Hong Kong Student Science Project Competition 2023
Template of Extended Abstract (Investigation)
(Word Limit: 1,600 words, Pages: 3 pages only)

Team Number: JBBC102

Project Title: Nasty but useful

Project Type: Investigation

***To our best knowledge, there are** * **similar works in the field*; (if there are,) related research links are as below:**

https://powerup.mingpao.com/%e8%b6%85%e7%b4%9a%e9%ba%a5%e7%9a%ac%e8%9f%b2%e6%98%af%e4%bb%80%e9%ba%bc%ef%bc%9f%e5%8f%af%e6%b6%88%e5%8c%96%e5%a1%91%e8%86%a0%ef%bc%9f-%e5%88%9d%e4%b8%ad%e7%94%9f%e7%94%b1%e5%a4%96%e8%b3%a3%e7%9b%92/#:~:text=%E5%9C%98%E9%9A%8A%E7%99%BC%E7%8F%BE%EF%BC%8C%E6%AF%8F%E6%A2%9D%E8%B6%85,%E9%9F%BF%E7%89%A0%E5%80%91%E6%B6%88%E5%8C%96%E5%A1%91%E8%86%A0%E3%80%82

The enhancement our project made / the difference with related research are:

We aim to find an optimum environment by different factors(e.g. temperature, vibration rate) for the superworms to eat plastic at the fastest rate, which is not seen in the related research.

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**

Background information:

Microplastics is an unsolved crisis to the environment, as it is decomposed in the environment, staying in the landfill and taken in by marine organisms, ultimately affecting their health and also human's health when humans eat these organisms. And as the use of plastics is increasing in an overwhelming rate, it requires an immediate solution.

Highlights of literature review:

In the literature reviews, we found that superworms can eat plastics faster than all other worms, we found how to conduct experiment to find out the presence of microplastics in the feces, and get the inspiration to find out the optimum environment for worms to eat plastics in the fastest rate, instead of proving if it can eat plastics or not.

Research gap:

Firstly, there is no research showing what vibration rate/temperature specifically is the most optimum for superworms to eat plastic. Secondly, some websites stated that the superworms can decompose all plastics, but some say they still egest microplastics. So we will test on various factors by changing the independent variable to find out the most optimum environment, and test on the feces of the superworms to see if there is microplastics inside, so the research gap and the controversies can be filled.

II. Objectives

Through our investigation into superworms, we hope to alleviate plastic pollution. Our investigation includes finding out whether superworms can fully digest plastics, what plastics do the worms eat the most, and how to make the worms eat more plastics to increase the rate of decomposition of plastics.

III. Hypothesis

Hypothesis 1: In the same time period, the same amount of different plastics is consumed.
Hypothesis 2: No matter what type of plastics superworms eat, they do not egest microplastic.
Hypothesis 3: The higher the temperature, the more foam the superworms eat.
Hypothesis 4: The higher the frequency of vibration, the more foam the superworms eat.
Hypothesis 5: With syrup added, the more foam the superworms eat.

- Can be tested by changing the independent variable, and keeping all variables the same, and let the superworms eat the plastics for 3 days, and examine the results.

IV. Methodology

Experiment 1: Materials: plastic box, different types of plastics, electronic balance
Different groups of worms (groups of the same size) are given different types of plastics to eat for three days. We weigh the plastics before and after the process of eating, to see how much plastics they ate. This is to find out what plastics the superworms love to eat the most. In the end, most of the plastics were not loved by the superworms, and the groups mostly only ate 0.01g to 0.04g of the plastics. Meanwhile, the styrofoam groups ate all 0.17g of plastic, meaning styrofoam is the superworms' favorite plastic.
Experiment 2: Apparatuses: beakers, Fenton's reagent, 65% nitric acid, PTFE filter, water bath, absolute ethyl alcohol
By conducting experiments on the feces by digesting it using the above chemicals and multiple filtrations, we can find if there is microplastics.
Experiment 3:
Materials: plastic box, test tube shaker, rocking shaker, electronic balance
Different groups of worms (50 worms, 8 groups in total) are put in different incubators with different temperatures, and find out the amount eaten of four of the groups. The initial weight is 1.27g
Experiment 4:
materials: test tube shaker, rocking shaker, plastic box, styrofoam
Different groups of worms(50 worms, 6 groups in total) are put with different vibration rates(2 77/min, 2 200/min, 2 act as control) to find the amount eaten. The initial weight of the foam is 0.78g.
Experiment 5: Materials: plastic box, syrup, styrofoam
We prepared 4 groups of 50 worms each, then 2 groups were added syrup into it, and 2 groups acted as control, without adding anything. The syrup gives a sense of sweetness, to see if it can attract the superworms to eat more.

