

Synthetic amino acids (Methionine and lysine) in local feed formulated from the flour of *Hermetia illucens* larvae on some zootechnical performances of *Clarias gariepinus* fry in tanks

Abstract

Objective: this study focused on the effect of a local feed supplement with synthetic amino acids (methionine and lysine) on the survival and growth of *Clarias gariepinus* fry in tanks.

Study design: the study took place at the DJOKWE aquaculture farm located in the Cameroon Littoral Region, Mounjo Department, Nkongsamba 1st District.

Methodology: Six (06) local T0- diets without synthetic amino acid negative control, T0+ coppers imported food positive control, T1 (L1.5/M1) containing 1.5% lysine and 1% methionine, T2 (L1, 5/M1.5) containing 1.5% lysine and 1.5% methionine, T3 (M1/L2) containing 1% methionine and 2% lysine, T4 (M1/L2.5) containing 1% methionine and 2.5% lysine were tested in triplicate on 540 fry of 10 ± 3.1 g distributed in 18 happas of 0.5 m². The fish were fed 3 times per day at a rate of 8% of the ichthyo biomass. Every 14 days, zootechnical parameters were evaluated.

Results: depending on the level of supplementation, the survival rate was higher for the T0+ coppers treatment, 96.66%, and lower for T4 (M1/L2.5) supplemented with 1% methionine and 2.5% of lysine with 80%. The significantly highest average weight gain ($p < 0.05$) was recorded with the T0+coppers treatment (89.67 ± 1.52 g) compared to the T1 (L1.5/M1) and low (66.33 ± 0.00 g) compared to treatment T3 (M1/L2). The specific growth rate was higher ($p > 0.05$) or ($2.83\% \pm 0.16$ g/d) with T2(L1.5/M1.5) and lower ($0.78\% \pm 0.02\%$ g/d) for T0+ coppers. As for the condition factor K, it is significantly higher for the T0+coppers treatment ($0.46\% \pm 0.030$) and lower for the T4 treatment (0.29 ± 0.023).

Conclusion: the incorporation of 5% of black soldier fly larva into local feedd supplemented with 1.5% lysine and 1% methionine makes it possible to improve the survival of *Clarias gariepinus* fry but also their growth as well as the production cost

Keywords: maggot meal, synthetic amino acids, local feed, *Clarias gariepinus*, growth

INTRODUCTION

Comment [er1]: Correct:

A) Formulated flour from *Hermetia illucens* larvae to ascertain synthetic amino acids and zootechnical performances on *Clarias gariepinus* fry.

B) Formulated flour from *Hermetia illucens* larvae to evaluate methionine, lysine presence and their zootechnical performances on *Clarias gariepinus* fry.

Comment [er2R1]: Every title should not be more than 18 words. Or, more than 21 words as this instruction differs from region to region, or country to country.

Comment [er3]: Remove the following highlighted words: objective, methodology, results, conclusion from your abstract. Then make the first word: this into This.

Abstract has no paragraphs. After the first four lines of sentences, move: Six local close to district and continue like that to the end.

Comment [er4R3]: Please ensure your Abstract is not more than 200-250 words. Please check Asian journal of Fisheries and Aquatic research for their abstract guidelines.

Comment [er5]: Put black soldier fly larvae in bracket and instead put the scientific name: *Hermetia illucens* before the black soldier fly larva which has been bracketed.

