4.67 to 9.55 mg/L and 3.80 to 9.89 mg/L and the mean values were 7.13 (± 0.224) mg/L and 6.175 (± 0.352) mg/L in C-1 and C-2, respectively. The maximum DO of 9.55 mg/L in C-1 and 9.89 mg/L were recorded in the 3rd week (6 March), whereas the minimum of 4.67 mg/L was recorded in C-1 at the end of 3rd week and 3.80 mg/L in C-2 at the middle of 4th week.

pH: During the study period the values of pH ranged from 9.12 to 10.18 in C-1 and 9.12 to 10.33 in C-2. The average P^H values were recorded as 9.818 (± 0.057) and 9.825 (± 0.062) in C-1and C-2, respectively. There was a significant ($P<0.05$) difference ($F = 0.063$) between C-1 and C-2 in respect of pH. The maximum pH values of 10.18 and 10.33 were recorded in both cisterns on 22 and 27 February in the 2nd week, whereas the minimum of 9.12 was recorded in both cisterns in the 4th week (14 March) of the study period.

Nitrate-Nitrogen (NO_3-N): The concentrations of NO_3-N varied from 3.58 to 10.9 mg/L in C-1 and 2.4 to 5.7 mg/L in C-2. The mean values of NO_3-N were 6.52 (± 1.584) and 4.05 (± 0.739) mg/L in C-1 and C-2, respectively. There was highly significant ($P<0.05$) variation ($F = 13.924$) between C-1 and C-2 in respect of NO_3-N. The maximum values of 10.9 mg/L in C-1 and 5.7 mg/L in C-2 were recorded in the second week (23rd February), whereas the minimum of 3.58 mg/L in C-1 and 2.4 mg/L in C-2 were recorded in the 3rd week and in the 1st week, respectively.

Ammonia–Nitrogen (NH_3-N): The ranges of NH_3-N were 0.26 to 0.4 mg/L and 0.86 to 1.73 mg/L in C-1 and C-2, respectively. The average values were recorded as 0.322 (± 0.29) and 1.207 (± 0.202) mg/L in C-1 and C-2, respectively. There was highly significant ($P<0.05$) variation ($F = 81.536$) between C-1 and C-2 in respect of NH_3-N. During the study period, the maximum values were recorded as 0.4 mg/L in C-1 and 1.73 mg/L in C-2 in the 3rd week (3rd March), whereas the minimum values of 0.26 mg/L in C-1 and 0.86 mg/L in C-2 were recorded in the 2nd and 1st week, respectively.

Phosphate-Phosphorus (PO_4-P): The ranges of PO_4-P were 7.5 to 3.4 mg/L in C-1 and 5.5 to 3.1 mg/L in C-2. The average values of 5.42 (± 0.899) and 4.1 (±0.529) mg/L were recorded in C-1and C-2, respectively. There were highly significant ($P<0.05$) variation ($F = 40.47$) between C-1 and C-2 in respect of PO_4-P.

Conductivity (Ms): The ranges of conductivity were 0.412 to 0.719 Ms and 0.280 to 0.678 Ms in C-1 and C-2, respectively. The average values were calculated as 0.517 (± 0.81) and 0.465 (± 0.103) Ms in C-1 and C-2, respectively. There was insignificant ($P<0.05$) variation ($F = 2.613$) between the two cisterns in respect of conductivity. The maximum conductivity of 0.719 Ms in C-1 and 0.678 Ms in C-2 were recorded in the 4th week (14th March), whereas the minimum of 0.412 Ms in C-1 and 0.280 Ms in C-2 were recorded in the 3rd and 1st week, respectively.

Periphyton production

Qualitative analysis: During the study period, four groups of phytoplankton and two groups of zooplankton were observed. Among phytoplankton, Chlorophyceae was the most dominant having 62% *Chlorella* followed by Bacillariophyceae having 15% *Navicula* and 12% *Cyclotella*, Cyanophyceae having 5% *Oscillatoria* and 2% *Anabaena*, and Euglenophyceae having 2% *Euglena* and 1% *Phacus.* Other periphytons were found on artificial substrates during the study are shown below:

i) Phytoplankton: Chlorophyceae - *Gonatogygon*, *Oedogonium*, *Oocystis*, *Spyrogyra*, *Volvox*, *Zygnema*; Bacillariophyceae - *Fragillaria*, *Gomphonema* and *Nitzschia*;

ii) Zooplankton: Crustacea - *Cyclops*, *Daphnia*, *Diaphanosoma* and *Nauplius*; Rotifera– *Brachionus* and *Keratella*.

