International Journal of Recent Engineering Research and Development (IJRERD)
ISSN: 2455-8761
www.ijrerd.com || Volume 09 – Issue 03 || May - Jun 2024 || PP. 01-10

Effect of protein level on the zootechnical and economic performance of Tilapia, *Oreochromis niloticus* (Linnaeus 1758) case of the local strain and GIFT raised in hapas in Kalemie, DR Congo

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Abstract: The present study aims to evaluate the performance of local Tilapia against the GIFT strain, above all, to determine the protein content in the food which is both economically profitable and favors obtaining better weight gain.

A batch of 240 fry including 120 of the local strain and 120 others of the GIFT strain, with an initial average weight of 9.88±1.73 g and 10.10±2.31 g respectively for the local strain and GIFT, was subjected to three types of foods different in their protein content: AL1 (35% protein), AL2 (37.5% protein) and AL3 (40% protein). The experiment was carried out using a factorial design with two levels and three repetitions (2x3 factorial). The results show that after 35 days of experimentation, the average daily weight gain is 1.23±0.11 g/d for the GIFT strain and 1.20±0.09 g/d for the local strain. The food (AL3), containing 40% protein, had a high value of 1.21±0.09 g/d. The feed cost per kg of growth shows that the GIFT strain gave a lower value of 2214.40±196.83 CDF and the feed containing 37.5% protein gave a value of 2192.59±189.43 CDF.

In fish farms, it is preferable to use fry of the GIFT strain and in the extreme case the use of the local strain with a food containing 37.5% protein because this leads to obtaining good weight growth of tilapia fry while minimizing the production cost per kg of fish.

Keywords: Tilapia strain, *Oreochromis niloticus*, protein level, zootechnical and economic performance Kalemie.

1. Introduction

In DR Congo, natural fishing on the various bodies of water still remains artisanal and far from meeting the national demand for fish. As a result, the country's fish supply deficit becomes enormous with fish production estimated at only around 250,000 tonnes/year, against a demand of more than 800,000 tonnes/year, according to several international reports (Alongo et al., 2012). To make up for this deficit, DR Congo imports more than 100,000 tonnes of frozen fish each year; this dependence on imports of fish products constitutes a great threat to food security and a loss of foreign currency for the government; therefore, the Congolese State can compensate for this by promoting national potential through the development of sustainable fish farming.

The cultivation of Nile Tilapia (*Oreochromis niloticus*) dates back to antiquity in Egypt, Africa (Lazard, 1990).

It has a high growth rate, adaptability to a wide variety of rearing conditions and is in high demand by consumers (Kestemont et al. 1989). Its production is successful in both intensive and subsistence systems. *Oreochromis niloticus* has become the pillar of Tilapia fish farming (Lazard, 1990).

The constraints to the development of fish farming are: lack of access to credit, lack of qualified personnel to provide technical supervision, lack of quality fry, lack of technical and financial support as well as the problem of flood which destroys earthen dikes. (Lokinda et al., 2017 and Lumonakiese, 2020). Added to this is the problem of ignorance of the strain of Tilapia capable of responding favorably to the need for zootechnical performance, ignorance of the protein content to best ensure the nutrition of Tilapia and the cost of the kg of growth.

In DR Congo and particularly in Kalemie, Tilapia farming is a promising activity due to the availability of significant water potential favorable to this type of fish farming. The economic interest of intensive and /or semi-intensive depends not only on the availability of feed and the cost of less expensive feed but also on a strain with good zootechnical characteristics. Thus, the reduction of costs linked to feed and control of the cost of production of farmed fish are the priorities in aquaculture (Jauncey and Ross, 1982).

In Kalemie, fish farming exploits local strains of tilapia while fertilizing ponds with agricultural by-products such as rice bran for food, it is more than urgent and important to find other ways and means to achieve the elimination of this extensive exploitation to thus allow fish farmers to make their activities profitable. ; The objective of this study is to evaluate the effect not only of the protein level but also that of the strain on the zootechnical and economic performance of Tilapia, *Oreochromis niloticus* (Linnaeus 1758) raised in hapas in Kalemie. In this part of our work, we test the hypotheses according to which, first of all, among the three protein levels of the food, one would give the best zootechnical performances and would lead to obtaining a lower food cost compared to others and then, the local strain would present good zootechnical performances despite being lower than those of the GIFT strain.

2. Environment, Materials and method

2.1. Environment

The experiment was carried out in the fish farming site of the LBT-A farm located 23 km in the territory of Kalemie, on the Nyuzu axis, province of Tanganyika, South-East of the Democratic Republic of Congo. It is located between latitude 5°46'49.81"S and longitude 29°7'25.89"E and at an altitude of 942 m above sea level.

According to the Koppen classification, it benefits from a humid tropical climate of type Cw5 which is characterized by high temperatures, the average of which is estimated at 29°C. This climate has an alternation of two seasons (the rainy season and the dry season). The rainy season usually begins in November and ends in May. This season has a bimodal rainfall regime divided into two periods of rain interrupted by a short dry period often in February. The dry season goes from May to November. The region experiences an average annual rainfall estimated at 1150 mm. Figure 1 below gives the location of the experimental site.

