Investigating Manure Potentials On Zooplankton Performances And Water Quality In Concrete Pond Culture

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Abstract: An inquiry on the blatant effectiveness of manure on zooplanktons and water quality in a concrete pond culture was reviewed within durations of twelve weeks. Zooplanktons were obtained using scooping net and water sample analysisdetermined using standard techniques. Result revealed a higher culture of zooplanktons using poultry manure than those from cow dungs: 10 zooplankton species belonging to Rotifera, Cladocera and Crustacea was recorded with *Brachionuscalyciflorus*and *Brachionusleydigi*, *Miona spp.* and *Daphnia spp.* the dominating species in both ponds exposed to treatment manures while *Asplanchnaherricki*, *Bosmina spp.* and *Nauplius spp.* were encountered less in both treatment exposures. Water from cultured ponds were well oxygenated (5. – 7.5 mg/l for cow dung tank &6.4 – 7.8 mg/l for poultry dropping tank) with extremely low BOD_5 (0.93 – 1.75 mg/l in cow dung tank and 0.77 – 1.55 mg/l in poultry dropping tank) and slightly acidic-alkaline pH (6.4-7.5 in cow dung tank and 6.5 – 7.3 in poultry dropping tank). The high abundance of rotifers and crustaceans in both culture media shows that manure fosters zooplanktons growth and development and can supplement for fish meal.

Keywords: Manure potentials, Water quality, zooplankton performances and concrete pond tanks

1. INTRODUCTION

Fish to eat and for various other food making is a vital resource providing employment and income for many million individuals in the world. Apart from eating fish as protein source, income derived from it alone around the world has been estimated to be more than US$190billion (FAO, 2011). In decades past, cost of rearing fish dissuades an enthusiastic or current fish farmer as the cost of procuring fish meal for fish do not equate the resulting profit after the whole productivity. However to supplement this financial diminution, the wide use of various animal fecal products in pond fertilization around many countries of the world was noted possibly for their availability with no competition in use and cost in accessibility (Peker and Olah, 1990). Fertilizing ponds using poultry droppings, cow dungs, goat, sheep, and pig excretes and culturing planktons to feed fishes were common practices till the present decade (Yeamin*et al.*, 2006).Even if, utilization of poultry dropping has been reported to give a very high yield of planktons since they contain nitrogen and phosphorus (Dhawan, 1986). Even with the many reports on plankton culture using pond organic fertilization and nutrient prerequisites, not all order species are reported to be successful and sustainability has not been reported, therefore calling on more studies on this area in other countries. It would be so beautiful if zooplanktons could be mass produced in cultured media and sold to retail fish farmers either as whole pack or admixed with other feed stuffs including insects, fibers and lot more viable resources. Planktons either phytoplankton or zooplankton cannot be left aside as long as their importance has been noticed in food chain.Planktons as name implied are floating aquatic organisms in water bodies including ocean, sea, rivers, lakes, pond, estuary, reservoirs and puddles. Some plankton are adept swimmers which can move many lengths within limited time James (2008) reiterated. However due to their drifting nature, small size and the level they occupy in the niche, their ultimate distribution has been controlled by water current which are overall stronger than the organisms themselves. (Marine bio conservation society 2012). Zooplankton though minute are heterotrophic in nature either carnivorous feeding on other zooplanktons, herbivorous feeding on phytoplankton or detrivorous feeding on bacteria and dead matters. This extensive feeding mechanism allows them to form a crucial link in the aquatic food chain running from primary producers (phytoplankton) to secondary producers and consumers respectively. Zooplanktons responds relatively fast to phytoplankton abundance in culture media which are encouraged by increased primary productivity and increase in the organic level of the water.This study is thus directed at investigating the comparative effect level of two organic fertilizer (poultry droppings and cow dungs) potentials on the performances, productivity and abundance of zooplanktons and also on water quality of the culture concrete ponds.

