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EFFECT OF DRIED TIGERNUT (*Cyperus esculentus L.)* SUPPLEMENTARY DIET IN FORMULATED FEED ON *Clarias gariepinus* FECUNDITY, FERTILIZATION, HATCHABILITY Of EGGS AND SURVIVAL RATE OF THE HATCHLINGS

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ABSTRACT

Study was carried out in the demonstration farm of the Department of Aquaculture and Fisheries Management to evaluate the effect of tigernut (*Cyperus esculentus*) supplementary diet on fecundity, fertilization, hatchability and survival rate of *Clarias gariepinus* hatchlings. Twenty female brood stock with average of 859g were sourced and randomly distributed into ten concrete tanks. Experimental diet of 40% crude protein containing 0%, 5%, 10%, 15% and 20% of wet and dry tiger nut respectively were included in the feed, formulated and fed to the female brood stocks at 3% of body weight twice daily for 30 days. Data on fecundity, percentage fertilization, hatchability and survival rate were collected and analysed using two-way ANOVA with Genstat. In the average weight of egg with egg sac, the dried tiger nut treatment diet was significantly higher than that of wet. The fecundity of the fish result shows that there is significant difference between the wet and dry tiger nut supplementary diet with TSD 15 showing the highest value for the wet and dry followed by TSD 05 and TSD 10. Which were significantly different from other treatments and the control. The result of the fertilization shows no significant difference between wet and dry control, TSD 5, TSD 10 respectively, but is significantly different for TSD 15 and TSD 20. The hatchability result shows the control with no significant difference between the wet and dry treatments of hatchability, TSD 20, TSD 15, TSD 10 also shows no significant difference between the wet and dry treatments except for TSD 5 which shows significant difference. TSD 10 of the dry treatment shows the highest value while TSD 15 has the lowest value. The survival rate result shows that there is a significant difference between wet and dry tiger nut diet in TSD 00, TSD 05, TSD 10 and TSD 15. TSD 15 have the highest significant value in survival rate more than any other treatments in wet experimental diet This study has shown that inclusion of tiger nut in the feed of fish enhance fecundity, fertilization, hatchability and survival of *C. gariepinus* fry. This study established the efficacy of tiger nut seed meal as fertility enhancer and hatchling survival in *C. gariepinus* brood stock and should be encouraged as it will minimize the dependence on synthetic drugs as fertility enhancing agents.

Keyword: Tigernut, Fecundity, Fertilisation, Hatchability.

INTRODUCTION.

Background of the Study.

Tiger nut are edible tubers with a sweet nutty flavor (Akuoma *et al*, 2000). When they are dried, they are quite hard and are generally soaked in water before consumption for those that want the soft. Tiger nut has several varieties (black, brown and yellow and they have been described as an important food of

high nutritional and economic values (Oguntona and Akinyele, 1995) and a good source of starch for human consumption and industrial use (Barko and Smart, 1979). It yields more milk upon extraction and contains lower fat and more protein (Okafor and Okolo, 2003). It has considerably high levels of fibre, protein, carbohydrates especially natural sugars (Soluble Glucose), Potassium and Phosphorus. The very high fibre content combined with a delicious taste make it ideal for children, older and sports men (Annon, 2005). Although, tiger nut is gluten and cholesterol free, it is rich in essential amino acids (lysine, threonine and cysteine), oil, oleic acids, Vitamins C and E and very low in sodium content. Medically, it is regarded as a digestive tonic, having a heating effect on the digestive system and alleviating flatulence. The nut is used in the treatment of Boil, Cold, Polio, Ulcers (Chevalier, 1990).

Among the cultivable fish in Nigeria includes *C. gariepinus,* which is a major tropical aquaculture species in Africa (Ayinla and Akande, 1988) and *it has* a very good commercial value in Nigerian markets (Ayinla *et al*, 1994). Fish seed production is an important aspect of aquaculture that has witnessed continuous research and innovation for increased fish production. Artificial propagation methods constitute the major practicable means of providing enough quality seed for rearing in confined fish enclosure waters such a fish ponds, reservoirs and lakes (FAO, 2006).