Comment [er6]: Correct: feed

Comment [er7]: Please check every line to enforce the right corrections

Comment [er8]: Italicise the word: *Clarias gariepinus*

Fishing and aquaculture remain a vital resource for feed, income and livelihoods for around a hundred million people around the world. On a global scale, the supply of fish has reached a record figure of 20.3 kg/inhabitant/year [1] and it remains one of the most consumed feeds in Africa. It thus contributes approximately 50% of protein intake of animal origin in Sub-Saharan Africa [2] and covers almost 50% of the demand for animal proteins of populations in Cameroon. National demand for fish products has increased considerably in recent years following the growing population. It increased from 409,519 tonnes in 2013 to an average of 433,616 tonnes in 2015 and the forecast for 2020 is estimated at 496,891 tonnes according to the Ministry of Livestock, Fisheries and Animal Industries in 2018. However, fishing alone is no longer enough to sustainably satisfy the ever-increasing demand, due to overfishing, climate change and environmental degradation [2]. Faced with this drastic situation, aquaculture is becoming an essential alternative for fish production. But its emergence is faced with several problems, so food remains one of the main challenges [3] due to the unavailability of food, the high cost of inputs and their quality on the health of the final consumer [5] and **more** importantly the use of fish meal from the natural environment as the main source of proteins and amino acids, which leads to a degradation of biodiversity. To address this problem, other sources of animal protein can be used, such as *Hermetia illucens* larvae, but their limiting amino acid intake is only half of what fish meal provides. The use of synthetic products such as amino acids is one of the ways to resolve this problem. Feed represents a significant part of the cost of fish production [5]. In intensive aquaculture, the feed component represents 55 to 60% of the cost of fish production [6]. Reducing feed costs, and consequently reducing the total cost of fish production, is one of the priorities in Aquaculture [3].

Because the use of imported food in livestock farming is a common practice in most developing countries. The economic interest of this type of breeding is therefore very dependent on the availability and cost of food [7]. Thus, research in Aquaculture must use other alternative sources by producing quality local feeds at a lower cost and which will not be a source of depletion of biodiversity in the natural environment with the use of fish flour, maggots and synthetic amino acids. One of the ways to achieve this is the use of local by-products, alternative sources to fish meal and oil, and finally synthetic products. Hence the importance of this study based on the effect of the supplementation of two synthetic amino acids (Methionine and lysine) in the local food formulated based on the lava flour of *Hermetia illucens* on **some** zootechnical performances of the fry of *Clarias gariepinus*. The general

Comment [er9]: Correct: *Hermetia illucens* should be italicised

Comment [er10]: Remove: some

objective of this study was to contribute to improving the production of *Clarias gariepinus* through the use of feeds made from local inputs and synthetic products.

MATERIAL AND METHODS

Study zone

The DJOKWE fish farm is located in the Cameroon Littoral Region, Moungo Department, Nkongsamba 1st District located in the Lonako village. Following 4°27' and 4°30' North Latitude and 9°57' and 10°20' East Longitude at an average altitude of 17.5 m. The climate is the same throughout the city. It is an equatorial type climate with 02 distinct seasons, namely: a rainy season going from March to October and a dry season going from November to February.

Biological material

The experiment lasted 56 days, with the aim of evaluating the tracking rate, growth parameters as well as the cost of producing the feed. 540 *Clarias gariepinus* fry with an average weight of 10±3.1g were taken from the fry production of the DJOKWE farm where they were all fed with the same coppens food.

Non-biological material and experimental device

Twelve happas with a mesh diameter of 0.2mm and a dimension of 0.4x0.4x1m, previously sewn, were installed in a 24m² concrete tank. 540 fry were distributed in triplicates in 6 treatments of 90 individuals with an average weight of 10±3.1g following a completely randomized design (3 repetitions x 6 treatments). Each replicate contained 30 fry and each treatment 90 fry. Every two weeks (14 days), control fishing was carried out and the weight and height of each individual was taken.

• Origin of methionine and lysine

The amino acids were purchased from a local feed store.

• Experimental diets

For this experimental study, the ingredients for the production of our feed were purchased in a local feed mill, a feed with 50% protein was formulated. Once the purchasing operation was completed, the ingredients were weighed according to the previously established formula, then ground to obtain a fine powder, after grinding they were mixed and extruded. Then the feed from the excavator was dried in the sun in order to eliminate impurities and increase the feed conditioning time. Once dry, it was packaged in a hermetically sealed bag and stored in the store.

A total of six diets were formulated.

