EFFECT OF THREE DIFFERENT SUBSTRATES ON THE GROWTH OF BLACK SOLDIER FLIES LARVAES *Hermetia illucens* (L. 1758) AIMEDFOR *Clarias gariepinus* FEEDING

I. Abdoullahi[1,6], F.Z. Bienvenu[2], F.Djitie Kouatcho[3], P.D. Mbougueng[1*], B. Maliki Ibrahim[4], S. B. Iya[4], R.M. Radu-Rusu[5]

[1]Department National School of Agro-Industrial Sciences. University of Ngaoundere, Cameroon.
[2]University Institue of technology University of Ngaoundere Cameroon
[3]Faculty of Sciences, University of Ngaoundere,Cameroon.
[4]Institute of Agricultural Research for development (IRAD), Maroua Agricultural Research Center, Cameroon
[5]Faculty of Food and Animal Sciences, "Ion Ionescu de la Brad" Iasi University of Life Sciences, 8 MihailSadoveanu Alley, 700489 Iasi, Romania
[6]Institute of Agricultural Research for development (IRAD), Garoua Multpurpose Agricultural Research station, Cameroon

Abstract

The present study has been conducted at the Wakwa Agricultural Research Center. It was focused on the use of three different substrates on the growth of black soldier flies larvaes and the effect of these in feeds manufactured for Clarias gariepinus (African catfish). Specifically, it was a question of evaluating the growth indices of black soldier fly larvae subjected to corn bran, cow dung and the mixture consisting of corn bran and cow dung. And to evaluate the quality of the feed formulated by these larvae from the three substrates. To achieve this, we first set up the devices and launched the rearing of black soldier fly larvae under the conditions described by [3]. Here, 90g of four-day-old black soldier fly larvae were randomly distributed into nine tanks (50cm x 30cm x 15cm) comparable to each other, and subjected to three treatments for fourteen days. These treatments included the SM diet (corn bran), consisting of 10kg of corn bran, the BV diet (cow dung) consisting of 10kg of cow dung, and finally the M diet (mixture) consisting of 5kg of corn bran. and 5kg of cow house. After harvesting the larvae, they are weighed, immobilized in boiling water then dried and crushed before being analyzed with the other ingredients of a part, then, the foods formulated using the application Feed Access was also analyzed. Secondly, we designed an extruder to manufacture extruded foods. From this methodical approach. It appears that the black soldier fly larvae of diet M present after fourteen days of growth the highest morpho-biometric characteristics. In particular the average weight with 180 mg followed by the RT diet: 177 mg then the R3 diet: 103 mg finally the R2 diet: 78 mg.

Key words: *Clarias gariepinus*, *Hermetia illucens*, substrates, pre-pupae

INTRODUCTION

The growing demand of fish meal in live stock farming in general and in the aquaculture sector in particular has caused a marked reduction in the availability of fish. And the increase in their price[4, 5]. This exponential demand for fish meal in the farming sector is in direct competition with human nutriton, which is an obstacle to the fight against hunger and food self-sufficiency in the world [8, 12].

* Corresponding author: pides_mbougueng@yahoo.fr
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Where as they are rich in proteins and energy, with a controlled life cycle (figure 1), black soldier fly larvae *Hermetia illucens* demonstrate a strong potential as alternative feeds for the aquaculture industry. Then, it is necessary to determine the nature and composition of the substrate intended for their feeding. In order to appreciate their potentials uses, it seems chemical composition of the produces larvaes, the yield production of the different substrate and the growth parameters of each of the substrates used.Specifically, it was a question of:

- ✓ Evaluate in *Hermetia illucens* larvae the effect of different substrates (corn bran, cowdung and their mixture) on growth parameters and bromatological value.
- ✓ Evaluate the effect of *Hermetia illucens* larvae on the nutritional value of the manufactured food

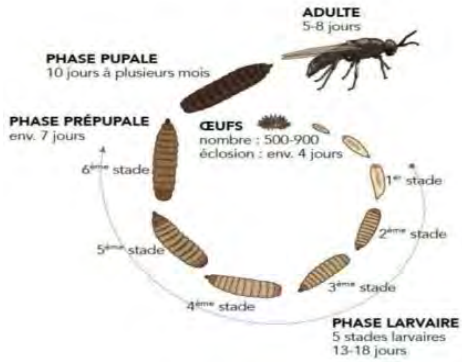

Figure 1: MSN Life Cycle [16]

MATERIAL AND METHOD

Presentation of the study area

This study was carried out in the facilities of the fishing and aquaculture section of the animal and fishery production division of the Agricultural Research Institute for Development (IRAD) in its Wakwa Center (CRA-WK) in Ngaoundéré in the Adamawa region in Cameroon.

