THE UNIVERSITY OF ZAMBIA

EFFECT OF PORCINE TESTICULAR FLUID INCORPORATED IN FISH FEED ON THE GROWTH AND PERFORMANCE OF *OREOCHROMIS ANDERSONAII*

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UNZA, LUSAKA

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A RESEARCH REPORT SUBMITTED TO THE SCHOOL OF AGRICULTURAL SCIENCES IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF BACHELOR OF AGRICULTURAL SCIENCES DEGREE

DEPARTMENT OF ANIMAL SCIENCE

SUPERVISED BY DR. P. C. SIANANGAMA

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ABSTRACT

This study designed to evaluate the potential of porcine testicular fluid incorporated in feed on the growth performance of Tilapia (*Oreochromis andersonaii*) fry. A total of 150 five-day-old fry with an average weight of 60mg were randomly allocated to two sets of experimental aquaria with three replicates for each. Two diets were formulated; one by incorporating 250ml of the testicular fluid to the diet and the other incorporating testicular fluid that had been treated with activated charcoal. The diets were randomly distributed among the experimental units in a completely randomized design. The fry were fed twice a day at a fixed feeding rate of 20% body weight and cultured over a period of 64 days. Morphometric parameters like total body weight, standard length and total fry length were measured and evaluated. There were significant differences amongst the results of each measured parameter between the fry fed on the testicular fluid sprayed diet (TFS) and the steroid-free testicular fluid sprayed diet (STFS). The average weight of the fish were 0.12±0.005 and 0.09±0.004 *(P=0.006)*; whilst standard lengths obtained were 1.5±0.03 and 1.4±0.02 *(P=0.007)*; and total lengths measured were 1.9±0.03 and 1.8±0.029 *(P=0.04)* for the TFS and STFS diets respectively. The results obtained therefore, suggest that testicular fluid can be used as growth promoter to influence the growth and development of fry in intensive aquaculture.

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CHAPTER 1

1.0 INTRODUCTION

Aquaculture is the breeding, rearing and cultivation of aquatic animals and plants in all types' of water environments including ponds, rivers, lakes, and the ocean. Aquaculture produces food fish, sport fish, bait fish, ornamental fish, mollusks, crustaceans, algae and fish eggs and it is the fastest growing animal food-producing sector (White, 2004)

Aquaculture is developing, expanding and intensifying in almost all regions of the world as the global population demand for aquatic food products is expected to increase. Globally, production from capture fisheries has leveled off and most of the main fishing areas have not reached their maximum potential. Sustaining fish supplies from capture fisheries will, therefore, not be able to meet the global demand for aquatic food. In recent years the demand for fish as the leading protein supply globally has been the leading source of production increase particularly amongst developing countries like that of Zambia.

Tilapia in particular has become the third most important fish in aquaculture after carp and salmon (Ridha, 2006); worldwide production exceeded 1,500,000 metric tons in 2002 and increases annually. Because of their high protein content, large size, rapid growth (6 to 7 months to grow to harvest size), and palatability, a number of tilapine cichlids—specifically, various species of *Oreochromis*, *Sarotherodon*, and *Tilapia*—are the focus of major aquaculture efforts. Tilapines are among the easiest and most profitable fish to farm due to their mode of reproduction, tolerance of high stocking density, and rapid growth (the fry do not pass through a planktonic phase), their tolerance to poor water quality and the fact that they eat a wide range of natural food organisms. Other advantages of tilapia species is the ease with which they can breed, good utilization of artificial diets, resistance to disease, in addition to their excellent quality of flesh and are finely appetizing to consumers (Corpei, 2001). In some regions the fish can be raised in rice fields at planting time and can grow to edible size (12–15 cm, 5–6 inches) when the rice is ready for harvest (Corpei, 2001).

According to Adewolu *et al.,* (2008) the major problem hindering the increased production and development of aquaculture is the scarcity of fish fingerlings whose availability largely depends on their health and size at a given time. For this reason aquaculture requires deliberate human intervention in their productivity to achieve yields beyond those from the natural environment alone (Akinwande *et al.,* 2009).