2. MATERIALS AND METHODS

2.1. Experimental site

This experimental study was carried out in freshly prepared concrete tanks situated at the Department of Animal and Environmental Biology, Delta State University, Abraka (site 2). The pond was supplied with water from a borehole at same location. Two designated tanks A and C each of 1.2 m^2(width) and 1 meter depth, which when filled to 0.7 meter depth holds about 1000 liter of water was used for the experiment. Other tanks comprising two reservoir larger tanks and several hatchery, nursery, grow-out and brook stock holding tanks were also located at the experimental site. The tanks have inlet and outlet pipes respectively.

2.2. Preparation, Curing and Fertilization of tanks
Tank A and C were old existing concrete tanks which had been drained and left to dry for 2-3 months. The tanks were thoroughly cleared, swept and crevices were cracked wider and filled with a cement paste. The wall and bottom floor of the tanks were coated with pure cement paste and left to dry for several days. After a week, water was let into the tanks from the bottom to the top and left for about 3 days to check tank firmness and free leakages. Tanks were further drained of water, refilled again to the top and left for durational periods. About a week life such as phytoplankton, chironomid larvae, mosquito larvae, dragon fly larvae and other insect larvae were noticed in the tank. Presences of these organisms in the tank signified that the tanks were already cured. The tanks were drained again after curing and water was let in from the borehole to about 70 cm depth mark with a holding capacity of 1000 liters of water. Tank A and C were each fertilized with 2kg each of organic fertilizers (cow dung and poultry droppings) for tank A and C respectively.

2.3. Method of fertilization, Source and Collection of zooplanktons
The zooplanktons stocked into the experimental tanks were amassed from a lentic drainage containing fresh water in Delta State University, Abraka (site 1). Zooplankton collection was aided using a zooplankton net of 50 µm mesh size. The net was passed through the water by dipping and towing it cross the water for about 5 – 10 times for a single collection. The plankton filtered into a plastic container and transported to the experimental site. The content of the plastic container was emptied after several hours into a 15 liters plastic container; then the samples were processed by sieving it through a mosquito net to remove mosquito larvae aquatic insects and debris. The processed samples were then used to inoculate the tanks for both qualitative and quantitative analysis as well as their population dynamics.

2.4. Harvesting, Identification and preservation of zooplanktons
Zooplanktons were harvested using suitable zooplankton harvesting net with 50 µm mesh size and this was done by moving the harvesting net to and fro the sides and across the mid of the pond with the net just beneath the water surface. Zooplanktons were mostly found through horizontal trawl method (Obhahie, 2008). The harvested zooplanktons were emptied into 60 litres rubber container and 100ml of the samples were preserved in a 120ml plastic bottle by adding 10ml of 40% formaldehyde to 90 ml of the zooplankton samples. The container containing the preserved samples were labeled A and C with date of collection recorded. The samples were stirred for even distribution and taken with a dropper and placed on a petri dish for microscopic identification with the x40 magnification lens using identification manual by Jeje and Fernando (1986) and thereafter counted for abundance.

2.5. Water sample analysis
Water collected from two replicate concrete ponds was subjected to water quality test thrice a week for the first 2 weeks and twice for the remaining weeks. Water temperature was determined using a mercury-in-glass thermometer that is calibrated 0-100^{0}C and transparency using a secchi disk. While water chemical analysis was carried out in the department of chemistry teaching laboratory, Delta State University, Abraka following standard methods of preparation to determine biological oxygen demand (BOD_5), nitrate – nitrogen, phosphate – phosphorus, Ammonia – nitrogen, dissolved oxygen andhydrogen ion concentration (pH).

2.6. Data analysis
Data collected from the study were analyzed using Microsoft excel package using analysis of variance (ANOVA). Descriptive statistics including mean, standard error, and plotting of graphs were respectively computed using same package. Zooplankton species exposed to both treatments were correlated to check for significance.

3. Results
Table 3.1 discloses the summary of the mean values and standard errors of the various physiochemical parameters recorded in the cultured media within the study durations. Due to treatment exposures, all sampled water quality parameters were significantly different within weeks($p< 0.05$) except for pH for poultry manure. Whilst, all water quality parameters werenot significantly different between treatments($p> 0.05$) in the culture media.

