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COMPARATIVE STUDIES ON ZOOPLANKTON PRODUCTION USING DIFFERENT TYPES OF ORGANIC MANURE

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ABSTRACT

This study compares the species composition, diversity and abundance of zooplankton produced, using three different sources of organic manure as culture media. The study lasted for twenty-eight (28) days. Nine (9) concrete tanks, each of dimension 1m x 1m x 1m, were respectively filled with one hundred and fifty (150) litres of water from the same source and used for the study. The tanks were randomly grouped in threes and labelled $A_1 – A_3$, $B_1 – B_3$ and C_1 - C_3. Two kilograms of cow dung mixed with 1 Kg of humus tied in a porous bag was put into each of tanks $A_1 – A_3$. Tanks $B_1 – B_3$ received 2 Kg of poultry droppings and 1 Kg of humus while tanks $C_1 – C_3$ received pig dung and humus in the same proportion. Zooplankton was harvested weekly by the horizontal trawl method, using a micro - filament plankton net of 50 μm^{-1} mesh size and collected in a 50 ml glass bottle. The samples collected were stored in 10 % buffered formalin. Samples collected were identified and enumerated in the laboratory using a binocular dissecting microscope at a magnification of x100. Data collected were analysed, using one-way analysis of variance (ANOVA) and means were separated using Duncan's multiple range test (DMRT). Mergerlef's diversity indices was used to test for species diversity in each of the culture media. Result showed that total number of individuals produced was highest in cultures using poultry droppings. This was however not significantly different ($P>0.05$) from those cultured using pig dung, but was significantly different ($P<0.05$) from those cultured using cow dung. Result further revealed that cow dung produced more rotifers, poultry droppings produced more cladocera pig dung more copepods. In terms of species diversity, poultry droppings culture was more diverse and even, compared to those from the other cultures. Thus poultry droppings is the preferred media for use in zooplankton culture to feed fish and fish larvae.

Key words: Zooplankton species, diversity, culture media, fish, fish larvae, feeding.

INTRODUCTION

Plankton is derived from the Greek word "planktos" meaning errant which by extension means "drifter" or "wanderer". They are aquatic organisms e.g. animals, plants or bacteria, inhabiting the pelagic zones of the oceans, seas or freshwater bodies and are incapable of swimming against the water current (Ekelemu, 2010). Plankton are defined by their ecological niche rather than taxonomic classification. They provide a crucial source of food to larger, more familiar aquatic organisms such as fish and crustaceans.

Zooplankton which are the animal components of the plankton, derive their name from the Greek word "zoon" meaning animal. Many of the zooplankton are too small to be seen individually with the naked eye (Jude *et al*, 2005). They feed extensively on phytoplankton and bacteria and are regarded as heterotrophic (sometimes detritovorous type of plankton). Through their consumption and processing of phytoplankton and other food sources, zooplankton play an important role in the aquatic food web, both as a food resource for consumers or higher trophic levels (including fish), as a means of packaging the organic material in the ecological system. Since they are typically of small size, zooplankton can respond relatively fast to increases in phytoplankton abundance. Zooplankton are the initial prey item for almost all fish larvae, as they switch from their yolk sacs to external feeding. Fish rely on the density and distribution of zooplankton, to march that of the new larvae, which would otherwise starve. Natural factors e.g. current variations and man-made factors such as river dams can strongly affect zooplankton which in turn, strongly affect larval survival, and therefore breeding success (Emiliani, 1991). Evidence from the stomach content analysis of the fingerlings of *Clarias gariepinus* and *Clarias anguilaris*, showed that within the first few weeks of life, zooplankton was the predominant food item.

