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# Water quality analysis of two different aquatic media

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## Abstract
Water quality refers to the chemical, physical and biological characteristics of water. pH of the water normally remains higher in aquatic media II (7.87 ± 0.06) and lower in aquatic media I (7.50 ± 0.01). However, higher concentration of dissolved oxygen was noted in aquatic media I (11.96 ± 0.15) and low DO was observed in the aquatic media II (5.8 ± 0.05). Hence, the cowdung used in this study help to enriche the nutrient level in the aquatic media II.

**Keywords:** water quality, aquatic media, cowdung, organic manure

## 1. Introduction
Water is one of the most important components of the ecosystem and it is the source of energy and governs the evolution and functions of the earth. All life depends on the water and it is one of the most essential constituents of the human environments. It is used for many purposes including industrial water supply, irrigation, drinking, propagation of fish and hydro-powers. The water quality in ponds, rivers and streams may vary depending on the geological morphology, vegetation and land use in the catchment.

The physicochemical and biological characteristics in the water environment offers the most favorable conditions for the existence of fish as well as other biota which constitute essential components of the food chain (Gupta and Gupta, 2006) [9]. The maintenance of good water quality is essential for both survival and optimum growth of culture organisms. The pond fertilization techniques through the application of organic manure such as cow dung, poultry manure and pig manure helps to overcome nutrient deficiencies. The direct applications of fertilizers enhance the production of microorganism in water bodies. Pond fertilization practices using animal wastes are widely used in many countries to sustain productivity at low cost (Gupta and Noble, 2001 and Majumder *et al*., 2002) [8, 11]. In India cowdung is the most common organic manure applied in fish ponds (Singh *et al*., 2007) [18].

The water quality analysis of any water body is the essential pre requisite before starting any water related studies. The production of aquatic biota and microorganisms in the water body is directly related with few variables of water quality. The nutrient content of the water body helps to increase the primary productivity. Hence the present study was designed to evaluate the effect of cowdung enrichment on the water quality parameters.

## 2. Materials and methods
### 2.1 Experimental Set Up
The experiments were conducted in six fiber tanks (capacity 100 L). There were two experiments each had three replications. The cowdung manure were collected from local dairy farm and allowed to decompose for 10 days prior to application. In the first experiment (Aquatic media I- pond water) no manure was added. In the second experiment 2 Kg cowdung manure was added in 100 litre water (Aquatic media II- cowdung enriched pond water).

### 2.2 Water Quality Analysis of Water
Water samples were collected weekly at 9 A.M from each tank in 1L glass sampling bottle. Water samples for biological oxygen demand (BOD) were kept inside ice packs, until analysis. Water samples meant for dissolved oxygen (DO) analyses were collected in 100 ml Winkler's bottles and were fixed using manganous chloride and alkaline iodide soon after collection. These samples were collected from approximately 15-20 cm below water surface and care must be taken not to catch any floating material or bed material into the container. Water samples for other analyses were brought to the laboratory in plastic cans.

DO and BOD were determined by Winkler's method (Welch and Ullman, 1993) [19].

Water temperature was measured at the tanks using a mercury thermometer. The pH was measured *in situ* using a portable pH meter. Turbidity of samples was analyzed using a systronics nephelometer. Total dissolved solids (TDS) were measured by filtering the water samples to remove the particulate matter, the filtrate evaporated to dryness and residue weighed. The TDS was calculated according to the method of Boyd and Walleye, (1975) [5]. Electrical conductivity was measured with a conductivity meter. Estimation of sulphates, nitrates and phosphates were carried out by photometric analyses. Sodium and potassium was estimated by systronics digital flame photo meter, water quality parameters such as calcium, magnesium and chloride were estimated as per the method described in APHA (1998) [2].