Table 3.1 *Summary of some water quality parameters in two treatment tanks from November2016 to January, 2017*

Parameter	Treatments	Mean	F-ANOVA		P-probability	
			Weeks	treatment	weeks	treatment
Water temperature (°C)	Control Cow dung Poultry manure	26.08±0.22 (24.45–27.23) 27.07±0.19 (26.33-28.60) 26.45±0.20 (25.25-27.60)	84.64* 71.06* 7.84*	0.89 0.17 0.14	5.4E-09 1.38E-08 0.0009	0.366 0.69 0.71
Hydrogen concentration (pH)	Control Cow dung Poultry manure	6.7±0.11 (6.3–7.6) 7.0±0.09 (6.4-7.5) 6.8±0.07 (6.5-7.3)	12.60* 3.06* 2.33	0.02 0.08 0.37	0.0001 0.04 0.09	0.89 0.78 0.56
Dissolved oxygen (mg/L)	Control Cow dung Poultry manure	6.2±0.15 (5.4–7.3) 6.7±0.17 (5.6-7.5) 7.0±0.13 (6.4-7.8)	7.56* 44.47* 16.27*	0.03 0.26 2.10	0.0011 1.69E-07 3.01E-05	0.88 0.62 0.18
Biochemical Oxygen demand (mg/L)	Control Cow dung Poultry manure	2.59±0.11 (2.08–3.14) 1.23±0.07 (0.93-1.75) 1.10±0.07 (0.77-1.55)	73.63 5.87* 49.81*	0.03 0.21 0.28	1.14E-08 0.0033 9.25E-08	0.87 0.66 0.61
Phosphate-phosphorus (mg/L)	Control Cow dung Poultry manure	0.26±0.02 (0.19–0.37) 0.26±0.02 (0.19-0.34) 0.30±0.07 (0.14-0.42)	21.83* 10.64* 57.26*	0.83 1.70 2.02	6.86E-06 0.0002 4.4E-08	0.38 0.22 0.18
Nitrate-nitrogen(mg/L)	Control Cow dung Poultry manure	0.22±0.02 (0.13–0.40) 0.24±0.02 (0.16-0.32) 0.26±0.01 (0.19-0.34)	17.50* 25.30* 22.19*	0.65 1.00 1.26	2.1E-05 3.22E-06 6.31E-06	0.44 0.34 0.29
Ammonia-nitrogen (mg/L)	Control Cow dung Poultry manure	1.02±0.12 (0.39–1.69) 0.41±0.07 (0.05-0.90) 0.98±0.08 (0.43-1.37)	22.00* 7.92* 10.45*	1.29 0.04 0.01	6.59E-06 0.0009 0.0003	0.28 0.84 0.95

Note: values are means ± standard Error, minimum and maximum values are given in parentheses. * indicates significant difference (P<0.05) by ANOVA

ZOOPLANKTON ABUNDANCE

After inoculation of amassed zooplanktons, three (3) zooplankton orders (Rotifera, Cladocera and Crustacea) were encountered, with ten speciesidentified and recorded all together throughout the experimental period. Amongst the six species of rotifers recorded*Brachionuscalyciflorus* and *Brachionusleydigi* were the most encountered and *Asplanchnaherricki* was encountered less (table 3.2). Also within the Cladocerans, *Mionaspp* was recorded most among the two species and *Daphnia spp.*encountered most too (table 3.2). From the cow dung culture tank, *Brachionusleydigi*and*Brachionusanguiaria*, *Mionaspp*,*Daphnia spp.*weremost encountered rotifers, cladocerans and crustacean respectively (table 3.3). However between treatment exposures, poultry dropping produced more zooplanktons than cow dungs with a total of 2419, 722, and 1595 against 2255, 646 and 1223individuals for rotifers, cladocerans and crustacean respectively.There was a very high significant correlation between zooplanktons encountered within weeks of the experimental period (table 3.4). This study reveals from the pictograph (fig. 3.1) that rotifers and crustaceans thrived higher compared to cladocerans.