The abundance of planktonic organisms in a water body influences the feeding regime of fish. In fish farm operations, lack of suitable food is believed to be the main source of mortality of early larval and fry stages of fish. Such mortalities can be greatly reduced, if not completely prevented by provision of adequate amounts of natural food (plankton). Zooplankton are very important in the food web of open-water ecosystems, in both marine and freshwaters (Ekelemu, 2010). Zooplankton are eaten by relatively small fish (planktivores), which are then eaten by larger fishes. Thus the zooplankton are an important link in the transfer of energy from the algae (primary producers) to the entire ecological and economic fish community (consumers). Most zooplankton are secondary consumers, that is, they are herbivores that graze on phytoplankton (unicellular or colonial algae) suspended in the water column. The success of hatchery operations have been linked to the availability and supply of these natural feed, notably of zooplankton. Adeyemo *et al*, (1994), reported that the survival rate of fish larvae (fry) is greatly enhanced if these 'baby fish' are maintained on a diet of zooplankton instead of artificially formulated feeds. Young stages of fish in the wild, have used these naturally occurring organisms for their survival and successful recruitment. In addition to their serving as food, information regarding the relative status of plankton communities, gives insight into the quality of a water body and possible success or failure of the culture season.

Within the last few decades, the use of imported artemia cyst hatched into nauplii, has been projected as the most favoured food for larval rearing in the country. However, results from studies have shown that artemia does not serve as the best feed for fresh water fish fry and larvae, based on the fact that artemia as a marine organism dies in fresh water within two hours of introduction, due to osmoregulatory problems (Porticelli, 1987; Ovie *et al*, 1993). Studies by Gatesoupe (1982) and Kibria *et al* (1997) revealed that zooplankton are a valuable source of protein, amino acids, lipids, essential minerals and enzymes needed by fish larvae, for effective growth and survival. Improved performance in fish larvae fed natural indigenous live fresh water zooplankton, have been reported (Arimoro, 2005). As a result of problems associated with the importation of artemia as well as the lack of technical know-how in it's usage, by the local farmers, this study therefore seeks to determine the best, easy and sustainable means of producing zooplankton for use in fish culture.

MATERIALS AND METHODS

This study to compare the zooplankton composition, abundance and diversity, produced using cow dung, poultry droppings and pig dung as sources of organic manure, was conducted in the Delta State University teaching and research farm. The study lasted for twenty-eight (28) days. The manure types were respectively sourced from the cattle, poultry and piggery units of the university farm, while humus was obtained from a waste dump also in the university. Nine (9) concrete tanks, each of dimension 1m x 1m x 1m, were respectively filled with one hundred and fifty (150) litres of water from the same source and used for the study. The tanks were randomly grouped in threes and labelled $A_1 – A_3$, $B_1 – B_3$ and C_1 - C_3. Two kilograms of cow dung mixed with 1 Kg of humus tied in a porous bag was put into each of tanks $A_1 – A_3$. Tanks $B_1 – B_3$ received 2 Kg of poultry droppings and 1 Kg of humus while tanks $C_1 – C_3$ also received pig dung and humus in the same proportion. Zooplankton was harvested weekly by the horizontal trawl method, using a micro-filament plankton net of 50 μm^{-1} mesh size and collected in a 50 ml glass bottle. The samples collected were stored in 10 % buffered formalin. Samples were decanted to remove the supernatant. Distilled water was added to the sediments and centrifuged. Samples were again decanted to remove the supernatant. Sediments in the centrifuge tube were made up to 10 ml, by adding distilled water and agitated to brake up the lumps. 1 ml sub-samples were pipetted onto the counting chamber, for identification and quantitative estimation of zooplankton fractions in each sample. Zooplankton samples collected, were identified to generic and species level where possible, in the laboratory using a binocular dissecting microscope at a magnification of x100 keys according to Willoughby (1976) and Green (2007), and a monograph by Jeje (Ogbeibu and Egborge, 1995). Zooplankton number (no/ml) was calculated according to the formula by Boyd and Lichktoppler (1979).

$$\text{Number of zooplankton / ml} = \frac{T \times 1000}{A \times N \times \text{Vol. of concentrate in ml/ Vol. of sample}}$$

Where

T = total number of zooplankton counted

A = area of grid in mm^2

N = number of grids counted

1000 = area of counting chambers in mm^2

Data collected were analysed, using one-way analysis of variance (ANOVA) and means were separated using Duncan's multiple range test (S.A.S., 1998). Mergerlef's diversity indices (Ogbeibu, 2005), was used to test for species diversity in each of the culture media.

