The effect of Hemp by-products in mealworm (*Tenebrio molitor*) Diet

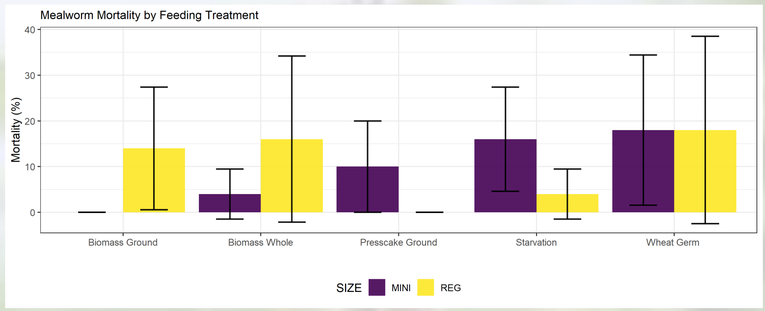
Ashya Reid, Heather Grab, Zachary Stansell

Introduction

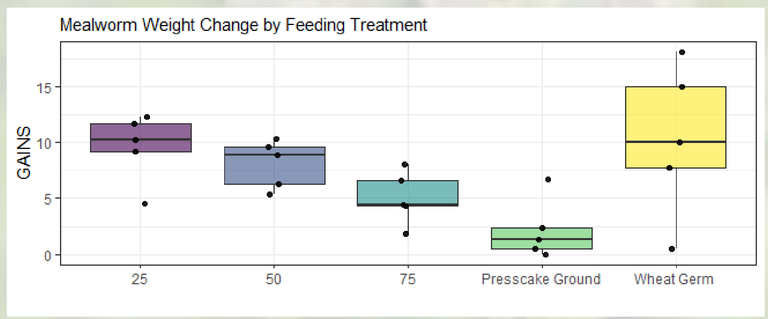
Is the consumption of hemp byproducts something that effects the nutritional composition of mealworms? Mealworms are used as feed additives due to their high protein and fatty acids (Stull et al., 2019). Easy on the economy, easy to rear, and easy on the environment. Hemp is an up-and-coming industry. The plant can be used for fiber, grain, and seed oil. Typically, the plants' byproducts are disposed of in waste fields. They accumulate high amounts of green house gases, which are harmful to our environment. Mealworms can be used to dispose of those said byproducts. Not only do they consume grains such as wheat germ, but they also consume dead plant matter (i.e., hemp byproducts). These insects are multipurpose. Disposing of excess plant matter, producing fras(waste) that can be utilized as fertilizer, and feeding animals in need of protein. All they need is a dark, room temperature, and relative humid environment(Rumbos et al., 2020).

The image to the left depicts the mealworms living in wheat germ (WG), as their main feed source. All colonies were separated from their original feed source and converted to WG. When placed into their treatments, we ~1g of feed per worm, more than can be consumed in one week.

Results

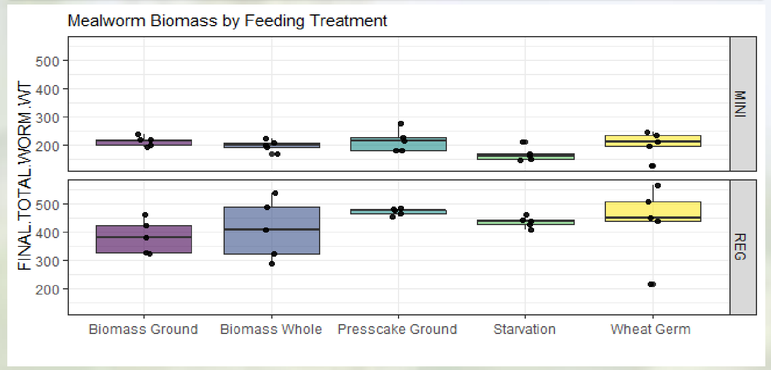


The figure above is a bar plot with variance that measures the percentage of life in comparison to the different diet treatments. There are no consistent or significant correlations between any specific feed and the mortality rate.



This box plot tells us that wheat germ combined with presscake up to 75% allots for significantly adequate weight gain.

Results Continued



Individual growth was higher in wheat germ; however, mortality was also high resulting in no difference in overall biomass among treatments.

