

Hong Kong Student Science Project Competition 2022

Template of Extended Abstract (Investigation Design Proposal)

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

Team Number: SDBC223

Project Title: Food Protein

Project Type: Investigation Design Proposal

To our best knowledge and after thorough literature research, as at 9 / 6 / 22 , there are / ~~are no~~* similar works. If there are, the reference links are as below:

<https://www.wageningenacademic.com/doi/abs/10.3920/jiff2019.0057>

The enhancement our project has made for the existing related products or research is summarized as below:

To compare the economic sustainability of various ways of utilising mealworms as a food source compared to conventional poverty or disaster relief food.

*Please delete if not applicable. HKSSPC values the originality of works. Students must conduct literature research thoroughly to ensure that their works are unique, and to list relevant reference materials to complement the research or invention.

I. Background

- Provide background information of project and/or state the problem to tackle
 - Poverty is a huge problem nowadays. 9.2% of the world, or 689 million people, live in extreme poverty. One main consequence of poverty is the lack of food. By doing this investigation, we hope to find ways to provide alternative sources of food to alleviate the problem of poverty.
- Provide highlights of the **literature review** with the support of pertinent and reliable references
 - The yellow mealworm, the larval stage of the darkling beetle *Tenebrio molitor*, shows great promise as an alternative source of animal protein. Herein we present the 312 Mb draft genome assembled using 10x Genomics linked-read technology to inform research efforts and to provide resources to optimise yellow mealworm for mass production and consumption. The genome with a contig N50 of 39,478 bp contains 89% of conserved arthropod genes among the > 20,000 genes assembled (complete and partial genes). This draft assembly represents a valuable resource to understanding *T. molitor* biology as a means of producing alternative, sustainable protein for the growing population and in the face of changing climates.
(Source: <https://www.wageningenacademic.com/doi/abs/10.3920/JIFF2019.0057>)
- Provide an overview of work and mention the **research gap that the project is trying to fill**
 - We are going to compare the energy content of mealworms and other food, so as to find out whether mealworms are a suitable and reliable source of food. This project aims to find out if mealworms are cost-effective in terms of energy content, and whether mealworms are suitable for people in underdeveloped countries as a daily food.

II. Objective(s)

- State the **aim(s)** of project
The aim of the project is to compare the economic sustainability of directly consuming and using mealworm frass as a fertiliser to that of regular food.

III. Hypothesis

- Propose an explanation for a phenomenon and stating how the **hypothesis** can be **tested** by experiments
 - Mealworms have higher energy content than rice of the same cost.
 - Plants grown with mealworm frass will have higher energy content than a normal plant.

IV. Methodology

- List out the materials to be 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** to be used in the investigation

Calorie test by burning mealworms vs typical disaster relief food

Test mealworm frass as fertiliser + calorie test of the product

Calorie test

Apparatus:

Electronic balance, combustion spoon, measuring cylinder, test tube, Bunsen burner, thermometer

Procedure:

1. Measure and record the weight of different food
2. Put the mealworms in the oven for 4 days
- 3.. Put 10 cm³ of water into each test tube
4. Record the initial temperature of the water
5. Ignite the food with a Bunsen burner
6. Put the food under the test tube until the food completely burns out
7. Record the final temperature of the water
8. Repeat it for different food
9. Calculate the energy content per gram of different food by formula $E=mc\Delta T$

Growth test

Procedure:

1. Put 5 mung beans in cotton, in cotton added fertiliser, and in cotton added mealworm frass
2. Place it under sunlight and wait for it to grow
3. Record the average length after 1 week

V. Expected Results and Impact of research

- Describe the **expected results** with the selected approach
 - Mealworm should contain a higher energy content
 - Seedlings should grow faster in soil containing mealworm frass
- Discuss **limitation** and compare with existing related works (if any)
 - The environmental factors in Hong Kong are different from other countries
 - Mung beans are not the main food source
 - The time of growth is too short to have significant results
 - The amount of mealworm frass may be too little to be used as fertiliser
- Discuss the importance or impact of the research and how it is applicable to real problems
 - Mealworms are cheap and full of proteins. If mealworms are cost-effective in terms of energy content, it can tackle the problem of poverty and hunger in underdeveloped countries.
 - If mealworm frass can be used as fertiliser, it is beneficial to farmers because mealworm frass is much cheaper compared to artificial NPK fertilisers

VI. Conclusion

- Make a conclusion of the design project and the way forward of the research
 - This project aims to find out whether mealworms can be used as a food resource for daily life. We are also comparing its economic sustainability with other food. By doing this investigation, we hope to find ways to tackle the problem of hunger, so that more people can escape from poverty with cost-effective methods

*** Our project is developed based on our school's previous project and the enhancement is as below:**

Our project is based on the knowledge acquired from the school's Biology Value-Added Programme 2021-22. However, the investigation is wholly designed by our team and our team only, with the focus being to compare the economic sustainability of various methods of utilising mealworms for sustainable development.