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MONTHLY VARIATIONS OF PHYSICO-CHEMICAL CHARACTERISTICS OF FRESHWATER CARP CULTURE PONDS IN KUMBAKONAM AREA THANJAVUR DISTRICT, TAMIL NADU, INDIA

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ABSTRACT

Monthly variations of physico-chemical characteristics were carried out in freshwater carp culture ponds at Kumbakonam area Thanjavur district, Tamil Nadu, India, for a period of seven months (September 2014 to March 2015). Nine various physico-chemical parameters were analyzed by using standard methods (APHA, 1998). Water temperature varied from 25.7 to 31.5ºC, pH ranged from 6.8 to 8.2. Turbidity was from 21.8 to 36.7 cm, Dissolved oxygen content varied between 4.23 to 6.77 mg/L, calcium (22.7 to 48.6 mg/L), phosphate (0.78 to 0.125), nitrate (0.019 to 0.38 mg/L) and ammonia (0.23 to 0.48 mg/L) also varied independently.

Key words: Physico-chemical characteristics, Monthly variations, Freshwater carp culture, Water quality.

INTRODUCTION

Water quality is critical for survival, health and growth of carps, especially in semi-intensive and intensive culture. To maintain good water quality, the physical and chemical properties of water should be kept within certain safe levels, for example, dissolved oxygen supply should be adequate for carp respiration, and toxic substances generated from the decomposition of organic compounds in the bottom sediment should be prevented or removed. Phytoplankton is a predominant type of a plant found in most aquaculture pond. In recent years, the carp culture industry has been facing serious problems due to microbial diseases in the coastal belts of Tamil Nadu, India. In view of this, the present investigation has been carried out to study the carp cultured in semi-intensive ponds in the Kumbakonam area Thanjavur District.

Dulic *et al*. (2010) examined the physical, chemical and biological parameters showed that there were no statistically significant differences in the water quality between fish ponds with different supplemental feed, looking at the overall picture it could be concluded that the pond that had the lowest quality of feed (row cereals), having high organic matter and chlorophyll*a* during most of the trial period as well as the specific phytoplankton successions including potentially harmful blue-green alga, had consequently the lowest water quality. Shahin *et al.* (2011) were recorded water quality analysis showed that the mean values of water temperature, pH, dissolved oxygen, ammonia-nitrogen, nitrite-nitrogen, nitrate-nitrogen, phosphate-phosphorus. Chaudhary Preeti, (2012) have reported the study of four fish culture ponds of Dhar town, MP.

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In these ponds water quality and fish production are correlated. Studies have revealed that the ponds are in trophic status. Chlorides, total hardness, alkalinity, BOD, pH and plankton population were high level in wild ponds in comparison to managed ponds. Due to these conditions dissolved oxygen and fish growth/yield was low in wild pond in comparison to managed pond. Hence the fish growth is not directly related with net primary productivity. The deterioration of water quality indicated that higher BOD, pH, and High planktonic diversity decrease the fish growth. Management of water quality in ponds may help in enhancing the fish production though aquaculture. Rengarajan *et al.,* (2012) were carried out to assess the water quality parameters of carp culture pond in Thanjavur district.

METHODOLOGY

Study areas chosen were freshwater carp culture fish pond –I (Kumbakonam), fish pond-II (Thirupananthal) in Kumbakonam area Thanjavur District, Tamil Nadu, India. The observed in the semi-intensive carp culture ponds were located at Kumbakonam aria during the study period from September 2014 to March 2015. In the selected area, freshwater was used for carp culture. The average area of each pond was 1.5 acre. 2 litre capacity of plastic cans for physico-chemical samples were used to collect surface water samples and kept immediately in an ice box and transported to the laboratory. The samples were analyzed every month during January 2017 to December 2017. The various physico-chemical parameters were analyzed by using standard methods (APHA, 1998). Temperature : In the present study water temperature of the lake water recorded by using Mercury field celcious

thermometer. pH : The pH was determined by using Elico, model LI. 120 Digital pH meter. Turbidity: It can be determined by using turbidity meter. Dissolved oxygen: The Dissolved oxygen was determined by the modified Winkler's method (1888). The other parameters like, calcium estimated by EDTA Titrimetric method, phosphate estimated stannous chloride method, nitrate was determined by the Brucine method and ammonia was determined by the Nesslerization method (APHA, 1998).

