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Effects of Two Commercial Feeds on Growth and Survival of Tilapia *Oreochromis niloticus* (Linnaeus, 1758) Larvae Reared in Happas at Layo (Dabou)

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Abstract

A study was conducted from February 20 to April 20, 2025, at the Layo experimental station (Dabou) to assess the effects of commercial feeds on the growth performance and survival of *Oreochromis niloticus* larvae. Thus, 300 individuals of average weight 0.02± 0.001 g and average length 11.13± 1.03 mm were divided into two groups of 150 subjects each (Batch 1: fed with Koudijs feed and Batch 2 : fed with Dibaq feed). The batches were treated in triplicate at a density of 1 individual per liter of water. Each week, 10 fish sampled at random from each happa were weighed and measured individually. Physico-chemical parameters were also measured. At the end of the trial, all live fish were counted by batch and measured. The results showed that the average physico-chemical parameters obtained in the happas were 27.63 ± 0.08°C for temperature, 6.23 ± 0.12 mg/l for dissolved oxygen and 6.73 ± 0.06 for pH. These values were in line with recommended standards for rearing this species. In terms of zootechnical performance, batch 2 performed best in terms of weight (1.65 ± 0.29 g), length (45.2 ± 2.96 mm) and ADG (0.018 ± 0.006 g/d). In contrast, the survival rate of larvae fed with Koudijs (Batch 1) was 99.33 ± 0.88%, higher than that of individuals fed with Dibaq (96 ± 1.33%). Similarly, the biomass of batch 1 (49.66 ± 0.44 g) was higher than that of batch 2. In short, it would be interesting to repeat this study over a longer period for a clearer conclusion.

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Keywords

Oreochromis niloticus, Feed, Growth, Survival rate, Dabou.

Introduction

Aquaculture remains the fastest-growing food production sector in the world (FAO, 2020). However, in recent years, annual landings of this foodstuff supplied by the world's fisheries have stagnated or even fallen, to around 90.3 million tonnes per year (FAO, 2022).

The yearbook of fisheries and aquaculture statistics puts average per capita consumption per year at 25.6 kg in Côte d'Ivoire (MIRAH, 2019). However, national fisheries production is struggling to reach 100,000 tonnes for a requirement of over 618,182 tonnes Yayo N'cho *et al.,* (2020). The shortfall is made up by imports of frozen fish, which result in a substantial outflow of foreign currency. To facilitate local self-sufficiency in fish, the Ivorian government has set up research structures, including the Oceanological Reasearch Center (ORC). One of the ORC's main missions is to identify and study local species with high aquaculture potential, in order to

make them available to fish farmers. Among these species, the tilapia *Oreochromis niloticus* is a good candidate for fish farming. Its flesh is highly prized by the local population. The species also has good resistance to handling and is fast-growing. However, the search for good-quality, low-cost feed to improve the breeding of this species remains problematic. More detailed knowledge of the role played by commercial feeds in the growth and survival of tilapia larvae *Oreochromis niloticus* is therefore required. So, what is the effect of commercial feeds on the growth and survival of larvae of this fish species?

The main aim of this work is to help improve production of this species. Specifically, the aim is to evaluate the quality of the farm water and to determine some of the fish's zootechnical parameters.

Materials and Methods

Study area

The study took place at the Layo Aquaculture Experimental Sation, from February 20 to April 20, 2025. This station is located on the north bank of the Ebrié Lagoon, about 40 km west of Abidjan on the Abidjan-Dabou axis (Figure 1).

Biological material

The animal biological material consisted of 300 larvae of *Oreochromis niloticus* (Figure 2). These larvae were obtained from a reproduction carried out in a breeding happa at the Layo Experimental Station. They had an initial average weight of 0.02± 0.001 g and an initial average length of 11.13± 1.03 mm.

Commercial Koudijs and Dibaq (Figure 3), with a diameter of 2 mm, were used for feeding.

Technical equipment

The technical equipment used consisted of:

- a Fisher Scientific digital balance, accurate to 0.01 g with a maximum capacity of 600 g, for weighing the larvae during sampling and the daily ration;
- a 30 cm graduated ruler, to measure fish size during sampling;
- an HQ Series multi-parameter, to determine the temperature, dissolved oxygen and pH of the rearing water;
- a landing net with 6 mm mesh handles, for harvesting fish during sampling;
- buckets and other containers, for transporting fish during sampling;
- rubber bowls, to serve the daily ration;
- trays for transporting the daily ration.