Comment [er11]: Correct: instead of following, write: on a 4°27'..... Please strike out the full stop after village to enhance your sentence continuation

Comment [er12]: What does "tracking rate" mean? Every language used should be concise and clear to readers. Please re-phrase.

Comment [er13]: Correct: Experimental design and not experimental device

Comment [er14]: Correct: happas, not happas

Comment [er15R14]: Strike out all bullets starting from: origin or.... To experimental....

Comment [er16]: Please include the name of manufacturer. Was this synthetic form powder or liquid?

Secondly, write out the name of the local feed store, the region is feed store is situated in Cameroon.

Did you draw out the amino acids to add to formulated feed? What needle size and syringe size did you use? And in what percentage to achieve your 50% protein formulation.?

The excavator used should have a name and model.

Your hermetically sealed bag, what size was it?

Your store, used to store the experimental diet, what is the size of your store?

Comment [er17R16]: Be sure to add name of extruding machine, your grinder make and model.

How long did you dry your feed in the sun? Did you consider loss of ingredients to dry-sunning?

Comment [er18]: How were the soldier fly larva processed? Were they killed or mutilated? Or was there a way to get the lysine and methionine in them without sacrificing them? This needs to be clearly stated.

Worthy of note, is that once the soldier fly larva were sacrificed, ethical violations are in place. You need to state how this was done to obtain the lysine and methionine without ethical violations which involve sacrificing

T0- (ss): without supplement (negative control);

T0+ : imported feed coppens (positive control);

T1(L1.5/M1): feed supplemented with 1.5% lysine and 1% methionine;

T2(L1.5/M1.5), food supplemented with 1.5% lysine and 1.5% methionine;

T3 (M1/L2): feed supplemented with 1% methionine and 2% lysine;

T4 (M1/L2.5): feed supplemented with 1% methionine and 2.5% lysine.

Table 1: centesimal composition of the experimental feed

Ingredients	Percentages (%)
Fishmeal	17,6
Soy flour	16
Maggot meal	3,2
Peanut cakes	16
Cotton cakes	14 ,4
wheat four	12
Corn four	12
Rice	4,8
Premix 10%*	3,2
Rafined oil	0,8
TOTAL	100
Calculated chemical composition (% of dry matter)	
Proteins	50,47
Lipids	8,2
Carbohydrates	12
Ash	9,18
Energy (Kcal)	2554,80
Chemical composition analyzed (%)	
Proteins	40,75
Lipids	4 ,36
Carbohydrates	49,70
Dry matter	97,01
Ash (%)	2,05
Energy (Kcal)	49,70

*Premix 10%; Metabolizable energy = 2300 Kcal/Kg; Raw protein = 43,8%; Lysine = 3.1%; Methionine = 1.5%; Calcium = 8%; Phosphorus = 3,1%.

Conduct of the test

Each treatment thus contained a total of 90 fry, therefore 3 happas of 30 fry each. These fry were fed at a frequency of four times (4) per day at a regular interval of 3 hours including 7 a.m., 10 a.m., 1 p.m. and 4 p.m. with quantities of feed equivalent to 11% of their biomass during the first month then 8 % over 6 weeks of experience for all treatments. A control fishing was carried out every two weeks (after 14 days) and at the end of the fishing, the growth characteristics such as weight were measured using a balance sensitive to 0.001g when loaded. then with an SF-400 balance with a sensitivity of 1g, the size (total length) of

Comment [er19]: Correct: Centesimal not centesimal

Comment [er20R19]: Correct: all percentages this way e.g. 17.6 instead of 17.6.....

Comment [er21]: Correct: hapas not happas

the fry was measured using graph paper. The fry were placed in a bucket containing water and were handled so as not to leave them out of the water for long. Before distribution of the different diets, the quantities proportional to the densities of the fry for each **happa** were calculated, weighed and crumbled. These quantities of food distributed to the fry were adjusted according to their development. A TDS/EC/PH/SALT/SG/ORP brand multi-parameter was used for taking the temperature and the JBL brand analysis kit for taking the physicochemical parameters.