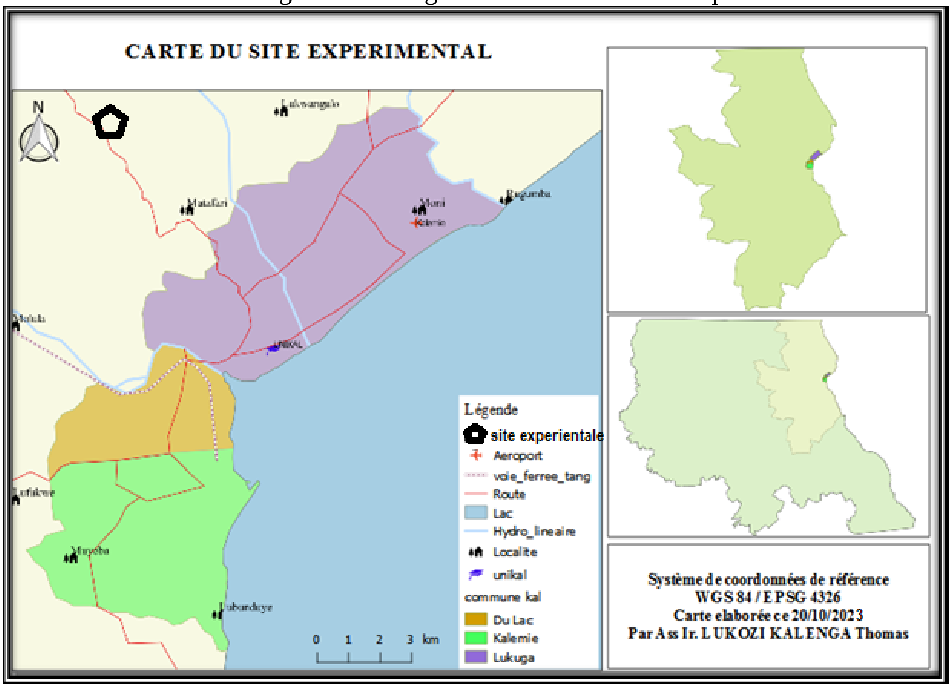

Figure 1. The map of the experimental site

2.2. Material

2.2.1. Biological material

The tilapia fry used came from two different origins, notably the GIFT strain from Bukavu, in the Kashusha hatchery and the local strain was produced from broodstock raised in the Fundiswata hatchery, installed in the LBT-A farm. The selected fry (240 fry) had an average weight of 9.88±1.73 g and 10.10±2.3 g repeatedly for the local strain and GIFT. The stocking density was 10 fry per square meter.

2.2.2. Formulation of rations

In order to test the effectiveness of the rations, three food formulas were put in place, differing in their protein content: AL_1 (35% protein), AL_2 (37.5% protein) and AL_3 (40% protein).

2.2.3. Determination of the proportions and quantities of the basic ingredients

The trial and error method with the Excel spreadsheet was used to determine the proportions and quantities of the different ingredients which are included in the composition of the foods to be tested in order to obtain a final mixture which would titrate 35, 37.5 and 40% protein. All ingredients were purchased from Kalemie.

Table 1: Food incorporation rate based on their bromatological value

Ingredients	AL_1	AL_2	AL_3
Cassava flour	5	5	3
Fishmeal	21	21	24
Blood meal	5	5	5
Toasted soy flour	39	47	51
Palm oil	0,25	0,25	0,25
Corn bran	20	15	10
Rice bran	8,25	5,25	5,25
Methionine	0,25	0,25	0,25
Lysine	0,25	0,25	0,25
Premix	0,25	0,25	0,25
Bone powder	0,25	0,25	0,25
Salt (NaCl)	0,25	0,25	0,25
Yeast	0,25	0,25	0,25

Legend: AL1: food containing 35% protein, AL2: food containing 37.5% protein and AL3: food containing 40% protein.

Table 2: Nutritional contribution of each type of food used per Kg of dry matter

Ingrédients	AL_1	AL_2	AL_3
Energy (Kcal)	3123,7	3211,7	3258,9
TNM	35,2	37,5	40,3
Fat	9,8	11	11,6
CB	2,8	2,2	1,6
Ca	1,4	1,5	1,6
P	1	1	1,1
Lysine	2,5	2,7	2,9
Méthionine	0,8	0,8	0,9

Legend: TNM: Total Nitrogen Matter, CB : Crude fiber; Ca : Calcium, P : Phosphorus.

