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CULTURE OF ROTIFERS USING DIFFERENT TYPES OF LIVESTOCK WASTES

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ABSTRACT

A ten-day study was conducted to evaluate the suitability of different livestock manures as organic media for rotifer culture and to assess the associated water quality parameters. Twelve 6-L microcosms arranged in triplicate were assigned to four treatments: control (municipal tap water only), rabbit droppings (RD), poultry droppings (PD), and sheep droppings (SD), each supplemented with NPK fertilizer and soybean cake except the control. Rotifers were isolated from river water and inoculated into the culture media after three days of aeration. Baker's yeast was provided as feed throughout the culture period. Rotifer abundance was determined every other day from the second day of culture, while temperature, pH, dissolved oxygen (DO), carbon dioxide (CO_2), and alkalinity were monitored. Water quality remained within acceptable ranges for rotifer production: temperature (21–25°C), pH (6.7–7.5), dissolved oxygen (8.1–11.3 mg/L), carbon dioxide (9–14 mg/L), and alkalinity (90–111 mg/L). No significant differences ($P > 0.05$) were observed among the measured physicochemical parameters across treatments. Rotifer populations increased steadily and reached peak abundance on the eighth day of culture before declining slightly by the tenth day. The poultry droppings treatment recorded the highest mean rotifer yield (131.33 individuals/mL), followed by rabbit droppings (108.67 individuals/mL) and sheep droppings (94.00 individuals/mL). Although differences in rotifer yield among the organic media were not statistically significant ($P > 0.05$), poultry droppings demonstrated the greatest carrying capacity and sustained higher rotifer production throughout the culture period. The findings indicate that livestock manures can serve as effective and inexpensive nutrient sources for rotifer culture. Among the media evaluated, poultry droppings showed the greatest potential for large-scale rotifer production because of their superior productivity and ability to sustain rotifer populations over an extended period. The use of locally available livestock manure offers a practical and sustainable approach for producing live feed to support fish hatchery operations and aquaculture development.

Keywords: Rotifers, live feed, livestock manure, poultry droppings, water quality, aquaculture.

INTRODUCTION

Nigeria's population and opulence offers the largest market for fisheries products in Africa. Fish from capture fisheries has been erratic and on the decline in recent years, resulting in increase in poverty and nutritional deficiency. Aquaculture production remains the best option to bridge the gap between the total fish demand and total domestic production in the face of high cost of production input and unstable government policies.

According to Fapohunda (2005) a large number of fish farms in Nigeria have failed to attain profitability in one or more years due to major disruptions in the production process. It may be due to late delivery of supplies of fingerlings or other related services. Lack of adequate technology or technical information and expertise as regards hatchery propagation remains a bane of the venture. Fish like other animals have a requirement for essential nutrients in order to grow properly. In the wild, natural feeds are available and as the fish forage for these, they are able to meet their body needs.

When fish is removed from its natural environment to an artificial one, enough food must be supplied in order to enable them grow. Artificial diets may be either complete or supplemental. Complete diet supply with all the ingredients (protein, carbohydrates, fats, vitamins and minerals) is necessary for the optimal growth and health of the fish. Supplemental diet do not contain a full complement of nutrients needed but are used to help fortify the naturally available diets. In view of these, rotifers have been used in various research works with the aim to fill in the space for the unavailable wild feeds but their production has been a problem in aquaculture leading to an inefficient effort to fill up the space between wild feeds and feeds supplied to domesticated fish larvae and fingerlings.

MATERIALS AND METHODS

Experimental site

This study was carried out at the fisheries and Hydrobiology laboratory of the Department of Zoology, Faculty of Natural Science, Unversity of Jos, Jos Plateaus State

Experimental procedure

Nutrient medium was prepared by adding animal waste, soybean cake (for enrichment) and NPK fertilizer (for stimulation of algal growth) into plastic tanks of 6 L capacity. 100ml of the nutrient medium was transferred to (9) plastic tanks in three replicates and before transferring the nutrient media into the tanks, the tanks were washed with bleaching powder for sterilization (Akodogbo, Bonou, Sossou, Adande

& Fiogbe, 2015). Each tank was filled with 5 L of water and labelled as C, RD, PD, and SD for control, Rabbit droppings, poultry droppings, and sheep droppings respectively.