This can be achieved through use of synthetic hormones of either male or female origin, to stimulate growth (Ndimele *et al.,* 2012).

1.1 LITERATURE REVIEW

1.1.1 Feeds and feeding of fish

There are increasingly new requirements for feed and raw materials for feed, creating a great need for research in nutritional biology. As more species are becoming relevant for aquaculture, it is important to build specialized expertise, as the needs and preferences of each species can vary greatly (Efnen *et al.,* (2013). Terrestrial animal byproducts including poultry by-product meal, blood meal, meat and bone meal have been widely used as protein sources for many fish species, due to their high protein content and good essential amino acid content which accounts for about 50% of fish feed (Tacon, 1993). Due to high feeding and protein costs demand for growth promoters as cheaper means of production have steadily been on the rise (Efnen *et al.,* (2013).

1.1.2 Methyl testosterone as a growth promoter

A variety of materials can be added to feed in order to stimulate feed intake and the growth of fishes. Anabolic hormones like testosterone are among these substances (Ariman, *et al.,* 2001). The administration of various steroids is known to be associated with a gain in body weight (McCullagh, *et al.,* 2013). Amongst those hormones used in aquaculture, the most is that of 17 α - methyl testosterone (Macintosh, 2005). This hormone is a white crystalline compound sold in powder or tablet forms; it is also known as 17 beta-Hydroxy-17 alpha-methyl-4- androsten-3-one or plainly as MT. 17α -methyl Testosterone (MT) is a synthetically produced anabolic and androgenic steroid hormone. It promotes both muscle growth and the development of male sexual characters. Considerable information is available on the growth promoting efficiency of anabolic steroid hormones in fishes (McBride, 1973). Dan and Little (2001), who compared the culture performance of different species of stains of *Oreochromis niloticus,* found that the MT treated feed increased the final size of the fish by 10.7%.

MT closely mimics the naturally-produced hormone testosterone and, consequently, this and other synthetic forms of testosterone have been used widely as a hormone supplement replacing natural testosterone (Macintosh, 2005) as a growth promoter and tool for sex reversal.

Recently, a more potent form of testosterone, 17aa-1-testosterone, has become widely available and increases muscle growth and/or fat loss to a higher extent (Macintosh, 2005). However, at high dosages exogenous male hormones, including MT, are known to cause side effects, especially liver damage (Valcour, 2001), but lower levels actually produce various scientific benefits, including improved growth employed in aquaculture. Additionally, a number of studies have linked MT to environmental and health concerns in terms of waste disposal and prolonged exposure and handling by farm workers of hatcheries. Thus, need for organic alternatives to use of MT as a growth promoter has risen.

This has increased the need, amongst fish breeders, for less harmful means for sex reversal and growth promotion in fish which, under normal circumstances is achieved using endogenous testosterone. Endogenous testosterone is produced by the testicles in male animals and in much lower quantities by the ovaries and other tissues of female animals. The adrenal glands also produce small amounts of testosterone in both sexes.

1.1.3 Use of Natural Sources of Testosterone

Studies have shown that testosterone is used for sex reversal and since bull testes have shown their ability to be used for sex reversal, they can therefore be used as potential sources for growth promotion as well. Several other natural sources of testosterone have shown growth stimulating properties like in the experiment carried out by Mishirgi and Yosif (1988) in which lamb testicles meal was fed to tilapia fry and an increased growth rate was observed. Similarly, Fashina *et al.* (2008) also found that fish fed with goat testes meal grew faster than the control group fed with commercial starter diet. Furthermore, Haylor and Pascual (1991) who fed ram testes to fish also found that it stimulated fish growth.

1.1.4 Porcine Testicular Fluid

Porcine testes as byproducts of the pork industry are found in large quantities as waste of slaughter houses and could be used as alternative and potential source for tilapia feeding and sex reversal. Cost benefit analyses indicated that these sources can be used as single dietary protein sources for culturing of *Nile tilapia* (El Sayed, 2003).

