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Growth Performance of Oreochromis Niloticus Fry Fed with Two Different Starter Diets

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study was conducted at Joseph Sarwuan Tarka University, Benue State, Nigeria to assess the growth performance of Nile tilapia (*Oreochromis niloticus*) fry fed Coppens and Skretting starter diets. A total of 200 fry were stocked at a density of 50 fry per 50 litre tanks. The experimental diets, Coppens and Skretting starter feeds were administered 4 times daily to satiation for a period 8 weeks (56 days) in two replicates per diet, utilizing four aerated plastic tanks. Weekly sampling was conducted to evaluate specific growth rate (SGR) and survival rate across the treatments.

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Statistical analysis revealed to significant differences (p>0.05) between the two diets treatment in terms of weight gain and length increment, although slight variations were observed. The average water temperature and pH during the experiment were 27.45°C ±0.77 and 7.35±0.15, respectively. The results indicates that both feed types performed comparably in promoting growth and survival rates of the fry. However, considering the higher costs of Coppens feed, Skretting starter feed is recommended as a more cost-effective alternative for aquaculture operations.

Keywords: Growth performance; survival rate; Nile tilapia; fry; coppens; skretting.

1. INTRODUCTION

Feeding plays a crucial role in the successful culture of *Oreochromis niloticus* (Nile Tilapia), especially during the fry stage when nutritional needs are particularly high. Proper nutrition at this early stage of development is essential for maximizing growth rate ensuring healthy development and improving survival rates. Fish nutrition plays a significant role in promoting the growth performance as well as sustaining the health of cultured fish. Artificial diets manufactured from various feed ingredients act as the primary source of nutrition in intensive aquaculture systems. Cultured fish are fed with different diets of complete feeds based on species, age, and production purpose in which protein is the limiting factor. Protein, carbohydrates, and lipids are distinct groups of nutrients that the body metabolizes to produce the energy needed for physiological processes and physical activities (Otoh *et. al*., 2022; Otoh *et. al*., 2023; Otoh *et. al*., 2024 a; b; c; d).

Food is an essential component of an organism for its growth, development, reproduction, and other physiological activities are dependent on the energy generated by the consumed food material. Feeding is an important physiological activity of fishes like other living organisms. Fish require nutrients for growth, reproduction, and other normal physiological functions. In a natural aquatic environment, phytoplankton, zooplankton, plant materials, insects, insects' larvae, worms, and smaller fish are the major food types of fish (George, *et. al*., 2011). Fish tend to show a preference for particular food items within their environment. The availability of food in any aquatic environment determines the well-being and reproductive potential of fish (George, *et. al*., 2013; Keyombe *et al.,* 2015). The weight and size of fish are a reflection of food availability in the aquatic ecosystem (Bolarinwa and Popoola, 2014).

Nile tilapia (*Oreochrois niloticus*) is the most preferred cultured fish species in many tropical and subtropical countries of the world and constitute the third largest farmed finfish with annual production growth rate of about 11.5%. Nile tilapia (*O. niloticus*) is a well-known tropical food fish native to Africa. *O. niloticus* are principally herbivorous, although occasionally omnivorous. The fish is an efficient converter of waste foodstuff and appears to thrive well on artificial supplemental feed (Omoregie, *et al.,* 2009).

Tilapia farming is more acceptable, technically and economically more viable and sustainable. Tilapia culture is a profitable enterprise and even subsistence farmers in Nigeria can afford to culture tilapia to augment their income. Tilapia is consumed by poor people as it is relatively low-priced commodity. They are mainly of commercial importance in aquaculture because they are highly resistant to diseases, exhibit rapid growth, efficient feed conversion, breed in captivity, and have good consumer acceptance (Nyonje, *et al.,* 2011). A variety of factors influencing its growth rate include sex, stocking density, decrease in water temperature, and supplemental feeding (Liti, *et al.,* 2005; Mizanur, *et al.,* 2014).

Many environmental factors, such as water temperature, food availability, stocking density and environmental conditions, influence the food selection behavior of fish. The size of food items and the size and age of fish can also determine their food selection behavior (Otieno *et al.*, 2014). Mainly, fish feed on items that can fit into their mouth and what their stomach can digest. As fish grow, the stomach becomes longer and their digestive system becomes more developed. However, the feeding rate relative to body weight decreases, whereas the absolute rate of food consumed increases (Wakil, *et al.*, 2014). Therefore, administering quality feeds to fish is of great importance as it plays an important role in its growth as well as behavior of the fish.

