

Using Insects to Valorise Waste & Co-products; Case Study with AgriGrub at the Eastern Agri-Tech Innovation Hub



Black Soldier Fly Larvae; Valorising Food-Waste



Executive Summary

A decade ago, the knowledge and enthusiasm to use insects to process waste was virtually non-existent in Europe. Thanks to infrastructure funding from the Cambridge and Peterborough CA Growth Fund, the Eastern Agri-Tech Innovation Hub can support local growth and waste related businesses such as insect breeding. Two companies; Entomics and AgriGrub have benefited from the facilities here.

Funding from the EU Interreg2Seas BioBoost Project enabled additional R&D at the Hub and linked two pilot sites: in the UK (NIAB) and in Belgium (INAGRO).

Entomics was set up in 2016 and after growth and successful development left in 2018. AgriGrub took over and remains on site at EAIH; both have grown and developed with new products being tested.

Challenges

There was existing knowledge about the biology, of some potential insects that could be used to valorise waste, but this was mainly derived from their life cycle, food preference and preferred environmental conditions in wild, free living situations. Considerable work was needed to convert this knowledge to a farmed /controlled growth situation. Three species were initially selected for trials: Black soldier Fly (*Hermetia illucens*) BSF, Mealworm (*Tenebrio molitor*) MW and Crickets (*Gryllus bimaculatus*) Cr. Initial choice was based on their breadth of food choice, the need for a vegetarian diet and acceptability of products to customers.

The first step was to determine mating and breeding requirements; translation of the behavioural expectations of these species was used to inform pilot specifications, which had to be economically viable, so that '**valorisation**' an increase in the value of waste products, was achieved. And was manageable in the different situations being investigated. The next step was to understand food and environmental requirements of these species for optimal growth.

Several factors need to be understood including available waste locally, cost, fly genetics and growing environment.

Food and Environment choices

Temperature, light, oxygen, type/quantity of waste products from the insects themselves, type and supply of feed (waste/co-products) optimal growth rate, potential for disease breakout in hatcheries /growth chambers and insect genetic resources selected were considered.

Another factor that emerged was impact on insect farmer staff. Two of the species (crickets and, to a lesser extent, mealworms) stimulated allergic reactions over time. While it is possible to develop health and safety procedures (masks, gloves filters, etc) this would incur potentially unacceptable ongoing expense and difficulties for future insect farmers.

The need for waste to be available between a given range of water content was another limiting factor. Waste and co-products are supplied in forms outside of the control of the insect farmers. The need to reduce water-content could have profound limitations on economic sustainability, since de-watering can be expensive.

Each species has relatively narrow flexibility in terms of maximum protein consumption as a proportion of total feed. Beyond the maximum, excess protein is degraded to ammonia. This is both wasteful and leads to negative environmental impact. Growing facilities that produce volatile toxins are not acceptable, and impact local residents.

Potential benefits from the system

Conversion of mixed, sometimes hazardous food waste was the goal of this activity - this is a good example of waste or co-product valorisation to a higher value alternative

product that can be used by either the producer or the alternative customers. In the worst-case scenario, food waste must be disposed safely, which often incurs a cost. Alternatively, some mixed food waste can be used in low-grade applications such as AD (anaerobic digestion) for biogas generation, or as a soil amendment.

There is potential for production of highly focused feed or food production from the insect rearing process. In some cases, this could replace feed that is currently either expensive or becoming difficult to source, for example through over-exploitation of natural resources or changes in local production

SME Growth at EAIH

Entomics was the first EAIH licensee from 2016. The NIAB Bioboost Project enabled infrastructure improvements in 2017 and enabled collaboration with the INAGRO team from Belgium. Each have optimised components of the system; hatcheries, waste food choices and growth conditions. These two teams worked synergistically to consider different waste/co-product sources at different sites and under differing regulatory frameworks (UK and Belgium).

At the NIAB site, NIAB staff managed the pilot facility providing an incubator for Entomics, which contained its own innovative expert staff. Initial free waste of many kinds was sourced from a local Sainsbury (which would have been sent to landfill). By mid-2018, Entomics Ltd had grown and matured, it split into two companies; Entomics left EAIH to concentrate on high-end-products and consider a fermentation step and novel insect genetic resources. A new SME, AgriGrub, was set up, directed by Joe Halstead formerly in Entomics. AgriGrub continued to optimise selected waste food for alternative pet food markets. AgriGrub has connected with companies and farmers to source waste direct from producers and are optimising fruit waste mixed with spent brewer's grains.

Results and Return on Investment

As with research into AD microbial degradation of waste, it is vital to balance the various components of the feed to ensure a balance of nutrients in terms of fat, carbohydrate and protein alongside water and various vital vitamins/nutrients. Poultry feed was initially used as an amendment to less nutritionally rich waste feedstocks. Entomics products include fish food and AgriGrub is selling dried larvae for the pet food industry and the by-product frass.

Since 2018, with connections and support from the Hub, AgriGrub has grown and matured. Both companies are fine examples of what

can be achieved at the EAIH. Both have been successful in winning R&D many awards. Most recently, AgriGrub have won funding from WRAP in partnership with NIAB and an EAIH club member Microbiotech Ltd The partners will be looking at the potential green pesticide properties of frass and trialling it as an alternative mushroom substrate to soya.

Development & Future Plans

Currently, the AgriGrub team are looking into innovative ways of automating their production process. This could include the potential for robotic optimisation in the future when the necessary funding becomes available. Such is the success of this innovative idea in Europe that BSF farming as a concept now has its own Wiki site relating to use in waste-valorisation:

https://en.wikipedia.org/wiki/Hermetia_illucens

Connections at the EAIH

The Eastern Agri-Tech Innovation Hub are always looking for exciting new businesses to join us at the Hub, either virtually, by becoming a Hub Club member or by becoming a licensee and having space at the Hub. There is information on the website at:

www.innovationhubuk.co.uk

This includes a benefits page and how to get in touch if you require further information.

Figures (right)

- 1) Frass, insect waste for soil treatment
- 2) Early hatchery model at INAGRO
- 3) AgriGrub waste fruit choice and pet food products