Materials used

Animal material and habitat

The study is carried out on 90g of 4-day-old black soldier fly larvae and randomly distributed into nine comparable batches of 10g following a completely randomized plan comprising three treatments repeated three times. The latter were raised in nine plastic bins with the following characteristics: 42cm in length, 29cm in width and 25cm in height.

Plant material

The plant material consisted of corn bran, cow dung and a mixture of corn bran and cow dung, obtained in Ngaoundéré. These substrates were dried in the oven at 105°C until a constant weight was obtained. Once dried, they were crushed, and then sieved using a sieve with a mesh diameter of 0.9 mm. The flour obtained was analyzed.

Method

The production of the pre-pupae of black soldier flies was carried out in two stages, first the rearing of the black soldier flies was carried out in a well-ventilated and very well-lit structure where the mesh fly cages were placed (80 x 80 x 180 cm) as shown in image 2 below.

The temperature in the cage is maintained at around 35°C thanks to the transparent plastic installed on its four lateral sides. And the humidity is maintained between 60% and 80% by spraying water on the huts in the morning and in the afternoon. Then, in the second step, 90g of four-day-old black soldier fly larvae were distributed randomly in nine tanks (42cm x 29cm x 25cm) comparable to each other, and subjected to three treatments for fourteen days at a temperature of 26.83 ± 0.48°C. These treatments included the SM diet (corn bran), consisting of 10kg of corn bran, the BV diet (cow dung) consisting of 10kg of cow dung, and finally the M diet (mixture) consisting of 5kg of corn bran. and 5kg of cow dung. These breeding tanks have a downward-sloping exit ramp to facilitate the removal of pre-pupae from the substrates and are equipped with a PVC channel to allow automatic collection of larvae [16].

After harvest, the larvae were rinsed and soaked in boiling water for three minutes, then they were dried in the sun for 72 hours and then in an oven at 60°C for 48 hours until their weight stabilized.After harvest, the larvae were rinsed and soaked in boiling water for three minutes, then they were dried in the sun for 72 hours and then in an oven at 60°C for 48 hours until their weight stabilized. After drying, the larvae were ground into flour and stored in plastic bags and their biochemical composition was determined before incorporation into the composition of diets intended for feeding *Clarias gariepinus*. After the mixing and grinding stage, the food is introduced into the extruder designed by us, shown in image 3 below. This machine is equipped with two reels, the first of which has a power of 20 horse power with a speed set at 900 revolutions per second. The second three-horsepower coil is mounted in front of the feed outlet at the level of the dies equipped with four knives with a speed of 3000 revolutions per second.

Image 2 : Fly cage

Image 3 : Extruder

Data collected and parameters studied

- ✓ **Growth parameters**

Using a precision 0.01g electric balance, the larvae of black soldier flies were weighed and the results of body mass gain (GMC), yield (Rd), growth rate (TC) were obtained by calculated according to the following formulas: GMC = mass of final msn larvae - mass of initial msn larvae, Rd = (mass of initial msn larvae - mass of final msn larvae)/100, IC = (mass of final substrate - final substrate mass)/body mass gain

- ✓ **Bromatological value of BSF larvae flour**

Crude protein such as crude fiber and moisture were analyzed by the SPRINT brand rapid analyzer which allows the rapid and direct determination of protein levels and other parameters in dairy products and meats. The analysis of protein levels is carried out by a non-polluting and non-toxic chemical process which facilitates the direct detection of proteins in less than five minutes. The Sprint uses iTAG protein labeling technology which detects and measures only proteins, not non-protein forms of nitrogen.

