The Effects of Diet Manipulation on the Protein Content of *Tenebrio Molitor*

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BACKGROUND

- Today, edible insects have been identified as a way in which global hunger, malnutrition, and food insecurity can be alleviated. Also, insects are seen as an option for substitution for conventional livestock regarding climate change, specifically because they do not produce methane (Stull et.al, 2019).
- Across the globe, insects have been an important part of the human diet because there are a variety of species to study, and they are nutrient dense Insects are rich in fat, minerals, and proteins.
- *Tenebrio molitor* has been studied extensively, which has allowed the nutritional value of larvae being reared on different diets and under different conditions to be well-understood and documented.
- *T. molitor* are easy to rear and have been found to be nutritionally dense.
- They can consume a wide variety of organic materials as well as waste, which makes them a great candidate for study.
- *T. molitor* larvae were found to be compromised of 46.44% protein (Ravzanaadii et.al, 2021).

METHODS

- **Feeding Trials:** Larvae were reared over a period of two weeks. In order to measure individual growth, each larva was assigned a specific well which was documented and labeled. A weight range was implemented in the selection of larva dependent on their stage in its life cycle. For younger larvae it was 15-30 mg, and for older larvae it was 30-60 mg. With regards to the food source of the larva, for each trial they were fed oats and carrots. When adding the varied nutritional supplement for each trial, 10 mg of the supplement was added per 1 gram of oats. Throughout this two-week period, the larvae were weighed every 2-3 days. Upon the end of the rearing period, the larvae were stored at low temperatures, then baked in an oven to obtain their dry weights and prepared for protein assays. This was done by centrifuging the specimens with PBS buffer twice, the first with 1 mL of PBS buffer and glass beads, and then again after diluting with 4 mL of PBS buffer.
- **Varied Food Sources:** Casein, L-lysine, peanuts
- **Coomassie Bradford Protein Assays:** Coomassie (Bradford) protein assay reagent, containing Coomassie G-250 dye, methanol, phosphoric acid and solubilizing agents in water. When Coomassie blue dye binds to the protein of the larvae in an acid medium, this causes an immediate shift in the maximum absorbance from 465 nm to 595 nm, in which there is a color change from brown to a blue/purple. The assays were set up by taking 25 µL of the larva sample and pipetting it into a cuvette. Then 1 mL of the Coomassie dye as added.
- **Spectroscopy:** Once the Bradford assays were set up in the cuvettes, the spectrophotometer was calibrated, with the Coomassie dye being the blank. The absorbance was measured for each sample at 595 nm.

REFERENCES

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RESULTS

Casein

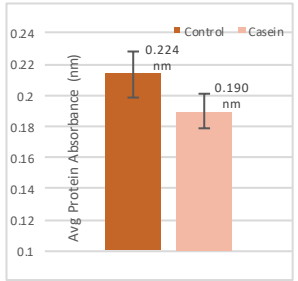

Fig. 1. Average protein absorbance (nm) in mealworms as a function of diet manipulation with casein. No significant effect found (t = 1.73, df = 51, p= 0.089678).

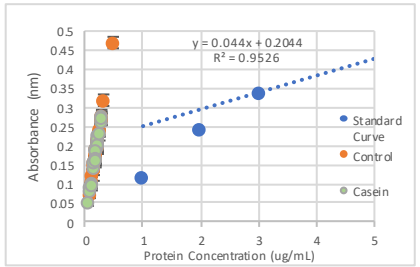

Fig. 2. Protein absorbance (nm) in mealworms as a function of diet manipulation with casein plotted against a standard curve. No significant effect found (t = 1.73, df = 51, p= 0.089678).

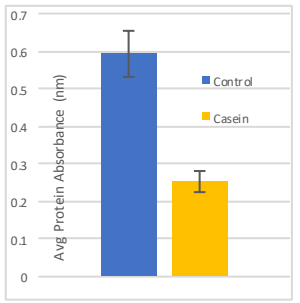

Fig. 3. Average protein absorbance (nm) in mealworms as a function of diet manipulation with casein and exercise. Significant effect found (t = 5.14, df = 9.87, p = 0.000445).

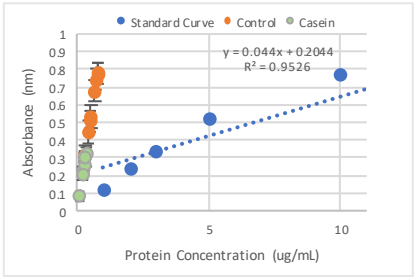

Fig. 4. Protein absorbance (nm) in mealworms as a function of diet manipulation with casein and exercise plotted against a standard curve. Significant effect found (t = 5.14, df = 9.87, p = 0.000445).

L-Lysine & Peanuts

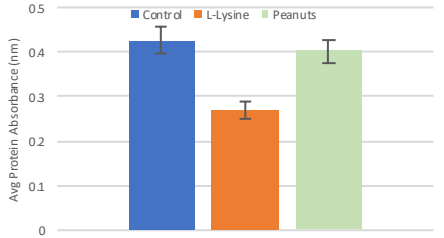

Fig. 5. Average protein absorbance (nm) in mealworms as a function of diet manipulation with L-Lysine and peanuts. Significant effect found for L-Lysine (t = 4.32, df = 33, p = 0.000135) but no significant effect found for peanuts (t = 0.63, df = 30.66, p = 0.526591).

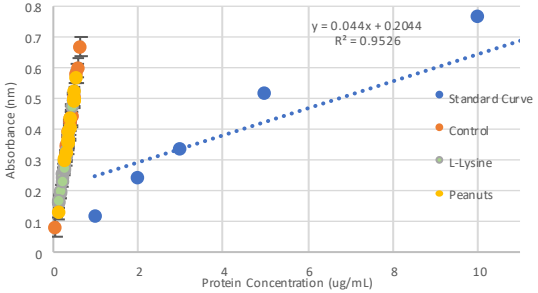

Fig. 6. Protein absorbance (nm) in mealworms as a function of diet manipulation with L-lysine and peanuts plotted against a standard curve. Significant effect found for L-Lysine (t = 4.32, df = 33, p = 0.000135) but no significant effect found for peanuts (t = 0.63, df = 30.66, p = 0.526591).

DISCUSSION

- Figs. 1 & 2 show that casein did not have a significant effect on protein absorption in *T. molitor*, whereas Figs. 3 & 4 found casein to have a significantly negative effect on protein absorption in the species. This is an unusual finding, as it has been well-documented that casein tends to increase protein absorbance in *T. molitor* (Ravzanaadii et al. 2021) and could possibly be explained through further trials.
- Figs. 5 & 6 show that peanuts did not have a significant effect on protein absorbance in *T. molitor*, but that L-Lysine had a significantly negative effect on protein absorbance in the species. This is also an unusual finding, as L-Lysine is a common amino acid used for the building of protein and has been cited as having significantly positive effects on protein absorbance (Leinonen et al. 2019).
- More research is needed to understand the effects of various food sources on protein absorption in mealworms in order to achieve a sustainable global protein economy.