Comment [er22]: Correct: Hapa not happa

Zootechnical parameters and characteristics studied

➤ **Survival rate (SR)**

$$SR (\text{en}\%) = 100 \times NF/Ni$$

NF = number of fish at the end of the experiment and Ni = number of fish at the start of the experiment.

Growth characteristics

➤ **Live weight**

At the start of the test and every 14 days thereafter, fish from each experimental unit were weighed. The weekly weight gain was obtained by taking the difference between 2 consecutive average weekly live weights

- **Average weight gain (AWG in g)** = final average fish weight (FAFW in g) - initial average fish weight (IAWG in g);
- **Average daily gain (ADG in g/day)** = (FAWG-IAWG)/t With IAW = initial average weight (g), FAW = final average weight (g), t = duration of the experiment (in days);
- **Specific growth rate (SGR in %day)** = $[(\ln P_{mf} - \ln P_{mi}) / \text{rearing time (day)}] \times 100$; Pmi = initial average weight (g), Pmf = final average weight (g);
- **Feed conversion ratio (FCR)** = Quantity of feed distributed / Body mass gain;
- **Condition factor (K)** = $W \times 100 / LT^3$ with W: weight (g), LT: Total length (cm).

Data on survival rate, growth characteristics were subjected to one-way analysis of variance (ANOVA 1). In the event of significant differences between the means of the treatments, Duncan's test was applied to separate at the significance level of 5%. SPSS 20.0 (Statistical Package for Social Sciences) statistical software was used for these analyses.

Results

Survival

Figure 1 shows the variation in the survival rate depending on the treatments. It appears from this figure that the significantly ($p < 0.05$) higher rate was observed with the fry fed with imported feed T0+ coppens, (96.66%) and the lowest rate of 80% was observed. to treatment T4 (L1/M2) which was fed with feed supplemented with 1% methionine and 2% lysine.



Figure 1: Variations in the survival rate depending on the treatments

T0- (ss) no supplement Corresponding respectively to the local feed with 0% supplementation; T0+ coppens= imported food; T1 (L1.5/M1)= feed containing 1.5% lysine and 1% methionine; T2(L1.5/M1.5)= feed containing 1.5% lysine and 1.5% methionine; T3 (M1/L2)= feed containing 1% methionine and 2% lysine; T4 (M1/L2.5) = feed containing 1% methionine and 2.5% lysine. P= probability; M=methionine; L=Lysine.

Zootechnical performances.

It appears from Table 2 that whatever the treatment considered over the entire period of the trial, with the exception of the specific growth rate and the consumption index all other parameters (final average weight, weight gain, average daily gain and condition factor K) were significantly ($p < 0.05$) affected by local feed supplementation with lysine and methionine.

Table 2: Variations in growth characteristics of *Clarias gariepinus* fry fed local feed supplemented with lysine and methionine

Characteristics studied	Treatments						P
	T0- ss	T0+ coppens	T1 (L1.5/M1)	T2 (L1.5/M1.5)	T3 (M1/L2)	T4 (M1/L2.5)	
Ni	90	90	90	90	90	90	
Nf	81	87	81	78	78	72	
IAW (g)	10±3	10±3	10±3	10±3	10±3	10±3	
FAW(g)	75,66±4,16 ^b	99,33±1,154 ^a	94,66±0,57 ^a	89,33±2,08 ^a	78,66±6,50 ^b	76±11 ^b	0,001
AWG (g)	66±4,358 ^c	89,67±1,52 ^a	84,67±0,57 ^{a, b}	78,67±3,21 ^b	68,33±6,50 ^c	66±10,00 ^c	0,000
DWG (g/j)	1,33±0,577 ^{ab}	1±0,000 ^b	2±0,000 ^a	2±0,000 ^a	1,33±0,577 ^{a, b}	1,33±0,577 ^{a, b}	0,055
SGR (%/j)	1,91±0,35 ^a	0,78±0,02 ^a	2,43±0,19 ^a	2,83±0,16 ^a	2,12±0,80 ^a	1,95±1,02 ^a	0,456
FCR	1,62 ^a	2,53 ^a	1,5 ^a	1,86 ^a	2,42 ^a	2,68 ^a	0,201
K (%)	0,32±0,021 ^c	0,46±0,030 ^a	0,40±0,043 ^{a, b}	0,35±0,060 ^{b, c}	0,29±0,023 ^c	0,32±0,014 ^d	0,001