Table 3: Price in CDF of one kilogram for each ingredient

Ingrédient	Price/kg(CDF)
Cassava flour	600
Fishmeal	1500
Blood meal	500
Toasted soybeans	3000
Palm oil	2000
Corn bran	600
Rice bran	400
Methionine	60000
Lysine	60000
Premix	30000
Bone powder	300
Salt (NaCl)	1500
Yeast	10000

2.3. Method

2.3.1. Conduct of the test

(a.) Distribution of fish into batches:

The stocking of 6 hapas, each of 2m2, was carried out with 20 *Oreochromis niloticus* fry with an initial individual average weight of 9.88±1.73 g and 10.10±2.3 g repeatedly. for the local strain and GIFT.

(b.) Feeding

In hapas, unlike nature, fish can only rely on artificial food to feed themselves, because the environment does not contribute or very marginally due to the high stocking density. The proposed food must therefore be able to meet all the nutritional needs of the fry. These foods were distributed 3 times a day, every three hours: at 8:30 a.m., 11:30 a.m. and 3:30 p.m., for 35 days. The fish, divided into 6 batches, were fed with the 3 experimental foods (AL1: food containing 35% protein, AL2: food containing 37.5% protein and AL3: food containing 40% protein). The food ration was calculated according to a theoretical feed rate based on size classes. For the size chosen during this experiment, a feeding rate of 10% was considered. These quantities of food distributed to the fish were readjusted after each control fishing according to the evolution of the weight of the biomass.

(c.) Control fishing

Control fishing took place every 7 days. This was followed by enumeration in order to best detect the survival rate and the individual and/or average weight gain of the fish, which was carried out on the same day. After each control fishing, the ration was readjusted according to the total biomass obtained.

2.3.2. Parameters observed

(a) Physico-chemical parameters

The physico-chemical parameters of the water such as pH and water temperature were monitored daily at 6 a.m., 12 p.m. and 4 p.m. throughout the duration of the experiment using a pH meter and a thermometer.

(b) Indices used to evaluate growth and economic performance:

To determine the growth of the fish during the experiment and prove the effectiveness of the strains and foods tested, the different zootechnical parameters were calculated. According to Ricker (1979), Tigoli et al. (2017), Zea BI UE et al. (2022), Kalala et al. (2021), survival rate (TS), average weight gain (GPM), average daily weight gain (GPQ), feed utilization rate (FUR) are determined using mathematical formulas.

(1.) Survival rate (SR)

This parameter reinforces the validity of the results obtained and is calculated from the number of fish at the end of the experiment based on the total number at the start of breeding. It can be expressed according to the following relationship:

$$\text{TS (\%)} = \frac{\text{Final number of live fish}}{\text{Initial number of fish}} x100$$

(2.) Daily weight gain (DWG)

Weekly measurements of fry weights made it possible to calculate average daily weight gain (GPQ) by relating the average weight gain during a period over the duration (in days) of the period. It was determined using the following formula:

$$\text{DWG} = \frac{\text{weight gain during the test period (g)}}{\text{duration of the test (g)}}$$

(3.) Food utilization rate

This is the ratio of the quantity of food consumed during a period to the weight gain during this same period. It is unitless and the formula used to determine it is as follows:

$$\text{FUR} = \frac{\text{Quantity of food consumed (g)}}{\text{weight gain (g)}}$$

(4.) Specific growth rate (SGR)

It resembles the average daily weight gain, but this is expressed as a percentage (%) of the weight of the fish for a specific period.

$$\text{SGR} (\%.d^{-1}) = 100.(\ln Wf - \ln Wi).\Delta T^{-1}$$

Including: ln: natural logarithm, Wf: final weight (g), Wi: initial weight (g) and $\Delta T^{-1:}$ time (day).

(5.) Food cost per kg of growth (FC)

The food cost per kg of growth was calculated by looking for the product between the Food Conversion Rate and the price per kg of food, i.e.:

(FC) (CDF) = Food conversion rate x the price per kg of food (CDF)

2.3.3. Statistical analysis of data

The zootechnical and economic parameters were subjected to two-way analysis of variance (ANOVA 2). This test was followed by that of multiple comparisons of the Tukey means for the parameters presenting a significant difference (p-value <0.05) in order to identify specific differences between the batches. The raw data were processed with the Excel 2016 spreadsheet and on the other hand the analyzes were carried out with the R 3.6.2 software.

3. Results

3.1. Physico-chemical parameters

During the test, the physical parameters observed are: temperature of the ambient environment and that of the water, and for the chemical parameters of the water, the pH. Also note that all the hapas were installed in the same pond, this does not allow a variation in the physicochemical parameters between batches.

3.1.1. Ambient temperature (°C)

Ambient temperature of the environment during our test varied with a minimum value of 23°C at 6 a.m. and 4 p.m. observed in the first, second and 3rd week and with a maximum value of 32°C at 12 p.m. observed in the fourth week. Figure 2 below shows the evolution of the ambient temperature during the experiment.