RESULTS

In the present study, physico–chemical characterstics of freshwater fish cultured ponds in pond –I (Sirukadambur), fish pond-II (Unnjini) in Ariyalur District. Tamilnadu, India was investigated from September 2014 to March 2015 (Table 1 and 2).

Temperature: Water temperature fluctuated from 25.7 to 30.9 ºC in freshwater fish culture pond – I. It was found to be low (25.7ºC) in the month of November 2014 and high (30.9 ºC) in March 2015 (Table 1 and Figure 1). Freshwater carp culture pond – II water temperature ranged between 25.8 to 31.5 ºC. Maximum (31.5ºC) range was recorded in the month of March 2015 and minimum (25.8 ºC) was recorded in December 2015 (Table 2 and Figure 1).

Turbidity: Turbidity of the freshwater carp culture pond depends on availability of either zooplankton or phytoplankton and suspended soiled particles. The transparency of the freshwater fish culture pond-I varied from 21.8 to 36.5 cm. It was found to be low (21.8 cm) in the month of December 2014 and high (36.5 cm) in March 2015 (Table 1 and Figure 2). Transparency of the freshwater carp culture pond-II ranged from (25.3 to 34.4 cm). It was found to be low (25.3 cm) in the month of December 2014 and high (34.4 cm) in March 2015 (Table 2 and Figure 2).

pH: pH is another important biological parameter. pH of the fish culture pond-I water showed alkaline ranges throughout the study period. It varied from 6.9 to 8.2. It was found to be minimum (6.9) in November 2014 and maximum (8.2) in the month of March 2015 (Table 1 and Figure 3). pH of the fish culture pond-II varied between 6.8 to 7.5. It was found to be high (7.5) in March 2015 and low (6.8) was recorded in the month of November 2014 (Table 2 and Figure 3).

Dissolved Oxygen: Dissolved oxygen is important biological factor. Freshwater fish culture pond-I dissolved oxygen content ranged from 4.51 to 6.77 mg/L. Low value was observed (4.51 mg/L) in March 2015 and high value was noted (6.77 mg/L) in December 2015 (Table 1 and Figure 4). Dissolved oxygen of culture pond-II content varied in between 4.23 to 6.77 mg/L. It was found to be low (4.23 mg/ L) in the month of March 2015 and high (6.77 mg/ L) in December 2015 (Table 2 and Figure 4).

Calcium: Calcium content of freshwater culture pond-I ranged from 22.7 to 48.6 mg/L. Maximum was recorded (48.6 mg/L) in the month of March 2015 and minimum was reported (22.7 mg/L) was recorded in December 2014 (Table 1 and Figure 5). Calcium content of culture pond-II ranged in between 24.1 to 48.6 mg/L. It was found to be low (24.1 mg/L) was recorded in the month of December 2014 and high (48.6 mg/L) in March 2015 (Table 2 and Figure 5).

Phosphate: Phasphate content of pond-I fluctuated from 0.084 to 0.125 mg/L. Lowest value was observed (0.084 mg/L) in the month of December 2014 and highest value was noted (0.125 mg/L) in March 2015 (Table 1 and Figure 6). Phosphate content of the freshwater fish culture pond-II varied from 0.078 to 0.124 mg/L. It was found to be low (0.078 mg/L) in the month of December 2014 and high (0.124 mg/L) in March 2012 (Table 2 and Figure 6).