Common practices in hatcheries such as transportation, handling, cleaning, use of chemicals, overstocking, water quality problems are not the only factors that may negatively influence fish reproduction (Adeparusi *et al.,* 2010) but quality of eggs is also suspected. These common factors affect fertilization success in both artificial and natural reproduction. As a result of these factors, low quality fish seeds are produced (Adeparusi *et al*., 2010). The need for acceptability and affordability pro-fertility agents in fish for quality fish seeds availability informed the study of tiger nut in female *C. gariepinus* brood stock and its medicinal properties for adequate fish seed production.

MATERIALS AND METHODS.

Research Area.

The research was carried out at the Department of Aquaculture and Fisheries Management Fish Farm, Shabu-Lafia Campus. Nasarawa State University Keffi, Lafia is located on latitude $8^{0}35^{0}$N, longitude $8^{0}32^{0}$E and altitude 181.53m above sea level with mean temperature of 34^{0}C, relative humidity of 40-86% and average day light of 9-12hours. (NIMET, 2011)

Collection and Acclimation of Experimental Fish.

Twenty (20) female experimental *C. gariepinus* brood stock of mean weight between 650g-1kg were sourced from a commercial farm in Lafia, Nasarawa State. The brood stocks was acclimated for one weeks in concrete holding tanks at the Department of Aquaculture and Fisheries Management Fish Farm, Nasarawa State University, Keffi Nigeria. During this period, they were fed with commercial diets of 40% crude protein twice daily at 3% of their body weight.

Experimental Diet Preparation.

The feedstuff and tiger nut was obtained from various market in Nasarawa State, Nigeria. Part of the tiger nut was sun dried and then grounded into fine powder. Treatment diet was formulated to provide 40% crude protein. The ingredients was milled to small particles size and graded level of tiger nut meal was

added at 0% (control diet), 5%, 10%, 15% and 20% inclusion level. Ingredients including vitamin premix and tiger nut meal (dry) were thoroughly mixed to obtain a homogenous mass. The feed was pelletized using extruder machine and the pellets were sun-dried immediately to required minimum moisture level for storage.

Experimental Setup

Two (2) females brood stocks were randomly selected and kept into five different concrete ponds (1m by 1m by 1.5m) in three replicates (i.e. tiger nut inclusion level of 0%, 5%, 10%, 15% and 20%) dried tiger nut. The experimental brood stocks were starved 24 hours to the commencement of the experiment. The experimental brood stocks were fed with the varying inclusion level of the experimental diet twice daily at 3% of their body weight per day for a period of seven weeks. The quantity of feed was adjusted based on the weight attained by the fish fortnightly throughout the feeding trial. The water quality standard was strictly adhered while the water in each tank was completely changed twice a week and tanks were washed regularly to ensure optimum quality of the culture medium and healthy condition of the fish according to (Adewole and Owolabi, 2007).

Sampling and Data Collection

Initial and final mean weight at the beginning and at the end of the period of this study of randomly distributed fish were done using sensitive weighing balance respectively. Data collected were processed and used to compute parameters for weight of the fish and feed utilisation.

Growth Assessment.

The following indices was used to determine the biological evaluation of growth performance of the experimental fish according to methods described by Jobling (1983).

Mean Weight Gain (MWG).

The weight gains of fish in each treatment group was taken. All fish per treatment was individually weighed on a spring weighing balance and the respective means was recorded.

Percentage Mean Weight Gain (PMWG).

This was calculated using the formula:

$$\text{Percentage mean weight gain} = \frac{W_f - W_i}{W_i} \times 100$$

Where, W_f is final mean weight and W_i is initial mean weight

Reproductive Performance.

At the end of the feeding trial, six females randomly selected per dietary treatment were weighed, killed and dissected to remove the egg sac. Fecundity estimation was done using volumetric sub-sampling (wet method) as described by Okaeme, *et al*., (2013). The egg sac were carefully weighed after cleaning the blood stain and removing attached tissues. The egg sac is then placed in 100ml of distilled water in a measuring cylinder and the volume (V) recoded. A small sample of the eggs was gotten from the egg sac and placed in 5ml of distilled water in a measuring cylinder and the volume (v) was recorded. The egg sample was counted and recorded as (n) and was calculated using the formulae below:

$$X/n=V/v$$

Where X= Unknown number of eggs in the total sample collected, n= Number of eggs counted in sample,

V= Total displaced volume, v= Volume of the sample

Egg Quality Assessment and Larval Production.