No animal waste and inorganic material was used in T0 (control). Only 5 L of clean water (Bore well water) was filled into it. Treatments (Control, RD, PD, and SD) contained concentrations of animal-wastes; soybeans cake and NPK fertilizers (Table 1). Baker's yeast was used as feed for Rotifer at equal quantities (2mg/L) in all treatments. In case of all treatments where animal manures were introduced, (RD, PD, and SD), vigorous aeration was carried out to allow escape of obnoxious gases. After three days of aeration, inoculation of rotifers was done. 27 ind./ml of rotifers were inoculated in each tank using a Pasteur's pipette. From the day of inoculation exchange of 200ml of water was done every day.Water quality parameters of Temperature, Dissolved oxygen (DO), Free carbon dioxide (CO2), pH and Alkalinity levels in the experimental tanks were analysed during the experimental period following standard protocols (APHA, 2004). Triplicates were made for each sample and mean values of the replicates were analysed statistically by using one-way analysis of variance (ANOVA). rotifers population was estimated every other day throughout the period of the experiment. Before counting of individuals, the media was stirred to ensure even distribution of rotifers after which 1ml of the culture was taken with the aid of a syringe at a position between the edge and centre of the bowl containing the media. The 1ml of the media was then distributed in drops on many slides and 10% formalin drops were then added to the drops on the slides containing the rotifers to demobilize them. Individual rotifer was counted using the 10x objective of Olympus microscope. The range of the water quality parameters and the mean yield of rotifers during the 10 days period of the experiment are as shown in figure 2 and 3 below respectively. The data obtained in this study were subjected to Analysis of variance (ANOVA) using Statistical Package for Social Sciences (SPSS) and Microsoft excel® data analysis platform.

Table 1: Composition of treatments

Treatments	Combination of ingredients
$T0_{R1}$	Control (municipal tap water)
$T0_{R2}$	Control (municipal tap water)
$T0_{R3}$	Control (municipal tap water)
$T1_{R1}$	RD 5g + SBC 5g + NPK 10g
$T1_{R2}$	RD 5g + SBC 5g + NPK 10g
$T1_{R3}$	RD 5g + SBC 5g + NPK 10g
$T2_{R1}$	PD 5g + SBC 5g + NPK 10g
$T2_{R2}$	PD 5g + SBC 5g + NPK 10g
$T2_{R3}$	PD 5g + SBC 5g + NPK 10g
$T3_{R1}$	SD 5g + SBC 5g + NPK 10g
$T3_{R2}$	SD 5g + SBC 5g + NPK 10g

$T3_{R3}$	SD 5g + SBC 5g + NPK 10g

Keys: **NPK** = (nitrogen-phosphorus-potassium) fertilizer; **RD** = Rabbit dung, **SD** = sheep dung; **PD** = poultry droppings; **SBC** = soya bean cake.

RESULTS

All culture media in the set up supported the increase of rotifers (Branchionus calyciflorus pallas, Keratella lenzi (Hauer), Brachionus ureceolaris, Brachionus plicatis, and Asplanchna priodonta gosse) for the period of 10 days. The highest yield was obtained in the media containing broiler chicken droppings (PD), N.P.K fertilizer, and soybean cake on the 8th day with a mean yield of 131.33 individuals per ml (Table 3). The media containing the rabbit dung (RD) yielded a mean of 108.67 individuals per ml while that of sheep dung (SD), had a mean yield of 94.00 individuals per ml. However, the yield started to decline after the 8th day as a result of a rapid decrease in the nutritive value of the media (Figure 1). At $P < 0.05$, there was no significant difference between the mean yields in the various culture media. The water quality parameters were at acceptable range; Temperature: 210C – 240C; pH: 6.7 – 7.5; Dissolved oxygen: 8.1 – 11.3; CO2 9mg/L – 14mg/L; Alkalinity 90ppt – 111ppt. There was no significant difference between their ranges at $P < 0.05$.

Table 2: Range of physicochemical parameters of the media for a period of 10 days

Media	Temperature (^{0}C)	pH	D.O	CO_2	Alkalinity
Control (T0)	21-24	6.7-7.2	8.2-11.3	11-14	90-96
RD (T1)	21-24	7.2-7.5	8.6-11.	19-11	93-111
PD (T2)	22-25	6.9-7.4	8.1-10.7	10-13	92-108
SD (T3)	22-24	6.8-7.3	8.3-11.2	10-13	94-101

Table 3: Mean yield of rotifers for 10 days

	Days				
Media	**2**	**4**	**6**	**8**	**10**
Control	14.33	24.67	41.33	91.33	71.33
RD	14.67	45.33	84.67	108.67	85.67
PD	16.67	51.33	94.33	131.33	117.33
SD	15.00	33.33	72.33	94.00	77.00

Figure 1: Graph showing the mean yield of rotifers for a period of 10 days.

DISCUSSION

The findings of this study showed that rotifers can be successfully cultured using locally available animal wastes, demonstrating that organic manure can serve as a low-cost and readily available nutrient source for the production of live feeds. The use of organic manure based culture systems offers a practical solution for small-scale fish farmers and hatchery operators, particularly where commercial live feeds are expensive or difficult to obtain. Similar observations were reported by Okunsebor (2014), who successfully cultured zooplankton for use as live feed for Heterobranchus bidorsalis hatchlings using organic enrichment techniques.

