

Table 1: Microscopic observation for sex determination of *Oreochromis niloticus*

Category (Age)	Hormone period in days	No. of Males	No. of Females	No. of Intersex	Total
Fry from mouth having no yolk sac	42	9	0	1	10
		10	0	0	10
		9	0	1	10
		Total			
	21	7	0	3	10
		9	0	1	10
		9	0	1	10
Total				30	
Fry from the mouth with yolk sac	21	9	0	1	10
		8	0	2	10
		9	0	1	10
		Total			
	30	8	0	2	10
		9	0	1	10
		10	0	0	10
		Total			
Yolk sac fry hatched in incubators	60	10	0	0	10
		10	0	0	10
		10	0	0	10
		Total			
	21	10	0	0	10
		10	0	0	10
		10	0	0	10
		Total			

The results from Pearson correlation are shown in Table 2. According to Pearson Correlations, category and sex of fish was significant at ($P < 0.05$), as showed in table 2. Hormone period and category (age) was highly significant at ($P < 0.05$). Pearson correlation showed that there was no significance between hormone period and sex of fish. Category was significantly correlated to period of exposure. The interaction between the category of fry and period of exposure was significant ($P < 0.05$). Category was also significantly correlated to sex reversal inversion. The period of exposure to hormone was not significantly correlated to sex inversion.

Table 2: Pearson Correlations of sex of fish, category and period of exposure to hormone

		Category	Period of exposure to hormone	sex of fish	Temperature
Category	Pearson Correlation	1	-.242(**)	.174(*)	-.008
	P-value	.	.001	.019	.912
	N	180	180	180	180
Period of exposure to hormone	Pearson Correlation	-.242(**)	1	-.132	-.009
	P-value	.001	.	.077	.904
	N	180	180	180	180
sex of fish	Pearson Correlation	.174(*)	-.132	1	.014
	P-value	.019	.077	.	.852
	N	180	180	180	180
Temperature	Pearson Correlation	-.008	-.009	.014	1
	P-value	.912	.904	.852	.
	N	180	180	180	180

** Correlation is significant at the 0.01 level.* Correlation is significant at the 0.05 level.

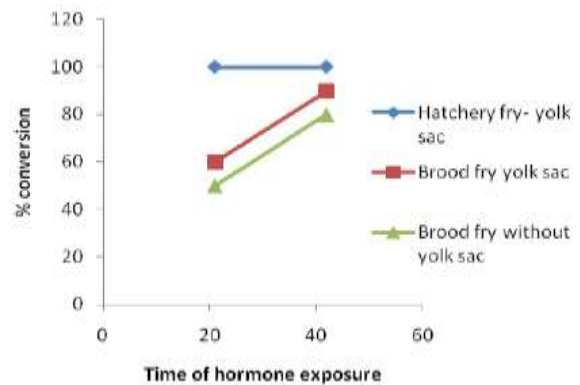


Figure 1: Interaction between fry category and hormone exposure

8. Discussion

In the present study, an inversion rate of 100% was observed in fry that were hatched from eggs in the laboratory. Both yolk-sac-fry and those lacking the yolk from the mouths of brooding mothers did not achieve 100% sex inversion. Further, no pure females were observed during microscopic examination and all departures from pure males were intersex individuals. This observation suggests that all fry had access to the hormone treated feed in one way or the other. Others authors found that producing a monosex population of *O. niloticus* for aquaculture is high priority since males have a higher growth rate as compared to females and their observations revealed male percentage above 90% but less than 100% Utete and Victor (34). The results as indicated by others here meant that the methods used were crude and need refinement. This may lead to lack of pure female. Most experimental evidence only partially supports a monofactorial model for sex determination in tilapia; autosomal and environmental factors also are thought to influence sex determination (8).

The present study revealed that after 21 and 42 days of hormone exposure of *O. niloticus* fry from brooding mothers without the yolk sac produced both males and intersex. *O. niloticus* fry from the mouth of brooding mothers which had yolk sac and exposed to hormone for the same period resulted into more males and less intersex. However, the extension of time exposure to the hormone to 60 days slightly reduced the number of intersex fry. It is likely that from this result, the fry with yolk sac performed better than those without. This is because the fry without yolk sac were higher age as compared to fry with yolk sac. It is well established in the literature that fry of lower age respond better than an advanced aged fry (24). It is more likely that the hormone was absorbed by yolk which was intern a simulated by the fry since the sole nutrition of the fry dependent on the yolk. This result agrees with (2) on their results which showed that yolk sac fry exposed for a longer period to hormone feed led to higher rate of male conversion with very few intersex observed.

The result of the present study indicated that the yolk sac fry from the incubator had 100% conversion efficiency into males both at 21, 42 and 60 days of exposure to hormone. In this set up, eggs were incubated at a higher temperature which decreased embryonic development time and the same time, the swim-up fry had the first encounter to only hormonal feed. Given that sex determination conversion efficiency is dependent on age of fry; such fry are relatively younger and are more likely to be transformed with higher conversion efficiency into males. Gonadal tissue differentiation is presumed to occur between 8 to 25 days post-hatch, which is influenced by environmental conditions (8). In the present study, fry were exposed to hormone one day post-hatch. It is likely that masculinization hormonal stated its influence before the on-set of gonadal differentiation thus culminating into 100% conversion efficiency. This result did not conform to any result of other authors (22). The reason for the non conformity was because the current experiment was carried out within a confined aquaria environment which exposed all fry to hormone feed.

9. Conclusion

The present study demonstrated that it is possible to achieve 100% all male mono-sex population. However to achieve this result fry must not be beyond the lower limit of 8 days post-hatch before exposure to hormone. For lower age fry conversion was independent of duration of exposure whereas for fry beyond 8 days post-hatch, the rate of male conversion was positively related to duration of exposure. Incubator hatched fry gave 100% male conversion rate whereas those snatched from the mouth did not attain 100% conversion efficiency at the duration of the experimental examination. Fry which had yolk sac from mouth brooding mothers and those hatched from eggs in the laboratory differed in their rates of conversions despite both having yolk sac they yielded different results in terms of male conversion efficiency. It was found that temperature was a key factor for faster egg and fry development.

10. Recommendations

The age of fry is highly significant for efficiency of 17 α -methyltestosterone on sex reversal and a target below 8 days post-hatch could be taken into account. Sex reversal should start with fry of below 8 days old after hatching and duration of exposure for twenty one (21) days would be sufficient.

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