Nitrate: Nitrate content of pond-I varied from 0.013 to 0.034. It was minimum (0.013 mg/L) in the month of December 2014 and maximum was observed (0.034 mg/L) in March 2015 (Table 1 and Figure 7). Nitrate content of the fish culture pond-II in between from 0.019 to 0.038. It was found to be low (0.019 mg/L) in the month of December 2014 and high (0.038 mg/L) in the month of March 2015 (Table 2 and Figure 7).

Ammonia: Ammonia content of the freshwater fish culture pond –I fluctuated from 0.24 to 0.47 mg/L. It was found to be low (0.24 mg/L) in the month of November 2014 and high (0.47 mg/L) in March 2015 (Table 1 and Figure 8). Ammonia content Pond-II in between from 0.23 to 0.48 mg/L. It was recorded maximum (0.48 mg/L) in the month of September 2014 and minimum (0.23 mg/L) in December 2014 (Table 2 and Figure 8).

DISCUSSION

In the present study physico-chemical parameters such as temperature, turbidity, pH, dissolved oxygen, calcium, phosphate, nitrate and ammonia were tested from freshwater carp cultured pond –I (Kumbakonam), fish pond-II (Thirupananthal) in Thanjavur district, were investigated from September 2014 to March 2015. Water temperature was found to be low in the month of November and December 2014 and high in March 2015. Variation of temperature ranged from 16.60 to 35.68°C observed to be suitable for fish culture which agreed with the findings of Hossain *et al*. (1997) and Wahab *et al.* (2001). Ehsan *et al*. (1997) found the highest water temperature (31.70ºC) in the month of June and the lowest (25.20ºC) in January in Chanda beel which is similar to this study. Temperature range of 28-32°C supports normal growth of fish. Increase in temperature increases metabolism and there by growth, but as the temperature increases the demand for oxygen also increases. At higher temperatures, the demand for oxygen increases to such an extent that physiological capacity of carp fails to meet the demand. The capacity of water to hold oxygen also decreases with increase in temperature. At high temperature carp remain stationary at bottom. If the condition continues, carps get infected and swim disorientedly to the surface or die due to exhaustion. Decreases in temperature reduces metabolism and there by growth and feed consumption. Present study was similar to the report of earlier workers Das and Bhuiyan (1974) and Lashari *et al.* (2009). Present observation, the turbidity of the freshwater fish culture pond, it was found to be low in the month of December 2014 and high in March 2015. Variations in the turbidity may be due to the suspended particle nutrients and the abundance of phytoplankton.

Table 1. Physico-chemical characteristics of carp culture pond-I Kumbakonam water samples

Month and Year	Temp. (°C)	Turbidity (cm)	pH	DO (mg/L)	Calcium (mg/L)	Phosphate (mg/L)	Nitrate (mg/L)	Ammonia (mg/L)
Sep-14	30.4	30.5	7.2	4.79	33.5	0.108	0.029	0.46
Oct-14	28.5	26.4	7.4	5.36	41.4	0.11	0.027	0.39
Nov-14	25.7	23.2	6.9	5.92	28.5	0.095	0.016	0.024
Dec-14	26.3	21.8	7.4	6.77	22.7	0.084	0.013	0.27
Jan-15	28.5	27.1	7.1	5.08	33.8	0.117	0.025	0.35
Feb-15	28.7	31.5	7.5	4.79	42.1	0.123	0.029	0.44
Mar-15	30.9	36.7	8.2	4.51	48.6	0.125	0.034	0.47

Table 2: Physico-chemical characteristics of carp culture pond-II Thirupananthal water samples

