Technical basis for the small-scale production of Black Soldier Fly meal as fish feed in Benin

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Introduction

In Benin, the feeding of farmed fish is a major predicament. The food compositions suffer from the lack of a dependable source of protein.The Black Soldier Fly larvae, *Hermetia illucens* (Diptera: Stratiomyidae) that have excellent nutritional references can fulfill this role. However, the species is little known in Benin and breeding techniques are ignored by producers.

The present study aims at establishing a technical reference for the breeding of this fly in Benin. the specific objectives are:

- to produce a device adapted to larval rearing,
- to determine the optimal load density,
- to evaluate the efficiency of the harvesting system.

Materials and Methods

- ***Study Site***

The experiment was conducted in Benin (West Africa) within the Laboratory of Hydrobiology and Aquaculture, University of Abomey-Calavi (UAC).

- ***Design of the Larvarium***

To build the larvarium, we've used a white-colored, rectangular and transparent plastic bin, measuring 42 cm x 29 cm x 25 cm in size. An exit ramp for the prepupae have created by cutting one faces along one length and the two widths. A polyvinyl chloride pipe was installed at the end of the ramp as a collector.

- ***Black Soldier Fly larvae (BSF)***

A reproduction was carried out with *H. illucens* adults. To obtain a sufficient quantity of larvae, 3000 prepupae were used for this reproduction.

- ***Determination of the optimal load density***

Larvae used for this study had an average weight of 0.01g. The experimental device consisted of 9 larvariums; 3 densities were tested in triplicate: T1 (1 larva/g); T2 (2 larvae/g), and T3 (3 larvae/g). In each larvarium, 2 kg of chicken feed was spread around and was wetted with 2.5 liters of water. Every other day, 60 larvae were sampled from each larvarium and weighed individually with an electronic scale.

- ***Insect meal production***

The production process is described in figure 3.

The meal obtained was weighed per batch using an electronic balance of 0.1g sensitivity.

- ***Data Processing***

The Waste Reduction Index (WRI) was calculated in g/d. The rate of automatically-harvested prepupae (TPR) per larvarium was also computed.

The Kruskal Wallis test was performed to test the effect of density on the growth of BSF larvae. One-way ANOVA was performed to compare the prepupae harvest rates, and the quantity of meal produced between the treatments. In case of significant differences, the Wilcoxon or LSD test is used to determine the conditions involved.

All statistical analyzes were performed with the R 3.03 software.

Figure 1: Prototype of larvarium. The dots represent the cut lines. 1: window opening covered by a mosquito net, 2: prepupae collection trough, 3: exit for the prepuae, 4: closed end, 5 and 6: prepupae exit ramp.