Replacement of fishmeal by cheaper ingredients or the use of growth promoters of either animal or vegetable origin in aquatic animal feed is necessary because of the rising cost and uncertain availability of fishmeal (Abdel Fattah, 2005).

Studies have shown that the use of testes as a means of improving the growth rate of fish produces a positive result (Sulieman *et al.*, 2012). The effects of testes on the growth and

masculinization of Tilapia has been broadly studied and different processing techniques have been used to incorporate this by-product into the feed. It has been shown that the whole testes is used by either freeze drying or oven drying and incorporating into feed, and thus it not clearly known whether the success of this treatment is as a result of the extra protein content of the testes tissue or largely due to the hormones (Sulieman *et al.*,2012). Sulieman and his associates in their studies further found that the growth rate of Nile Tilapia fed diets containing dried bull testicles increased significantly with increase in the testicular tissue inclusion level. This could have possibly been due to the increased testosterone effect which is a known to be an anabolic agent and to an improvement in the quality of dietary protein. There are also several other studies (Robles *et al.*, 2011 and Kefi *et al.*, 2012) that link use of the androgenic hormone in sex reversal to growth enhancement and protein synthesis, resulting into greater muscle mass gains.

1.2 JUSTIFICATION

The use of 17-alpha-methyl-testosterone for sex reversal and promoting growth and performance is known to cause detrimental effects on the health of consumers and environment (Macintosh, 2005). Testicular fluid is more available, cheap and not associated with MT problems. The composition of natural testosterone allows for it to be readily metabolized by the fish and eliminated from the fish system in less than 100 hours after its administration has been stopped. The booming aquaculture industry imposes strain on organic breeders in terms of uniformity, which may not be possible with using testes which also provide additional protein in varying quantities. Testicular fluid does not have these extra proteins that could affect the growth rate of the fish.

Additionally, no studies have yet been done on the effect of natural sources of testosterone on *Oreochromis andersonaii* as a growth stimulant or promoter.

1.3 AIM

To determine the effect of porcine testicular fluid incorporated in feed on the growth and performance of *Oreochromis andersonaii.*

1.4 RESEARCH OBJECTIVES

1.4.1 General Objective

To improve the quality and efficiency of production of fish in the aquaculture industry.

1.4.2 Specific Objectives

To determine the effect of porcine testicular fluid incorporated in feed on weight, standard length and total length of *Oreochromis andersonaii.*

To evaluate the effect of porcine testicular fluid incorporated in feed on improving the performance of *Oreochromis andersonaii.*

1.5 HYPOTHESES

1.5.1 Research Hypothesis

If porcine testicular fluid is added to fish feed then the growth and performance of the fish will be enhanced.

1.5.2 Statistical Hypothesis

Null Hypothesis (H_o)

There is no effect of porcine testicular fluid incorporated in feed on the growth and performance of the fry.

Alternate Hypothesis (H_1)

There is an effect of porcine testicular fluid incorporated in feed on the growth and performance of the fry.

CHAPTER 2

2.0 MATERIALS AND METHODS

2.1 Site

The research experiment was carried out at the School of Agricultural Sciences Department of Animal Science laboratories from the 15th of April to the 17th of June, 2015.

2.1 Experimental design of aquaria

The aquaria were made of Perspex glass measuring 5mm in thickness. The aquarium dimension was 27cm width, 90cm length, and 30cm height. Each aquarium was equipped with an aerator and tubing for providing air.

2.2 Preparation of the pig testes and experimental diet

Ten testes (4.6 kg) from mature pigs were bought from Real Meats Slaughter House in Lusaka. The testes were skinned and the testicular fluid was extracted as previously described by Bettella *et al.*, (2005) using a method known as testicular fine needle aspiration with mapping. The method involved use of the pointed edge of a surgical blade to puncture the testes directly at different sections until the entire area was covered with punctures in order to aspirate the fluid without a formal scrotal incision. The fluid collected amounted to 500mls and was separated into two flasks. The fluid in one of the flasks was first stripped of its androgens by sieving it over activated charcoal. This was repeated twice to ensure all of the androgens in the fluid were removed and the fluid collected was filtered.