Month and Year	Temp. (°C)	Turbidity (cm)	pH	DO (mg/L)	Calcium (mg/L)	Phosphate (mg/L)	Nitrate (mg/L)	Ammonia (mg/L)
Sep-14	30.8	32.1	7.4	5.08	35.2	0.105	0.031	0.48
Oct-14	29.4	29.6	7.1	4.79	43.6	0.114	0.034	0.43
Nov-14	26.5	26.8	6.8	5.51	35.2	0.099	0.022	0.29
Dec-14	25.8	25.3	7.2	6.77	24.1	0.078	0.019	0.23
Jan-15	28.6	27.5	7	5.92	34.9	0.104	0.026	0.31
Feb-15	29.3	29.2	7.2	4.79	45.7	0.112	0.035	0.35
Mar-15	31.5	34.4	7.5	4.23	48.6	0.124	0.038	0.41

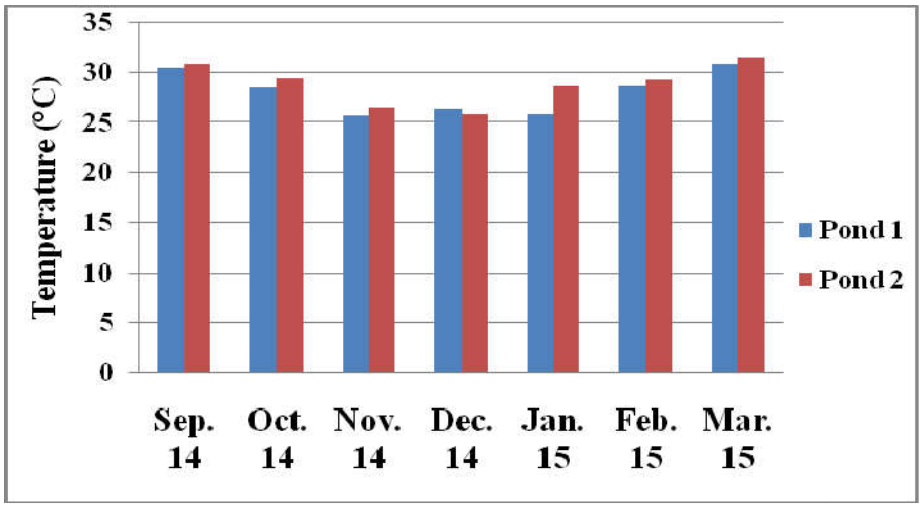

Figure 1. Temperature (^{0}C) of freshwater culture ponds (September 2014 to March 2015)

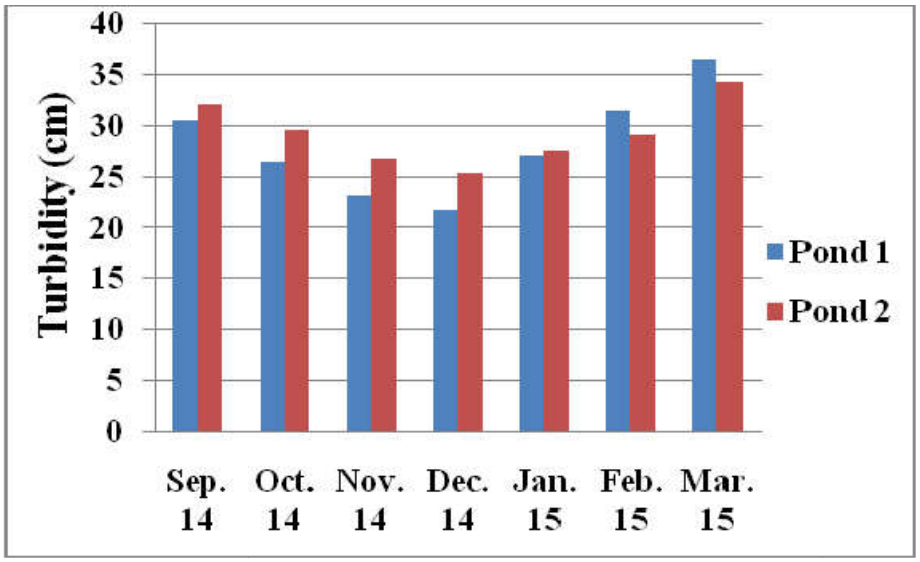

Figure 2. Turbidity (cm) of freshwater ponds (September 2014 to March 2015)