After seven weeks of feeding trial, two females were randomly selected per dietary treatment, weighed and injected with ovaprim hormone according to manufacturer's recommended dosage of 0.5/kg body weight. The Fish was kept in a bowl for 12 hours (twelve hours) as latency period and eggs was collected by manual stripping of the sexually gravid females while milt from the male fish prepared for the experiment was used for the fertilization of eggs. The incubators was kept well oxygenated with aerators while the ambient temperature (hatchery) was kept within 28^0C and eggs hatched after approximately 24 hours of incubation in plastic tanks.

The percentage of egg fertilized as well as the percentage number of egg hatched and percentage survival was computed according to the methods described by Ayinla (1988):

% Egg Fertilized = No. of eggs incubated − No. of opaque eggs / Total no. of eggs incubated × 100.

% Egg Hatching = No. of whitish broken eggs / No. of eggs fertilized × 100

% Survival = No. of hatchling alive up to larvae stage / Total number of hatchlings × 100, which was determined after 10^{th} day of hatching.

Statistical Analysis

Data obtained were analysed by two-way Analysis of variance (ANOVA) and significant mean differences was separated at 0.05 probability level as described by Steel *et al*. (1997).

RESULTS.

Analysis of feed and inclusion rate of tiger nut in percentage.

Result of proximate analysis of formulated diet of the experiment is presented in table 4. Result of moisture, ash and crude protein show that DTSD 10, 15 and 20 were significantly the same but they were significantly higher than the control.

Result shows that Ether extract and Nitrogen free extract of treatment DTSD 20 was significantly higher than other treatments.

Average Weight of the Fish.

The result for the average weight of fish treated with dry tiger nut supplementary diet is shown in Figure 1. Result shows that there is no significant difference between the value obtained for the average weight of fish treated with dry and wet tiger nut supplementary diet. However, treatment TSD 10 and TSD 15 were each significantly higher than other treatments. The control treatment had the lowest value recorded for average weight of the fish treated with experimental diet.

Average weight of egg with egg sac of *C. gariepinus* treatment with tiger nut supplementary diet.

The average weight of egg with egg sac is presented in Figure 2. Result of ANOVA show that there is significant difference between the treatments. The dried tiger nut treatment diet was significantly higher than that of wet. Treatment TSD 10 value recorded were significantly higher than that of other treatments. Treatment TSD 20 for wet tiger nut treatment had the lowest recorded value for weight of egg with egg sac.

Average number of egg of C. gariepinus female treated with dry and wet tiger nut supplementary diet (Fecundity).

The result of the average number of eggs in female fish treated with dry and wet supplementary diet is presented in figure 3. The result for the average number of eggs in fish shows that there is significant difference between the wet and dry tiger nut supplementary diet.

Table 1: Composition of experimental diet.

S/N	COMPONENTS	TREATMENTS				
		FTSD/ DTSD 0% (ctrl)	FTSD/ DTSD 5%	FTSD/ DTSD 10%	FTSD/ DTSD 15%	FTSD/ DTSD 20%
1	Fish meal (kg)	16.06	16.06	16.06	16.06	16.06
2	Soybean meal (kg)	18.98	18.98	18.98	18.98	18.98
3	Groundnut cake (kg)	20.44	20.44	20.44	20.44	20.44
4	Millet (kg)	14.60	14.60	14.60	14.60	14.60
5	Wheat offal (kg)	16.06	16.06	16.06	16.06	16.06
6	Cassava flour (kg)	11.20	11.20	11.20	11.20	11.20
7	Vitalyte premix (kg)	0.37	0.37	0.37	0.37	0.37
8	Lysine (kg)	1.07	1.07	1.07	1.07	1.07
9	Methionine (kg)	0.61	0.61	0.61	0.61	0.61
10	Salt (kg)	0.61	0.61	0.61	0.61	0.61
10	TOTAL	100	100	100	100	100
Additives	Dried Tiger nut meal (%)	0.00	0.50	1.00	1.50	2.00

Table 2: Proximate composition of the experimental diet (Dry tiger nut).