DISCUSSION

This study determined manure potentials on zooplankton performances and water quality in a concrete pond culture in Abraka, Delta State. Results revealed only three (3) zooplankton orders (Rotifera,Cladocera, and Crustacea). Of the ten species of zooplanktons documented throughout the experimental period, rotifers(*Brachionuscalyciflorus* and *Brachionusleydigi*), Cladoceran (*Miona spp.*) and Crustacean (*Daphnia spp.*) were encounteredmost while *Asplanchnaherricki*, *Bosmina spp.* and *Nauplius spp.*the least rotifer, cladoceran and crustacean encountered in the poultry dropping tank. Also from the cow dung tank, *Brachionusleydigi*and*Brachionusanguiaria*, *Miona spp.*and*Daphnia spp.* were the most encountered rotifer, cladoceran and crustacean while the least species remain the same as in the poultry dropping tank.The findings of this study is in agreement with the findings of Ekelemu&Nwabueze, 2011. Statistically, it was observed that all physical and chemical parameters were significantly different ($P< 0.05$) except for pH in poultry dropping within the cultured media. However, the correspondence in water quality parameters may be because both tanks were not far apart and thus are exposed to similar environmental conditions. Algae bloom was strongly observed in poultry dropping tank than in the cow dung tank may be due to the significantly higher level of nitrogen, phosphate and potassium content of the poultry droppings used in fertilizing the tank (Yeamin*et al.,* 2006). Although, fungi and bacteria may be associated with organic fertilizers and even to a greater proportion in poultry manure (Mischike 1999). This culmination might have led to more oxygen depletion and a low biological oxygen demand reported mostly in the poultry dropping tank. Similarly, Adedeji*et al*., 2011 noted a positive correlation between increased algal blooms and increasing pH with increased alkalinity. This study recorded a high nitrate-nitrogen, phosphate-phosphorus and ammonia-nitrogen; this correlates with findings of notable researchers (Yeamin*et al*., 2006, Adedeji*et al*., 2011 amongst others). With respect to the cultured media, zooplanktons were more abundant in poultry dropping tank with a total individual of 2419, 722 and 1595 for rotifers, cladocerans and crustaceans compared to the cow dung tank 2255, 646, and 1223. The high zooplanktons recorded in poultry dropping tank might be ascribed to the fact that poultry birds expel nutrient-rich and quality-undigested feed and also the fact that poultry droppings contains more bacteria and fungi(Agatha 2011). Following the abundance of zooplanktons it is assumed that both fertilizers favored the growth of rotifers and crustaceans than cladocerans. Poultry manure favored the growth of *Brachionuscalyciflorus, Daphnia spp.* and*Miona spp.*in contrast cow manure favored *Brachionusleydigi.*Since this study revealed a strong affinity in the use of poultry manure in pond fertilization to encourage zooplankton, it is imperative to apply poultry manures in a measure to aiding fish feed augmentation. Therefore, in the absence of commercially sold fish feed it is recommended to devise this natural means of fish feed to encourage a maximized fish production and preventing a reduction in fish breeding to minimal.Zooplanktons in culture media in this study tolerated physical and chemical variations including temperature, nutrient compositions of nitrogen (N) and phosphorus (P) and increased. This study is in agreement with study of Oladele and Omitogun, (2016) which reported increased zooplankton populations with organic manure applications as experimental periods increased till the populations reached their peaks. Also, this study is in accordance with works of Wurts (2004) and Morris (1995) who used organic manures to advanceappropriate zooplankton species, such as rotifer species,*Moina spp.*and *Daphnia spp.*