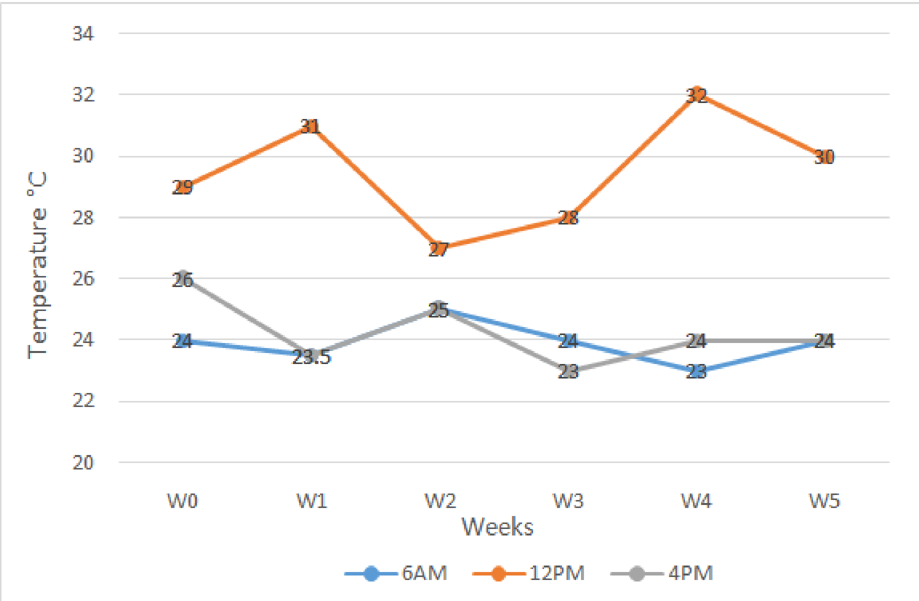

Figure 2: Ambient temperature

3.1.2. Water temperature (°C)

For the water temperature, the minimum value (21°C) was observed in the first week at 6 a.m. and an extreme value of 27°C observed in the 4th and 5th week. Figure 3 below shows the evolution of the water temperature in the pond where the hapas were installed.

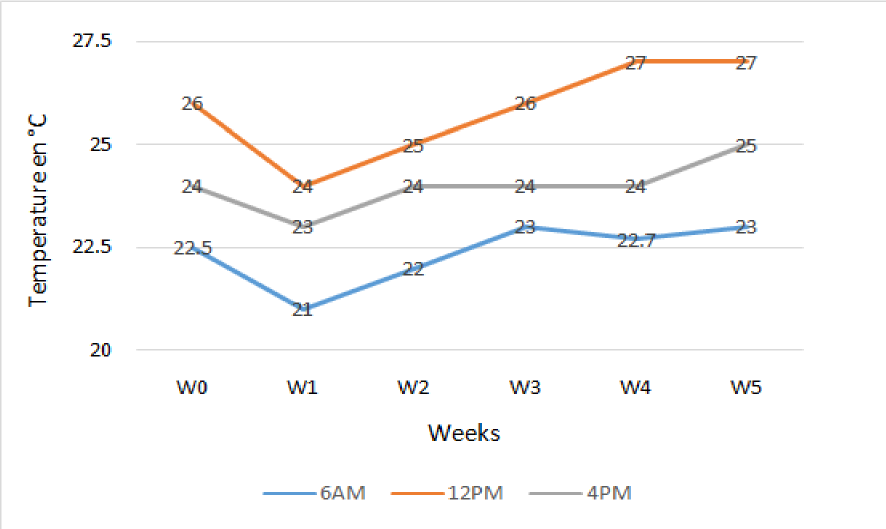

Figure 3: Water temperature

3.1.3. Hydrogen potential

The hydrogen potential during this experiment varied between 6.8 for the second week of the experiment and 7.5 for the start of the experiment and the last week. Figure 4 below illustrates the evolution of the hydrogen potential in the pond where the hapas were installed

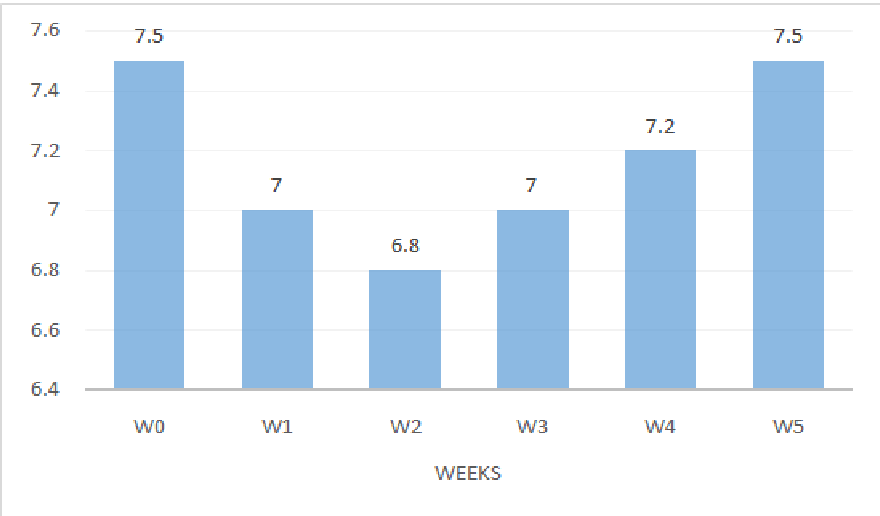

Figure 4: Hydrogen potential

3.2. Weight growth

The results relating to weight growth are shown in Tables 4 below.