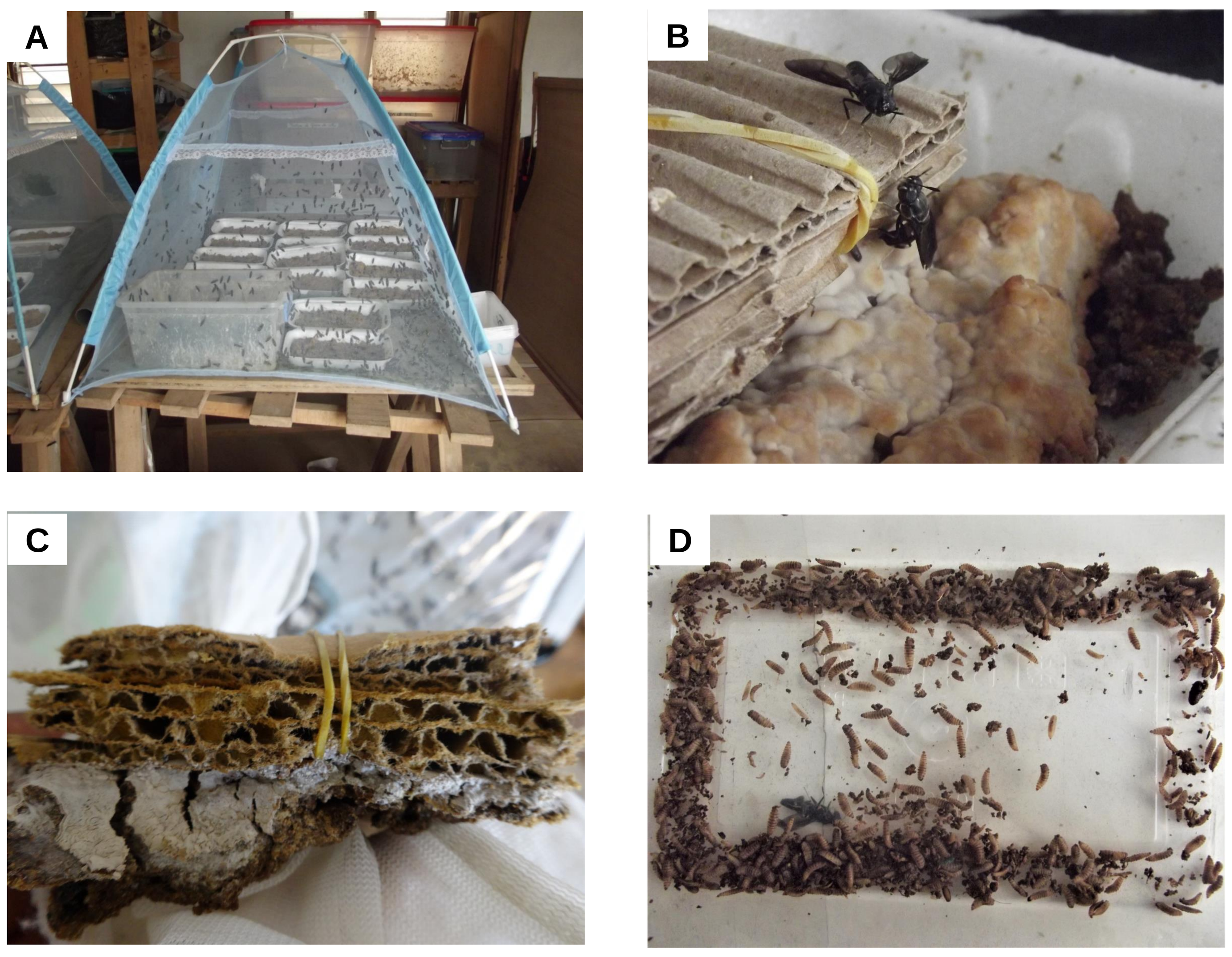

Figure 2: Reproduction of *Hermetia illucens.* (A): Imagos breeding cage; (B): Egg laying; (C): nesting with the eggs inside the crevices; (D): BSF larvaes.