Treatments	Moisture	Ash	Crude protein	Ether extract	Crude fibre	Nitrogen Free extract
DTSD 00	11.58500^{b}	14.2150^{b}	39.3500^{b}	14.0550^{e}	2.2750^{d}	18.4650^{e}
	(0.0071)	(0.0071)	(0.0707)	(0.0071)	(0.0354)	(0.0071)
DTSD 05	11.58985^{b}	14.2193^{b}	39.4277^{ab}	14.1619^{d}	2.3169^{cd}	36.6342^{d}
	(0.0029)	(0.0059)	(0.0047)	(0.0037)	(0.0062)	(0.0075)
DTSD 10	11.61830^{a}	14.2425^{a}	39.4437^{a}	14.2638^{c}	2.3370^{bc}	36.2821^{c}
	(0.0205)	(0.0083)	(0.0070)	(0.0067)	(0.0078)	(0.0043)
DTSD 15	11.62150^{a}	14.2553^{a}	39.4766^{a}	14.3715^{b}	2.3605^{ab}	35.9071^{b}
	(0.0082)	(0.0069)	(0.0051)	(0.0087)	(0.0048)	(0.0163)
DTSD 20	11.63155^{a}	14.2593^{a}	39.4918^{a}	14.4819^{a}	2.3877^{a}	35.5597^{a}
	(0.0056)	(0.0066)	(0.0077)	(0.0071)	(0.0037)	(0.0022)

DTSD 00= Dry Tiger nut supplemented diet 0% (control), DTSD 05= Dry Tiger nut supplemented diet 5% , DTSD 10= Dry Tiger nut supplemented diet 10%, DTSD 15= Dry Tiger nut supplemented diet 15% , DTSD 20= Dry Tiger nut supplemented diet 20%

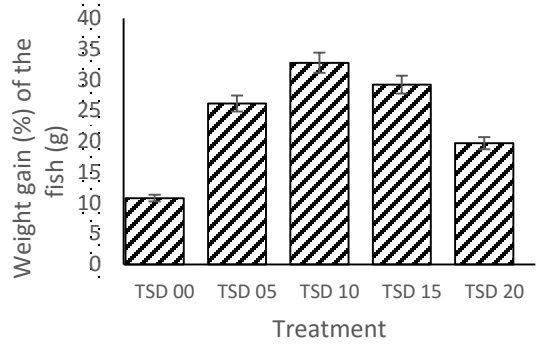

Figure 1: Average weight (%) of *C. gariepinus* female fed experimental diet for 30days

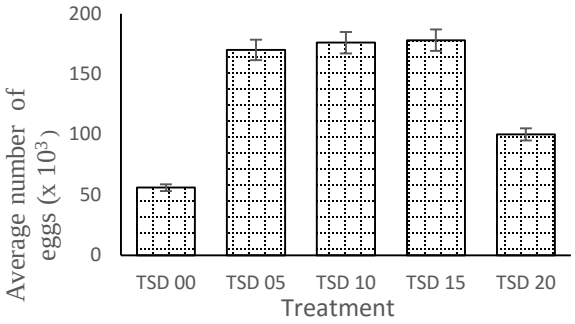

Figure 2: Average number of egg of *C. gariepinus* female fed experimental diet for 30days

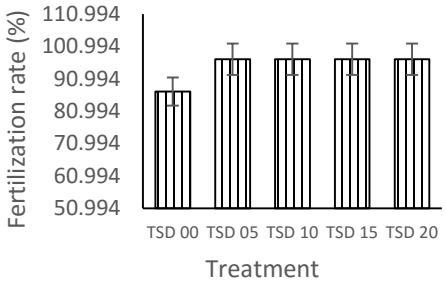

Figure 4: Effect of tiger nut experimental diet on Fertilization rate of *C. gariepinus* eggs

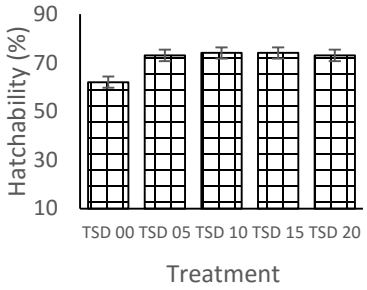

Figure 5: Effect of tiger nut experimental diet on the Hatchability Rate of *C. gariepinus* fry