It is important to note that the early-stage development of organism (fish) determine the successful growth and development of that organism. The fry stage of Nile Tilapia (*O.*

nitoticus) is a critical and fundamental stage. They are most fragile and reactive to any sudden change, positive or negative. Good management and feeding during this period are important for sustainable growth.

The selection of an appropriate starter diet is thus a critical decision for aquaculture operations seeking to enhance production efficiency and sustainability. This study focuses on comparing the growth performance of *O. niloticus* fry fed with Coppens and Skretting starter diets, evaluating factors such as growth rates, survival rates and proximate composition. By identifying the more effective feed for this species, the study aims to provide insights that can help improve Tilapia farming practices.

2. MATERIALS AND METHODS

2.1 Study Area

The study was carried out in the departmental hatchery unit at Joseph Sarwuan Tarka University Makurdi, the state capital of Benue State. The state lies in the middle of the country and share boundaries with five others namely, Nasarawa to the North, Taraba to the East, Cross-River to the South, Enugu to the South-West and Kogi to the West. The State also shares a common boundary with the Republic of Cameroon on the South-East.

2.2 Experimental Fish

A total of 200 Nile tilapia (*Oreochromis niloticus*) fry were used as experimental fish.

2.3 Experimental Diets

The starter diets used to evaluate the growth performance of *Oreochromis niloticus* are Coppens and Skretting starters. The diets were obtained from a fish feed seller in Makurdi.

2.4 Experimental Setup

The experiment was conducted for a period of 8 weeks. 4 (four) plastic tanks. (50-litre), each half-filled with water was aerated continuously using air compressor. A total number of 200 fry were obtained from fish seed production unit at the Joseph Sarwuan Tarka Research Fish Farm and acclimatized to laboratory conditions for 7 days and distributed randomly into the four-plastic tanks. (50 fish per tank) representing two starter dietary treatments. The fry was divided into 4 groups (50 each) and placed into 4 plastic tanks. Two replicates of plastic tanks were used for each experimental diet. The fry was fed 4 times daily to satiation; in the morning at 9:00 am, afternoon at 12:00 pm, in the late afternoon at 3:00 pm and evening at 6:00 pm. The water quality parameters such as dissolved oxygen, pH, temperature, Total dissolved solids, electrical conductivity, were monitored using multichannel water quality parameter kit.

2.4.1 Water quality parameters

Water quality parameters that were measured include temperature, electrical conductivity, dissolve oxygen, total dissolved solids and pH. These parameters were measured based on the standard methods describe by (APHA, 2005)

2.4.2 Growth indicators and feed utilization

Growth indicators and feed conversion, in terms of survival rate (SR), weight gain (WG), percentage of weight gain (%WG), specific growth rate (SGR), length gain (LG) and growth rate (GR) were determined using the following equations:

SR = (final fish number / initial fish number) ×100,

WG = final weight (g) - initial weight (g)

WG (%) = 100 × [final weight (g) - initial weight (g)] / initial weight (g)

LG = final length (l) - initial length (l)

SGR = 100× [Ln (final weight) - Ln (initial weight)] / experimental period

2.5 Data Analysis

Analysis of variance (ANOVA) was used at 95% significance level to test for significant differences between the various treatment means obtained for the growth and feed utilization (WG, WG%, DGR, SGR, FCR and PER) and body Fisher's Least Significant Differences test (LSD-test) will be applied to compare the average values (means ± standard deviation) and the significant differences was defined at $p < 0.05$.

3. RESULTS

3.1 Growth performance of *Oreochromis Niloticus* fry Fed Different Starter Diets

Table 1. shows the mean growth performance of *Oreochromis niloticus* fry fed two different treatment diets. There is an observable

Table 1. Mean growth performance of *Oreochromis niloticus* fry fed different starter diets

Growth Parameters	Treatments		P-Value
	Coppens	Skretting	
Mean Weight Gained	1.02±0.03[a]	0.63±0.04[b]	0.01
Mean Length Gained	3.47±0.07[a]	2.75±0.05[b]	0.01
Growth Rate	0.018±0.00[a]	0.01±0.00[a]	0.13
Specific growth Rate	0.039±0.00[a]	0.031±0.00[b]	0.00
Survival Rate	75.00±1.00[a]	41.00±1.00[b]	0.00