a, b, c,: Values with the same letter on the same line are not significantly different ($p>0.05$). T0=no supplement Corresponding respectively to the local feed with 0% supplementation; T0+ coppens= imported feed; T1 (L1.5/M1)= feed containing 1.5% lysine and 1% methionine; T2(L1.5/M1.5)= food containing 1.5% lysine and 1.5% methionine; T3 (M1/L2.5) = feed containing 1% methionine and 2.5% lysine; T4 (M1/L2) = food containing 1% methionine and 2% lysine. P= probability; M=methionine; L=Lysine. IAW = Initial average weight; FAW= Final average weight; AWG= Average weight gain; DWG=daily weight gain; SGR= Specific Growth Rate; K= Condition Factor; FCR= Feed conversion ratio.

Average weight gain

The evolution of the average weight gain according to the breeding periods is illustrated in Figure 2. It appears that all the curves have a regular and increasing appearance, whatever the period of the study. From the 14th day, the weight gain curve of fish fed imported feed (T0+ coppens) remained above all the other curves with a significantly higher average value ($p>0.05$) at 56 days of 89.67±1.52 compared to other treatments. The weight gain curves of fish fed with supplemented food T3 (M1/L2) supplemented with 1% methionine and 2% lysine, and T4 (M1/L2.5) supplemented with 1% methionine and 2.5% lysine remained **confused** and below the other curves throughout the trial period, with a significantly lower mean value at 56 days ($p<0.05$) of 68.33±6.50g and 66.00±10g respectively compare to other treatments.

Comment [er23]: Correct: Characteristics instead of characteristics

Comment [er24]: What do Ni and Nf mean? Add their meanings to the footnotes below where you have the IAW etc....

Comment [er25]: Please ensure your results from the first treatment to the last are inputted correctly. So, correct: 75.66±4.16^b instead of 75,66±4,16^b from the FAW to K. Do this throughout all the inputted results for table 2

Comment [er27]: Remove the word CONFUSED. This is not scientific language.

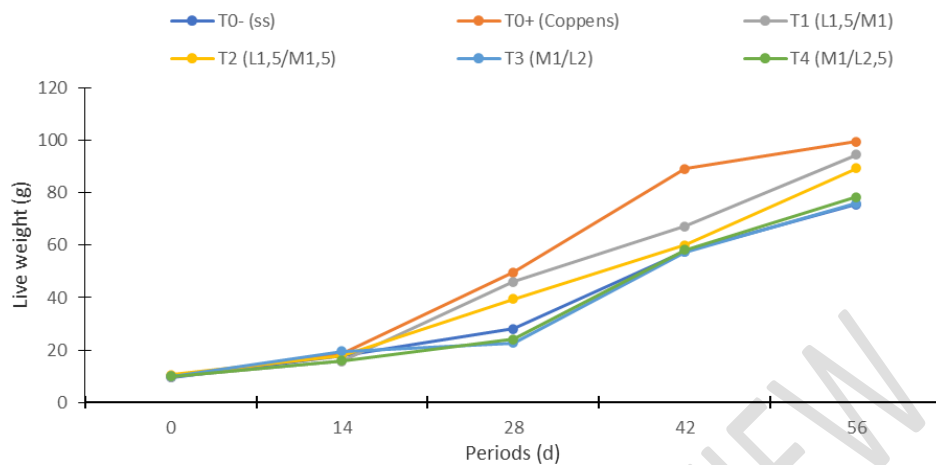


Figure 2: Evolution of average weight gain depending on the breeding periods

T0-no supplement Corresponding respectively to the local food with 0% supplementation; T0+ coppens= imported feed; T1 (L1.5/M1)= feed containing 1.5% lysine and 1% methionine; T2(L1.5/M1.5)= feed containing 1.5% lysine and 1.5% methionine; T3 (M1/L2.5) = food containing 1% methionine and 2.5% lysine; T4 (M1/L2) = feed containing 1% methionine and 2% lysine. P= probability; M=methionine; L=Lysine; d= day.