V. Results

Hypothesis 1: type of plastics
From our results, we can conclude that the worms do indeed prefer one type of plastic in particular, and that is styrofoam.Online articles all emphasize that superworms eat polystyrene when we search for 'plastic eating worms', and our results match with those.
Hypothesis 2: After checking the results, there is no microplastics, meaning that the superworms have digested all plastics and egested no microplastics and that no matter what condition(temperature, vibration rate) and type of plastic it is, there isn't any microplastics.
Hypothesis 3: After filtration, we have measured the weight of the styrofoam inside the plastic boxes with an electronic balance. Here are the results presented in a graph:
We can observe that the superworms ought to digest the best at 25ºC. It shows that these worms cannot digest quickly in environments that are too cold or hot. The worms do not digest more foam under a higher temperature, but within their optimal temperature range.
Hypothesis 4:
After inspecting the results, we arrived at the conclusion that when it comes to the digestion rate of the insects, a less intense vibration will lead to a group of insects eating plastics more rapidly compared to the initial weight of polystyrene (0.73g) for all the setups.
The result of the amount of plastic consumed is shown below:
This might be a result of the fact that they could not stabilize themselves before getting down to eating as well as their consciousness being affected due to the rapid shaking intensity of the setup. Superworms prefer a gentle and slower vibration compared to a fast and intense vibration in order to eat plastic at a fastest rate and so the hypothesis does not stand.
Hypothesis 5:

After examining the results, we came to the conclusion that the worms digest more styrofoam with increasing sweetness. We measured the weight of remaining styrofoam in the plastic box after filtration with an electronic balance, then we subtracted the measured number from the initial weight (0.78g).
Amount of plastic consumed:
There is a significant increase in superworms' digestion rate of styrofoam with syrup when compared to the ones without. The worms may be attracted to the sweetness of the syrup, but it is also possible that the sugar inside the syrup catalyzes their gut enzymes to digest microplastics. To conclude, the hypothesis stands and superworms tend to eat more styrofoam if it is sweet.
Through such results, we can find how to let superworms eat plastics in the fastest rate, reducing the amount of pollution by plastics in the world.

VI. If your team will compete the Sustainable Development Award, please indicate the specific sustainable development goal the project is related to, and provide justification for competing for this award. ***(Word limit: 300 words)***

Our project is mainly related to 'life below water'. Through our project, we find the best conditions for superworms to eat plastics, and through our investigation of that it does not excrete microplastics, we can prevent microplastics from infiltrating into the soil, flowing to the river and to the sea. Nowadays, marine organisms die because they are trapped by plastics or they eat too much microplastics, but after the introduction of 'superworm farms', where plastics are eaten by superworms in a large scale before flowing to the sea, it can save lives of the marine organisms and solve water pollution.

VII. If your team will compete the Social Innovation Award, please list the target group or social issue the project focuses on, and provide justification for competing for this award.
(Word limit: 300 words)

Hunger and poverty. Poor people. When such microplastics flow to rivers, it will pollute the river and when poor people drink it, when they do not have enough water supply, they will get harmed easily due to them having anorexia and kwashiorkor. Also, when marine organisms eat too much microplastics, and poor people relying on agriculture eat such marine organisms, causing health problems as they only rely on those organisms as their food source. Also, farmers are affected too as when the soil has too much microplastics, it affects the soil fertility and therefore the crops. This will only cause the poor people to have a lack of healthy food sources, causing hunger, and also diseases when they take in too much microplastics.

VIII. Conclusion

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

In conclusion, we have conducted five experiments, and we found out that the superworms would have preferences when eating plastic, since all the styrofoam was eaten while the other plastics weren't eaten as much, only around 0.01g to 0.04g was eaten for most types. Also, no micro plastics were present in the feces of the worms, since we could not find any in our test results. Moreover, factors such as temperature, vibration, and the sweetness of the plastics (styrofoam) would affect the consumption rate of plastic of the superworms. Our project has met the objectives, since we have found the answer to our initial questions or uncertainties. In the future, we want to investigate how and why the superworms are able to digest plastics, to help alleviate the severe plastic pollution crisis.

✖ Our project is developed based on previous project and the enhancement is below:

Adding onto the research we found above, we found out what is the optimum temperature, vibration rate, sweetness of the foam etc for the worms to eat the plastics. Moreover, we also conducted the experiment to test on microplastics in feces thoroughly, which is not stated in the news article.