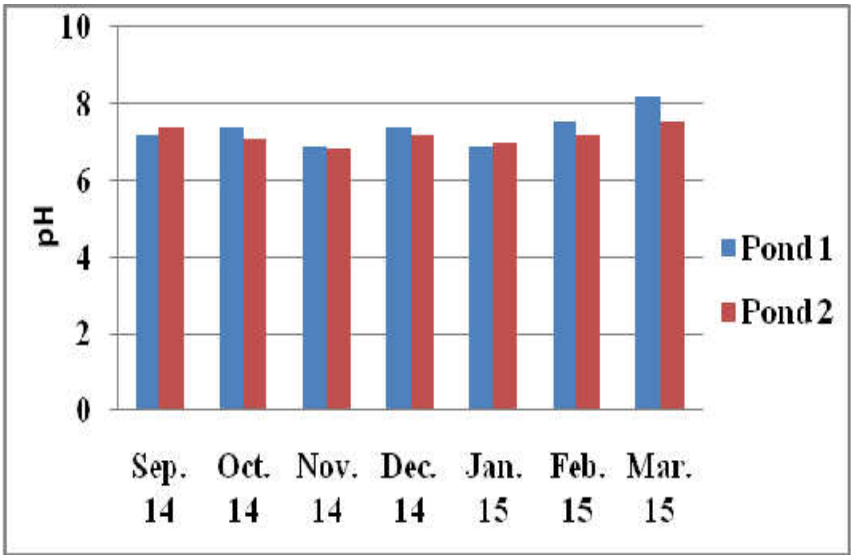

Figure 3. Showing the pH of freshwater ponds (September 2014 to March 2015)

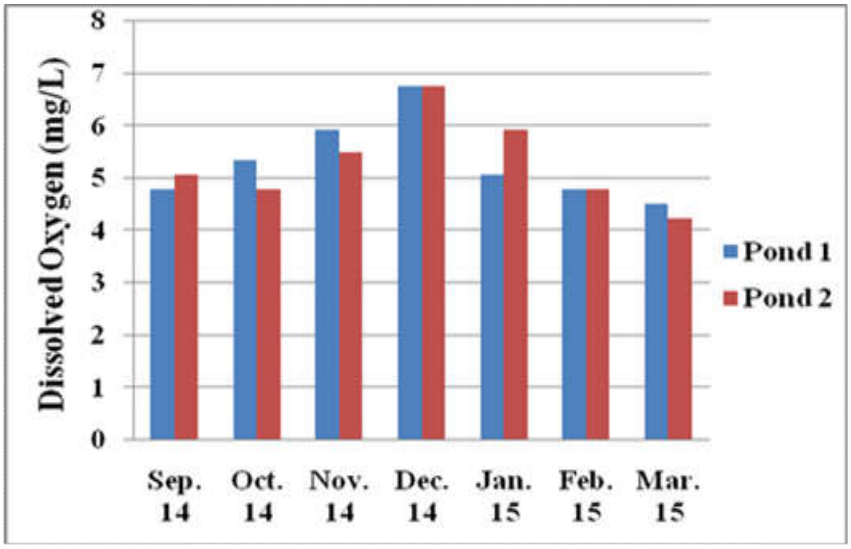

Figure 4. Dissolved oxygen (mg/L.) of fish ponds (September 2014 to March 2015)