## 3. Results and discussion

Water quality parameters directly as well as indirectly influence many abiotic and biotic components of aquatic ecosystem. Temperature is one of the major factor affecting water quality. In the present study higher temperature was noticed in aquatic media II (33.2 ± 0.34ºC). This may be due to the presence of high amount of suspended particles in the cowdung. These suspended particles absorb heat from the sunlight and making the water in warm conditions.

pH is defined as the intensity of the acidic or basic character of a solution. pH is an indicator of the existence of biological life. A pH value 7 is considered to be the best and most ideal for most of the reactions and for human beings as well. In this present study, pH of both aquatic media ranged from neutral to slightly alkaline. This neutral pH plays an important role in the rate of bacterial attachment in different surfaces. In this study pH of the water normally remains higher in aquatic media II (7.87 ± 0.06) and lower in aquatic media I (7.50 ± 0.01). The variation occurs in the pH values due to change in the values of $CO_2$, carbonate and bicarbonate in the water. Prasad and Patil (2008) [14] and Agbaire and Oyibo (2009) [1] reported similar views.

Alkalinity is the acid neutralizing capacity (ability to resist changes in pH) of solutes in a water sample. In the present study alkalinity was high in aquatic media II than aquatic media I. This was supported by Jha *et al.* (2004) [10], who reported that the high application rates of cowdung and poultry manure significantly increased the alkalinity of the water.

In the present investigation hardness was high in aquatic media II (319±2 mg/L). Gopalakrishna (2011) [7] stated that the hardness of water mainly depends upon the amount of calcium or magnesium salts or both. When the cowdung is applied in pond water the calcium and magnesium content of water increases, which in turn elevate the hardness of water in the aquatic media II.

Total dissolved solids refer to the total amount of all inorganic and organic substances. Ogbeibu and Edutie (2006) [12] stated that excessive organic manuring and feed wastage can leads to increased TDS. In the present study there was an increasing trend in the TDS level in both the aquatic medium from 7$^{th}$ day to 35$^{th}$ day of observation. But cowdung enriched pond water showed a fourfold increase in the TDS level when compared with aquatic media I. This may be due to the addition of cowdung in the aquatic medium II.

Turbidity is the amount of cloudiness in the water. In the present study high turbidity was observed in aquatic media II (9.7 ± 0.26 NTU). This may be due to the presence of suspended matter such as clay, silt and finely divided organic and inorganic matter in the cowdung enriched water. Pathma and Sakthivel (2012) [13] reported similar views and their observation was in concordant with the present findings. Electrical conductivity is a measure of a materials ability to pass an electric current. In the present study EC was high in aquatic media II (1193±2.5 micro mho/c). This higher electrical conductivity may be due to the presence of more total dissolved solids and chloride content in the cowdung, which is in coherence with the results of Arunan *et al.* (1992) [3]. High specific conductance causes deterioration of water and unsuitable for domestic purposes. So the water is not suitable for recreational purposes.

Dissolved oxygen is an essential parameter in water quality assessment. In the present study dissolved oxygen content was gradually decreased from first day of observation to 35$^{th}$ day of observation in both aquatic media. DO content was higher in the aquatic media I during initial days of observation than aquatic medium II. However towards 35$^{th}$ day of observation DO content of both aquatic media remains more or less same. A low DO would indicate poor water quality. This may be due to the presence of considerable amount of biodegradable organic matter. Similar study was carried out by Rani *et al.* (2004) [15], who reported that the higher rate of organic matter decomposition reduces the dissolved oxygen level. Moreover the increasing temperature is also one of the reasons for low DO in the aquatic environment. Higher temperature observed during the initial days of observation in the aquatic media II may be the reason for the decreased DO content during initial days of observation. Garg *et al.* (2009) [6] reported similar inverse relationship between water temperature and DO content in the enriched medium as observed in the present study.

Like DO content, BOD also showed decreasing trend in both the aquatic media from the initial days of observation to 35$^{th}$ day of observation. The percentage of decrease was higher in aquatic media I than aquatic media II. BOD is a measure of aquatic pollution to both waste and surface water. High BOD indicates pollution by biodegradable materials. Higher BOD observed in the aquatic media II in the present study may be due to the presence of higher suspended and dissolved solids in the cowdung fertilizer. This was supported by Schroeder (1974) [17], who suggested that BOD of any decomposable organic matter should be judged based on their percent dry matter content. Moreover the ambient temperature and dry matter content of the cow dung manure apparently deviated the BOD values of the cowdung enriched water in the present study as suggested by Banerjee *et al*. (1979) [4].