**Means in the same row with different superscripts differ significantly*

Table 2. Mean water quality parameters of experimental media

Water Quality Parameters	Treatments		P-Value
	Coppens	Skretting	
Dissolved Oxygen	4.10±0.20[a]	3.80±0.20[a]	0.40
Temperature	27.50±0.00[a]	27.45±0.15[a]	0.77
pH	7.35±0.15[a]	7.35±0.05[a]	1.00
Total Dissolved solids	210.50±0.50[a]	230.10±0.00 [a]	0.02
Electrical Conductivity	610.50±2.50[a]	633.00±0.00[a]	0.42

**Means in the same row with different superscripts differ significantly*

Table 3. Mean proximate composition of *Oreochromis niloticus* fry fed different starter diets

Proximate Components	Treatments		P-Value
	Coppens	Skretting	
Crude Protein	56.96±0.08[a]	56.72±0.16[a]	0.32
Fat	20.68±0.47[a]	20.00±0.35[a]	0.37
Ash	12.72±0.25[a]	13.01±0.12[a]	0.39
Moisture	4.74±0.60[a]	5.55±1.09[a]	0.58
Crude Fibre	0.00±0.00	0.00±0.00	_

**Means in the same row with different superscripts differ significantly*

significant difference between treatment 1 and treatment 2 (P<0.05). Coppens diet was higher than Skretting in all the parameters studied, mean weight gain, mean length gain, growth rate, specific growth rate and survival rate, 1.02±0.03, 3.47±0.07, 0.018±0.00, 0.039±0.00 and 75.00±1.00 respectively. treatment 2 (P<0.05). Coppens diet was higher than Skretting in all the parameters studied, mean weight gain, mean length gain, growth rate, specific growth rate and survival rate, 1.02±0.03, 3.47±0.07, 0.018±0.00, 0.039±0.00 and 75.00±1.00 respectively.

3.2 Water Quality Parameters

Table 2. shows the mean water quality parameters of each of the treatment. Here, the water quality parameters in the two treatments do not differ significantly except for TDS and electrical conductivity that is slightly higher in Skretting diet.

3.3 Proximate Composition of *Oreochromis niloticus* Fry fed different Starter Diets

Table 3. below shows the proximate composition of *Oreochromis niloticus* fry fed two different treatment diets. There is no significant difference between the proximate composition of the two starter diets, but Coppens fed fry had higher CP (56.96±0.08) and fat (20.68±0.47) than that of Skretting which recorded 56.72±0.16 and 20.00±0.35 for CP and fat but lower in Ash. No significant difference was observed in all the parameters.

4. DISCUSSION

The present study was aimed at comparing the growth performance of *O. niloticus* fry fed with two different Starter Diets (Coppens and Skretting). The water quality parameters showed little variation in electrical conductivity and TDS. However, the range of temperature

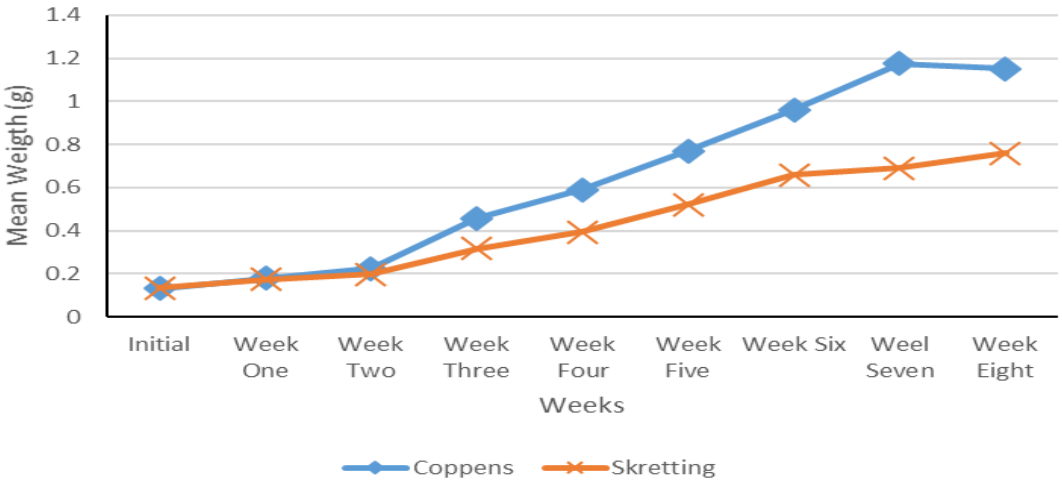

Fig. 1. Mean weekly weight of *oreochromis niloticus* fry fed different starter diets