Table 4: Average values of the weight evolution of fish

variables	W_0(g)	W_7(g)	W_{14}(g)	W_{21}(g)	W_{28}(g)	W_{35}(g)
Strain	NS	*	NS	NS	*	*
GIFT	10.10±2.31	15.65±2.99a	21.15±2.61	29.15±2.61	37.49±2.61a	51.99±2.99a
Local	9.88±1.73	14.07±2.61b	20.99±2.99	27.99±2.99	36.99±2.99b	50.49±2.61b
Food	NS	NS	***	***	***	**
AL_1	9.82±1.86	14.17±3.01a	19.17±3.01b	25.67±3.01c	33.67±3.01c	45.67±3.01b
AL_2	988±2.37	14.52±2.39a	20.02±2.39b	28.02±2.39b	36.02±2.39b	48.02±2.39ab
AL_3	10.10±1.82	15.90±3.00a	22.40±3.00a	30.40±3.00a	38.40±3.00a	50.40±3.00a

Legend: a, b, c, d: Means in the same column followed by different letters differ significantly at the 5% threshold, * significant ($P < 0.05$); ** very significant ($P < 0.01$); *** highly significant ($P < 0.001$); NS: not significant; W_0: weight on the first day of fattening, W_7, W_{14},W_{21},W_{28},W_{35} : weight on the first, second, third, fourth, and fifth week of fattening, AL_1, AL_2 and AL_3: foods with 35%, 37.5% and 40% protein respectively.

At the start of the experimental phase, the initial average weight depending on the strain was between 9.88±1.73 g and 10.10±2.3 g respectively for the local strain and the GIFT, thus presenting no significant difference between strains (p-value>0.05).

One week (7 days) after the start of the test the weight weight of the tilapia varied between 15.65±2.99 g for the GIFT strain and 14.07±2.61 g for the local strain. After analysis of variance, a significant difference was observed in favor of the GIFT strain (p-value <0.05). In relation to food, it was found that for fish fed with food (AL1) dosing 35% protein had a weight of 14.17±3.01 g and 15.90±3.00 g for food containing 40% protein. The analysis of variance shows that no significant difference was observed (p-value>0.05).

On the 14th day, the weight result of tilapia varied between 20.99±2.99 g for the local strain and 21.15±2.61 g for the GIFT strain, after analysis of variance, no significant difference was observed (p-value>0.05).) and referring to the food, it was observed that 19.17±3.01 g was for the fish fed with the food dosing 35% protein (AL1) and 22.40±3.00 g for the food containing 40% protein; after analysis of variance, a very highly significant difference was observed (p-value<0.001)

On the 21st day, the weight result of tilapia varied between 27.99±2.99 g for the local strain and 29.15±2.61 g for the GIFT strain, after analysis of variance, no significant difference was observed (p-value>0.05) and referring to the food, a weight of 25.67±3.01 g was observed for the fish fed with the food containing 35% protein (AL_1) and 30.40±3.00 g for the food containing 40% protein; after analysis of variance, a very highly significant difference was observed (p-value<0.001).

The average weight at 28 days shows that fish from the local strain gave an average of 36.99±2.99 g compared to fish from the GIFT strain which gave 37.49±2.61 g; after the analysis of variance, a significant difference was observed (p-value<0.05) and in relation to the food, it was observed that 33.67±3.01 g was for the fish fed with the food containing 35% protein (AL1) and 38.40±3.00 g for food containing 40% protein; after analysis of variance, a very highly significant difference was observed (p-value<0.001).

The average weight on the 35th day shows that the fish of the local strain gave an average of 51.99±2.99 g compared to the fish of the GIFT strain which gave 50.49±2.61 g, after the analysis of the variance, a significant difference was observed (p-value<0.5) and in relation to the food, an average weight of 45.67±3.01g was observed for the fish fed with the dosing food 35% protein (AL1) and 50.40±3.00 g for the food containing 40% protein; after analysis of variance, a highly significant difference was observed (p-value<0.01).

3.3. Zootechnical parameters

The average values of zootechnical and economic parameters (SR, DWG, FUR, SGR and FC) are presented in Table 5.

Table 5: Average values of Average Daily Weight Gain (DWG), Food Utilization rate (FUR)and Feed Cost per Kg of growth (FC).