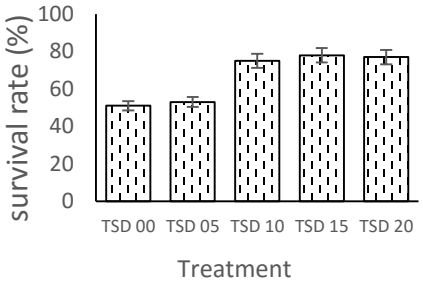

Figure 6: Effect of tiger nut supplementary diet on Survival Rate of *C. gariepinus* hatchlings

TSD 00= Tiger nut supplementary diet 0% (Control) TSD 05= Tiger nut supplementary diet 5% inclusion level
TSD 10= Tiger nut supplementary diet 10% inclusion level TSD 00= Tiger nut supplementary diet 15% inclusion level
TSD 00= Tiger nut supplementary diet 20% inclusion level

TSD 15 shows the highest value for the wet and dry followed by TSD 05 and TSD 10. There is no significant difference between TSD 05 and TSD 10 but are significantly different from other treatments and the control. TSD 15 also shows the highest value for the wet and it is significantly different from the control and other treatment. TSD 05 and TSD 10 are not significantly different from each other in the experimental diet. TSD 15 also showed highest value for the dry and it is significantly different from the control and other treatments among the dry tiger nut experimental diet.

Effect of tiger nut supplementary diet on the Fertilization rate of *C. gariepinus* eggs.

The result of the effects of tiger nut supplementary diet on fertilization rate of C. gariepinus eggs is shown in Figure 4. The result of the fertilization shows no significant difference between wet and dry control, TSD 5, TSD 10 respectively, but is significantly different for TSD 15 and TSD 20. There is no significant difference between the control, TSD 5 and TSD 10 respectively for the dry treatment but there is significant difference for TSD 15 and TSD 20 record the lowest value for dry treatment. The wet treatment

only shows significant difference for TSD 15, while control, TSD 5 TSD 10 and TSD 20 shows no significant difference.

Effect of tiger nut supplementary diet on the Hatchability Rate of *C. gariepinus* fry.

The effect of tiger nut supplementary diet on C. gariepinus hatchability rate is presented in figure 5.

The control shows no significant difference between the wet and dry treatments of hatchability, TSD 20, TSD 15, TSD 10 also shows no significant difference between the wet and dry treatments except for TSD 5 which shows significant difference. TSD 10 of the dry treatment shows the highest value while TSD 15 has the lowest value. TSD 5, TSD 20 and control has no significant difference, between them, but are significantly different from TSD 15 and TSD 5, while TSD 5 records the lowest value.

Effect of tiger nut supplementary diet on Survival Rate of *C. gariepinus* fry.

The effect of tiger nut supplementary diet on survival rate of C. gariepinus hatchling is presented in figure 6.

The result shows that there is a significant difference between wet and dry tiger nut diet in TSD 00, TSD 05, TSD 10 and TSD 15. TSD 15 have the highest significant value in survival rate more than any other treatments in wet experimental diet while TSD 05 of the dry tiger nut experimental diet has the significant value for survival rate.

DISCUSSION.

The general increase in body weights of the experimental fish in all the treatments in this study indicated that the diets were adequate in dietary protein and other nutrients required by female catfish. Similar results were obtained when tilapia fingerlings fed on different grains and *Clarias gariepinus* fed cocoyam based diets respectively (Solomon *et al*, 2007; Aderolu and Sogbesan, 2010). The increase in body weight might be attributed to the nutrient rich of the tiger nut which might have allowed proper absorption of the nutrients which have allowed proper utilization of the nutrients.

The result of this study shows that tiger nut supplementary diet affects the fecundity, hatching rate and percentage survival of *C. gariepinus* larval. Similar result was reported for using ethanol extract of *Gacinia kola* seed as fertility-promoting agent for *C. gariepinus* (Dada and Ajilore, 2001). Adesanya *et al*., (2007) reported an increase in the sperm count of wistar rats after treatment with ethanol extract of *G .kola* seed for 6 weeks.

