ENHANCING BLACK SOLDIER FLY LARVAE *Hermetia illucens* MEAL NUTRITIVE VALUE AS AQUAFEED INGREDIENT

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Background

- Fish meal is commonly used as aqua feed ingredient as it is highly digestible and an excellent source of protein, lipids, minerals and vitamins. However its expensive and environmentally not sustainable.
- Insect meal, particularly black soldier fly larvae (BSFL, *Hermetia illucens*), shows comparable protein content to FM, but its application is hindered by lower digestibility, mainly due to the chitinous exoskeleton, which reduces nutrient utilization and feed efficiency.
- Chitin in BSFL can be reduced through chemical, enzymatic, or microbial treatments, many of these approaches require additional processing costs and operational complexity.
- This study investigated bacterial fermentation as a cost-effective strategy to enhance BSFL nutritional quality. Enhancement of the fermented BSFL was evaluated by analysing changes in the proximate composition, amino acid profile, fatty acid profile and in vitro protein digestibility.

Key Outcomes for Industrial Applications

- **Improved Nutritional Quality of BSFL Meal:** Fermentation with 0.1% EBM100 for 8 hrs increased arginine, histidine and methionine content, enhancing the amino acid profile and value of BSFL as an aquafeed ingredient.
- **Enhanced Digestibility Through Full-Moisture Fermentation:** Full-moisture fermentation improved *in-vitro* protein digestibility, potentially supporting better nutrient utilization and feed efficiency in aquaculture species.
- **Cost-Effective and Sustainable Processing Strategy:** Bacterial fermentation offers a practical alternative to expensive chemical or enzymatic digestion methods for improving insect meal quality.
- **Commercial Potential for Sustainable Aquafeed Development** Optimized fermented BSFL can support partial replacement of fish meal, contributing to more sustainable and circular aquafeed production systems.

Experimental Design

- This experiment was conducted at Feed Development Lab, Aquatic Health Hub, Aquaculture Innovation Centre, Singapore-529757.
- BSFL were pre-treated by crushing to increase surface area, and then fermented in an organic waste digester using an EBM bacterial mix supplied by YuQuan Biotech Pte Ltd.
- Fermentation was conducted in two sequential batches to optimize EBM dose and fermentation duration first, followed by evaluation of moisture levels under the optimal conditions, with analyses including proximate composition, amino acid profile, fatty acid profile, and *in-vitro* protein digestibility.