- ✓ **Valeur nutritional value of the manufactured food**

The parameters: Crude protein, Crude fiber, lysine, methionine, were evaluated by the Sprint brand analyzer described

Statistical analysis

The data were processed using the Excel spreadsheet and analyzed using the computer software SPSS version 23.0 and subjected to one-way analysis of variance (ANOVA) (treatment level). The means were separated using the Duncan test at the 5% threshold when their differences were significant [15]. The statistical model used is as follows:

Xij = μ + αi + eij;
Xij: observation on animal **j** having received ration or treatment iμ: General average
αi: Effect of treatment level **i**
eij: Residual error due to animal j having received ration or treatment **i**

RESULTS

Growthparameters

Table 1 and figure 2 illustrates the effect of substrates on the growth parameters of black soldier fly larvae; it appears from this table that, black soldier fly larvae from treatment with corn bran recorded a gain in body mass of 2.57±0.35g While those of the treatment with cow dung and the cow dung and corn bran mixture recorded 1.95±0.48g and 2.30±0.41g respectively. Regarding the yield, the larvae from the corn bran treatment presents 3237.67±0.22 while that of the larvae from the cow dung treatment is in last position 2414.00±0.21. Image 4 shows the larvae of black soldier flies.

Table 1 Food consumption by black soldier fly larvae

Parameters	LMSN SM	LMSN BV	LMSN mix
Initial substrate(g)	10133.33±0.07^{a}	10066.66±0.14^{a}	10100.00±0.36^{a}
Residual substrate (g)	2233.33±4.76^{a}	1956.66±3.41^{a}	2206.66±3.28^{a}
Consume substrate(g)	7900.00±0.30^{a}	8110.00±1.24^{a}	7893.30±0.39^{a}
Prepupa at 14days (g)	2566.66±0.35^{a}	1966.66±0.09^{b}	2313.33±0.34^{c}
Mittales larvae(g)	100.00±0.00^{b}	103.33±0.52^{a}	103.33±0.00^{a}
Final larvae(g)	2566.67±0.35^{a}	1966.667±0.93^{b}	2313.33±0.46^{b}
Weight gain (g)	2.57±0.35^{a}	1.95±0.48^{b}	2.30±0.41^{b}
Conversion rate	183333±0.02^{a}	140000±0.02^{a}	166667±0.06^{a}
Consomption index	3.72±0.81^{a}	5.14±0.51^{b}	4.47±0.73^{a}

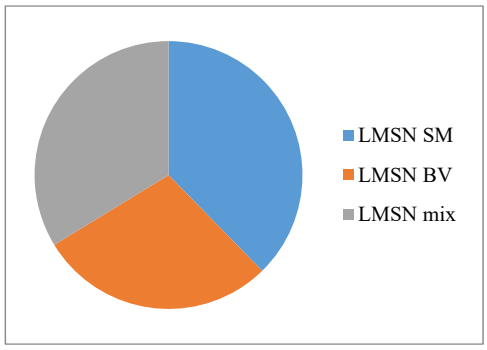

Figure 2: Weight gain from substrates

Image 4: Black soldier fly larvaes

Table 2 and Figure 3 illustrate the effect of substrates on the growth parameters of black soldier fly larvae, it appears that the production yield of black soldier fly larvae fed on corn bran presents the best yield

Table 2: Growth parameters

Parameters	LMSN SM	LMSN BV	LMSN mix
Bridge (g)	47.67±3.06^{a}	41.31±2.85^{b}	46.58±3.02^{a}
Larvae phase (day)	14.00±0.86^{a}	14.00±0.42^{a}	14.00±0.83^{a}
Days before emergence	35.00±0.83^{a}	34.33±0.71^{a}	35.00±0.79^{a}
Incubation duration	8.67±1.52^{a}	9.00±1.46^{a}	9.33±1.14^{a}
Life cycle	46.67±1.23^{a}	45.33±1.21^{a}	44.67±1.28^{a}
Yield	3237.67±0.22^{a}	2414.00±0.21^{b}	2921.66±0.25^{a}