The experimental diet was formulated on dry weight basis from a 1kg of commercially available fish feed pellets bought from Tackle pet shop containing a crude protein content of 26% and fish meal made from dried fishes. Both the pellets and the fish were ground into a powder and sieved into separate containers. Pearsons square was then used to determine the quantities of the feed and fish meal in order to formulate a feed of 45% percent crude protein.

Therefore, the fish pellets added were 560g whilst the fish meal added was 440g to make a kilogram (appendix 1). After combining the two ingredients the feed was mixed well and divided equally into two separate containers. To one portion of the formulated experimental feeds the pure testicular fluid was then added and mixed evenly; to the other, steroid-free testicular fluid was added and mixed evenly. Both samples were then oven dried for two days at 90°C, cooled, ground, sieved and stored for later use.

The steroid-free testicular fluid was obtained by filtering of the testicular fluid over activated charcoal to remove the androgens present therein. This was possible as activated charcoal is

ordinary charcoal treated with dextran which allows the carbon to absorb the androgens present (Snyder, *et al.,* 2005). This allowed for a comparison of testicular fluid and its other components to rule out the possibility of other components in the fluid affecting the outcome (growth) of the fish.

2.3 Feeding Trial

Five day old Tilapia fry (*O. andersonaii*) of 0.7cm in length were collected from Chilanga Fisheries on the 15th of April, the average weight of fry was 0.0064g. The aquaria were divided into two groups of three aquaria each. Fry were stocked at a rate of 25 fry per tank. The aquaria were emptied every week washed to remove the accumulated faeces and food and immediately refilled with fresh tap water. The fish in all treatments were fed at a rate of 20% of their body weight daily at two time intervals (10:00 am and 4:30pm), for the first 28days. The remaining days the fish were fed with untreated feed in both treatments until the end of the experiment. The fish body weight was taken using an electronic balance scale whilst the fish body length was determined using a 30cm ruler at the beginning and end of the experiment (growing period) which extended for 64days.

2.4 Data Analysis

Depending on the type of data collected, growth parameters of the fry and all analysis of variance for all quantitative data obtained was conducted using General Linear Model Procedures of the Statistical Analysis Software (SAS, version 8.2, 2001). When main effects were significant, means were separated using least square means and considered significant if $P<0.05$. Additionally, in order to compare the results from each treatment, more practical aspects were determined; these include Specific growth rate, feed conversion ratio and condition factor using linear equations $SGR = 100 \times (\log_e W_f - \log_e W_i)/ (t_f - t_i)$, $W_f - W_i / t_f - T_i$ and $K = 100 \times (W/ L^3)$, respectively (Mamcarz, 1995 and Abowei 2010).

CHAPTER 3

3.0. RESULTS

The average weight, standard length and total length of the fish fry fed the TFS was 0.12g, 1.4cm and 1.9cm respectively whilst that of the fish fry fed on STFS was 0.09g, 1.3cm and 1.8cm, respectively (appendix 2).

3.1 Performance of Tilapia

Table 1: ANOVA for performance of fish fry fed on testicular fluid sprayed (TFS) or steroid-free testicular fluid sprayed (STFS) diets.

Parameters	TFS	STFS	Level of Significance
Initial Weight (g)	0.06	0.06	N.S
Feed intake (g/day)	0.013	0.013	N.S
Final weight (g)	0.12	0.097	**
Weight gain (g)	0.047	0.033	-
Feed conversion ratio	0.289	0.36	-
Total Length (cm)	1.9	1.8	*
Feeding period (days)	64	64	-
Mortality	80%	78.67%	-

In this and subsequent tables N.S=not significant, **=p<0.01, *=p<0.05
TFS=androgen diet, STFS=stripped diet.

The final weight difference between treatments was highly significant. The degree to which these differences extended is demonstrated below; by use of the Specific Growth Rate (SGR).

