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Research Article

Growth Performance of Monosex and Mixed Sex of *Oreochromis tanganicae* (Günther, 1894) Raised in Semi Concreate Ponds

Sauti Kalima[1]*, Jere WL[2], Alexander Shula Kefi[3]

[1]Department of Aquaculture and Fisheries Science, Diploma Fisheries Science, Lilongwe University of Agriculture and Natural Resources, Lilongwe Malawi, Zambia; [2]Lilongwe University of Agriculture and Natural Resources, Lilongwe Malawi, Zambia; [3]Ministry of Fisheries and Livestock, Department of Fisheries, Chilanga, Zambia

ABSTRACT

The current study evaluates the growth performance of mono and mixed sex *O. tanganicae* under semi concreate pond culture conditions. Monosex *O. tanganicae* were produced on a 60mgMT/kg (17 Methyl- Testosterone) hormone incorporated diet while the mixed sex was raised on same feed but devoid of the hormone for a period of 28 days. The experiment was replicated three times and in a Complete Randomized Design (CRD). Five hundred fry were stocked in each hapa and fed with commercial Novatek feed containing 45% protein @ 10% of their body weight per day for 30 days. A day after post exposure of the hormone for the monosex, the growth (Length and weight) and SGR was compared among both the groups. The highest mean weight gain of 2.184 ± 0.184 g and SGR 6.506 ± 0.242 was noticed for monosex *O. tanganicae*. These growth parameters were statistically significant as compared to mixed sex. The study therefore, revealed that on the basis of better growth performance, monosex *O. tanganicae* it is recommend farming technique for better returns.

Keywords: Growth; Monosex; Mixed sex; *O. tanganicae* ; Aquaculture; Farming system

INTRODUCTION

Tilapia, sometimes referred to as the aquatic chicken, is tolerate a wide range of environmental conditions but are also fast growing. This make them an importance crop in the world of aquaculture. Tilapia is one of the most important fish in tropical and sub-tropical aquaculture. It is a major source of animal protein and income throughout the world. The genera Tilapine is a group of cichlids endemic to Africa. This group consists of three important genera - *Oreochromis, Sarotherodon* and *Tilapia* [1].

In terms of the breeding habits, Tilapia is a substrate spawner with both parents guarding the spawn in the nests. The species in the genus *Sarotherodon* exhibit biparental or paternal mouth brooding of the eggs where both the males and females guard the spawn or the males only providing the parental care. *Oreochromis* species are named for their maternal mouth brooding behaviour. The mouth brooding aspect is an important characteristic in aquaculture as the spawn can be collected from the mouth of the fish for possible hatching control and sex manipulation. Compared to other fish species such as catfish, *Oreochromis* species exhibit low fecundity that may mean keeping large numbers of broodfish [2] if reasonable quantities of fish seed for stocking in fish ponds are to be produced. However, low fecundity assures high survival of the offspring [3]. Furthermore, its ability to reach sexual maturity at an early age usually before the market size poses another challenge. Early sexual maturity may have a negative effect on the growth rate leading to a phenomenon called stunting thus fewer marketable size fish [4,5]. Given that *Oreochromis* species reared are mouth brooders with low fecundity and sluggish initial growth rates, there is every need to explore their specific reproductive biology by exploiting ways of manipulating their reproductive and growth potential.

Several scholars have suggested that the grow-out of monosex male population minimizes recruitment and thereby competition between recruits and stocked fish which, in mixed sex populations, can significantly reduce harvested yields [6]. The difference can be attributed to energy expenditure on male-male and male-female interactions behavior and on gamete production is also minimized at the expense of growth potential. Several attempts have been developed to achieve monosex male populations, among them; direct hormonal sex reversal being the most commonly applied

Correspondence to: Sauti Kalima, Department of Aquaculture and Fisheries Science, Diploma Fisheries Science, Lilongwe University of Agriculture and Natural Resources, Lilongwe Malawi, Zambia, Tel: 260979432675; E-mail: sautikalima82@gmail.com; sauti.kalima@yahoo.com