Among the different manure treatments used in this study, poultry droppings resulted in the highest rotifer population compared with rabbit droppings and sheep dung. The better performance of poultry manure may be related to its rel high nutrient content, especially nitrogen and phosphorus, which enhance the growth of microorganisms and phytoplankton that serve as food sources for rotifers. Organic fertilizers contribute to increased microbial activity and primary productivity within culture systems, thereby improving zooplankton abundance (Arimoro, 2006). The ability of poultry manure to release nutrients gradually into the culture medium may also explain its capacity to maintain continuous food supply that support sustained rotifer production.

The higher rotifer yield observed in the poultry manure treatment agrees with the findings of Arimoro (2006), who reported successful production of Brachionus calyciflorus with organic enrichment methods. Similarly, Gaur and Chari, (2007).reported that poultry manure promotes plankton productivity through the continuous release of soluble nutrients, which increases the availability of natural food organisms for filter-feeding zooplankton. The present study therefore confirms that poultry manure is a suitable organic fertilizer for rotifer culture, particularly in areas where the use of commercial feeds such as artemia may be economically challenging.

The differences observed in rotifer abundance among the manure treatments may be attributed to variations in nutrient composition, decomposition rate, and microbial activity associated with each manure type. Poultry manure generally contains higher levels of organic matter and essential nutrients that encourage microbial decomposition and the development of natural food organisms which create a favourable environment for rotifer reproduction and population increase.

Successful rotifer production depends on maintaining suitable environmental conditions, including appropriate temperature, pH, dissolved oxygen, and continuous availability of suitable food resources (Hoff & Snell, 2007; Lubzens *et al*., 2001). The water quality parameters recorded throughout the culture period remained within suitable ranges for rotifer production. Temperature values ranged from 21–25°C, with the highest rotifer abundance recorded at approximately 24°C. Temperature plays an important role in regulating rotifer metabolism, reproductive rate, and population growth. Lubzens *et al*. (2001) reported that rotifers generally perform well under moderate temperatures, although the optimum range may differ depending on the species and culture conditions. The temperature range recorded in this study was therefore considered favourable for rotifer growth and survival.

The pH values observed during the experiment (6.7–7.5) were also within a suitable range for rotifer culture. A value close to neutral promotes microbial activity and nutrient availability, which indirectly supports the production of natural food organisms within manure enriched systems. Dissolved oxygen levels (8.1–11.3 mg/L) remained adequate for rotifer survival throughout the culture period. The slight reduction in dissolved oxygen observed towards the end of the experiment may be associated with increased biological activity resulting from higher rotifer abundance, bacterial growth, and decomposition of organic materials. Conversely, the increase in carbon dioxide concentration was likely due to increased respiration and microbial breakdown of organic matter in the culture media. The observed relationship between decreasing dissolved oxygen and increasing carbon dioxide reflects the biological changes that occur as rotifer populations and microbial communities increase during culture. Similar patterns have been reported in fertilized zooplankton production systems, where increased biological activity leads to greater oxygen consumption and carbon dioxide accumulation

(Kibria *et al*., 1997). Therefore, regular monitoring and management of water quality conditions are essential for maintaining a stable culture environment and preventing deterioration during intensive rotifer production.

Overall, the results of this study demonstrate that poultry manure was the most effective fertilizer for rotifer production, recording the highest mean abundance of 131.33 individuals/ml. This finding supports previous reports that identified poultry manure as a suitable organic fertilizer for enhancing zooplankton production. The use of livestock manure for rotifer culture provides a simple, affordable, and sustainable method of producing live feed for aquaculture, particularly in developing regions where access to commercial live feed systems is limited.

CONCLUSION

This study demonstrated that livestock manures can effectively support rotifer production under controlled culture conditions. Poultry droppings produced the highest rotifer abundance compared with rabbit droppings and sheep dung, indicating its greater potential as an organic fertilizer for mass production of rotifers. The superior performance of poultry manure may be attributed to its nutrient composition and ability to promote microbial and plankton productivity, which provide essential food resources for rotifers.

The favourable water quality conditions observed during the experiment were temperature (21–24°C), pH (6.7–7.5), dissolved oxygen (8.1–11.3 mg/L), carbon dioxide (9–14 mg/L), and alkalinity (90–111 mg/L), suggesting that these parameters are suitable for maintaining rotifer populations. However, proper management of water quality is necessary to sustain high production levels and prevent deterioration of culture conditions.

Based on the findings of this study, poultry droppings are recommended as an effective and affordable organic fertilizer for rotifer mass production. The use of locally available livestock manure can contribute to sustainable aquaculture development by providing a locally available and reliable source of live feed organisms for fish hatcheries, particularly for the rearing of larval of species such as Clarias gariepinus and Heterobranchus bidorsalis that usually breed in captivity.

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