Specific growth rate (SGR)

$SGR = 100 \times (\log_e W_f - \log_e W_i)/ (t_f - t_i)$

Where W_f = mean weight (mg) at the end of the period; W_i = mean weight at the beginning of the period; $t_f - t_i$ = time in days of the period (Mamcarz and Kozlowski 1995).

For Treatment 1(androgen diet)

$SGR = 100 \times (50.8 - 27.8)/ 64$
$= \mathbf{35.97\%}$

For Treatment 2 (stripped diet)

$SGR = 100 \times (42.1 - 27.8) / 64$
$= \mathbf{22.39\%}$

3.2 Weight

The average weights of the fish fry fed on the TFS and STFS diets were 0.12g and 0.09g, respectively. There were significant differences among weights between treatments (TFS and STFS diets) *(P=0.006)*.

Table 2: ANOVA for fish fry weights fed TFS and STFS diets.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	15	0.008	0.0005	2.04	0.09
TRT	1	0.003	0.003	13.30	0.0024**
FISH(TRT)	10	0.004	0.0004	1.49	0.23
TANK	2	0.00002	0.000007	0.03	0.97
TRT*TANK	2	0.0006	0.0003	1.17	0.34
Error	15	0.004	0.0002		
Corrected Total	30	0.01			

For the above and subsequent tables: **=p<0.01, *=p<0.05.

Table 3: Least square mean weights of fish fry fed TFS and STFS diets

TRT	WT LSMEAN	Standard Error	H0: LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
TFS	0.12	0.005	<.0001	0.0060**
STFS	0.099	0.004	<.0001	

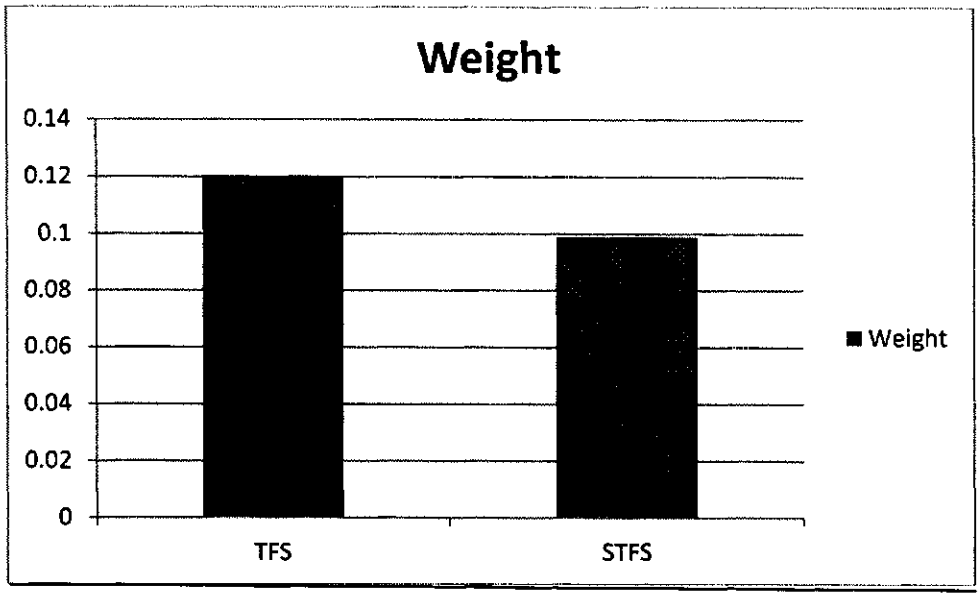

Figure 1.0: The mean weights obtained from the fish fry that were fed TFS and STFS diets.

3.3 Standard Length

The average standard length of the fry fed on the TFS was 1.4±0.03 whilst that of the STFS was 1.3±0.02. There was a significant difference between these two means *(P=0.007)*.

Table 4: ANOVA of performance in relation to standard lengths of the fish fry fed the TFS and STFS diet

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	15	0.32	0.02	3.00	0.02
TRT	1	0.086	0.086	12.08	0.0034**
FISH(TRT)	10	0.185	0.019	2.60	0.046
TANK	2	0.038	0.0191	2.68	0.10
TRT*TANK	2	0.012	0.006	0.82	0.46
Error	15	0.107	0.007		
Corrected Total	30	0.428			

Table 5: Least square means of standard lengths of fish fry fed on TFS and STFS diets.