Farming structure

This experiment required the use of six (06) happas measuring 50 cm long, 40 cm wide and 40 cm high. The water height in each happa was around 25 cm, giving a water capacity of around 50 liters. They were constructed from 1.5 mm fine mesh mosquito netting and arranged in two rows of three happas (Figure 4). Each happa was supported by four Chinese bamboo poles, firmly embedded in the ground.

Methodology applied

Constitution of experimental batches

Before setting up the experimental batches, 30 larvae were selected (at random) from a breeding happa, weighed and measured individually using a precision balance and a graduated ruler, to determine their average weight and initial average total length. To carry out the experiment, 300 individuals were selected and divided into two batches (Batch 1, Batch 2) of 150 subjects each. The batches were treated in triplicate at a density of 1 individual per liter of water, i.e. 50 individuals / happas. The batches were as follows

- Batch 1: where larvae were fed with Koudijs feed;
- Batch 2: larvae fed with Dibaq feed.

Breeding

The larvae were fed at 10% of their biomass with a daily ration distributed manually at 7 a.m, 11 a.m and 3 p.m. Weekly sampling was carried out to monitor zootechnical parameters. To do this, 10 individuals were taken at random from each happa and then weighed and measured individually, using a precision balance and a graduated ruler respectively. At the end of the experiment, all larvae were manually counted, measured and weighed. In addition, temperature, pH and dissolved oxygen were measured using the multi-parameter, once a week and on a constant day. To do this, the device's probe is immersed directly in the water, then switched on. After stabilization, the values displayed were recorded.

Zootechnical parameters determined

- Growth in weight and length

Average weight was estimated using the following formula:

Aw () = Sum of weights of individuals weighed / Total number of individuals weighed.

Average length was calculated as follows:

Al (mm) = Sum of lengths of subjects weighed / Total number of subjects weighed

- Average Daily Gain (ADG)

It is calculated as follows:

ADG (g/d) = (Average final weight - Average initial weight) / Rearing period

- Survival rate (SR)

SR (%) = (Number of remaining fish / Number of initial fish) X 100

- Final Total Biomass (FTB)

The final total biomass is the total weight of all remaining individuals in each batch, at the end of the experiment.

Data processing and analysis

The data collected was processed using a computerized tool. Values were expressed as average ± standard deviation. Excel version 2016 was used to enter and organize the data, and to produce the graphs. Some results were subjected to a one-way analysis of variance (ANOVA) using STATISTICA 7.1 software. The significance threshold was 5%. The result obtained was significant if the weight is less than 0.05 and non-significant if the weight is greater than 0.05.

Results and Discussion

Farm water physico-chemical parameters

The data collected during rearing are shown in Table 1. The temperatures obtained varied little. This variation ranged from 27.50 ± 0.02°C to 27.77 ± 0.03°C, with an average of 27.63 ± 0.08°C. Dissolved oxygen levels also varied slightly overall. Calculated values ranged from 6.03 ± 0.12 to 6.33 ± 0.14 mg/l, with an average of 6.23 ± 0.12 mg/l. With regard to pH, a relatively slow evolution was observed. Values ranged from 6.62 ± 0.41 to 6.83 ± 0.67, with an average of 66.73 ± 0.06.

In fish farming, fish survival and growth are influenced by physico-chemical parameters such as pH, temperature and dissolved oxygen (Imorou Toko *et al.,* 2013). During the course of this study, the values recorded for physico-chemical parameters did not vary greatly. They all fell within the range favorable to optimal fish growth and survival. According to Dcada *et al.,* (2015), the optimum temperature for rearing this species is between 25 and 30°C. Average dissolved oxygen was in line with the value recommended for tilapia rearing by El-Sayed (2020). For this author, the level of dissolved oxygen in tilapia farming to ensure optimal survival and growth must be higher than 5mg/l. Similarly, the average pH has evolved in the same direction as that recommended by Boyd *et al.,* (2017), who showed that the suitable average for fish farming should be between 4.5 and 8.5. Similarly, other authors such as Lawson (1995); Tarazona and Munoz (1995), and Ross (2000) have shown that the recommended range for good growth in farmed fish is 27-29°C for temperature, 6.5 to 9 for pH and greater than 2.3 mg/l for dissolved oxygen. The compliance of the values obtained with the recommended standards could be explained by the fact that the experiment took place in a suitable aquatic environment. In fact, the maintenance activities carried out during the study, i.e. renewal of the rearing water and cleaning of the experimental happas, contributed to obtaining good physico-chemical parameters.