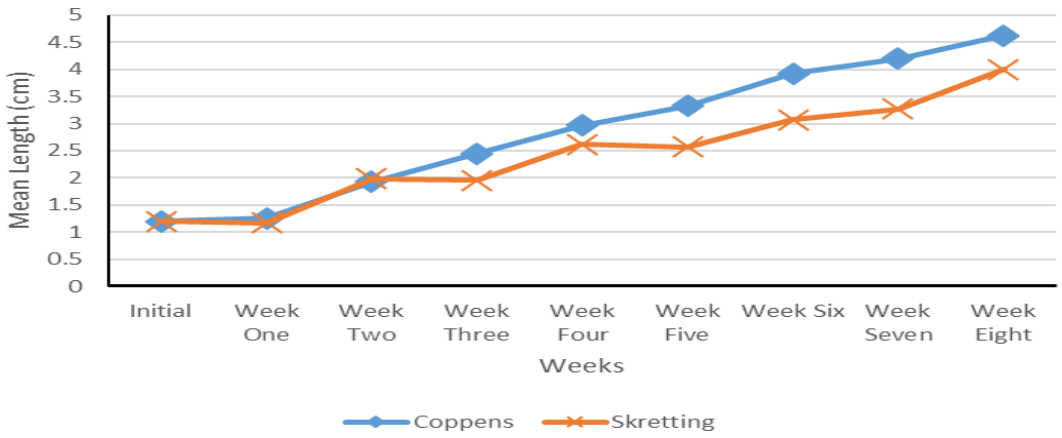

Fig. 2. Mean weekly length of *oreochromis_niloticus* fry fed different starter diets

(27.4°C-27.5°C), pH (7.3-7.3) and dissolved oxygen (3.8-.4.1mg/l) obtained were favorable for fish culture and were within the range described as optimal by Jamabo *et al.,* (2015) and Jonah and George (2019). Balogun *et al.*, 2004 reported a higher specific growth rate (SGR) value of 3.19% using Coppens, Vital and Ajanla feed, which may be due to feeding frequency and the type of feed. With respect to specific growth rates, *O. niloticus* fed Coppens diets showed a higher performance than those fed with Skretting diet. The high growth rate recorded in Coppens fed fry may be attributed to the high nutritive value of the feeds and tolerable physico-chemical parameters.

The problem associated with the low survival rate in Skretting fed fry arose due to the change in the physico-chemical parameters of the water. The ability of an organism to utilize nutrients especially protein will positively influence its growth rate (Sogbesan and Ugwumba, 2008). The growth of fish depends upon the ingredients and its percentage in the formulated feed (Glencross, *et al.,* 2007).

The results of this study shows that mean weight of Coppens fed fry increases up to week 7 and then reduces on week 8 while Skretting fed fry increases up to week 8. However, Coppens fed fry had higher mean weight gain, mean length gain, growth rate, specific growth rate and survival rate than Skretting fed fry. Coppens fed fry also had better results in terms of proximate composition. The better growth rate exhibited by Coppens fed fry can be attributed to good feed quality in terms of its proximate composition (CP, fat and ash), acceptance of feed by fish and tolerance to physio-chemical water parameters,

feed utilization, which resulted in better growth performance and high survival rate. Conclusively, among the experimental feeds, Coppens is the best starter feed because the fish fed in this group showed better results than those fed with Skretting starter feed.

5. CONCLUSION

The growth performance of *O. niloticus* fry fed with Coppens and Skretting starter diets revealed that fry fed with Coppens showed superior results in key growth parameters such as mean weight gain, length gain, specific growth rate and survival rate. In addition, the proximate composition of fry fed with Coppens was also more favourable. Therefore, it is recommended that Coppens starter diets be used for *O. niloticus* fry in aquaculture, as they promote better growth performances and survival rate compared to Skretting starter diets.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that they have no known competing financial interests OR non-financial interests OR personal relationships that could have appeared to influence the work reported in this paper.

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