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in the industry of late, monosex hybrids and manual sexing are also produced in many hatcheries. Both methods are laborious and susceptible to human errors such that sex ratios greater than 90% male are rarely achieved. Hybridization has been reported to produce consistently high percentages of males, especially if *Oreochromis urolepis hornorum* is used as the paternal parent [6]. However, for most these freshwater aquaculture species including and not limited to *O. niloticus* are not allowed in some regions and Zambian waters are not exceptional as they are exotic. In the northern part of Zambia, farmers have developed interest in culturing of *O. tanganicae*, a mouth brooding tilapiine cichlid from Lake Tanganyika in Africa. This fish was first identified by Günther in 1894 as reported by [7]. This is a large, robust cichlid with a huge appetite and, interestingly, is the only tilapiine cichlid found in the lake [8]. *O. tanganicae* is an aggressive species and highly adaptable like another Tilapia. It is fast-growing, and can withstand extremes in temperature [8]. *O. tanganicae* is endemic to Lake Tanganyika [9]. Male *O. tanganicae* have an overall tan-green color, with many blue and green iridescent speckles. The dorsal fin on breeding males extends mid-way through the caudal and the anal fin is pointed. Females have a similar pattern, but are not as colorful and do not have the dorsal or anal fin extensions [7]. In view of the above the study was conducted to evaluate the comparative growth performance of mono and mixed sex *O. tanganicae* which is allowed for culture in some parts of the northern region of Zambia.

MATERIALS AND METHODS

Experimental site and fish

The experiment was conducted at Misamfu rresearch station, a research station belonging to the Ministry of Fisheries and Livestock, Department of Fisheries, Zambia in Kasama district (Latitude 10º 12' 31.82'' S and longitude 31º 11' 17.72''E) for a period of three (3) months, December to February, 2020. The parent stock fish were collected from within Misamfu Aquaculture Research Station (MARS), conditioned for fifteen (15) days while keeping the male separately from the females. On the 16th day, 28 brood stocks; 7 males and 21 females were stocked in (7m x 5m) semi concrete pond. After (21) twenty-one days, the seed, just after yolk sac absorption, were stocked in each hapa at a stocking rate of 500 fry/m^2, and fed on a Novatek commercial feed with 45% protein level. The mixed sex fry were fed on a hormone free feed while the monosex were fed on same feed but with hormone inclusion at 60mgMT/kg for a period of (30) thirty days.

Experimental setup

The experiment was setup in such a way that (6) six hapas were put in a semi concrete pond in a Complete Randomized Design (CRD) way, replicating each treatment thrice. The feeding was done @ 10% body weight but twice a day for entire experimental period. At the end of rearing period (30 days), Net weight gain, Percent weight gain and Specific growth rate (SDR) were compared to evaluate the performance of monosex and mixed sex culture.

Statistical analysis

The data recorded for evaluation of different treatments were statistically analyzed using standard procedures in R version 3.6.3. Shapiro test was employed to check if the data was normally distributed. Excel spread sheets and boxplots (Figure 1) were used

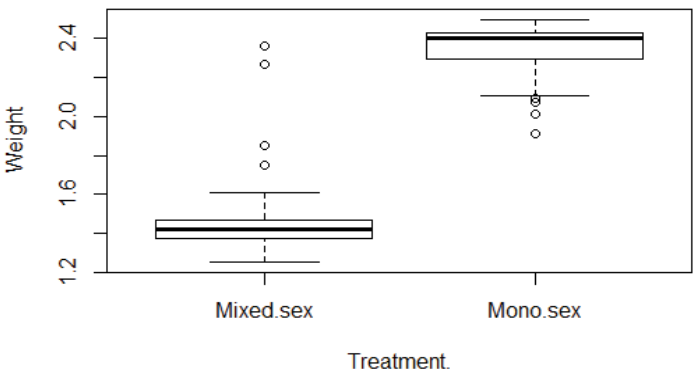

Figure 1: Box-plot for mono and mixed sex *O. tanganicae*.

to determine the standard error and aid in data interpretation respectively. T-test of unpaired independent sample was used to determine significance of experimental results (t =-37.103, df =134.8, p-value <2.2e-16).