Variables	SR (%)	DWG (g)	FUR	SGR (%/d)	FC (CDF)
Strain	NS	***	***	**	***
Gift	100±00	1.23±0.11a	2.28±0.21a	4.74±0.65a	2214.40±196.83b
Local	100±00	1.20±0.09b	2.21±0.20b	4.71±0.49b	2290.39±210.14a
Food	NS	**	NS	NS	***
AL_1	100±00	1.06±0.10b	2.33±0.23	4.43±0.56	2458.97±243.60a
AL_2	100±00	1.13±0.1ab	2.31±0.20	4.58±0.67	2192.59±189.43b
AL_3	100±00	1.21±0.09a	2.30±0.18	4.62±0.49	2326.02±177.43ab

Legend: Data are expressed as mean ± standard deviation AL_1, AL_2 and AL_3: foods with 35%, 37.5% and 40% protein respectively.

3.3.1. Survival rate (SR)

During 35 days of our experiment, the survival rate remained as is, with the average of 100±0.00% for not only the two strains but also for the three types of food. After analysis of variance, no significant difference was observed for the two factors (p-value>0.05).

3.3.2. Average daily weight gain (DWG):

At the end of 35 days of the experiment, the daily weight gain varied from 1.23±0.11g and 1.20±0.09g respectively for the GIFT strain and the strain local, after analysis of variance, a very highly significant difference was observed in favor of the GIFT strain (p-value<0.001). Regarding the food, the minimum daily weight gain was 1.06±0.10 g for fish fed with food containing 35% protein compared to a maximum of 1.21±0.09 g for the food containing 40% protein. % protein; after analysis of variance, a highly significant difference was observed in favor of fish fed with food containing 40% protein (p-value<0.01).

3.3.3. Food utilization rate (FUR)

this index varied during the experiment between 2.21±0.20 and 2.28±0.21 successively for the GIFT strain and the local strain, after analysis of variance, a difference very highly significant was observed in favor of the local strain (p-value<0.001) and in relation to the food, the means varied between 2.30±0.18 and 2.33±0.23 for the food containing 35% protein and 40% protein, the analysis of variance applied to these results reveals no significant difference between the protein levels used (p-value>0.05).

3.3.4. Specific growth rate (SGR)

The specific growth rate varied from 4.71±0.49 (%/d) for the local strain and 4.74±0.65 (%/d) for the GIFT strain, after analysis of variance, a highly significant difference was observed in favor of the GIFT strain (p-value<0.01). As for the different protein levels used, the averages varied between 4.43±0.56%/d and 4.62±0.49%/d respectively for the food containing 35% protein and 40% protein, the analysis of the variance reveals that no significant difference was observed (p-value>0.05).

3.3.5. Food cost per kilogram of growth (FC)

The average food cost per kilogram of believe varied between 2214.40±196.83 CDF and 2290.39±210.14 CDF respectively for the GIFT strain and the local strain, after analysis of variance, a very highly significant difference was observed in favor of the local strain (p-value <0.001). With regard to the food, the averages varied between 2192.59±189.43 for the food containing 37.5% protein versus 2458.97±243.60 for the 35% protein food, the analysis of the variance reveals that a very highly significant difference was observed to the detriment of the food containing 37.5% protein (p-value <0.001).

4. Discussion

The results obtained during this study sufficiently prove that the use of different protein levels influenced certain parameters on zootechnical and economic performance in tilapia; whether for the local strain or for the imported strain. This is particularly the case for average daily weight gain and the food cost per kg of growth. Furthermore, the survival rate, conversion index and specific growth rate showed no significant difference between protein levels.

The survival rate showed no significant difference for both strains and protein levels. This would be due to the fact that the environmental conditions were identical (hapas in the same pond), the number of fry per treatment remained identical from the start of the experiment until the last day of data collection. This result is not similar to that found by Elhadji et al.(2018). According to them, the survival rate is influenced by the density and the control time (p-value<0.001) for 3 types of densities of the same species with average survival rates of 97.67% for density one, 89% for second and 98.67% for third. In addition, the survival rate of this same population in the process of domestication varies in the same interval observed during previous studies, the values of which are between 75% and 100% regardless of the strain or population studied (Ridha, 2006 ; Bamba et al., 2008); This rate being generally higher than the loss threshold allowed in breeding (90%), this proves that the local strain can be taken into consideration.

Daily weight gain averaged 1.23±0.11 and 1.20±0.09g successively for the GIFT and local strains. This result is almost similar to that found by Sissao et al. (2019) on the same species with average values of 1.03 and 1.46 g/J. On the other hand, it is superior to the result found by Tigoli et al. (2018). Referring to the protein level, the daily weight gain of the fry varied between 1.21±0.09 g (AL1); 1.13±0.11 g (AL2) and 1.06±0.10 g (AL3); these gains are in the range of that found by Dibala et al. (2018) on three types of food ration, varying according to protein content, with an average in ascending order of 1.04 g.d-1; 0.99 g.d-1 and 1.15. This shows that the protein content in the food composition did influence the daily weight gain of the fry. Comparing the average daily weight gain found by other researchers elsewhere, taking into account the previous values, it is clear that the local strain presents interesting results although lower than those of the GIFT strain, however, a good diet of the local strain, a diet rich in crude protein would be responsible for good growth and survival of tilapia Dibala et al . (2018), coupled with a climate of the region (temperature).