Average daily gain

The evolution of the average daily gain as a function of the rearing periods is illustrated in Figure 3. Whatever the period of the test, the weight gain varied in all the treatments and evolved in a sawtooth pattern. From the 1st – 42nd days the weight gain curve of fish fed imported feed (T0+ coppens) was significantly ($p < 0.05$) above all the other curves. From the 43rd – 56th days the treatment curve T2 (L1.5/M1.5), containing 1.5% lysine and 1.5% methionine, made it possible to record the highest weight gain followed by the treatment T1 (L1.5/M1%) or the feed was supplemented with 1.5% lysine and 1% methionine.

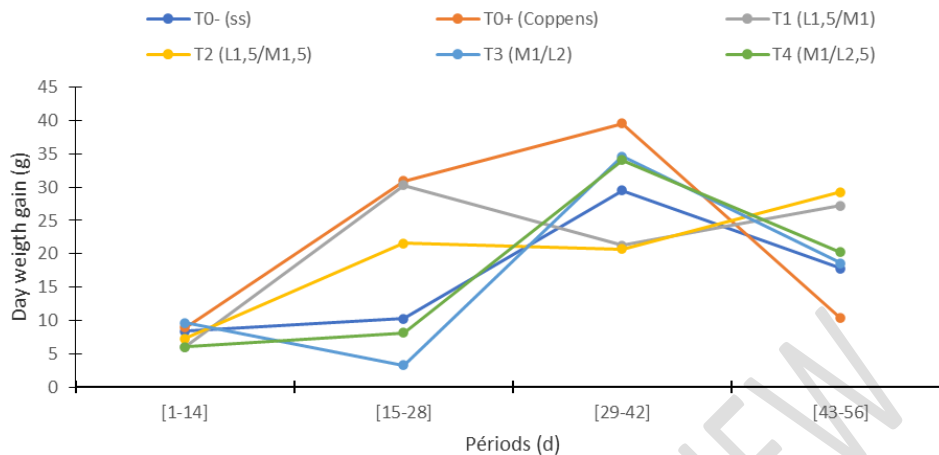


Figure 3: The evolution of weight gain depending on the breeding periods

T0-no supplement Corresponding respectively to the local feed with 0% supplementation; T0+ coppens= imported feed; T1 (L1.5/M1)= feed containing 1.5% lysine and 1% methionine; T2(L1.5/M1.5)= feed containing 1.5% lysine and 1.5% methionine; T3 (M1/L2.5) = feed containing 1% methionine and 2.5% lysine; T4 (M1/L2) = feed containing 1% methionine and 2% lysine. P= probability; M=methionine; L=Lysine; d= day.

Specific growth rate

The evolution of the specific growth rate as a function of the breeding period is illustrated in Figure 4. All the curves in this figure have a sawtooth evolution. However, the highest value was recorded from the 1st to the 14th day in fish fed with feed T1 (L1.5/M1) followed by T0+ coppens. In addition, at the end of the trial, from the 43rd to the 56th day, the highest rate was recorded with treatment T2 (L1.5/M1.5%) followed by T1 (L1.5/M1%) and weaker with T0+ coppens.

Comment [er28]: What I can deduce from your work are as follows:

1. you tried to ascertain the growth and survival of *Clarias gariepinus* fry with formulated Larva flour in comparison with coppens.

Your results stated when looking at your graphs that coppens performed well without the addition of lysine and methionine, followed by treatment T1 and then treatment T2. Please re-structure your results to look like your graphs.