Calcium and magnesium are the important micronutrients in the aquatic environment. In the present study Ca, Mg was higher in aquatic media II. This may be due to the presence of more calcium and magnesium content in the cowdung. Calcium and magnesium content gradually increase in both the aquatic media. Twofold increase in the calcium content and threefold increase in magnesium content were noticed in the present study. Sulphate is the salts of sulfuric acid. In the current investigation, higher sulphate content was noticed in the aquatic media II (49.4 ± 1.15 mg/L). This higher concentration of sulphate may be due to the decomposition of organic substances in the cow dung enriched water. Sakhare

and Joshi (2002) [16] observed similar findings.

Chloride is a natural substance present in fresh water as well as sewage effluents as metallic salt. In the present investigation the aquatic media II showed maximum concentration of chloride. This high chloride content may be due to the higher temperatures in the enriched medium.

Similar to other physicochemical parameters the phosphate was also high in aquatic media II. This may be due to the eutropication process of cowdung enriched water. Potassium concentration was also high in the enriched medium (31.6 ± 1.52 mg/L). This may due to the decomposition of organic matter in the enriched medium. Potassium is used by the microorganism as a catalyst in their metabolism.

## 4. Conclusion

Present study revealed that all the water quality parameters were high in the enriched media. But the analysis clearly shows that except turbidity all other water quality parameters are well within permissible limit. Hence, the cowdung used in this study help to enhance the nutrient level in the aquatic media II.

**Table 1:** Water quality parameters of aquatic media I (Pond water)

| Parameters | Number of days (observation) | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 7 | 14 | 21 | 28 | 35 |
| Temperature(ºC) | 28.9 ± 0.17 | 29.53 ± 0.50 | 29.66 ± 0.57 | 29.5 ± 0.5 | 29 ± 0 | 29.83 ± 0.76 |
| Turbidity (NTU) | - | 3.06 ± 0.30 | 7.13 ± 0.25 | 7.56 ± 0.25 | 8.4 ± 0.3 | 9.2 ± 0.3 |
| TDS(mg/L) | 144 ± 2.64 | 182.6 ± 2.51 | 207 ± 2 | 212.3 ± 3.51 | 218.3 ± 2.51 | 234 ± 3 |
| EC (Micro mho/c) | 213.3 ± 2.51 | 281 ± 3 | 293.3 ± 2.08 | 296.4 ± 2.51 | 331.3 ± 2.51 | 344 ± 3 |
| pH | 7.01 ± 0.08 | 7.25 ± 0.02 | 7.3 ± 0.02 | 7.36 ± 0.02 | 7.42 ± 0.02 | 7.50 ± 0.01 |
| Alkalinity (mg/L) | 145 ± 3 | 184.6 ± 3.51 | 206.3 ± 2.08 | 212 ± 3 | 218.6 ± 4.04 | 233.6 ± 2.51 |
| Hardness (mg/L) | 55 ± 1.73 | 61 ± 3 | 65.3 ± 2.51 | 84 ± 3 | 86.3 ± 3.05 | 90.6 ± 2.51 |
| DO | 11.96 ± 0.35 | 10.34 ± 0.20 | 6.8 ± 0.26 | 6.53 ± 0.30 | 7.06 ± 0.25 | 6.01 ± 0.15 |
| BOD | 32 ± 3 | 28.6 ± 1.52 | 23.6 ± 2.5 | 20.4 ± 2.1 | 18.3 ± 2.08 | 16.6 ± 1.52 |
| Calcium (mg/L) | 12.3 ± 2.5 | 14.65 ± 1.52 | 19.3 ± 2.51 | 24.3 ± 1.52 | 27.4 ± 2.5 | 31.7 ± 2.5 |
| Magnesium (mg/L) | 3.66 ± 1.52 | 6.13 ± 0.35 | 7.33 ± 0.25 | 7.86 ± 0.35 | 8.06 ± 0.25 | 8.63 ± 0.25 |
| Sodium (mg/L) | 5.66 ± 2.5 | 11.3 ± 2.51 | 13.6 ± 2.5 | 18.6 ± 2.08 | 21.3 ± 1.52 | 23.6 ± 2.08 |
| Potassium (mg/L) | 2.13 ± 0.70 | 14.17 ± 0.61 | 5.2 ± 0.7 | 5.7 ± 0.52 | 6.26 ± 0.35 | 6.8 ± 0.6 |
| Chloride (mg/L) | 23.2 ± 1.96 | 39.6 ± 2.3 | 47 ± 2 | 60.3 ± 3. | 63.5 ± 2.08 | 68.4 ± 2.08 |
| Sulphate (mg/L) | 2.6 ± 1.15 | 10.5 ± 1.32 | 14 ± 1 | 17.6 ± 1.52 | 22 ± 2 | 24.6 ± 1.52 |
| Phosphate (mg/L) | 0.11 ± 0.02 | 0.16 ± 0.02 | 0.23 ± 0.030 | 1.59 ± 0.05 | 1.64 ± 0.02 | 1.69 ± 0.02 |