Quantitative analysis: The total averages of periphyton mass production (Table 3) were 0.569 (±0.242) mg DM/cm^2 in C-1 and 0.276 (±0.182) mg DM/cm^2 in C-2. There was highly significant ($P<0.05$) variation ($F = 14.692$) between C-1 and C-2 in respect of periphyton production and insignificant ($F = 3.283$) weekly variations between two cisterns. According to data, C-1 showed higher production than C-2.

Table 3. Weekly average (± SE) periphyton mass production in two cisterns during the study period

Week	Cistern No.	Periphyton Mass Production (g DM/slide)	Periphyton Mass Production (mg DM/cm^2)	F-Value	
		Average (±SE)	Average (±SE)	(g DM/slide)	(mg DM/cm^2)
1st week	C-1	0.0326 (±0.0065)	0.315 (±0.063)		
	C-2	0.0139 (±0.001)	0.134 (±0.016)		
2nd week	C-1	0.0785 (±0.0106)	0.759 (±0.103)	Week Variation= 3.270	Week Variation= 3.283
	C-2	0.0144 (±0.00190)	0.139 (±0.018)		
3rd week	C-1	0.8453 (±0.1066)	0.8179 (±0.103)		
	C-2	0.0287 (±0.0012)	0.277 (±0.012)	Cistern Variation= 14.68*	Cistern Variation= 14.69*
4th week	C-1	0.0400 (±0.0072)	0.386 (±0.069)		
	C-2	0.0573 (±0.0095)	0.554 (±0.091)		
Total Average	C-1	0.5890 (±0.0250)	0.569 (±0.242)		
	C-2	0.0280 (±0.0180)	0.276 (±0.182)		

* Significant at 5% Level

Optimum harvesting time: As it is found, 3rd week was the optimum harvesting time for periphyton production.

DISCUSSION

Periphyton is of great importance in aquaculture which grows on different substrates. During the present study, four groups (Chlorophyceae, Bacillariophyceae, Cyanophyceae and Euglenophyceae) of phytoplankton and two groups (Crustracea and Rotifera) of zooplankton were observed on artificial substrates. Chloropyceae and Crustacea were the dominant groups among phytoplankton and zooplankton, respectively. The similar patterns of findings were observed by Islam (1996), Haque (1996) and Ali (1998). Various types of periphyton were identified by different scientists such as *Oscillatoria*, *Microcystis* and Diatom in Volta Lake by Obeleng-Asamoa (1977) and diatoms by Shortreed *et al.* (1984), etc. Among zooplankton, Rotifer was the most dominant group throughout the study period. More or less similar results were found by Chakraborty *et al.* (1959), Banerjee *et al.* (1979).

During the study period, total average mass periphyton production was 0.569 (± 0.242) mg DM/cm^2 in Cystern-1 and 0.276 (± 0.182) mg DM/cm^2 in Cistern-2. According to the data, the highest production in C-1 was obtained in the middle of the 3rd week and then gradually decreased upto 4th week. In C-2, periphyton production was reduced by a heavy phytoplankton bloom in the 3rd week of the study, subsequently abundant of zooplankton in the 4th week which might have dependent on huge growth of periphyton. Hossain (1996) noticed that phytoplankton showed inverse relationship with zooplankton, whereas primary productivity was found more or less direct correlation with phytoplankton and inverse correlation with zooplankton.

In the present study, higher range of temperature, nitrate and phosphorus were observed in Cistern-1 than in Cistern-2. As there is a direct relationship of water quality parameters with periphyton production, a higher periphyton production was observed in Cistern-1 than that of Cistern-2. Fritsch and Rick (1913) found that diatom was present in water which was rich in nitrate and phosphate. In the present study, Cistern-1 was identified as more productive due to its favourable water quality parameters, i.e., water temperature of 24.6 to 28.3ºC, Secchi disc readings of 18 to 33 cm, dissolved oxygen of 4.67 to 9.55 mg/L, P^H of 9.12 to 10.18, NO_3 - N of 3.58 to 10.90 mg/L, NH_3 - N of 0.26 to 0.40 mg/L, PO_4 - P of 7.5 to 3.4 mg/L, conductivity 0.412 to 0.719 Ms.