This might be attributed to the seeds of *Cyperus esculentus* established as a very nutritious (Paigen *et al*., 1987), rich mineral content especially vitamin E , phosphorus and potassium, oil resistance to peroxidation and fatty acid (palmitic acid, stearic acid, oleic acid and linoleic acid), alkaloids that prolonging the action of camp, they also affect glucagons and thyroid stimulating hormones, saponins and tannins are known to have antimicrobial activity, as well as other physiological activities (Sofoworo, 1993; Evans, 2005). The extract play an important role in enhancement fertility so it may improve reproductive system maturity (Almashhadani and Alessawe, 2010).

In this study, the larval of the brood stocks fed on diets 5% and 15% tiger nut supplementary diet survived well than the ones placed on other diets. Since most of the losses in hatchery are recorded at the critical transitional period of moving from endogenous feeding to exogenous feeding, any effort made to improve the quality of the egg will surely increase the survival of the larval (Davy and Chouinard, 1980). The significantly higher ($p<0.05$) percentage

fertilization and hatchability observed in the fish fed the diet 5% tiger nut supplementary diet agrees with Adewumi *et al*. (2005) who reported that *C. gariepinus* broodstock fed differentially heated soybean-based diets had smaller eggs and produced lower hatching rates and larval survives than the control fish which were fed on fish meal – based diet.

CONCLUSION.

Tiger nut supplementary diet improved the reproductive performance of cultured African catfish, *C. gariepinus* and was useful and reliable ingredient for propagating seedling production and rearing strategy of hatchlings. This study has shown that inclusion of tiger nut in the feed of fish enhance Fecundity, fertilization, hatchability and survival of *C. gariepinus* fry.

RECOMMENDATIONS.

This study established the efficacy of tiger nut seed meal as fertility enhancer and hatchling survival in *C. gariepinus* brood stock and should be encouraged as it will minimize the dependence on synthetic drugs as fertility enhancing agents. Therefore, future research should focus on the improvement of fresh seed production technology of different fish by tiger nut meal.

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PRELIMINARY STUDY OF SOME PHYSICO-CHEMICAL PARAMETERS OF KISRA RESERVOIR IN NIFFR ESTATE AT THE ON SET OF DRY SEASON.

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ABSTRACT.

Good water quality is needed for maintaining viable aquaculture production as poor water quality can result in low profit and low product quality. The water quality of Kisra Reservoir in NIFFR Estate was studied using the physicochemical parameters from October to December 2020 with the view to determine the quality of Kisra Reservoir suitability for fish production. The samples were collected at two (2) different points on the reservoir (Monk and Inlet). The parameters studied include: Temperature, Dissolve Oxygen (DO), Biological Dissolve Oxygen (BOD), Turbidity, Conductivity, Water Hardness, Colour and Alkalinity. The water parameters were Analyzed using standard Analytical Methods. The potential fish yield was also determined using the Morpho Edaphic Index (MEI). The results obtained were compared with the recommended range value. Most of the physico-chemical parameters of the Reservoir fall within the recommended range value except Hardness, Conductivity and Alkalinity which fall below the recommended range value. The potential fish yield was found to be relatively high when compared to other reports from reservoirs like Dadin kowa and Kiri. The reservoir is predicted from the results of this study to be suitable for fish production but the reservoir should be limed to raise the alkalinity and hardness to recommended level for sustainable fish production.

Keywords: Water quality, Physico-chemical, Reservoir, Potential Fish Yield.

INTRODUCTION.

Water is vital for life especially, for aquatic organisms without which survive has no alternative. All living organisms on the earth need water for survival and growth but, in recent times, serious challenges have been posed to Nigerian freshwater ecosystems and other water bodies through growing populations, intensification of agricultural practices, industrial and urban pollution which threaten the quality of natural water available to aquatic organisms. Optimum environmental quality is a major factor in obtaining high productivity in fish yield. There is no doubt that fishes survival and growth are driven by physico-chemical parameters surrounding their habitat (Beadle, 1981). Therefore, analysis of the physico-chemical parameters are necessary to study ecological and environmental pathways of aquatic resources. This work is intended to determine the water quality of Kisra Reservoir using the physico-chemical

parameters and the potential fish yield (PFY) using the Morpho Edaphic Index (MEI).for suitability of fish production in the Reservoir.

MATERIALS AND METHODS.

Description of Study Area.