**Table 2**: Water quality parameters of aquatic media II (Cowdung enriched pond water)

| Parameters | Number of days (observation) | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 7 | 14 | 21 | 28 | 35 |
| Temperature(ºC) | 32.66 ± 0.6 | 33.2 ± 0.34 | 31.8 ± 0.76 | 30.83 ± 0.8 | 32.6 ± 0.57 | 30.9 ± 0.90 |
| Turbidity (NTU) | 2.76 ± 0.8 | 4.23 ± 0.45 | 5.7 ± 0.3 | 6.8 ± 0.40 | 9.16 ± 0.25 | 9.7 ± 0.26 |
| TDS (mg/L) | 463.3 ± 2.08 | 770 ± 2 | 796.6 ± 2.51 | 804.3 ± 2.51 | 808.6 ± 3.51 | 812 ± 3 |
| EC (Micro mho/c) | 681.3 ± 4.04 | 1166 ± 3 | 1169 ± 3.05 | 1184 ± 2.51 | 1189.6 ± 3.05 | 1193 ± 2.5 |
| Ph | 7.09 ± 0.08 | 7.23 ± 0.02 | 7.43 ± 0.15 | 7.63 ± 0.05 | 7.6 ± 0.15 | 7.87 ± 0.06 |
| Alkalinity (mg/L) | 159.6 ± 2.5 | 315.3 ± 2.08 | 324 ± 3 | 327.6 ± 2.51 | 330.3 ± 1.52 | 336 ± 3 |
| Hardness (mg/L) | 134.6 ± 2.30 | 303.3 ± 2.08 | 308.6 ± 1.52 | 311.6 ± 1.52 | 315 ± 2 | 319 ± 2 |
| DO | 7.16 ± 0.25 | 6.8 ± 0.15 | 6.65 ± 0.05 | 6.10 ± 0.01 | 5.92 ± 0.04 | 5.8 ± 0.05 |
| BOD | 27.6 ± 2.3 | 25.4 ± 0.45 | 22.9 ± 1.65 | 22.5 ± 0.50 | 20.03 ± 0.55 | 19.6 ± 0.41 |
| Calcium (mg/L) | 29.6 ± 1.52 | 92.3 ± 3.08 | 97 ± 2 | 101.3 ± 2.08 | 105.3 ± 1.52 | 111.3 ± 2.51 |
| Magnesium (mg/L) | 13 ± 1.73 | 16.3 ± 2.08 | 17.6 ± 2.08 | 21.4 ± 1.52 | 23.7 ± 2.08 | 26.6 ± 2.51 |
| Sodium (mg/L) | 87.33 ± 2.08 | 94.3 ± 2.1 | 103.6 ± 2.4 | 107.3 ± 1.52 | 113 ± 2 | 114.7 ± 1 |
| Potassium (mg/L) | 11 ± 1.73 | 20.6 ± 1.52 | 24.6 ± 2.1 | 28 ± 2.64 | 28.3 ± 1.15 | 31.6 ± 1.52 |
| Chloride (mg/L) | 110 ± 3 | 155 ± 2.6 | 162.3 ± 1.15 | 166 ± 2.6 | 173.6 ± 2.5 | 178.7 ± 3.5 |
| Sulphate (mg/L) | 21.3 ± 2.5 | 22.6 ± 1.15 | 35 ± 2.64 | 43 ± 2 | 46.6 ± 1.5 | 49.4 ± 1.15 |
| Phosphate (mg/L) | 0.39 ± 0.17 | 0.85 ± 0.04 | 1.04 ± 0.01 | 1.13 ± 0.01 | 1.17 ± 0.32 | 1.66 ± 0.04 |

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