TRT	SLN LSMEAN	Standard Error	H0:LSMean1= H0:LSMEAN=0 Pr > |t|	LSMean2 Pr > |t|
TFS	1.497	0.025	<.0001	0.007**
STFS	1.392	0.022	<.0001	

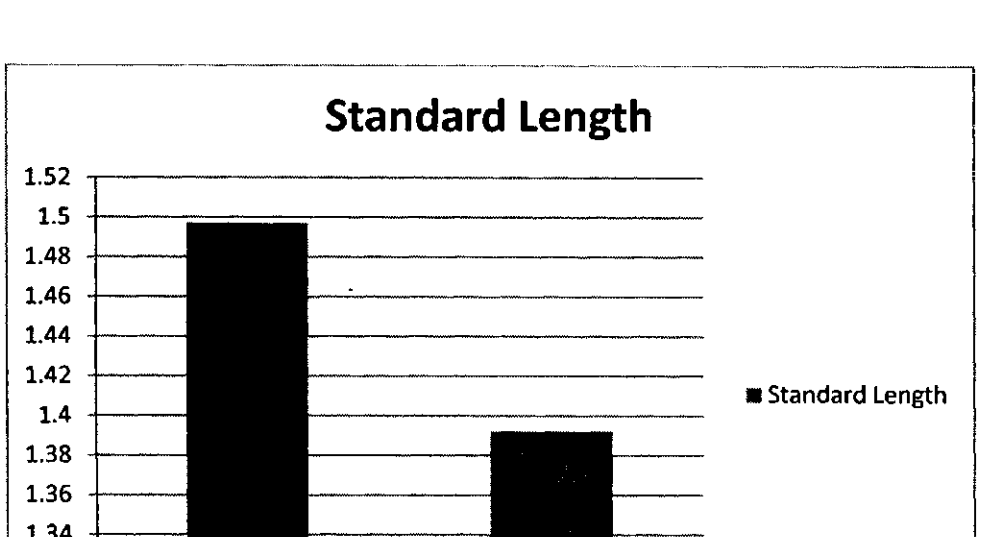

Figure 2.0: The mean standard lengths of the fry fed the TFS and STFS diets

3.4 Total Length

The average total lengths of the fry were fed on the TFS and STFS were 1.8cm and 1.9cm, respectively. There was a significant difference between these lengths *(P=9.04)*.

Table 6: ANOVA of fry performance in relation to total lengths between fry fed TFS and STFS diets.

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	15	0.296	0.0197	1.62	0.18
TRT	1	0.077	0.077	6.38	0.0233*
FISH(TRT)	10	0.15	0.015	1.26	0.33
TANK	2	0.028	0.014	1.14	0.34
TRT*TANK	2	0.037	0.019	1.53	0.24
Error	15	0.18	0.012		

Table 7: Least square means of total lengths of fry fed TFS and STFS diets

TRT	TLN LSMEAN	Standard Error	H0: LSMEAN=0 Pr > |t|	H0:LSMean1= LSMean2 Pr > |t|
TFS	1.91	0.03	<.0001	0.0403*
STFS	1.81	0.029	<.0001	