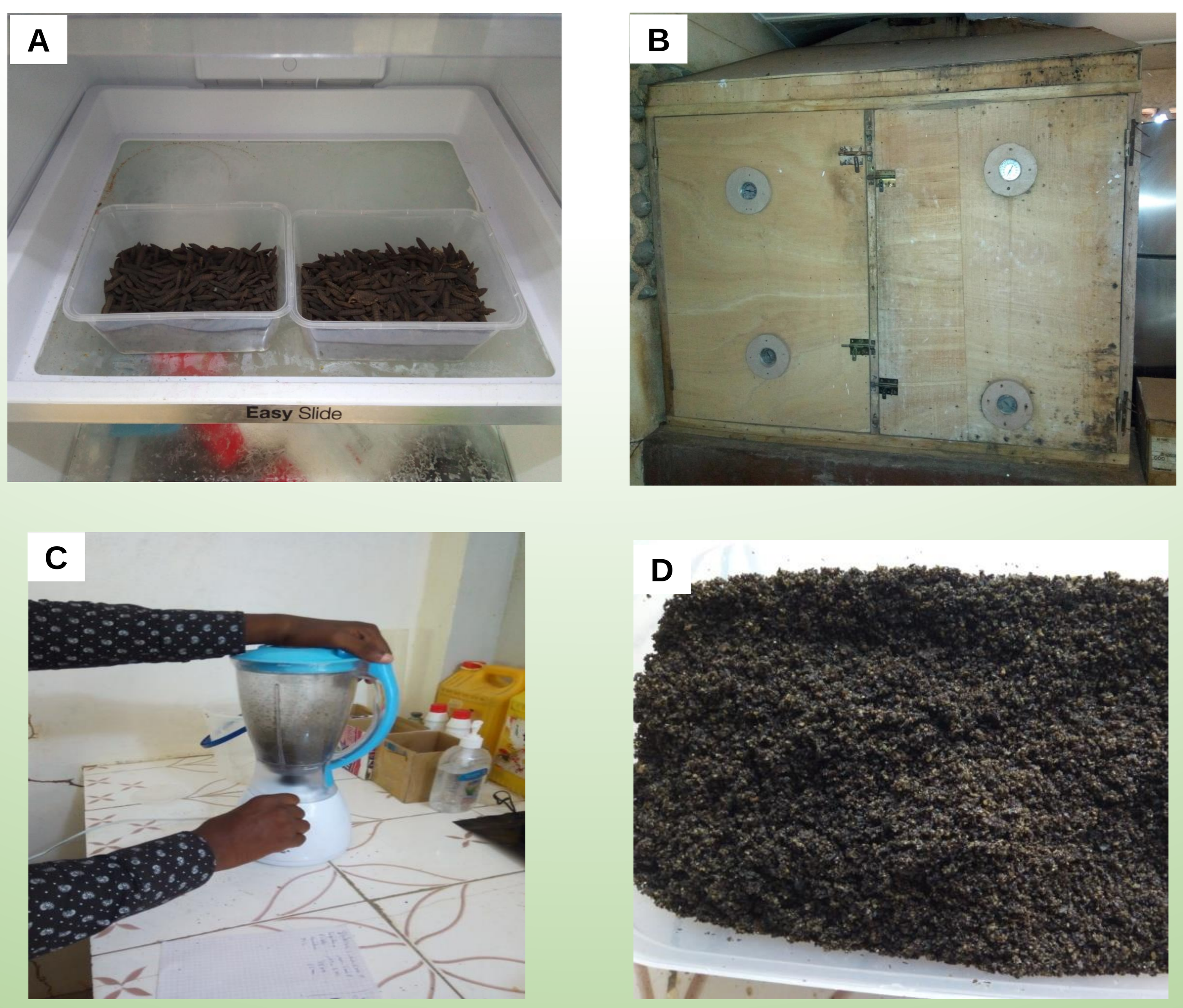

Figure 3: Insect meal production. (A): Freezing prepupae; (B): drying prepupae in tthe oven (60°C,6h); (C): Grinding in a kitchen blender; (D): Insect meal.

Results

- ***Prototype of the BSF larvarium***

Figure 4 shows the prototype of the larva rearing device. Fly larvae are raised inside the larvarium to the prepupa stage.

- ***Larval growth***

At the end of the breeding, the average weights were 0.24 ± 4.10^{-3} g for T1, 0.24 ± 4.10^{-3} g for T2, and 0.14 ± 2.10^{-3} g for T3. T3 showed a significant difference with the other two (P<0.05).

Figure 4 shows that the larvae reached their maximum weight on the sixth day. Growth then began to decline from the sixth onward to the tenth day in each and all treatments.