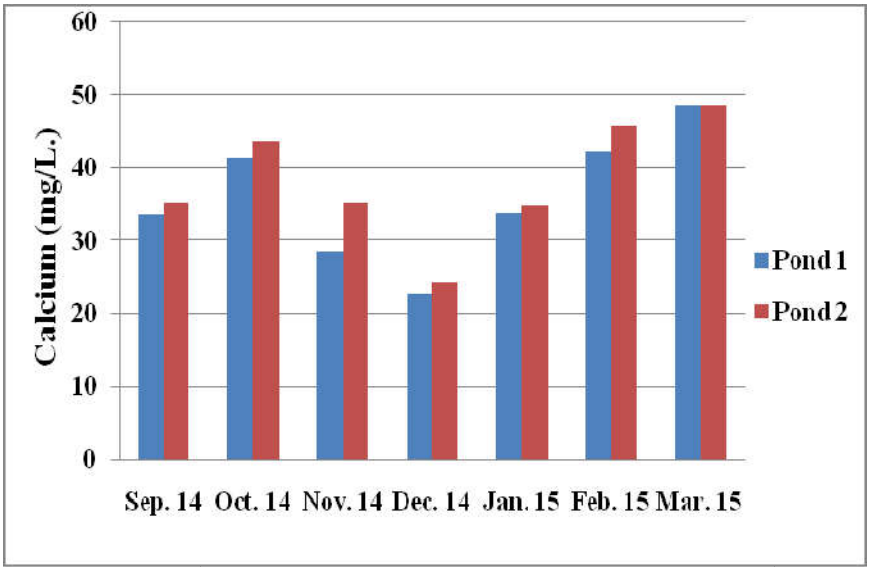

Figure 5. Calcium (mg/L) of freshwater ponds (September 2014 to March 2015)

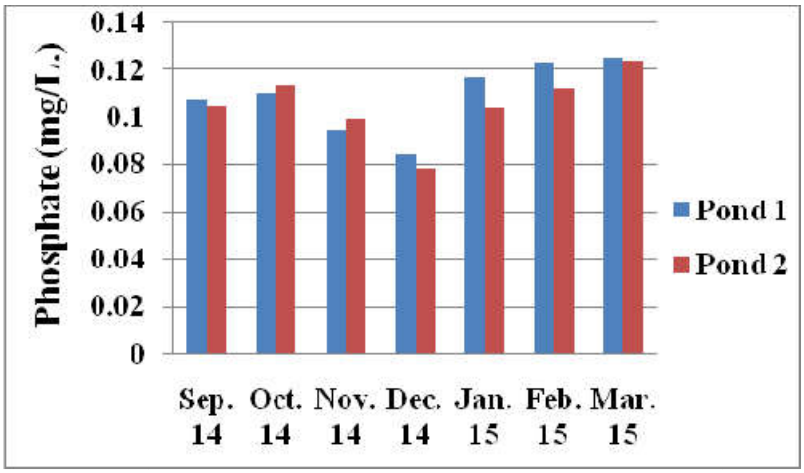

Figure 6. Phosphate (mg/L) of freshwater ponds (September 2014 to March 2015)

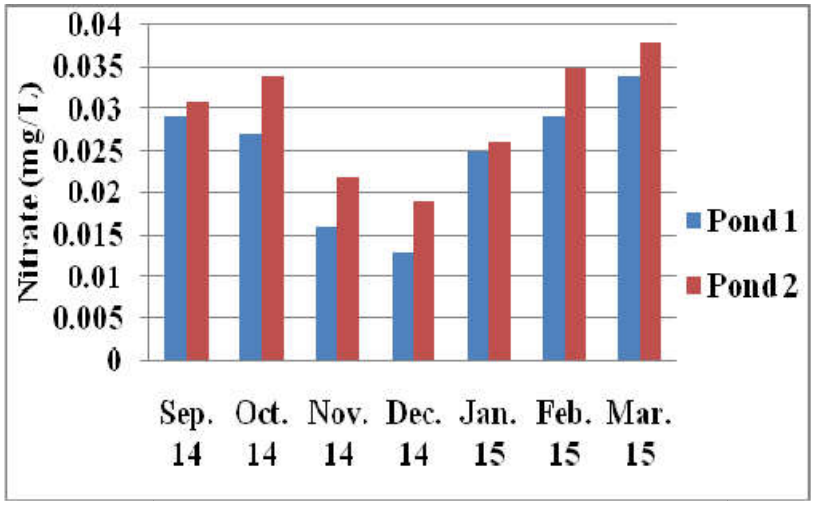

Figure 7. Nitrate (mg/L) of freshwater ponds (September 2014 to March 2015)