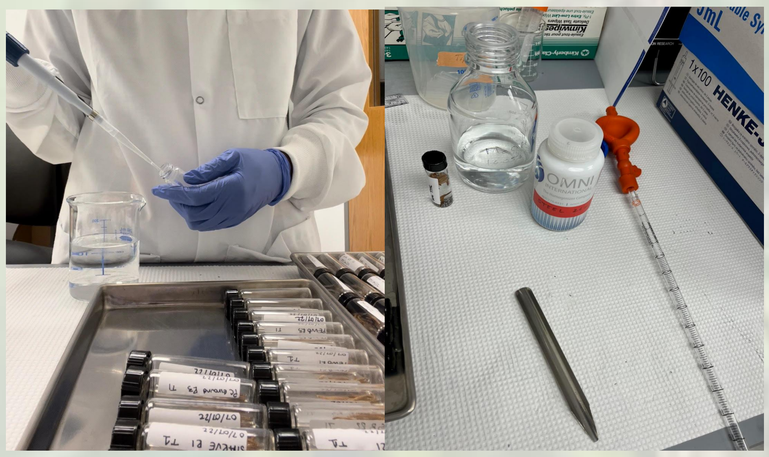
	VIAL	TRT	ST.WT	CBDA	CBD	Total CBD	CBGA	CBG	Total CBG	THCA	THC	Total THC
2	1	Mealworms: Wheat Germ	219.7	ND	ND	ND	ND	ND	ND	ND	ND	ND
3	2	Mealworms: Biomass Whole	138.6	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	3	Mealworms: Biomass Ground	143.1	LOQ	ND	LOQ	ND	ND	ND	ND	ND	ND
5	4	Mealworms: Starvation	141.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
6	5	Mealworms: Presscake	172.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
7	6	Presscake	200	LOQ	ND	LOQ	ND	ND	ND	ND	ND	ND
8	7	Post Extraction Biomass	200	1.62	0.11	1.52	0.03	0.01	0.034	0.07	0.01	0.066
9	8	Pre Extraction Biomass	200	6.81	0.16	6.13	0.22	0.04	0.224	0.32	0.07	0.34
10												

The table above are the results from the HPLC test. It was used to determine the cannabinoid percentages within

- ND = Not Detected
- LOQ = Limit of Qualification (1 microgram/mL is ~0.01% by weight)

Methods

Two colonies of mealworms varying in size were utilized. An incubator maintained darkness, temperature(25˚C), and humidity(65%). Each trial consisted: 1 size, 10 worms, 5 treatments, and 5 repetitions for 1 week. Weights were collected for each stage. The mealworms were placed in 12mL glass vials for the euthanatizing(-14 ˚C), freeze drying(~700mTorr), and extracting processes. Lipids were extracted using a 2:1 Chloroform: Methanol of 6mL each. They were dried (filter paper and fume hood) to account for lipid weight.



Lipid Extraction (Left); THC Extraction (Right)

The mealworms used for THC testing had each treatment containing one mealworm from each repetition. They were shaken up in a solution of 10mL methanol and ~25 omni-international steel 2.4mL beads until broken up. 1mL of the extract was placed into micro-centrifuge tubes(1.2mL), and one tube contained 1mL of the solvent MeOH as the control. The centrifuge was set on 5000rpm for 5 minutes. Afterwards, they were placed inside of mini vials used for the High-Performance Liquid Chromatography machine. The machine dictates accurate concentrations of chemicals, even at low concentrations. Due to timing and resources, proteins could not be tested, however, the mealworms will be sent off to a lab for further analysis.

Discussions

Our findings suggest that ground presscake is the most promising hemp byproduct that creates value as a feed source for mealworms, while also improving environmental sustainability by reducing waste. Mealworms that were fed presscake had a lower mortality and similar lipid profile to those fed solely wheat germ. We did not detect any residual cannabinoids in the mealworms post study, which deems them safe for livestock feeding. Future studies will evaluate the number of mealworms needed to optimize the value of nutritional benefits, as well as the benefits of fras use.

Cattle are just one example of the livestock that would be consuming these mealworms. The picture above is of a heifer and her newborn calf on the W. T. A. R. S. These cattle underwent an experiment utilizing hemp, feed additive, as a behavioral adapter during the weaning process.

Conclusions

If wheat germ is a percentage of their feed, the mealworms have adequate weight gain. When the treatment was 75% presscake and 25% wheat germ, they thrived equally as 25:75. The significant lack in weight gain became when no wheat germ was present. Additionally, HPLC, revealed that the mealworms did not contain any cannabinoids. The FDA prohibits livestock consumption or the introduction of products containing cannabinoids, as stated in **section 301(ll) of the FD&C** (Commissioner). Given that the mealworms fed hemp byproducts do not contain cannabinoids, they are viable for consumption.

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References

- Commissioner, O. of the. (n.d.). *FDA regulation of cannabis and cannabis-derived products: Q&A*. U.S. Food and Drug Administration. Retrieved July 25, 2022, from https://www.fda.gov/news-events/public-health-focus/fda-regulation-cannabis-and-cannabis-derived-products-including-cannabidiol-cbd#:~:text=With%20respect%20to%20products%20labeled,or%20CBD%20has%20been%20added.
- *Mealworm Care Sheet*. Fluker's Cricket Farm. (n.d.). Retrieved July 7, 2022, from https://flukerfarms.com/reptile-u/care-sheets/mealworm-care-sheet
- Selaledi, L., Mbajiorgu, C. A., & Mabelebele, M. (2019, August 7). *The use of yellow mealworm (T. Molitor) as alternative source of protein in poultry diets: A review - tropical animal health and production*. SpringerLink. Retrieved July 7, 2022, from https://link.springer.com/article/10.1007/s11250-019-02033-7