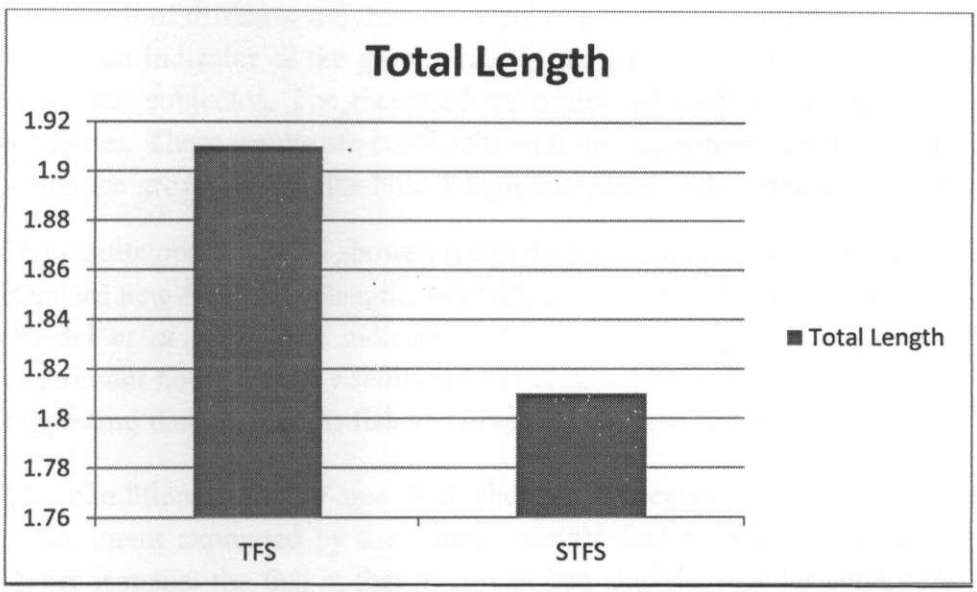

Figure 3.0: Means of total lengths of fry obtained from the fish fry that were fed the TFS and STFS diet.

From the data obtained the condition factor of the fish depending on the TFS and STFS they were fed was calculated.

Condition Factor (K) was calculated as

$K = 100 \times (W/ L^3)$

Therefore, the condition factor of the individual treatments was as follows:

Treatment 1 (androgen diet)

$K = 1.71 \times 10^{-3}$

Treatment 2 (stripped diet)

$K = 1.66 \times 10^{-3}$

CHAPTER 4

4.0. DISCUSSION

The results from this study gave a strong indication that testosterone functions as a growth promoting hormone (anabolic hormone). Despite the lack of visible differences and falling short of expected weights, the fish fed with feed with high hormone levels (TFS) showed significantly higher weights. These results are consistent with results obtained from Sulieman *et al.*, (2012), whose fish exhibited an increased growth rate as a result of the hormones. The calculated feed conversion ratios indicated that the ability to utilize feed by the fish in the first treatment containing androgens was better and this can be seen from the differences in weights.

As a result of different weights, the specific growth rates of the fish could then be calculated. This is an indicator of the growth rate of the fish with reference to the treatments to which they were subjected. The increased utilization of feed could therefore be attributed to the hormones. These results are consistent with the experiment done by Sulieman *et al.*,(2012) in which the growth rate of the Nile Tilapia increased with increased testosterone levels.

The results obtained also showed a significant difference between the treatments in terms of standard length and total length. According to other studies on the length-weight relationships (Riedel *et al.*, 2007), is indicative of isometric or allometric growth differences. In this experiment however, the condition is determined based on the analysis of length weight data suggesting that the heavier fish at a given length is in better condition.

The condition factor is one that shows the degree of well-being of the fish in their environment expressed by the length –weight factor. When the condition factor value was higher it meant the fish in that treatment had attained a better condition. This is affected by stress, season, feed quality and water quality parameters (Kallaf *et al.*, 2003). In this experiment, the condition factor at 1.71×10^{-3} was higher in treatment 1 (androgens) than it was with the stripped treatment feed at 1.66×10^{-3}. This indicated better utilization of resources by the fish fed TFS although in this study the values were much smaller than those ranging between 1.66 and 2.01 and 1.63 and 2.13 obtained by Anene, (2005) and Mahomoud *et al.*, (2011), respectively. These differences could have been due to the lower environmental temperatures to which the fish fry were subjected.

The feed conversion ratio of the fry fed the TFS diet was higher than that of the STFS which indicated an increase as a result of the hormone inclusion which was due to the increase in rate of weight gain (SGR) in the fish. This was also in agreement with the results found in the experiment done by Sulieman *et al.*, (2012).