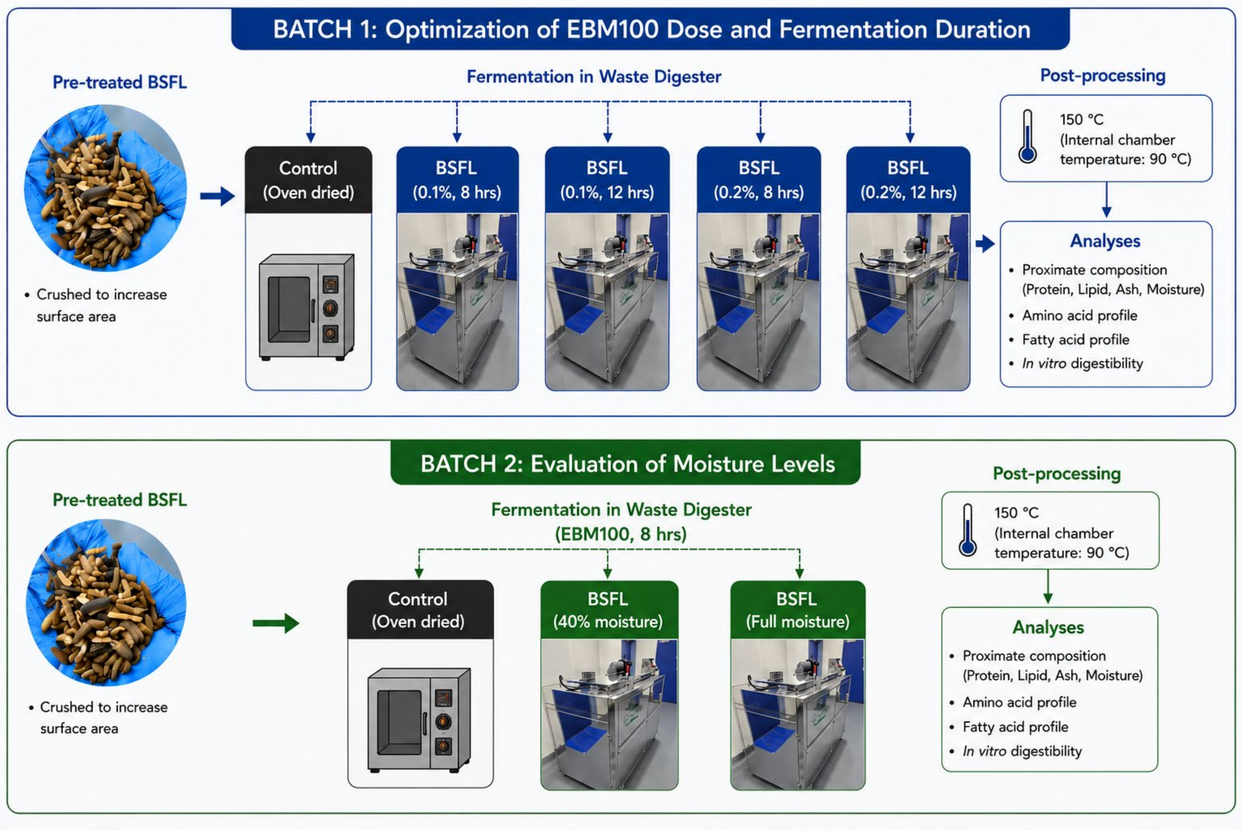


Figure 1. Experimental design of BSFL fermentation trials for optimization of EBM100 dose, fermentation duration, and moisture level using a waste digester system.

Results

- **Batch 1 : EBM dose and fermentation duration optimization:** Proximate composition (crude protein, lipid, ash, and moisture) showed no significant differences among treatments and control, while methionine was significantly higher in BSFL fermented with 0.1% EBM100 for 8 hours; no significant differences were observed in in vitro digestibility across groups.

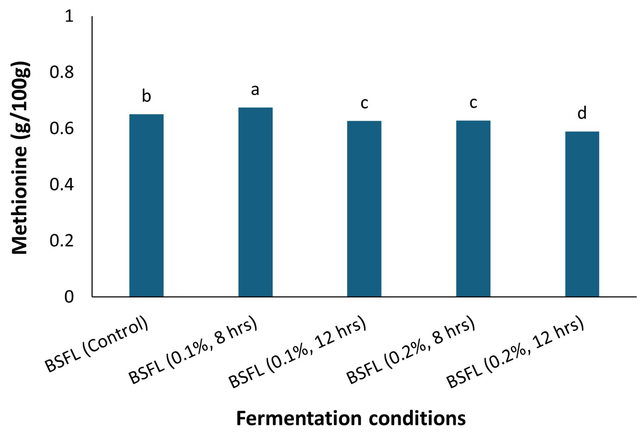


Figure 2. Methionine content of fermented black soldier fly larvae (BSFL) meal under different EBM bacterial doses and fermentation durations. Bars with different letters (a, b, c) indicate significant differences at the 95% confidence level.

- **Batch 2: Moisture level optimization:** Fermentation with 0.1% EBM100 for 8 hours under full-moisture conditions improved arginine, histidine methionine content and *in-vitro protein* digestibility compared to the control and 40% moisture treatment, while proximate composition and fatty acid profiles remained unaffected by moisture level.

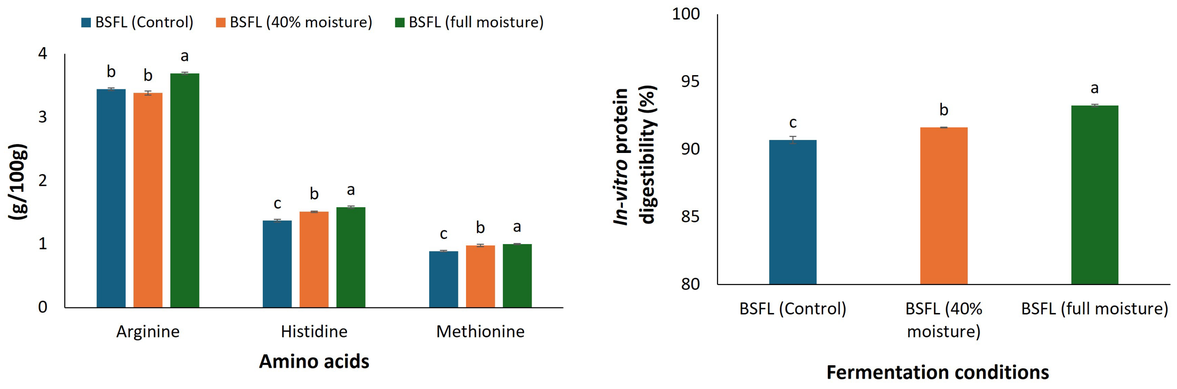


Figure 3. Amino acid composition and *in-vitro* protein digestibility of fermented black soldier fly larvae meal with heat-tolerant bacteria under different moisture levels. Bars with different letters (a, b, c) indicate significant differences at the 95% confidence level.

Acknowledgements

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