Species	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	Total
Rotifera													
Branchionuscalyciflorus	21 & 24	19 & 21	29 & 31	41 & 45	47 & 51	37 & 37	41 & 43	36 & 30	27 & 23	19 & 16	15 & 11	9 & 5	678
Brachionusleydigi	19 & 21	25 & 17	21 & 23	33 & 37	39 & 39	33 & 30	37 & 31	27 & 26	19 & 21	14 & 11	11 & 8	4 & 3	549
Brachionusanguiaria	14 &13	13 & 18	21 & 17	23 & 27	33 & 29	29 & 26	31 & 28	18 & 19	12 & 10	12& 9	9 & 4	5 & 2	423
Asplanchnabrightwelli	11 & 9	13 & 11	14 & 11	17 & 19	21 & 21	21 & 17	19 & 15	17 & 11	15 & 9	11 & 7	6 & 7	3 & 2	307
Asplanchnaherricki	7 & 7	9 & 11	7 & 9	13 & 11	15 & 13	9 & 9	11 & 11	14 & 8	6 & 4	8 & 7	6 & 6	3 & 1	205
Epiphaneclavulata	9 & 11	13 & 16	11 & 14	15 & 18	11 & 10	14 & 13	17 & 13	13 & 12	10 & 11	8 & 7	5 & 4	1&1	257
Total	**81 &85**	**92 &94**	**103&105**	**142&157**	**166 & 163**	**143 &132**	**156&141**	**125&106**	**90 & 78**	**72 & 57**	**52 & 40**	**25 & 14**	**2419**
Cladocera													
Miona spp.	13 & 11	19 & 21	27 & 21	25 & 23	33 & 31	43 & 37	29 & 29	23 & 18	18 & 13	9 & 11	6 & 6	2 & 1	469
Bosmina spp.	9 & 9	19 & 18	15 & 11	13 & 11	16 & 13	19 & 14	11 & 9	13 & 11	9 & 7	5 & 7	7 & 5	1 & 1	253
Total	**22 & 20**	**38 & 39**	**42 & 32**	**38 & 34**	**49 & 44**	**62 & 51**	**40 & 38**	**36 & 29**	**27 & 20**	**14 & 18**	**13 & 11**	**3 & 2**	**722**
Crustacea													
Daphnia spp.	33 & 27	37 & 29	31 & 39	69 & 74	95 & 88	75 & 71	55 & 45	33 & 29	23 & 25	19 & 23	11 & 9	9 & 9	958
Nauplius spp.	24 & 21	28 & 25	29 & 23	43 & 47	59 & 53	47 & 44	31 & 27	23 & 21	17 & 14	17 & 15	11 & 7	7 & 4	637
Total	**57 &48**	**65 &54**	**60 & 62**	**112&121**	**154 & 141**	**122 & 115**	**86 & 72**	**56 & 50**	**40 & 39**	**36 & 38**	**22 & 16**	**16 & 13**	**1595**

Table 3.3: *Summary of Zooplankton performances per week of cow dung pond (tank A) treatment exposurefrom November 2016 to January, 2017*

Species	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10	Week 11	Week 12	**Total**
Rotifera													
Branchionuscalyciflorus	9 & 6	16 & 19	19 & 17	17 & 22	23 & 19	21& 23	15 & 17	19 & 14	9 & 6	9 & 7	4 & 4	1 & 2	318
Brachionusleydigi	17 & 23	21 & 27	31 & 33	37 & 34	35 & 39	31& 31	39 & 33	39 & 42	27 & 22	17 & 14	11 & 8	9 & 5	625
Brachionusanguiaria	14 &11	17 & 21	27 & 24	23 & 22	30 & 27	43 & 37	31 & 28	23 & 19	17 & 14	11& 9	8 & 5	5 & 2	468
Asplanchnabrightwelli	5 & 6	8 & 9	15 & 18	27 & 27	22 & 21	19 & 17	18 & 14	21 & 21	19 & 14	11 & 8	5 & 5	2 & 2	334
Asplanchnaherricki	3 & 7	9 & 15	11 & 14	21 & 22	19 & 19	17 & 19	9 & 11	11 & 11	7 & 9	5 & 6	5 & 3	0 & 0	253
Epiphaneclavulata	9 & 11	13 & 16	11 & 14	15 & 18	11 & 10	14 & 13	17 & 13	13 & 12	10 & 11	8 & 7	5 & 4	1&1	257
Total	**57 & 64**	**84&107**	**114&120**	**140&145**	**140 &135**	**145&140**	**129&116**	**126&119**	**89 & 76**	**61 & 51**	**38 & 29**	**18 & 12**	**2255**
Cladocera													
Miona spp.	11 & 13	23 & 24	27 & 24	29 & 24	39 & 35	39 & 42	27 & 29	24 & 21	19 & 14	11 & 8	7 & 5	3 & 1	499
Bosmina spp.	2 & 3	5 & 7	7 & 9	9 & 7	11 & 13	17 & 15	7 & 8	5 & 3	3 & 5	1 & 3	3 & 4	0 & 0	147
Total	**13 & 16**	**28 & 31**	**34 & 33**	**38 & 31**	**50 & 48**	**56 & 57**	**34 & 37**	**29 & 24**	**22 & 19**	**12 & 11**	**10 & 9**	**3 & 1**	**646**
Crustacea													
Daphnia spp.	24 & 27	29 & 27	36 & 41	42 & 39	40 & 45	46 & 37	33 & 31	27 & 31	27 & 21	20 & 17	15 & 14	11 & 6	686
Nauplius spp.	19 & 22	23 & 23	29 & 25	37 & 33	43 & 39	39 & 32	28 & 27	18 & 19	13 & 13	13 & 12	11 & 11	6 & 2	537
Total	**43 & 49**	**52 & 50**	**65 & 66**	**79 & 72**	**83 & 84**	**85&69**	**61&58**	**45 & 50**	**40 & 34**	**33 & 29**	**26&25**	**17&8**	**1223**

