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ANALYSIS OF WATER PHYSICO-CHEMICAL PARAMETERS IN JEGA LOCAL GOVERNMENT AREA FISH FARMS OF KEBBI STATE, NIGERIA

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ABSTRACT

The study of Physico-chemical parameters in concrete fish tanks of three farms at different locations in Jega Local government area of Kebbi State, Nigeria was conducted to analyze the physico-chemical parameters of fish tanks in Jega Local government area of Kebbi State Nigeria and compare them with the set standard recommended for optimum fish production from November, 2021 to January, 2022. Water samples were collected from the tanks and analyzed using standard laboratory methods and procedures. The results showed variation in the observed parameters at the different sampling stations. Temperature ranged from 17.25±0.31^{o}c to 22.25±0.31^{o}c, pH ranged from 5.75±0.20 to 6.25±0.20, Dissolved oxygen values ranged between 2.54±0.08mg/l to 11.32±0.08mg/l and Turbidity recorded was from 37.75±0.75ppm to 60.0±0.75ppm. The observations in this study suggest that pond fish production in Jega Local government area of Kebbi State Nigeria could be practiced without adverse effects posed by the quality of water.

Keywords: Analysis, Physico-chemical parameters, concrete tanks, fish, Water

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INTRODUCTION

Water is a valued natural resource for the existence of all living organisms, but this resource is increasingly being threatened as human population grow and demand for high quality water for domestic purpose and economic activities increases (Olatunji et al., 2011). As air is to terrestrial animals, so also is water to fish. Fish perform all its body functions such as breathing, reproduction, excretion of waste, maintenance of salt balance, feeding and growth in water. Water temperature is one of the most important physical factors affecting fish growth and production (Viadero, 2005).

The study that includes aspects of the biological, physical, chemical and geological characteristics and functions of inland waters is referred to as Limnology. Water quality determines not only how well fish will grow in aquaculture operation, but whether or not they will survive (Ajayi, 1971). Water quality studies are not only of major importance to understand aquatic life but also for the development and management of aquatic environment. Regular monitoring of water quality properties is necessary in order to make fish comfortable in its environment. Changes in these properties will affect the growth, survival and distribution of fishes (Ufodike and Garba, 1992).

There has been a number of attempts at correlating fish yields with limnological factors influencing the productivity of lakes (J. Olah et al, 1987) coted (Rawson, 1955; Northcote and Larkin, 1956; Ryder, 1965). The physical properties of water that are important to fish production and growth include temperature and turbidity; the important chemical parameters include pH, dissolved oxygen, alkalinity, hardness, and metals. Each water quality parameter interacts with and influences parameters, sometimes in complex ways (Boyd, 1979). The various physical and chemical properties must be within the acceptable limits for optimum fish production (Boyd, 1979).

The physico-chemical parameters of pond aquaculture system, plays a great role in aquaculture venture. Based on available information, not much has been done on the assessment of physico-chemical parameters on various ponds in Jega. It is also observed that most fish farmers are ignorant of the significance of these physico-chemical parameters to the success of their farm operations or do not know how and when to carry out the assessments (Obe, et al, 2015).

Jega local government is blessed with abundance of fisheries resource in their riverine system that contribute to the livelihood of fishermen in Jega local government area. However basic environmental information on water quality parameters that determine the production rate, mortality rate, growth rate and survival rate of fish species both in the wild and enclosures (man-made fish habitat) are scanty so far. In recognition of the utmost importance, to understand the physico-chemical parameters is important because lack of ideas about these parameters will affect the culture of fish and the aquaculture sector at large.
The objectives of the research are:

i. To investigate the effect of physico-chemical parameters on fish tanks at Jega LGA, Kebbi State.
ii. To analyze the physico-chemical parameters of fish tanks in Jega LGA and compare them with the set standard recommended for optimum fish production.