2. in essence, I have gathered that one can still use coppens instead of going through the motions of formulating flour using larva of *Hermetia illucens* taking into consideration the various graded levels of methionine and lysine added to your formulated larva flour meal. If that be the case then, the point of this research is moot if i can still use coppens because it gives me higher growth rates for my fishes. However, all hope is not lost. Restructure your work and your graphs and your write up to state clearly that: COPPENS AND treatment T1 competed favorably, gave similar growth ranges and therefore, you recommend the dosage in treatment T1 to be used in lieu of buying expensive coppens since i gather the cost of production for the formulation (which you should state clearly) was cheaper and the formulation healthier for the fishes

3. Conclusively, I need you to add as a recommendation that further studies on the use of larva flour and another commercial feed be carried out to compare results.

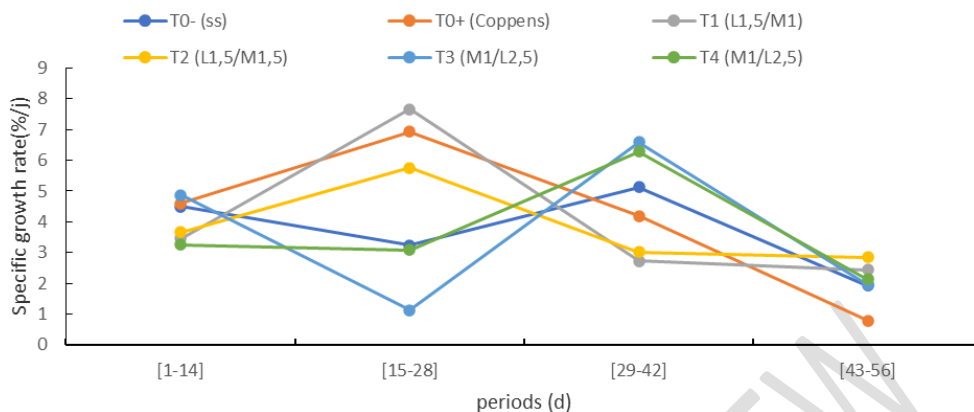


Figure 4: Evolution of the Specific Growth Rate at different treatments depending on the breeding period.

T0=no supplement Corresponding respectively to the local feed with 0% supplementation; T0+ coppens= imported feed; T1 (L1.5/M1)= feed containing 1.5% lysine and 1% methionine; T2(L1.5/M1.5)= feed containing 1.5% lysine and 1.5% methionine; T3 (M1/L2.5) = feed containing 1% methionine and 2.5% lysine; T4 (M1/L2) = feed containing 1% methionine and 2% lysine. P= probability; M=methionine; L=Lysine; d= day.

Condition factor K

From Figure 5, we observe a sawtooth evolution for all treatments. This while the highest value (0.49 ± 0.03) was obtained by the subjects fed with the imported food coppens followed by T1 (L1.5/M1) (0.40 ± 0.04) and the lowest values (0.29 ± 0.02); (0.32 ± 0.01) were obtained respectively in fish fed with supplemented food at T4 (M1/L2) followed by T4 (M1/L2.5).

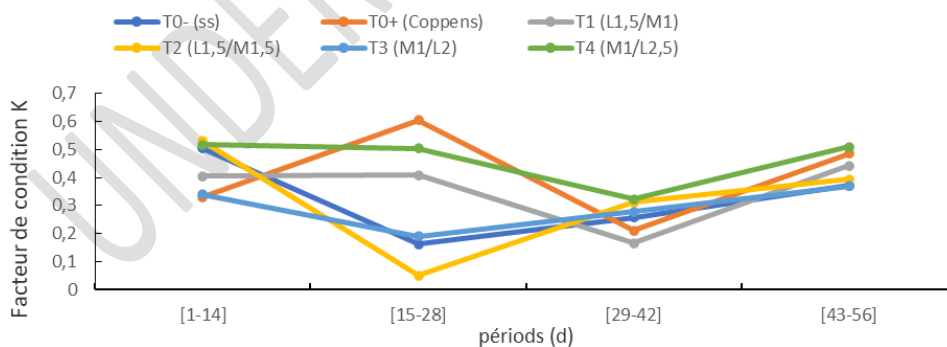


Figure 5: Evolution of the condition factor K at different treatments.