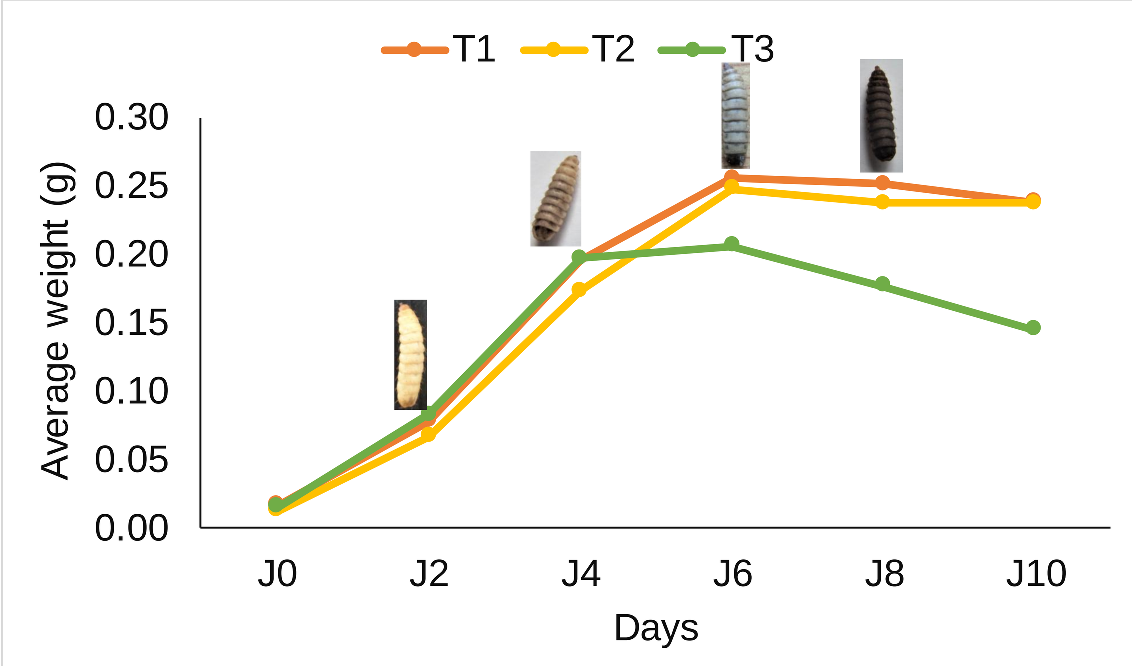

Figure 4: Variations in the average weight of the larvae throughout the breeding.

- ***Substrat reduction***

Table 1 shows that, substrates decomposition rate (D) is greater than or equal to 50% and "WRI" is the higher as the density increases.

Table1: Average rate (D) and Waste Reduction Index (WRI). No significant (a) difference between the treatements (p>0.05).

Treatement	D (%)	WRI (g/j)
T1	49.96[a]	5.00[a]
T2	83.05[a]	8.30[a]
T3	84.59[a]	8.46[a]

- ***Prepupae harvesting and meal production***

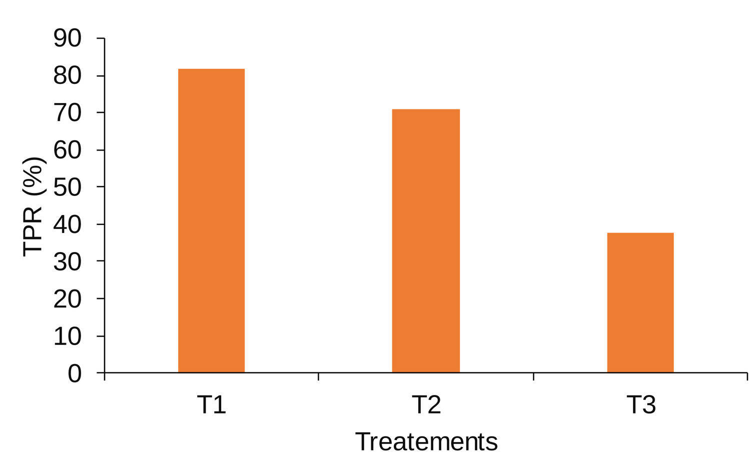

Figure 5*:* Rates of prepupae automatically harvested.

Table 2: Average meal quantity per treatment.

	T1	T2	T3
MQ (g)	254.77 ± 37.99	432.37 ± 54.36	289.30 ± 69.67

Conclusion

The proposed larvarium responds well to the requirements of rearing black soldier fly larvae. The density of 2 larvae/g optimizes production by ensuring good larval growth and maximal meal production.

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