Mussels to feed through the use of Black soldier fly

Introduction

Baltic blue mussel can act as a high-quality protein source in animal feed, however its direct use is challenging due to associated processing costs, especially in regard to shell separation. An alternative approach, relying on a biological separation through the use of the black soldier fly (*Hermetia illucens*) larvae composting and a consequent production of larvae in fish feed has been evaluated by SLU and RISE in the context of the Baltic Blue Growth project.

Mechanical pre-treatment of mussels

In preparation for larval composting, the blue mussels should be grinded after harvest. This step is necessary as it allows exposure of soft tissue to larvae during composting. For the tests, a 55 kW *''Palmia 200''* meat grinder was used, equipped with knives and grinding discs. The grinded material was then transferred to the larvae composting facility.

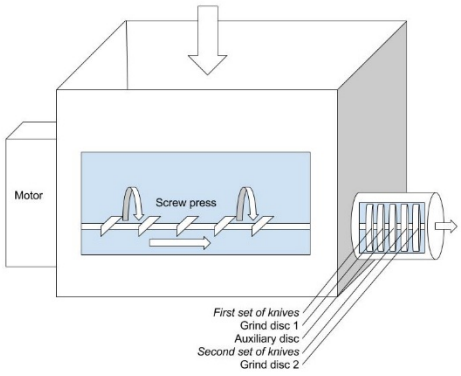


Figure 1: Schematic image of the ''Palmia 200''

Production of black soldier fly larvae

In the first stage, the evaluation of different crushing/grinding strategies in relation to the efficiency of larval composting was studied. The results showed that light crushing of mussel shells using only knives was optimal. For the highest nutritional quality of the final product, the mussels should be used directly after harvest or stored on ice no longer than 36 hours.

In the second stage, the efficiency of using blue mussels for the production of fly larvae was assessed. The mussel-to-biomass conversion ratio (the BCR), expressed on volatile solid basis (the organic component) was between 20 and 25%, slightly lower than when raising larvae on food waste (30-35%), while the survival of larvae was comparable to that found for food waste.

Figure 2: Crate used for treatment with the crushed mussels added (left) and the stacked treatment crates (right).

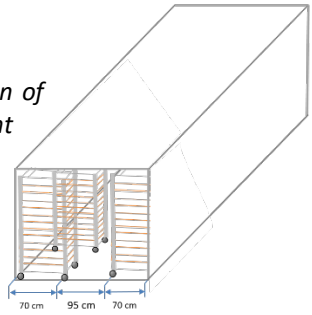
Each crate used for composting was stocked with 5000 young larvae and was fed with 15kg of mussels during the 10 days of production. On day 10, the larvae were separated from the residue and were killed by freezing them at -20 °C. On average, 1 kg of larvae were generated per crate in the process. The crates were stacked vertically in order to make the process more spatially efficient. It was ensured that the process was accompanied by strong ventilation, in order for the material to dry out.

Mobile medium-scale treatment facility

When using the mobile treatment facility, the process as described above, takes place in a mobile container. The characteristics of such a mobile unit are:

- 528 crate stacks
- Processing of 790 kg mussels daily
- Ventilation requirement for 119 m3/h

Figure 3: illustration of themobile treatment container



Separation of larvae from the residue

Prior to separation, drying of larvae and the residue is needed. The process consists of light fan-assisted drying, shaking and cyclone separation. The end results will be one fraction of fly larvae, which is the desired fraction, and one fraction with a mixture of shells and droppings from the larvae (manure).

Production of larvae based feed

Following the separation step, larvae were dried at 40°C for 12 hours to constant weight. Partial freezing of larvae at -18°C prevents fat separation during milling. Dry larvae were then turned into meal by milling by a high-impact hammer to a uniform particle size of ≤1 mm. The larvae meal was then added at inclusion level of 20% into a mash that was later pelleted for feeding to rainbow trout. Larvae meal contained 45% of protein on dry matter basis and 4mg/g fat of Omega-3 fatty acids.

Marketable products

In the treatment, two products are generated: fly larvae, that can be refined into fish feed; and treatment residue that can be used as an organic fertilizer. The treatment residue comprises mussel shells and larvae feces/droppings and contains N, Ca, P and Mg.

Further process development

In order to develop the process of using mussels and the black soldier fly larvae bioprocess in the context of animal feed, the following steps should be considered:

- Use of combined mussel/food waste substrates for larvae production could increase BCR.
- A hygienization step should be established during larvae processing to counteract possible contamination.
- If the processing facilities are to be established at a mussel farm, the material for larval composting should be available/harvested continuously to maintain the production. Alternatively, frozen mussels can be used.

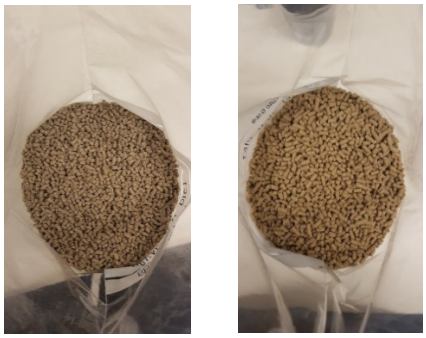


Figure 4: Pelleted rainbow trout feed, containing mussel meal and larvae meal.

More information regarding the research as presented in this factsheet can be found in the report 'Processing and storage of mussels: mussels to feed through fly larvae', which can be found on the page 'Publications' at www.balticbluegrowth.eu.

THE PROJECT

This factsheet has been elaborated by the Baltic Blue Growth project. The aim of Baltic Blue Growth is to advance mussel farming in the Baltic Sea from experimental to full scale to improve the water quality and to create blue growth in the feed industry. 18 partners from 7 countries are participating, with representatives from regional and national authorities, research institutions, private companies. The project is coordinated by Region Östergötland (Sweden) and has a total budget of € 4.7 million. It is a flagship project under the Policy Area "Nutri" of the European Union Strategy for the Baltic Sea Region (EUSBSR).

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