Project Summary

'Optimizing and Industrializing Black Soldier Fly (BSF) Production - Redirecting Food Waste to Livestock Feed Production' Project

KEY POINTS

- **Industry Impact**
  - Effectively monitored and improved the overall quality of the product
  - Improved process efficiency at different stages of the production line
  - Rapid non-invasive in-line monitoring of process and product quality with NIRS
- **Regulatory Impact**
  - hazards and critical parameters for controlling BSFL quality have been identified
  - Guidelines for good manufacturing practices for commercial BSFL facilities were created
- **Economic Impact**
  - catalysed Goterra to sign agreements >$10m per annum

Figure 1. Freshly harvested Black Soldier Fly Larvae (Figure courtesy of Goterra)

THE CHALLENGE

Prove that although the nutritional composition, safety, and the extent of accumulation of contaminants in Black Soldier Fly larvae will vary and will be influenced by the substrate, physiological age of the larvae (instar), and post-harvest treatments, the end product has no biological or chemical hazards and meets the animal feed safety requirements.

OUR RESEARCH

We aimed to show that the different safety attributes and nutritional composition of black soldier fly larvae (BSFL) when reared using different food waste streams in a commercial insect rearing setup met all the animal feed regulations and nutritional requirements, thereby extending the market for BSFL.

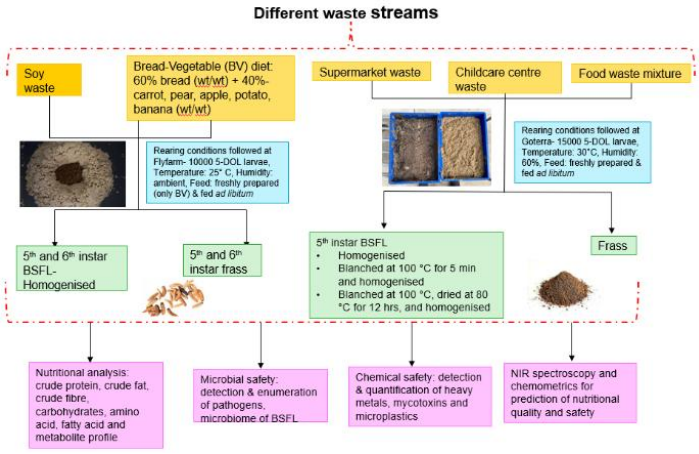

Figure 2. Experimental outlay.

OUTCOMES

BSFL, utilising Goterra's operational procedures, meets the regulatory biological and chemical safety requirements for use as animal feed.

Dried BSFL, regardless of the waste stream-fed, can successfully be used in commercially balanced broiler diets when incorporated using nutritional digestibility values (However, within Australia, regulation utilising BSFL fed on RAM waste needs to be adhered to).

Near Infra-Red spectroscopy can be used to monitor and control product quality throughout the processing procedures.

End Food Waste Cooperative Research Centre is funded through the Australian Government's CRC Program administered by the Department of Science, Industry and Resources.

Figure 3. Bagged Black Soldier Fly Larvae (Figure courtesy of Goterra)

IMPACT

Based on the scientific evidence provided, Goterra has signed contracts that will ramp up to a total contract value of +$10m AUD per annum.

Goterra is presently valorising ~1,845 tonnes of organic waste per annum.

Goterra has mitigated ~3,503,530 kgs of CO_2e

NEXT STEPS

- Spore forming bacteria can produce toxins
  - may contain emetic and enterotoxins (from *B. cereus*), alpha toxin from (From *C. perfringens*)
  - detect and quantify toxins and establish control measures for them
- Safe pathogen load of frass needs to be ensured
  - effect of heat treatments in reducing pathogenic loads in frass and their applications as fertilisers needs assessment
- Fate of mycotoxins in frass needs to be studied in detail
  - mycotoxins, if present in food waste, can pass through BSFL guts and can enter the frass
- Microplastics in frass can deter its use as organic fertiliser
  - can affect soil and water quality, eventually leading to eutrophication.
- Calibration data sets of NIRS can be improved by including a more diverse set of samples
  - BSFL samples from more waste streams, different batches of BSFL from the same waste stream, etc

PROJECT TEAM

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PROJECT REPORTS/PUBLICATIONS

Alagappan, S., Rowland, D., Barwell, R., Mantilla, S.M.O., Mikkelsen, D., James, P., Yarger,O, & Hoffman, L.C. (2022). Legislative landscape of black soldier fly (*Hermetia illucens*) as feed. *Journal of Insects as Food and Feed*, *8*(4), 343-355. https://doi.org/10.3920/JIFF2021.0111

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Alagappan, S., Hoffman, L.C., Mantilla, S.M.O., Mikkelsen, D., James, P., Yarger, O., & Cozzolino, D. (2022). Near Infrared Spectroscopy as a Traceability Tool to Monitor Black Soldier Fly Larvae (*Hermetia illucens*) Intended as Animal Feed. Applied Sciences, 12(16), 8168. https://www.mdpi.com/2304-8158/11/18/2894/pdf

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Alagappan, S., Mallard, S., Cozzolino, D., Mikkelsen, D, James, P., Olarte Mantilla, S.M., Yarger, O., & Hoffman, L.C. (2024). Effect of larval instar and post-harvest treatments on heavy metals in BSFL and frass reared on commercial food waste streams. *International Journal of Food Science & Technology,* https://doi.org/10.1111/ijfs.17511.

Alagappan, S., Kolobaric, A., Hoffman, L.C., & Cozzolino, D. (2024). Current and potential applications of vibrational spectroscopy as tool in the black fly soldier production and circular economy. *Applied Sciences*, https://doi.org/10.3390/app14167318

Alagappan, S., Hong, H., Mikkelsen, D., Mantilla, S. O., James, P., Yarger, O., Hoffman, L., & Cozzolino, D. Investigating the Effect of Larval Instar, Post-Harvest Treatments, and Substrate on the Nutritional Profile of Black Soldier Fly Larvae (*Hermetia illucens*). Submitted to *Journal of Animal Production Science* in March 2024

Alagappan, S., Hoffman, L.C., Mikkelsen, D, Olarte Mantilla, S.M., James, P., Yarger, O., & Cozzolino, D. (2024). Near Infrared Spectroscopy (NIRS) for monitoring the nutritional composition of black soldier fly larvae (BSFL) and frass. Journal of the Science of Food and Agriculture, 104, 1487-1496. https://doi.org/10.1002/jsfa.13044

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PROJECT WEBPAGE

OPTIMISING AND INDUSTRIALISING BLACK SOLDIER FLY (BFS) PRODUCTION – REDIRECTING FOOD WASTE TO LIVESTOCK FEED PRODUCTION USING INSECTS - End Food Waste Australia » End Food Waste Australia

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