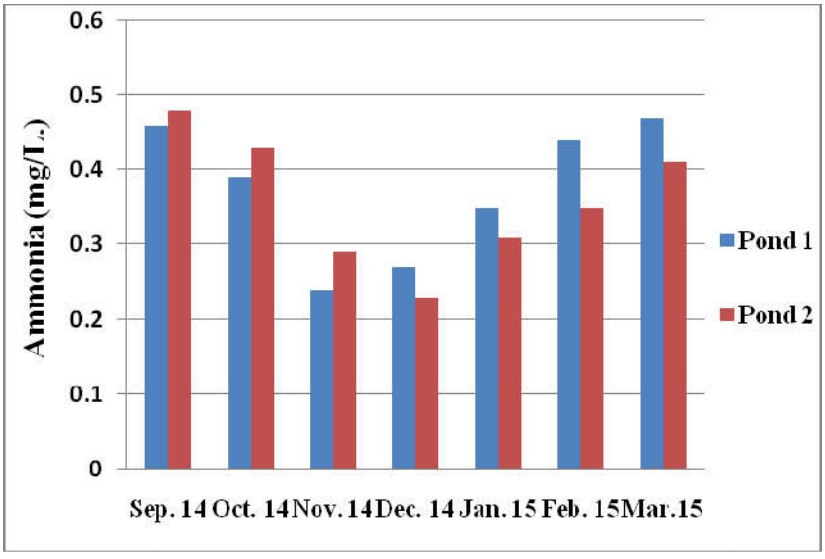

Figure 8. Ammonia (mg/L) of freshwater ponds (September 2014 to March 2015)

At the same time in the carp cultured ponds, turbidity level was observed in the optimum range. Higher values of turbidity in the wet season were also observed by Braide *et al*. (2004), Sikoki and Zabbey (2006), and Allison *et al*. (2007) in their various studies in the Niger Delta.

According to Rahman, (1999) recorded transparency ranged from 12 cm to 46 cm in his experiment in BAU campus, Mymensingh, which is similar to the results of present study. Lower transparency recorded during rainy season when there was turbulence and high turbidity, has a corresponding low

primary productivity, because turbidity reduces the amount of light penetration, which in turn reduces photosynthesis and hence primary productivity (USEPA, 1991; APHA, 1992). Present study, the pH of the fish culture pond water showed alkaline ranges throughout the study period. It was found to be minimum in January 2015 and maximum in the month of March 2015. The results of pH obtained throughout the study were optimum for fish culture, as reported by Bennett (1974) that pH of 5.5 to 10 is recommended for tropical fish culture. The value of pH remained in the range of 7.0-8.5 which was considered best for all fish species (Afzal *et al.,* 2008). Such type of result was also obtained by Rehman and Hussain (2008), who reported the range of pH value, was 9.07 to 8.72 by using the zooplankton as a food for major carps from the ponds of Rajshahi, University. According to Rahman, (1992) reported that the range of pH of a suitable water body for fish culture would be 6.5 to 8.5. The present study is a similar range was obtained lowest pH value was found during winter due to heavy rainfall and dilution effect by Shiddamallayya and Pratima, (2008).