Growth parameters

The mean length, weight and survival of the fish in each treatment were recorded on 30th days as per the following formula as outlined by Kefi et al.:

$$BWG(\%) = \left[\frac{\{F.wt(g) - Int.wt(g)\}}{Int.wt(g)}\right] \times 100$$

$$SGR(\%) = \left[\frac{LnF.wt - Ln\ int.wt}{time(days)}\right]_{\times} 100$$

$$AFCR = Wt.\ of\ feed\ used/increase\ in\ wt$$

RESULTS AND DISCUSSION

Water quality

Water quality parameters remind stable throughout the experiment and were within optimal level for culture of tilapia species (Tables 1 and 2). The differences in growth cannot be attributed to them as all the treatments were subjected to the same conditions, but due to the hormone treatment. (Both mono and mixed sex fish were stocked in one semi concreate pond but in different hapas replicated thrice). The results are in conformity with what Singh et al. The authors reported temperatures ranges of 19.5-25.65, DO of 6.03-7.02, but a pH of 6.73-7.32 and Nitrite of 0.016-0.030. The differences could be attributed to differences in climatic conditions and feed.

Growth parameters

The current study revealed that there was a significant difference ($p<0.05$) in growth among monosex (males) and mixed sex reared under the same culture conditions. After 30 days rearing the fish attained an average weight of 2.184 ± 0.184 g and 1.389 ± 0.033 g for monosex male and mixed sex *O. tanganicae* respectively (Table 3). Further, the respective SGR values for mono-sex and mixed sex groups were 5.030% and 6.506% (Table 3). AFCR also favored mono sex group; 746.78 ± 63.70 compared to 1225.85 ± 75.21 for mono sex and mixed sex respectively. The results of the present study on comparative growth performance of monosex and mixed sex *O. tanganicae* shows a better growth of the earlier. The results of the current study are in line the study by Dan and Little [10]

Table 1: Temperature and pH of the water during the experimental period (mean ± SE).

Month	Water quality parameter			
	Temperature (°C)		pH	
	Morning	Afternoon	Morning	Afternoon
January	19.9 ± 0.174	23.2 ± 0.596	6.6 ± 0.067	6.7 ± 0.045

Table 2: Conductivity (ms/cm), Dissolved oxygen (g/ml) and Nitrite (means ± SE) of the water during the experimental period.

Month	Water quality parameter		
	Conductivity (ms/cm)	Dissolved oxygen (g/ml)	Nitrite
January	0.090 ± 0.001	7.097 ± 0.028	0.150 ± 0.005

Table 3: NFW, BWG, SGR and AFCR of mono sex and mixed sex *O. tanganicae* (mean ± SE).

Parameters	Mono sex	Mixed sex
	After 30 days	
NFW	2.184 ± 0.184[a]	1.389 ± 0.033[b]
BWG (g)	1.875 ± 0.149[a]	1.082 ± 0.034[b]
SGR (%)	6.506 ± 0.242[a]	5.030 ± 0.086[b]
AFCR	746.78 ± 63.70[a]	1225.85 ± 75.21[b]

Different superscript in a row indicate Significant difference (p 0.05)

in which the GIFT attained a significantly ($p<0.01$) higher weight (387.7 g) compared to the Thai strain (351.6 g) and Veit strains (359.5 g). Their study further revealed that monosex fish of three strains grew significantly faster than mixed-sex fish.

In another study by Chakraborty et al. [11] mixed-sex fish yielded (85.9 g) compared to mean individual weight (290.4 g) of hormone treated monosex tilapia raised in ponds. Studies by Dan and Little; Mair et al. [12] in which they reported an increase in individual growth of Nile tilapia during monosex culture. Apart from genetics, brood stock management and environmental conditions including the quality and quantity of feed has an influence on the growth performance of tilapia [13,14]. The results of the present study revealed that the growth performance of mono-sex and mixed sex *O. tanganicae* reared for 30 days under the same culture conditions was significantly different.

CONCLUSION

The data obtained in the present study on growth parameters and feed indices (i.e., weight gain and SGR and AFCR respectively) of monosex (all male) and mixed sex of *O. tanganicae* clearly indicated better performance of all male. It is therefore recommended that for sustainable and higher yield in a bid to increase both production and productivity, the culture of all male *O. tanganicae* should be promoted.

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