RESULTS AND DISCUSSION

Results of the study are presented in tables 1 and 2 below. Table 1 shows the zooplankton species abundance in the different culture media. Three groups of zooplankton were identified namely rotifers, cladocera and copepods. Thirteen species were identified. Calconoid with one hundred (100) individuals, had the largest number of individual species. The zooplankton abundance in the poultry droppings and pig dung, were not significantly different ($P > 0.05$) from each other. Both were however significantly different ($P < 0.05$) from those in the cow dung culture medium.

Table 1: Mean zooplankton abundance in the three culture media (no/ml).

Species	Cow dung	Poultry droppings	Pig dung	Total
Rotifers:				
Branchionus calyciflorus	28	30	24	82
Filinia sp	32	14	16	62
Trichocera sp	14	22	10	46
Polyarthra sp	28	20	20	68
Lecanea sp	16	10	12	38
Keratella sp	20	-	18	38
Asplanchnia sp	20	22	8	58
Cladocera:				
Diaphnosoma cornuta	16	28	30	74
D. longispina	12	24	6	42
Bosmina longirostros	4	32	34	70
Bosnopsis sp	16	26	8	50
Copepods:				
Copepoid copepod	20	28	50	98
Calconoid copepod	24	34	42	100
Total (no/ml.)	250	290	278	

Organic manure has been used as a source of fertilizer to supply nutrients needed for plankton production in fish ponds. Fish production in ponds that were fertilized using organic manure such as cow dung and poultry droppings have been reported to almost double production in unfertilized ponds (Boyd,1982). Cow dung, poultry droppings and pig dung can be successfully used to fertilize fish ponds in fish culture, as they are capable of supplying the desired nutrients required for zooplankton production (Orji and Agunwa, 2005). This supports the result of this study which revealed that the different culture media, favoured the production different zooplankton species. The study, revealed that a total of three hundred and ninety-two (392) individuals of rotifers, were produced in the course of the study. Of this number, one hundred and fifty-eight (158) representing 41.14 % was produced from the cow dung culture medium, while 118 (30.73 %) and 108 (28.13 %) were produced from the poultry droppings and pig dung media respectively. The poultry droppings culture produced the highest number (110 or 46.61 %) out of a total of 236 cladoceran individuals from all three culture media while 92 individual copepods or 46.46 % out of a total of 198 individuals, produced from the three culture media was produced by the pig dung culture.

Table 2: Contingency table showing species diversity / organic manure medium.

	Cow dung	Poultry droppings	Pig dung
Total number of Taxa (*S*)	13	12	13
Number of Individuals (*N*)	250	290	278
Taxa Richness (*d*)	2.1735	1.9400	2.1322
Shannon-Weiner diversity index (*H*)	1.0344	1.0671	1.0318
Evenness index (*E*)	0.9286	0.9888	0.9263

Presented in table 2 is the contingency table showing species diversity / culture media. In the three different organic manure media, highest evenness index (*E*) of 0.9888 and highest number of individuals (*N*) 290 sampled, was recorded in the poultry droppings medium. The least number of individuals was recorded in the cow dung medium which also had the highest taxa richness (*d*). Results of the study, further show samples from the poultry droppings medium, to have the least number of taxa (*S*) and taxa richness (*d*) with values of 12 and 1.9400 respectively. The above not withstanding, individuals collected from the poultry droppings culture medium, were more evenly distributed among the different taxa, giving each taxa an equal opportunity of being produced. The study therefore reveals poultry droppings as a better source of organic manure compared to cow and pig dung.

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