Additionally, the exclusion of testicular tissue in this experiment allowed for uniformity in terms of testosterone supply which could not be seen in Sulieman *et al.*, (2012) who argued that the increase in growth could have been attributed to the improvement in quality of dietary protein from the testicular tissue.

CHAPTER 5

5.0. CONCLUSION

Based on the results obtained from this experiment, there was an effect on the weight, lengths and total lengths of the fry fed on the testicular fluid sprayed diet as well as on the performance of the fry as demonstrated by the calculated growth rates and condition factors.

It can therefore be concluded that the testicular fluid of boars can be used in place of the commercially available methyl testosterone (MT) as a growth promoter or stimulant in the culturing of *Oreochromis andersonaii.*

5.1 RECOMMENDATIONS

- Stress is one of the leading factors of retarded growth in fish. This is due to the fishes feed intake reduction. One of the main causes of stress in this experiment came from the frequency at which the water was changed. It would therefore be ideal to limit the number at which the tank water was changed to at least once in 10days as opposed to once in 7days.
- Increasing temperatures in the tanks by either warming the water or culturing the fish in warmer weather. As this would increase the feed intake and thus stimulate better growth.
- Use fry booster or feed that has been refined to a powder form as the feed intake at fry stage depends on the fineness factor of the feed.
- Determining the amount of testosterone that is provided by each boar testis through radioimmunoassay.

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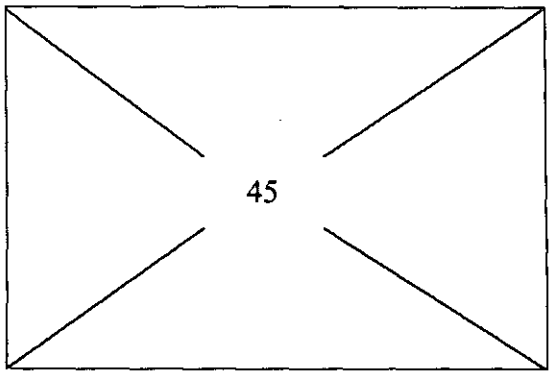
APPENDICES

Appendix 1: Pearsons square of feed formulated from fish pellets and fish meal

Fish Pellets 26 — 19



Fish Meal 60 — 15

Total: 34

Appendix 2: Weights, standard lengths and total lengths of fish fry fed on the TFS and STFS diets

TRT	TANK	FISH	WT	SLN	TLN
T1	1	1	0.136	1.6	2
T1	1	2	0.105	1.4	1.9
T1	1	3	0.111	1.7	2
T1	1	4	0.126	1.5	2
T1	2	1	0.129	1.6	2
T1	2	2	0.09	1.3	1.8
T1	2	3	0.132	1.6	1.9
T1	2	4	0.077	1.3	1.7
T1	2	5	0.131	1.7	2
T1	3	1	0.13	1.5	1.9
T1	3	2	0.094	1.3	1.7
T1	3	3	0.132	1.5	2
T1	3	4	0.131	1.5	1.9
T1	3	5	0.106	1.4	1.8
T1	3	6	0.13	1.4	1.9
T2	1	1	0.088	1.3	1.6
T2	1	2	0.073	1.3	1.7
T2	1	3	0.099	1.4	1.8
T2	1	4	0.085	1.4	1.8
T2	1	5	0.112	1.5	2
T2	1	6	0.109	1.5	1.9
T2	2	1	0.1	1.4	1.8
T2	2	2	0.092	1.3	1.7

T2	2	3	0.118	1.5	2
T2	2	4	0.099	1.4	1.9
T2	3	1	0.119	1.4	1.9
T2	3	2	0.072	1.3	1.6
T2	3	3	0.08	1.3	1.7
T2	3	4	0.103	1.4	1.9
T2	3	5	0.098	1.3	1.8
T2	3	6	0.1	1.4	1.7

TRT = Treatment; WT = weight; SLN = Standard Length; TLN = Total Length.
TFS = Androgen diet (T1); STFS = Stripped diet (T2).