In the present study, the dissolved oxygen contents were found to be low in March 2015 and high in December 2015. Oxygen distribution in water bodies is important as it is the direct need of many aquatic organisms and it favours the solubility and availability of many nutrients to the organisms and therefore increases the productivity of the aquatic ecosystem. Air contains 2% of oxygen. Oxygen from air diffuses to water until its pressure in air and water are equal. Solubility of oxygen is increases with increasing pressure, decreases with increasing temperature and decreases with increasing salinity. Dissolved oxygen was recorded minimum in winter Venkatesharaju *et al*. (2010). The low oxygen values coincided with high temperature during the summer months (Mazher sultana and Dawood sharief, 2004). Dissolved oxygen (DO) plays an important role in aquatic environment and is essential for growth of phytoplankton and fish productivity.

The inhabitant organisms are affected greatly due the diurnal and seasonal variation in the dissolved oxygen of the ambient water was reported (Kiran, 2010). Its concentration was generally low and ranged from 2.5 mg/L to 6.05 mg/L. The lowest value was recorded during summer and highest value during winter (Sankar Narayan Sinha and Mrinal Biswas, 2011). Present investigation, the calcium content ranged from 22.7 to 48.6 mg/L. It was found to be high in the month of March 2015 and low was recorded in December 2014. According to Harrison, (1978) high concentration of calcium, magnesium and phosphate ions also have a positive effect on ammonification. The maximum calcium was observed in May and minimum value in March. Calcium reached at peak in May and then show gradual decline was reported (Muhammad Naeem *et al.*, 2011). The same result was given by Shashikant and Anil (1990), Japo *et al.* (1995), Agarkar and Garode, (2001) that there were fluctuations in the ponds. Present observation, pohosphate contents were minimum in the month of December 2014 and maximum in March 2015. Phosphate is not usually toxic. It is the limiting nutrient in carp culture pond water and is particularly important where carp are being fed with preferred feed. Phosphate is a significant component of faecal waste. It could also be due to lower water hardness, thus less co-precipitation of phosphate with calcium carbonate, a phenomenon that has been reported to occur in many freshwater lakes (House, 1990; Heleen *et al*., 1995). Similar results were obtained by Jena *et al.* (2002a, b) at CIFA, Bhubaneswar. In the present investigation, the nitrate content was found to be low in the month of December 2014 and high in March 2015. Nitrate is the highest oxidized form of nitrogen. Nitrate represents the highest oxidized form of nitrogen. Carp culture pond water and soil contains present in the nitrogenous compounds. Atmospheric nitrogen fixed into nitrates by the nitrogen fixing organisms is also significant contributor to nitrates in the waters. Higher nitrate-nitrogen ($N0_3$-N) concentration during the rainy season could be due to surface run-offs as well as the decomposition of organic matter. Ufodike *et al*. (2001), made similar observations for Dokowa Mine Lake. Kennedy and Hain (2002), was reported that nitrate-nitrogen increase with surface run-off and at deeper depths. According to Comin *et al*. (1983), stated that high value of nitrate concentrations in lake is related to inputs from agricultural lands. Gupta *et al*. (2000) suggested that the permissible levels for nitrate and phosphate should be less than 0.1 and 0.01mg l^{-1} respectively. Although nitrates are not as toxic as ammonia or nitrites, they must be monitored to avoid stressing of fish. Present study, the ammonia content was lowest in the month of November 2014 and high in March 2015. Ammonia originates in pond water from microbial decomposition of organic matter (uneaten food, faeces, dead phytoplankton). According to Devendra Mohan and Devendra Choudhary, (2010) reported that the ammonia contents sharply increased after spawning and hatching. Present study agrees with earlier workers Beamish and Thomas, (1984), Fivelstad *et al*. (1990) and Abbas, (2006) also noted that there were fluctuations in the ponds.

Conclusion

Water quality analysis showed that the turbidity, calcium, ammonia levels were observed high ranges and dissolved oxygen levels were recorded slightly fluctuated in the cultured ponds. But, the nitrate, levels was showed lower in the cultured ponds. The normal ranges of phosphate content level were recorded cultured ponds. Temperature and pH levels were slightly fluctuated in the fish cultured ponds.

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