Species	Week 1	Week 2	Week 3	week 4	week 5	week 6	week 7	week 8	week 9	week 10	week 11	week 12
week 1	1											
week 2	0.919	1										
week 3	0.883	0.984	1									
week 4	0.917	0.981	0.985	1								
week 5	0.937	0.874	0.814	0.824	1							
week 6	0.910	0.954	0.917	0.902	0.962	1						
week 7	0.952	0.974	0.939	0.972	0.902	0.939	1					
week 8	0.869	0.988	0.983	0.985	0.808	0.915	0.963	1				
week 9	0.901	0.990	0.981	0.994	0.831	0.919	0.979	0.997	1			
week 10	0.974	0.983	0.958	0.976	0.919	0.952	0.989	0.957	0.974	1		
week 11	0.953	0.917	0.910	0.961	0.806	0.825	0.950	0.908	0.936	0.957	1	
week 12	0.979	0.875	0.854	0.866	0.946	0.903	0.892	0.807	0.840	0.936	0.894	1

Table 3.4 *Pearson's correlation matrix for encountered zooplanktons within weeks from November 2016 to January 2017*
Note: correlation values are significantly correlated when Critical r_s0.01, 10= 0.794 and r_s0.05, 10 = 0.648 is less than values.

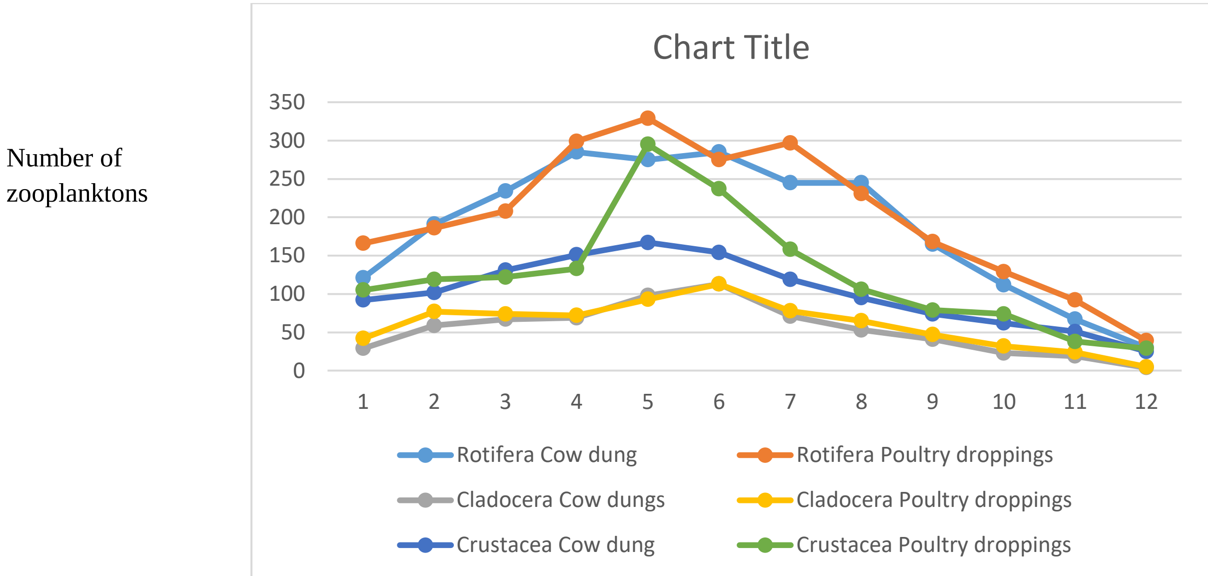

Figure 3.1 *showing the zooplankton abundance of both treatment exposures from November 2016 - January 2017.*

Conclusion

Results from this study has shown that zooplankton productivity can be enhanced more from poultry droppings culture ponds than in cow dungs culture ponds safely as earlier reported. In the absence of harmful effects from treatment exposures, this natural method can employed to breed zooplanktons easily for enhanced yield at low or no cost and supplementing commercial fish feeds in its absence. Water quality parameters encouraged zooplankton growth moderately. Futurestudy is needed on the different measures of organic manure usage at which a higher productivity is attained without impeding water quality parameters.

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References

[1] Adedeji, A.A., Aduwo, A.I., Aluko, O.A. and Awotokun, F. "Effect of chicken droppings as organic fertilizer on water quality and planktonic production in artificial culture media," Ife journal of science, 13(2), Pp 238 – 252. 2011.

[2] Agatha, A.N "Evaluation of methods of processing pathogen free poultry droppings for fish-cum poultry culture," International Journal of Science and Nature 2(4), Pp 768 – 798. 2011.