Taking into account the specific growth rate of the fry depending on the strain, the results obtained are of the order of 4.74±0.65%/day and 4.71±0.049%/day respectively for the GIFT and local strain. These results are, however, interesting compared to those reported by Dibala et al. (2018) whose specific growth rate varied between 0.73 to 0.90%/day. Furthermore, Jauncey et al. (1982) reported a specific growth rate of 3%/d on the same species and for the same growth stage. Referring to the foods used, 4.43±0.56%/d; 4.58±0.67%/day and 4.62±0.49%/day, successively for AL1, AL2 and AL3; these results are higher than those reported by Iga-iga R. (2008) with 1.56±0.8%/day as the average obtained from fish fed with SMAG food which, according to him, presented the best growth performance.

The food utilization rate observed after analysis of the results presents the averages opposite 2.28±0.21 and 2.21±0.20 respectively for the local strain and GIFT and 2.33±0.23; 2.31±0.2 and 2.30±0.18 respectively for food AL1, AL2 and AL3. In view of this result, it is clear that the food conversion capacity of the local strain is poorer compared to the GIFT strain. On the other hand, although this index is in favor of the GIFT strain, these two indices are superior not only to those found by Zea biue et al. (2022) with the test on three strains of which the Brazilian strain gave a better index of 0.83±0.10 but also with Kalala et al. (2021) who found values between 0.59 and 1.23 after a study on three protein levels (30, 40 and 50%).

In fact, the mediocrity of the index obtained at the end of this experiment could be justified by the fact that the exact quantity ingested by the fish could not be determined: hence, the quantity of food not ingested by the fish fry was taken into account. Especially since Pouemogne (1994) reports that this poor performance can be explained by the form of powdered food which was used in this study, causing a lot of food leaking into the water through leaching. Thus, the quantity of food distributed to the fish is greater than the food consumed.

The feed cost per kg of growth was 2214.40±196.83 and 2290.39±210.14 respectively for the GIFT strain and the local strain. This cost is far higher than what Iga-iga (2008) found, which varied between 257 and 578.10 F CFA, or approximately 1166.63 CDF and 2624.50 CDF. On the other hand, Kalala et al. (2021) obtained values between 1258.2 and 2049.3 FC, these values are lower than those obtained in this study. Furthermore, it is estimated that the more we use locally produced food, the more the cost of production of kg of fish. The high feed cost could be explained by the fact that the formulations incorporated expensive ingredients such as fish meal and soybean into the feed.

Conclusion

The emergence of livestock farming in any nation requires the application and strict respect of certain principles and rules, in order to experience radical change in the sector. These principles and rules are based on the results of several research carried out upstream by scientists, with a view to strengthening perfection in the field of breeding.

Apart from the mastery of principles and rules on the ecological and hygienic requirements for each species, the mastery of breeds and/or strains with high zootechnical performances and food with high nutritional potential, also contribute enormously to the expansion of the breeding in general and fish farming in particular. Thus, a study on two strains of Tilapia and three types of food, differing in protein content, was launched in order to evaluate their effects on growth and economic performance.

At the end of this study, it should be noted that the protein level and the strain all presented effects on certain growth and zootechnical, even economic, performance parameters of tilapia. The GIFT strain showed slightly better results compared to the local strain and the food with 37.5% protein is economically more beneficial than the other two foods.

Nevertheless, we believe that a study aimed at evaluating the growth of juveniles of these two strains for the production of commercial fish should be undertaken in the same area in order to establish the performance of the local strain compared to the GIFT strain.

References

[1]. Alongo L.S., Osombause J.S., Bolakonga I.A., Lokinda L.F., 2012.*Étude des filières agro-pastorales et agricoles dans les villages cibles du Projet Pilote REDD Géographiquement Intégré d'Isangi, RD Congo*, Inédit, 90 p,

[2]. Azaza M. S., DhraïefM. N., and KraïemM. M., 2008.Effects of Water Temperature on Growth and Sex Ratio of Juvenile Nile Tilapia, *Oreochromis Niloticus* (Linnaeus) Reared in Geothermal Waters in Southern Tunisia." Journal of Thermal Biology 33(2) : 98–105.

[3]. Bamba I., Mama A., Neuba D.F.R., Koffi K.J., Traoré D., Visser M., Sinsin S.B., Jean Lejoly J., & Bogaert J.J., 2008.Influence des actions anthropiques sur la dynamique spatio-temporelle de l'occupation du sol dans la province du Bas-Congo (RD Congo) *Sci. Nat.* 5(1) : 49–60,

[4]. Caldini N.N., Rebouças V.T., Cavalcante D.D.H., Martins R.B., Sá M.V.D.C., 2011. Water quality and Nile tilapia growth performance under different feeding schedules. *Acta Sci. Anim. Sci.*,33 : 427-430, DOI : http://dx.doi.org/10.4025/actascianimsci.v33i4.12207

[5]. Dibala C.I., Yougbaré M.C., Konaté K, Coulibaly N.D. and Dicko M.H., 2018.Production Du Tilapia Du Nil (*Oreochromis Niloticus*Linneaus,1758) Avec Des Aliments à Base de Protéines Végétales. *Journal of Applied Biosciences* 128(1999) : 12943–12952, DOI : https://dx.doi.org/10.4314/jab.v128i1.7.