The knowledge of the physico-chemical parameters which promote or inhibit fish production and performance of body functions has not been fully investigated in Jega LGA. This has contributed in low fish production and harvest which will have increased the abundance of protein palatable fish for human consumption and profit acquisition.

MATERIALS AND METHOD

Study Area

Jega is a local government area in Kebbi state, Nigeria. Its headquarters are in the town of Jega. It has an area of 891 km^2 and has an estimated population of 193,352 people as at the 2006 National population census (NPC). Projected using 3.1% as an annual increase (post offices, 2009). Its geographical coordinates are 12^0 13' 3" North, 4^0 22' 45" East (www.Maplandia.com).The postal code of the area is 863. It is inhabited by the Hausa's and their major occupations are farming and trade.

Figure 1: map of the sample area

Sample design

Water samples were collected once in two weeks, from three farms, all collections were made during the morning hours for a period of three (3) months from November 2021 to January 2022.

The three farms are located in Jega LGA; Farm A (Ummi Hadiza Farms), Farm B (Ksusta Teaching and Research Farm) and Farm C (Bilya Sulaiman Fish Farm).

Collection of samples

Water samples for the study were collected from three (3) functional fish tanks in Jega. These was taken at a depth of 15cm. Prior to sample collection, all the sampling bottles were washed thoroughly, sun-dried and rinsed with the same water it was collected from the ponds. The water samples were collected in 500ml DO bottles without agitating, bubbling or mixing with air in the morning and were taken to the laboratory shortly after collection.

Determination of water parameters

Temperature: Reading was taken in the field using mercury-in-glass thermometer graduated in degree Celsius ($0\text{-}100^0$c). The thermometer was placed in the water body for about five (5) minutes to stabilize after which the reading was recorded.

Dissolved oxygen (DO): Analysis was carried out using Winkler's method of Dissolved Oxygen determination.

pH (hydrogen ion concentration): This was measured by the use of indicator paper.

Turbidity: this was measured using Secchi disk with a diameter of 20cm.

Data Analysis

Statistical analysis was carried out using (SPSS version 25.0) and one-way analysis of variance (ANOVA) was used to calculate the mean. The difference in means were compared using Turkey-Test at (P-<0.05).

RESULTS

The results of this study are presented in Table 1. A total of 4 different Physico-chemical parameters were analyzed. The analysis was based on the samples taken from three farms A (Ummi Hadiza Farms), B (KSUSTA Teaching and Research Farm) and C (Bilya Sulaiman fish farm). The analysis shows that the highest mean temperature of 22.25±0.31^{o}c is observed in Tank A while, the lowest temperature of 17.25±0.31^{o}c is obtained in Tank C. The highest mean pH of 6.25±0.20 is observed in Tank A while the lowest value of 5.75±0.20 is recorded in Tank B. Highest Dissolved Oxygen level of 11.32±0.08mg/l was obtained from Tank C while the lowest value of 2.54±0.08mg/l was obtained in Tank A. Turbidity values ranged from 37.75±0.75ppm in Tank A, to 60.0±0.75ppm in both Tank B and C respectively. Significant variations were observed for the different parameters in the fish tanks (P<0.05). Table 2 shows values and limits from Federal Environmental Protection Agency (FEPA) and World Health Organization (WHO) for water quality parameters which can be compared to the present results.

Table 1: Physico-chemical parameters of three functional fish tanks

Parameters	Farms		
	A	B	C
Dissolved oxygen (ppm)	2.54±0.08^{c}	6.72±0.08^{b}	11.32±0.08^{a}
Ph	6.25±0.20^{a}	5.75±0.20^{a}	6.0±0.20^{a}
Turbidity (ppm)	37.75±0.75^{b}	60.0±0.75^{a}	60.0±0.75^{a}
Temperature	22.25±0.31^{a}	22.0±0.31^{a}	17.25±0.31^{b}