Water temperature influences the growth, reproduction and other biological activities of aquatic organisms. Water temperature of the present study was more or less similar with the findings (26.06 to 31.97ºC) of Rahman (1992). The favourable water temperature recorded in the present study also agreed with the findings of Ali (1998), Mollah and Haque (1978) and Paul (1998). Secchi disc values of a water body normally indicate its productivity. In the present study, Secchi disc readings of cistern - 1 were higher than cistern - 2, which indicated higher primary productivity in cistern-1. According to Rahman (1992), Secchi disc reading of productive water bodies should be less than 40 cm which agrees with the reading of cistern-1, i.e., 33 cm. Bhuyan (1970) reported that the concentration of DO from 5.0 to 7.0 mg/L is within the good productive range, which is almost similar with the DO of cistern-1. More or less similar DO was reported by David *et* *al.* (1969) of 5.28 to 8.0 mg/L, by Ali (1998) of 2.63 to 6.22 mg/L, by Mondol (1998) of 3.88 to 6.52 mg/L and by Wahab *et al*. (1995) of 2.0 to 7.0 mg/L. Villadolid *et al*. 1954 stated that P^H ranges from 7.3 to 8.4 provided optimum condition for favourable growth of plankton. P^H values ranging from 6.5 to 9.0 are considered as satisfactory (Swingle 1959), which is slightly lower than P^H values of the present study.

Periphyton production increased significantly with both nitrogen and phosphorus enrichment (Marks and Lowe, 1993). Nitrate ranging from 0.06 to 0.1 mg/L is of good productive range (Bhuyan, 1970). Paul (1998) recorded NO_3 - N ranging from 1.1 to 6.6 mg/L in the ponds. Dewan *et al.* (1991) found nitrate values from 3 to 25 mg/L in a lake of BAU Campus, Mymensingh, which agree with nitrate values of the present study. Reyes *et al.* (1996) reported the average NO_3 - N of 47.25 (± 18.95) mg/L from tanks in the recirculation system, which is much higher than the present study.

During the study period, relatively higher NH_3 - N was observed in Cistern-2 which might be due to higher organic matter, plankton bloom and decomposition of plankton. The values of NH_3 - N found in cistern-1 were agreed with Kohinoor *et al.* (1998) ranging from 0.25 to 0.5 mg/L, Hasan (1998) ranging from 0.00 to 1.75 mg/L and Ali (1998) ranging from 0.00 to 1.72 mg/L.

The availability of PO_4 - P is considered to be very important in aquatic productivity. In the present study, values of PO_4 - P were higher than the values ranging from 0.02 to 2.80 by Islam and Saha (1975), from 0.09 to 5.2 mg/L by Wahab *et al.* (1995), 0.11 to 2.0 mg/L.

As it was found, water quality parameters of cistern-1 were more favourable for periphyton production. Thus, Cistern-1 was more productive than Cistern-2, and 3rd week, i.e., 18th or 19th day of the substrate addition was identified as the optimum harvesting time of periphyton production.

CONCLUSION

Aquatic organisms, particularly plankton and periphyton, play an important role in the productivity of a water body. Fishes directly or indirectly depend upon primary and secondary producers as their source of food. Periphyton, both plants and animals attached or clinging to stems and leaves of rooted plants or on the surface projecting above the bottom, are the most important in a water body. These are very preferable food materials for many fishes. The study was conducted to determine the optimum water quality parameters and harvesting time for periphyton production on artificial substrates. During the study period four groups of phytoplankton and two groups of zooplankton were observed. Among phytoplankton Chlorophyceae was the most dominant having 62% *Chlorella* followed by Bacillariophyceae, Cyanophyceae and Euglenophyceae. The grand averages of periphyton mass production were 0.569 (± 0.242) mg DM/cm^2 in C-1. There was highly significant ($P<0.05$) variation ($F = 14.692$) between C-1 and C-2 in respect of periphyton production. According to data, Cistern-1 was identified as more productive due to its favourable water quality parameters. As it was observed, 3rd week, i.e., 18th or 19th day of the substrate addition was identified as the optimum harvesting time of periphyton production. Further studies are necessary to evaluate the economic return on periphyton production in earthen ponds.

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