[6]. Elhadji F., Serigne M.S., Mamouda A.T. et Malick G., 2018.Effet de la densité de stockage sur la croissance des alevins de Tilapia (*Oreochomis niloticus* L.) en cage fixes dans le lac de Guiers, Sénégal, *Afriqie SCIENCE* 14(3)278-390.

[7]. Iga-Iga R., 2008.*Contribution à la mise au point d'aliments pour tilapia Oreochromis niloticus à base d'intrant locaux : cas du Gabon*. Mémoire de fin d'études pour l'obtention du Master Sciences Agronomiques et Agroalimentaires. Institut de Recherche Agronomiques et Forestières (IRAF). Libreville (Gabon), 47 p,

[8]. Jauncey K., 1982.The effects of varying dietary protein level on the growth, food conversion, protein utilization and body composition of juvenile tilapias (*Sarotherodon Mossambicus*).*Aquaculture* 27(1) : 43–54,

[9]. Kalala B.G., Phanzu M.M., Mvaka M.J. R., Yengo M.M., & Matiti G., 2021.Effets de doses de protéine dans les rations à base d'ingrédients locaux sur la croissance d'*Oreochromis niloticus* dans le milieu tropical.*Congo Sciences*, 9(2), 97–103.

[10]. Kestemont P., Micha J.C., Falter U.V., 1989.*Les méthodes de production d'alevins de Tilapia nilotica*. Project reports. ADCP/REP/89/46. http://www.fao.org – Archives de documents de la FAO. 63p,

[11]. Lazard J., 1990.Transferts de poissons et développement de la production piscicole. Exemple de trois pays d'Afrique subsaharienne.*Revue d'Hydrobiologie Tropicale* 23 (3) : 251-265.

[12]. Lokinda N., Litemandia A., Wawana J., Mbeli A., Motondo S., Alongo., 2017.Caractéristiques de la pisciculture rurale en étang dans la réserve de biosphère de Yangambi en RD Congo.*Rev. Mar. Sci. Agron. Vét*. 6 (3) : 402-408,

[13]. Lumonakese A.M., 2020.Impact Socio-Économique de La pisciculture paysanne dans le secteur Kwilu-Kimbata.*Education et Développement* 24(1–8).

[14]. Pouemogne V., 1994.*Evaluation du potentiel de quelques sous- produits de l'industrie agroalimentaire et modalités d'apports des aliments*, Thèse de Docteur de l'ENSAR, Rennes,267P,

[15]. Ricker W.E., 1979.Growth rates and models. In : W.S. Hoar, D.J. Randall and J.R. Brett (eds), *Fish Physiology*, Academic Press, London. Vol. VIII, 677-743.

[16]. Ridha M.T., 2006. Comparative study of growth performance of three strains of Nile tilapia, *Oreochromis niloticus*, L. at two stocking densities." *Aquaculture Research*, 37: 172-179. DOI: http://dx.doi.org/10.1111/j.1365-2109.2005.01415.x

[17]. Sarr S.M., Thiam A., Faye E.H, Sene M, Ndiaye M., 2016. Production d'alevins de Tilapia (*Oreochromis niloticus*) avec 3 aliments à base de sous-produits agro-industriels au Nord du Sénégal. *Int. J. Biol. Chem. Sci*., 9(5): 2598-2606. DOI: http://dx.doi.org/10.4314/ijbcs.v9i5.29

[18]. Sissao R., D'Cotta H, Baroiller J-F., Toguyeni A., 2019. Mismatches between the genetic and phenotypic sex in the wild Kou population of Nile tilapia *Oreochromis niloticus*. *Int. J. Biol. Chem. Sci*. 13(6): 2603-2617, DOI: http://dx.doi.org/10.7717/peerj.7709

[19]. Tigoli K., Cisse M., Kone M., Ouattara1 M., Ouattara1 A., Gourene G.,2018. Effets de Deux Plantes Aphrodisiatiques Africaines *Garcinia Kola* et *Turraea Heterophylla* Sur Les Performances Zootechniques et Le Taux d'inversion Sexuelle Chez *Oreochromis Niloticus*, *Agronomie Africaine* 30(2): 135–46. https://www.ajol.info/index.php/aga/article/view/179616.

[20]. Zea Biue C., Ouattara I.N., Berte S., Kamagate B., 2022.Performances zootechniques des alevins de trois souches du tilapia du Nil *Oreochromis niloticus* L., 1758 du paysage aquacole de la Côte d'Ivoire élevées en happa implanté dans un étang.*Agronomie Africaine*, 34(2): 191-198,