Zootechnical performances

Growth in weight and length

The variation in the average weight of the fish is illustrated in Figure 5. From 0.02± 0.001 g at the start of the experiment, the average weight of the subjects reached 1.50 ± 0.41 g for the Koudijs feed and 1.65 ± 0.29 g for the Dibaq feed at the end of the experiment. Weight growth evolved in two main phases. From D0 to D14, there was a rapid increase in average weight, with the two curves superimposed. From D14 to D42, weight growth was spectacular in both batches. However, the growth of fish fed with Dibaq remained slightly above that of the Koudijs-fed batch, rising from 0.32 g to 1.65 g for Dibaq-fed larvae and from 0.29 g to 1.52 g for

Koudijs-fed larvae. However, no significant differences ($p>0.05$) were statistically observed.

The curve representing the length of the individuals is shown in Figure 6. The trend in total average length followed a similar pattern to that of weight growth. For both batches, total average lengths evolved rapidly and were merged from D0 to D14. From D14 onwards, larval growth in the Dibaq-fed batch was slightly higher than in the Koudijs-fed batch, until the end of the experiment (D42). Values ranged from 26.46 mm (D14) to 45.2 mm for batch 1 and 43.56 mm for batch 2. However, the values were not significantly different ($p>0.05$).

Data on the average weight and average length of *Oreochromis niloticus* larvae showed that the fish gained weight and size over time for both feeds used. This result could be justified by the fact that the feed used was of good quality and suitable for larval feeding.

According to N'dri *et al.,* (2024), a good quality of feed correlated with the positive effect of the rearing environment results in good fish growth. However, the superior growth observed with the Dibaq feed could be justified by the fact that this feed was more highly valued than the Koudijs feed.

Average daily gain (ADG)

Table 1 shows the ADG values of the larvae during the different sampling periods for each type of feed. For the Koudijs feed, values ranged from 0.016 ± 0.001 to 0.060 ± 0.018 g/d at week 1 and week 5 respectively. For the Dibaq feed, they ranged from 0.018 ± 0.002 to 0.049 ± 0.002 g/d. These extreme values were recorded in weeks 1, 5 and 6 respectively.

Over the whole duration of the experiment, the highest ADG was obtained with the Dibaq feed (0.018 ± 0.006 g/d) in contrast to that of the Koudijs feed, which was 0.016 ± 0.007 g/d.

The same observations regarding average weights are highlighted in the ADG obtained. Thus, the ADG of larvae fed with Dibaq food (0.018 ± 0.006g/day) was higher than that of fish fed with Koudijs food (0.016 ± 0.007g/day). However, compared to what FAO (2012) reports, the growth of larvae during our experiment was relatively low with both foods. Indeed, FAO (2012) observed a ADG of 1 g/day in this same species.

Survival rate (SR)

At the end of the experiment, the survival rate of individuals fed with the Koudijs diet (99.33 ± 0.88%) was higher than for those fed with the Dibaq diet (96 ± 1.33%). However, no significant difference ($p>0.05$) was observed.

The survival rate of larvae rationed with the Koudijs feed at the end of the experiment was higher than that obtained with the Dibaq feed. However, overall survival rates remained very high for both feeds. In all cases, the survival rates recorded were higher than the 80% described by Gangbé *et al.,* (2022) as a good survival rate. On the other hand, they were close to those of N'dri *et al.,* (2024), who obtained survival rates ranging from 98.67% to 100%, in their study on tilapia Sarotherodon melanotheron reared in happas. These high survival rates are thought to be linked to the fish's development under excellent rearing conditions. The low losses recorded would certainly be linked either to stress caused by handling during sampling, or to natural mortality.

Table.1 Water temperatures, dissolved oxygen and pH recorded during rearing

Week	Temperature (°C)	Dissolved oxygen (mg/l)	pH
Week 1	27.50 ± 0.02	6.03 ± 0.12	6.62 ± 0.41
Week 2	27.57 ± 0.03	6.18 ± 0.15	6.66 ± 0.45
Week 3	27.67 ± 0.04	6.23 ± 0.18	6.69 ± 0.49
Week 4	27.70 ± 0.01	6.28 ± 0.13	6.76 ± 0.53
Week 5	27.77 ± 0.03	6.33 ± 0.14	6.83 ± 0.67
Mean	27.63 ± 0.08	6.23 ± 0.12	6.73 ± 0.06

Table.2 Average daily gain of *Oreochromis niloticus* larvae as a function of time and type of feeds distributed