The study area was kisra reservoir located within the kainji lake region at Niffr estate, along Hatchery, New Bussa, Niger State. The reservoir was constructed in 2008. It is located at latitude of N9^{0}52'44" and a longitude of E4^{0}32'23". Its rainy season period is from April\May to October and a dry season from November to March.

SAMPLE COLLECTION.

The samples were collected in the morning using water sampling bottle between 09:30am to 10:30am and the samples were all analyzed within 24hrs after collection. The water sample was collected at two (2) different locations on the water body (monk and inlet). This experiment was carried out for three months (October, November and December).

Potential Fish Yield (PFY)

Potential fish yield was estimated using the Morpho Edaphic Index (MEI) method given by the equation:

Log Y = 0.9420 + 0.3813 logX

Where: Y = fish yield in kg/ha

X = MEI = Conductivity in µs/cm / mean depth in meters.

RESULT AND DISCUSSION.

The Plate 1 to 3 is a pictorial photograph of Kisra Reservoir from October to December of the Study. The results of the physico-chemical parameters of the Reservoir is shown in Table 2 while Table 3 presents that of the potential fish yield. Figure1 shows the Mean and percentage errors of some water quality parameter of this study in Kisra Reservoir. Results show that colour, BOD, water temperature of the Monk and Inlet were not significantly) different (p>0, 05) from each other. The mean pH, BOD and water temperature were 7.2, 4.3mg/L and 29.5 ^{o}C respectively. Water hardness of the Inlet and Outlet were significantly different (p<0, 05) from each other. Dissolved oxygen, Turbidity, Alkalinity and Conductivity of the Monk and Inlet were significantly different from each other but their mean were 70.3mg/L, 5.9mg/L, 16cm and 29.2µmhos/cm respectively. The result of the air temperature for November and December were not significantly different from each other but were significantly (p<0, 05) higher than that of October. The result of the potential fish yield of the reservoir was estimated to be 61.9kg/ha (Table 3).

pH: pH is important as it measure of the acidity and basicity of water. pH also affects the biological and chemical processes in the water. The average value of the pH of Kisra Reservoir was found to be 7.2. This value falls within the standard range of values of 6.0 - 9.0 as recommended by Davis (1993). The value recorded here can be said to be good for fish production.

Biological Oxygen Demand (BOD): The Biochemical Oxygen Demand (BOD) of Kisra reservoir was found to be 4.3mg/L. This value falls within the standard range of 3-20 mg/L as recommended by Boyd (2003). This simply implies that the organic load in the water bodies are of appreciable amount.

Water Hardness: Hardness is a measure of the amount of Calcium and Magnesium ions associated with carbonate. Sawyer and M$_c$carty (1978) recommended that water within 0-75mg/l is soft, 75-150mg/l as moderate, 150-300mg/l as hard and above 300mg/L as very hard. The value obtained in Kisra Reservoir was found to be 70.3mg/L, and this value implies that the water is soft as recommended above and indicates less dissolve $CaCo_3$ in the water bodies.

Table 1: Analytical techniques employed for the study.

Parameters	Analytical Techniques/tools
Colour	Secchi Disc
pH	pH Meter
B.O.D	5 days Tests
Water Temp.	Thermometer
Hardness	Titrimentric
D.O	Azide Modification
Turbidity	Secchi Disc
Alkalinity	Titration
Water Conductivity	Conductivity Meter
Air Temp.	Thermometer
Depth	Secchi Disc

Table 2: Result of Physico-chemical Parameters of the Kisra Reservoir
B-Brown GY-greenish yellow BOD- biological oxygen demand Temp. - temperature D.O-dissolve oxygen.

Parameters	October		November		December		Mean/S.D
	Monk	inlet	Monk	inlet	Monk	inlet	
Colour	B	B	GY	GY	B	B	
Ph	7.16	7.16	7.30	7.31	7.1	7.2	7.2±0.08
BOD (Mg/L)	2	2	4.0	3.8	7	6.9	4.3±2.04
Water temp. (^{O}C)	30.1	30.2	29.7	29.8	29.1	29	29.65±0.46
Hardness (Mg/L)	86.29	67.39	90.27	70.89	95.66	11.34	70.3±28.23
D.O (Mg/L)	5	4	6	5.8	7	7	5.8±1.06
Turbidity (cm)	20	23	31	19	10	10	16±11
Alkalinity (Mg/L)	25	20	50	40	30	10	29.2±13.04
Conductivity (µmhos/cm)	60	45	120	81	60	40	67.7±26.81
Air Temp. (^{O}C)	26.2	26.2	30.8	30	30.5	30	28.95±1.96
Depth (M)	0.65	0.50	0.45	0.37	0.21	0.19	0.4±0.16

S.D- standard deviation

Table 3: Potential Fish Yield in Kisra Reservoir.