Table 2: comparison of physico-chemical parameters with FEPA and WHO limits

Parameters	Farms			FEPA	WHO	Desirable range
	A	B	C			
Dissolved oxygen (ppm)	2.54 ± 0.08^{c}	6.72 ± 0.08^{b}	11.32 ± 0.08^{a}	8-9.0	8-10	5.0ppm to saturation
pH	6.25 ± 0.20^{a}	5.75 ± 0.20^{a}	6.0 ± 0.20^{a}	6-9.0	6.5-8.5	6.5-9
Turbidity (ppm)	37.75 ± 0.75^{b}	60.0 ± 0.75^{a}	60.0 ± 0.75^{a}	1.0	500	10-1000ppm
Temperature	22.25 ± 0.31^{a}	22.0 ± 0.31^{a}	17.25 ± 0.31^{b}		<35	20-30^{o}C

DISCUSSION

The observed water temperature in Farm A (22.25 ± 0.31^{o}c) and B (22.0 ± 0.31^{o}c) in this study is considered normal for aquatic life in Jega local government area of Kebbi State except for Farm C (17.25±0.31). The temperature observed in this study corroborates the report of Boyd (1979) for good pond fish production. Water pH affects metabolism and physiological processes of fish and also exerts considerable influence on toxicity of ammonia (ICAR, 2006). Except for the pond water in Farm B, the pH in Farm A and C agree with the desirable lower limit (Table 2). Generally, the pond water in all areas appeared slightly acidic and may need lime application although their effect may be minimal on acidity (Ewa *et al.*, 2011). Fish growth is limited in water of pH <6.5, reproduction ceases and fry can die at pH <5.0 (Boyd, 1982). Oxygen is needed for the body activities of the fish. It is introduced into the pond mainly through photosynthesis by aquatic green plants and dissolved oxygen from the air. Farm A has the lowest value of 2.54±0.08mg/l Dissolved oxygen. This is far below the lower limit of the desirable range of 5.0mg/l (Welch, 1948). Dissolved oxygen is a measure of the amount of gaseous oxygen dissolved in an aqueous solution that plays a vital role in the biology of cultural organisms (Dhawan and Karu, 2002 cited by Ehiagbonare and Ogundiran, 2010). The mean DO values obtained for Farm B and C range from 6.72±0.08mg/l to 11.32±0.08mg/l and can sustain aquatic life. These values also agree with the minimum DO of 5.0mg/l reported for tropical fishes by (Saloom and Duncan, 2005). Turbidities in natural waters seldom exceed 20,000mg/l (Irwin, 1945). Turbidity restricts light penetration, limits photosynthesis and production of undesirable macrophytes in ponds (Boyd, 1979). The turbidity values obtained in the Farms are within the desirable range. Turbidity relates to the amount of materials present in the water and this could be as a result of input of wastes by the fish farmers into these ponds especially in Farm A which has the value of 37.75±0.75, the presence of the suspended particles seemed to be much. Water from the various farms varies in solid concentrations depending on the degree of mineralization, amount of suspended clay and abundance of plankton (Boyd, 1982). In comparison, the observed values of the parameters fall within FEPA (1991) and WHO (1986) limits of good water for fish tank culture.

CONCLUSION AND RECOMMENDATION

This study observed that fish farmers in the study areas used slightly acidic water for fish production. Lime application will correct pH to a more acceptable and desirable level for farmers. The temperature level is acceptable for fish production except for Farm A, which can be corrected by the use of heating devices. Turbidity levels are within acceptable range of fish production; this means the water is clean. Dissolved oxygen are within desirable range of fish production except for Farm A, this can be corrected by agitating the water frequently also, partial drainage of with addition of new water and allow running water to come into the tank gradually from a top position into the tank. There is the desirable need to analyze the pond water at regular intervals. Farmers should be educated on better managerial practices bordering on feeding practices, pond management, good water exchange practice to reduce organic load and waste accumulation. This will ensure that some of the parameters in this study will not exceed levels that could be harmful to fish in the environment. Such a measure will guarantee the safety of the aquatic ecosystem, humans and environment for good and healthy production of fish.

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