ADG (mg/d)		
Period	**Koudjis Feed**	**Dibaq feed**
Week 0 - Week 1	0.016 ± 0.001	0.018 ± 0.002
Week 1 - Week 2	0.023 ± 0.002	0.025 ± 0.0002
Week 2 - Week 3	0.027 ± 0.004	0.030 ± 0.003
Week 3 - Week 4	0.040 ± 0.008	0.038 ± 0.003
Week 4 - Week 5	0.060 ± 0.018	0.049 ± 0.002
Week 5 - Week 6	0.016 ± 0.007	0.018 ± 0.006
Week 0 - Week 6	**0.016 ± 0.007**	**0.018 ± 0.006**

Figure.1 Geographical location of the Study Area

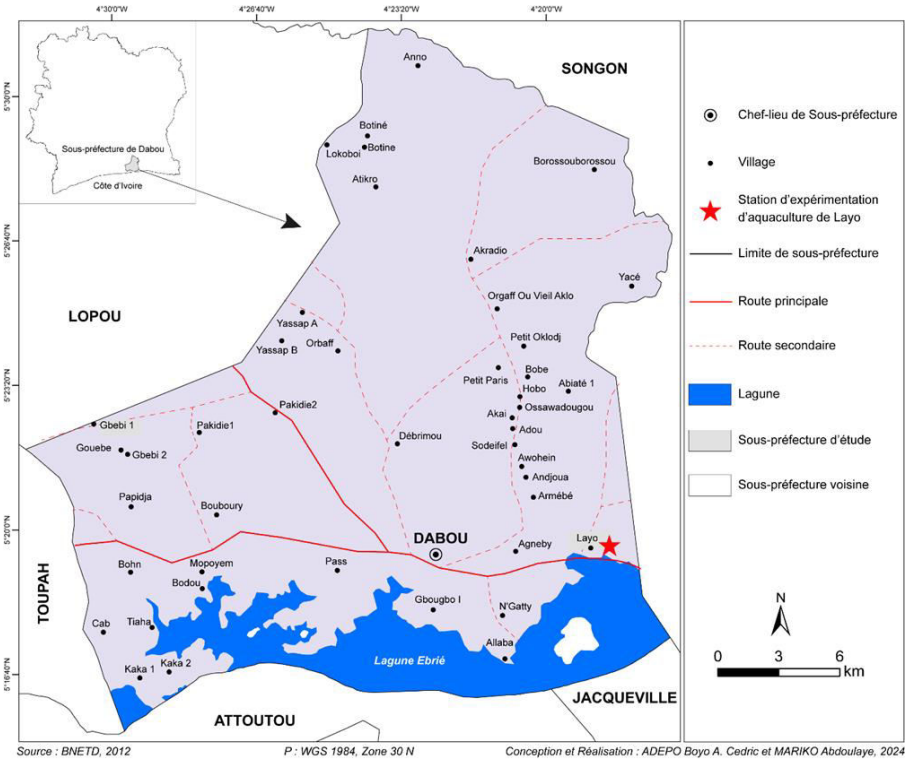


Figure.2 Tilapia *Oreochromis niloticus* larvae

Figure.3 Commercial feeds used

Koudijs feed	Dibaq feed
	

Figure.4 Installation of experimental happas

Figure.5 Variations in weight of tilapia *Oreochromis niloticus* larvae as a function of time and feed type**.**