[3] Boyd, C.E "water quality management for pond fish culture," Elseiver publishers, P 45. 1982.

[4] Dhawan, A. "Changes in the tissue composition and reproductive cycles in relation to feeding in major carp,

Chirrhniamrigal (Han)," Ph.D. thesis PAU. Ludhiana, India. 1986.

[5] Ekelemu, J.K and Nwabueze, A.A "Comparative studies on zooplankton production using different types of organic manure," International Journal of Science and Nature 2(1), Pp 140 – 143. 2011.

[6] Food and Agricultural Organization of the United Nations FAO "The State of World Fisheries and Aquaculture," Rome. 2011.

[7] Jeje, C.Y. and Fernando, C.H. "A practical guide to the identification of Nigerian zooplankton," Kainji Lake Research Institute, P 141. 1986.

[8] Marine Bio. Conservation society "Zooplankton," Marinebio.org/zooplankton; assessed on 7th, Nov. 2012.

[9] Mischike, C.C and Morris, J.E "Plankton management for fish culture ponds," Department of Ecology, IOWA State University 114: 2 – 5. 1999.

[10] Obhahie, A.I., Akintomide, O.T., Ahmed, R., Olafia, F.E "Fish fry Nutrition In: Fish Nutrition and the Economic way to feeding fish," Ed.OAK Ventures, Ogun State, Nigeria. Pp 31 – 44. 2008.

[11] Peker, F. and Olah, J. "Organic fertilization. In: R. Berka and V. Hilge (Eds.). Proceedings of FAO-EL FAC symposium on production enhancement in still water pond culture, Prague, Czechoslovakia," Pp 116-122. 1990.

[12] Yeamin, H., Momtaz, B., Zoarder, F.A., Ashabul, H., Abdul, K., and Abdul, W. "A study on the effects of iso-phosphorous fertilizers on plankton production in fish ponds," South Pacific Studies 26(2), Pp 101 – 110. 2006.

[13] Oladele, A.H and Omitogun, O.G "Raising zooplankton as a substitute for artemia for feeding the larval and fry stages of african catfish (Clariasgariepinus)," Livestock Research for Rural Development 28 (10), 2016.

[14] Wurts W A "Organic fertilization in culture ponds," World Aquaculture 35(2): 64-65.2004.

[15] Morris J E "Plankton management for fish culture ponds." Department of Animal Ecology, Iowa State University, Iowa, USA, 1-7.1995.