RESERVOIR	MEI	PFY (Kg/ha)
Kisra	169.25	61.9

plate1: Kisra Reservoir in October

Plate 2: Kisra Reservoir in November

plate3: Kisra Reservoir in December

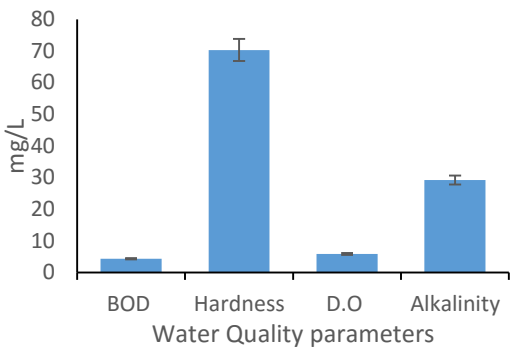

Figure1: Mean and percentage errors of some water quality parameter of this study in Kisra Reservoir

Figure: 1

Alkalinity: The alkalinity of water is a measure of its capacity to neutralize acids. Alkalinities of 30-150mg/L are preferred in fish culture operations (Dupee and Huner, 1994). The value obtained in this study was 29.2mg/L which falls slightly below the preferable range value. This can be increased by liming.

Conductivity: The value of conductivity obtained in this reservoir was 67.7µs/cm. This value falls below the recommended range value as recommended by Stone and Thomforde (2004) who recommended 100-2000µs/cm for fish culture. This result implies that there is less dissolved salt in the water body for the fact that the reservoir is mainly the accumulation of rain water.

Dissolved Oxygen (DO**):** Dissolved oxygen is one of the vital factors in aquatic life. Alabaster and Lloyd (1980) recommended that dissolved oxygen of 5mg/L must be maintained for a productive fish production. The mean value for dissolved oxygen in this study (5.8mg/L) falls within the

recommended value. The presence of this dissolved oxygen helps to improve the quality of water.

Temperature: The mean value of water temperature was found to be 29.56 ^{0}C and the Air temperature of 28.95^{o}c. These values falls within the normal range of 27.6 ^{0}C to 30^{0}C for optimum yield in aquaculture as recommend by FAO (2006). This implies that it is good for growth and body metabolism of the fishes in the water body. This is because rate of metabolism of warm water fish is closely associated with water temperature. The higher the temperature, the higher the metabolic rate.

Turbidity: The term turbidity indicates that a water contains suspended materials which intense with the passage of light. In fisheries, turbidity caused by plankton is not harmful to fish and so beneficial to fish growth. The mean value of turbidity obtained in this study was found to be (16cm) which indicates appreciable light penetration when compared to the depth of the reservoir (0.4m). Turbidity is an important water quality which a fish farmer has to control.

Potential Fish Yield (Pfy).
The potential fish yield of Kisra reservoir was found to be 61.9kg/ha. This was calculated on the basis of the Morpho Edaphic Index. The value obtained in Kisra Reservoir (61.9) could be said to have high potential when compared to other reservoirs like Dadin kowa (30.2). Kiri (42.7) and Ojirami (49.6) studied by Ovie *et al.* (2009).

CONCLUSION/RECOMMENDATION.

It was discovered in the course of the research that optimum yield of fish in fish farming operation is dependent on these properties of water. Most of all the parameters fall within the recommended range value except for conductivity, water Hardness and Alkalinity which was below the recommended value. The water was found to be of good quality and suitable for fish production. The potential fish yield was also relatively high when compared with other reservoirs.
It is recommended that the water should be limed to increase the Alkalinity and Hardness of the water. Also the reservoir should be looked into for aquaculture as it poses high quality and potential yield.

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