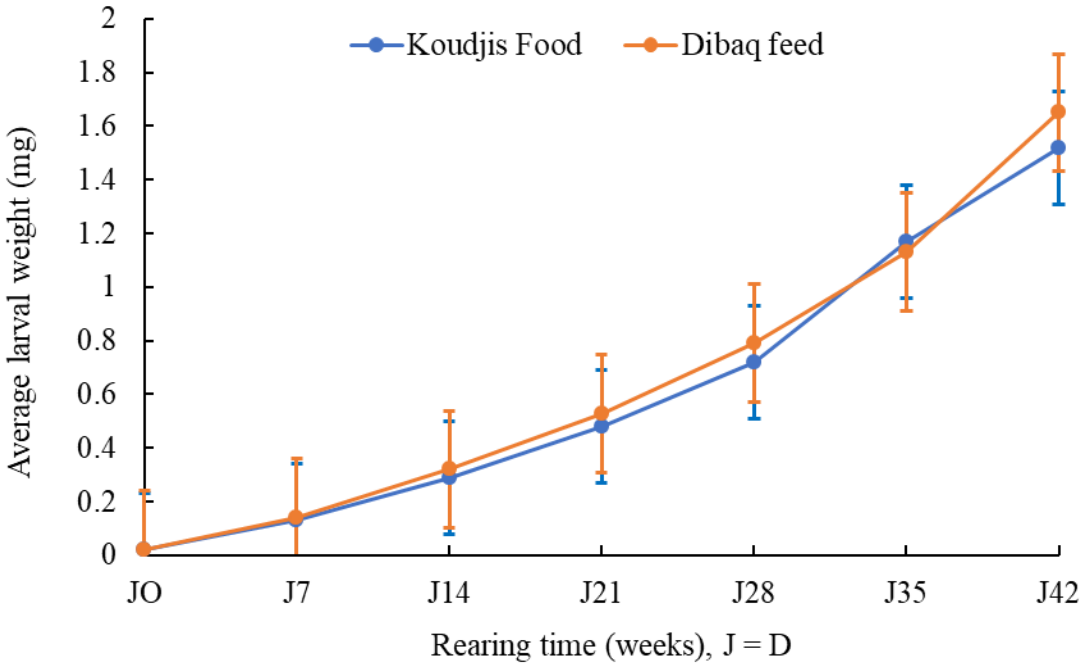
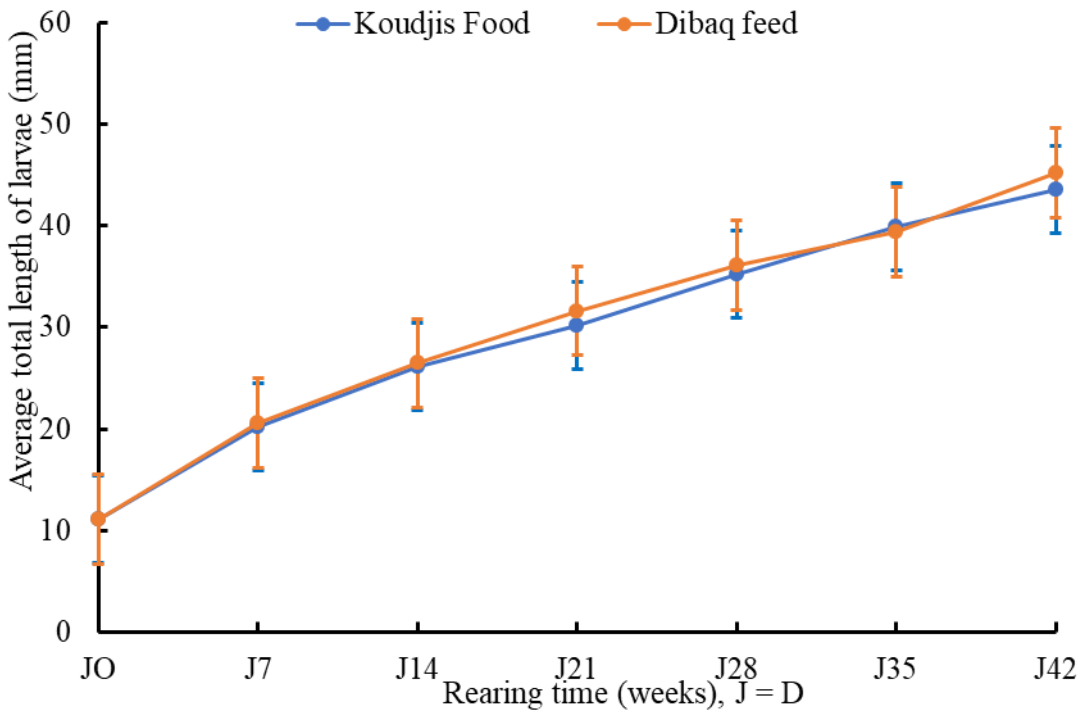


Figure.6 Evolution of total average length of *Oreochromis niloticus* larvae as a function of time and feed type.



Final total biomass

At the end of our work, the final average biomasses obtained were 48.00 ± 0.66 g for the Dibaq feed and 49.66 ± 0.44 g for the Koudijs feed, with no significant difference ($p>0.05$).

Conclusion

This study evaluated the effect of two commercial feeds, Dibaq and Koudijs, on the growth and survival of Tilapia *Oreochromis niloticus* larvae reared in happas. Results obtained after 06 weeks showed that these feeds had a positive effect on the zootechnical performances studied in these fish. Larvae fed with Dibaq had the best average weight, average length and ADG. However, the best survival rates and biomass were obtained by larvae fed with Koudijs. In short, this study shows that *Oreochromis niloticus* adapts well to happas rearing and that good aquaculture practices have a positive influence on fish size, weight and survival rates.

Conflict of interest

The authors declare that they have no competing interests.

Authors contributions

KMN, YLA and TO designed and carried out the study. TK and MD carried out the experimental data processing. KMN and YNA prepared the draft manuscript. KY supervised the work. All authors critically reviewed the manuscript and approved the final version.

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