Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Investigation)

(Word Limit: 1,000 words, Pages: 2 pages only)

Team Number: SBBC302

Project Title: Investigation on the hybridizing effects of multi-insect biorefinery

Project Type: Investigation

To our best knowledge and after thorough literature research, as at _25__/_06__/_2022__ , there are / are no* similar works. If there are, the reference links are as below:

Zheng L, H. Y. (2012). Biodiesel production from rice straw and restaurant waste employing black soldier fly assisted by microbes. *Energy*. https://www.sciencedirect.com/science/article/abs/pii/S0360544212006846

Li Q, Z. L. (2011). Bioconversion of dairy manure by black soldier fly (Diptera: Stratiomyidae) for biodiesel and sugar production. *Waste Manag*. https://pubmed.ncbi.nlm.nih.gov/21367596/#:~:text=The%20digested%20dairy%20manure%20was,from%20the%20digested%20dairy%20manure.

Leung D, Y. D. (2012). Biodiesel from Zophobas morio larva oil: process optimization and FAME characterization. *Ind Eng Chem Res*. https://hub.hku.hk/handle/10722/179563

Wang, R. L. (2017). Insect biorefinery: a green approach for conversion of crop residues into biodiesel and protein. *Biotechnol Biofuels*, 2-3. https://biotechnologyforbiofuels.biomedcentral.com/articles/10.1186/s13068-017-0986-7

Sinha, P., & Madavi, A. S. (2021). Study on Yield percentage of Biodiesel from Waste cooking oil using Transesterification. India: Research India Publications. https://www.researchgate.net/publication/353364587_Study_on_Yield_percentage_of_Biodiesel_from_Waste_cooking_oil_using_Transesterification

Rozina, M. A. (2021). Sustainable and eco-friendly synthesis of biodiesel from novel and non-edible seed oil of *Monotheca buxifolia* using green nano-catalyst of calcium oxide. Pakistan: Elsevier Ltd. https://www.sciencedirect.com/science/article/pii/S2590174521000672

Dong-Jun Lee, M. K. (2022). Direct conversion of yellow mealworm larvae into biodiesel via a non-catalytic transesterification platform. *Chemical Engineering Journal, Volume 427*. https://www.sciencedirect.com/science/article/abs/pii/S1385894721033635

I. Background

- Provide background information of project and/or state the problem to tackle
- Provide highlights of the **literature review** with the support of pertinent and reliable references
- Provide an overview of work and mention the **research gap that the project is trying to fill**

As the economic situation begins to accelerate around the world, energy consumption is a huge topic that captures our attention towards it. When people use coal, natural gas and other non-renewable energy sources, it is crucial to find out ways to sustain the energy consumption in our world such as developing new sources of energy.

II. Objectives

- State the **aim(s)** of project

To compare the efficiency of single-species conversion and multi-insects biorefinery through various investigations and analyses.

III. Hypothesis

- Propose an explanation for a phenomenon and stating how the **hypothesis** can be tested by experiments

Multi-insect biorefinery is more efficient and practical than uni-insect biorefinery.

IV. Methodology

- List out the materials used
- Describe the **experimental protocol** including the set-up of **control experiment** (if any), **repeated experiment** (if any), and its scientific theory
- Indicate with the support of reasons, the **analysis** used in the investigation

The collected corn stover is dehydrated in an electric oven and being chopped and ground using a laboratory blender, sieved to sizes below 3 millimeters, and dried again in an oven.

The first stage (STAGE I) of the multi-insect biorefinery is the production of biomass by yellow mealworm larvae (*Tenebrio molitor L.*). A hundred grams of dried, ground corn stover are added twice into 1700 yellow mealworms. Then, waste carrots are provided to the yellow mealworm larvae during the experiment under favourable conditions. After 63 days of feeding, dried insect biomass of yellow mealworms will be collected for further experimental procedures.

The second stage (STAGE II) of the multi-insect biorefinery is the grease extraction, biodiesel production and residue utilization by black soldier fly (*Hermetia illucens L.*). Four hundred black soldier fly larvae are introduced into 750 g wet residues in the greenhouse at a constant temperature and humidity similar to the first stage, which are done in triplicates to increase the experimental reliability. The mature black soldier fly larvae are then split from the residue and dried for further processing to produce biodiesel.

A control experiment is designed to measure the hybridizing effects of multi-insect biorefinery. Thus, only black soldier flies are used in the control set-up. Four hundred black soldier fly larvae are prepared and incubated in a greenhouse under the same conditions as described above. The experiment is done in triplicates as usual. Mature black soldier fly larvae are then separated from the residues and they are dried for further synthesis of biodiesel.

V. Results

- Present the **data** with figures, tables or photos
- **Data analysis** (if any, with emphasis on data reliability and the reproducibility based on statistics)
- Interpret the results and its implication
- Discuss **limitation** and compare with existing related works (if any)
- Discuss the importance or impact of the research and how it is applicable to real problems

In the first stage of the experiment, a reduction of total mass of wastes from 229.25 g to 182.09 g is recorded, which shows the consumption of the yellow mealworms (YMW). It is then further consumed by the black soldier flies (BSF), and is reduced from 182.09 g to 111.59 g.

After the second stage of experiment, the changes in substances, namely reducing sugar, lipid and protein are analyzed to show the utilization efficiencies. The amount of reducing sugar, lipid and protein in the wastes have decreased by 97.88%, 60.52% and 40.40% respectively.

It had been recorded that the percentage of bioconversion of the uni-insect biorefinery experiment is 1.39%, which is lower than that of the multi-insect biorefinery experiment of 3.71%.

VI. Conclusion

- Make a **data-driven** conclusion of the project and the way forward of the research
- Justify if the proposed project meets the objective(s)

It could be concluded that in producing biodiesel, multi-insect biorefinery is more efficient than single-species conversion. However, it is apparent that the adoption of multi-insect biorefinery in synthesis of biodiesel is not practical due to its low yield.