T0=no supplement Corresponding respectively to the local feed with 0% supplementation; T0+ coppens= imported feed; T1 (L1.5/M1)= feed containing 1.5% lysine and 1% methionine; T2(L1.5/M1.5)= feed containing 1.5% lysine and 1.5% methionine; T3 (M1/L2.5) = feed containing 1% methionine and 2.5% lysine; T4 (M1/L2) = feed containing 1% methionine and 2% lysine. P= probability; M=methionine; L=Lysine; d= day.

Comment [er29]: Correct: observed instead of observe.

What do you mean by "sawtooth evolution?" explain succinctly. Or, use a more clearer scientific language. Scientific language differ greatly from english language.

Comment [er30]: Rephrase this sentencing totally. Every explanation should be short and straight to the point. Pick treatment T1 and talk about it in a short sentence and add your full stop. No long sentencing else your explanation becomes moot.

Discussion

The survival rate ranges from 80 to 96%. These values are higher than that obtained by Burchell in 1822 after 50 days of rearing fry in aquariums and that of [3] after 8 weeks of rearing with a feed containing 20% protein (47,87-66,62). These differences in mortality observed between these authors could be attributed to the rearing environment which could be a source of stress for individuals during acid rain.

The average daily gain was highest (2g/d) at T1(L1.5/M1) and lowest (1g/d) in T0+ coppers. These values are greater than 0.05 g/day obtained by [8] in 5 g fry of the same species and 0.24 g/day recorded by [9] with an incorporation rate of 50% flour. maggots in *Clarias gariepinus*. This difference observed would be due to the effect of amino acids which would have improved the dietary balance, promoting better digestion and use of nutrients. Regarding the consumption index (CI), the values found in this study (1.50 to 2.68) are elevated to 1.59 obtained by [9] in 5 g fry of the same species compared to those obtained by [10] (1.95 to 2.08) and [5] (1.51 to 2.11). These differences could be attributed to underconsumption of the food distributed. Likewise, the differences between these values could also be linked to the variation in the physicochemical characteristics of the water during the test, creating stress and thus reducing food intake.

The specific growth rate obtained in this study varies between ($3.67 \pm 0.5\%$ /day and 4%/day) and remains higher than that obtained by [10] at the IRAD fish farming station in Fouban which varied from 0.04 to 0.18%/day and those presented by [11] in juveniles of *Clarias gariepinus* (3.60%/day). On the other hand, it is lower than the results obtained by [10] for *Clarias gariepinus*, which are between 4.78 and 5.8%/d and those of 4.26; 4.05 and 3.85%/day obtained respectively for fish fed with food containing 30 and 50% Azolla [12]. This difference in performance could be justified by the density and size of the fish used by the latter during their tests.

The condition factor K varied with the treatments. In fact, the values obtained were between 0.29 ± 0.02 and 0.46 ± 0.03 respectively of the T0+ coppers and T4 (M1/L2%), 1% methionine and 2% lysine treatments. These values were lower than those reported by [13] and [14] recorded 0.79 to 0.83% in *Clarias gariepinus* reared at several densities and fed a complete diet or those reported by [12] (0.06 to 0.74).

Conclusion

Comment [er31]: Italicize *Clarias gariepinus* e.g. *Clarias gariepinus*

At the end of this study on the effect of the supplementation of two synthetic amino acids (Methionine and lysine) in the local feed formulated based on the lava flour of *Hermetia illucens* on the survival and some growth performances of the fry of *Clarias gariepinus* in tanks, it appears from the results obtained that the food supplemented with amino acids had no effect on the survival rate of the fish. Growth and feed utilization characteristics remained superior in fish that were fed the feed containing 5% black soldier fly larvae in the local feed supplemented with 1.5% lysine and 1% methionine.

Comment [er32]: Remove: some

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