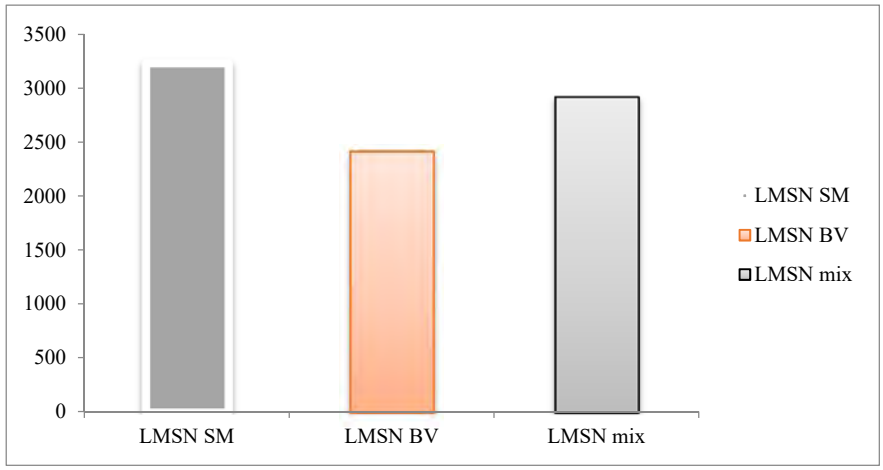

Figure 3: Yield production of larvaes

Bromatological value of BSF larvae flour

It appears from table 3 presenting the nutritional value of the manufactured food that the highest protein level is obtained from the treatment consisting of black soldier fly larvae resulting from the mixture of corn bran and cow dung, i.e. 52.33%±0.81^{b} While the highest crude fiber rate value of 9.00%±0.45^{b} is recorded in the larvae resulting from the treatment consisting of cow dung.

Table 3: Nutritional value of the manufactured food

Treatment (%)	LMSN SM	LMSN BV	LMSN mix
Crudeprotein	48.66±0.11^{a}	46.33±0.04^{a}	52.33±0.81^{b}
Crudefiber	7.67±0.28^{a}	9.00±0.45^{b}	8.33±0.09^{a}
Ash	9.06±1.31^{a}	9.43±1.07^{a}	9.15±2.17^{a}
Humidity	1.39±0.59^{a}	1.84±0.75^{b}	2.58±0.28^{c}
Lysine	7.00±0.95^{a}	6.00±0.27^{b}	6.33±0.89^{b}
methionine	6.03±0.91^{a}	5.53 ±0.75^{a}	6.01 ±0.84^{a}

DISCUSSIONS

There is no scientific evidence that corn bran has a direct effect on the body mass gain of black soldier fly larvae (*Hermetia illucens*), because black soldier fly larvae are decomposers. On the other hand, in this study, it is the gain in body mass of the black soldier fly larvae from the corn bran treatment which presents the best results (2.57±0.35g) compared to the remaining treatments. They mainly feed on decomposing organic matter [9, 13], such as animal droppings and food waste.

While Corn bran, as a residue of corn kernels, is not their natural food source. Corn bran contains fiber and nutrients, but not necessarily the essential nutrients that black soldier fly larvae need for optimal growth [15, 17], which is why corn bran must be mixed with cow dung to accelerate their decomposition and facilitate digestion.

The crude protein and cellulose values are similar for the three substrates, making it easier to mix the latter because they have approximately the same contents of crude protein and crude fiber, two essential elements for black soldier fly larvaeBecause their content indicates the rapid growth potential of the larvae on the one hand and their good digestibility on the other hand. This is also supported by [2, 10], in their work on edible insects in the Tonkpi region, Man, Ivory Coast in 2024. The chemical composition shows that it constitutes an abundant source of animal proteins (47.50-52.23%), [7, 18], comparable to animal meals and oilseed meals, commonly used in animal feed. The chemical composition of the larvae would depend, in addition to the substrate, on their stage of larval development.

Subsequently, the crude fiber content obtained was 9% for the larvae fed a diet composed of cow dung. On the other hand, it is the ration consisting of a mixture of corn bran and cow dung which has the highest crude protein content (52.33%) compared to the other two treatments. This result is in agreement with that found by [1, 11], in their work on improving production, extraction and drying techniques for house fly larvae.

CONCLUSIONS

Arrival of this study which focused on the effect of three different substrates on the growth of the larvae of black soldier flies (*Hermetia illucens* L. 1758) aimed at feeding on Clarias gariepinus. Following a rigorous methodology, it appears that the two substrates can be used separately or their mixture. However, it is important to use raw corn bran consisting of more organic matter and less crude fiber which could directly affect the growth and improve the quality of black soldier fly larvae.

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