Chemically Modifying Plastics to facilitate Degradation by Mealworms

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Abstract

Overwhelming amounts of garbage and unrecycled plastics plague the Earth and its oceans, and the amount of plastic is only growing as global population expands. Every day, thousands upon thousands of tons of plastic are dumped into landfills and ginormous patches of garbage in the ocean. Day by day this pollution is killing many animals and plants, and the surrounding ecosystem. If this practice continues, it will be nearly impossible for earth to support life in the near future. Although it has been found that mealworms are able to safely degrade polyethylene, an essential plastic that makes up 34% of the plastic market, the process is not efficient enough to be considered a legitimate solution to help solve the garbage crisis. However, if we were able to find a way to speed up this process, we could potentially use mealworms to assist in the degradation of plastic in landfills.

Materials and Methods

- We gathered all materials and dressed in our safety gear (masks, goggles, gloves) in order to prepare for the plastic melting process.
- Melted 100 ml of polyethene pellets over stovetop, doing this three times to form three disks.
- Added 10 ml of cornmeal to one disk, 10 ml of oatmeal to the second, and kept the last disk plain. To let cool, we placed the disks on a metal tray and left outside for 10 minutes to cool.
- We placed one of each of the newly created plastics in a glass tank and put 250 meal worms in each tank with a small slice of celery.
- Every three days for three weeks we recorded the mass of each type of plastic
- We then repeated this process two more times.

Figure 1- Pictured to the left are the results of the melting of the polyethylene. The top disk is oatmeal plastic, the middle disk is cornmeal plastic, and the final disk is plain plastic.

Figure 2- The picture on the right shows the mealworms consuming the modified plastic within the glass tanks.

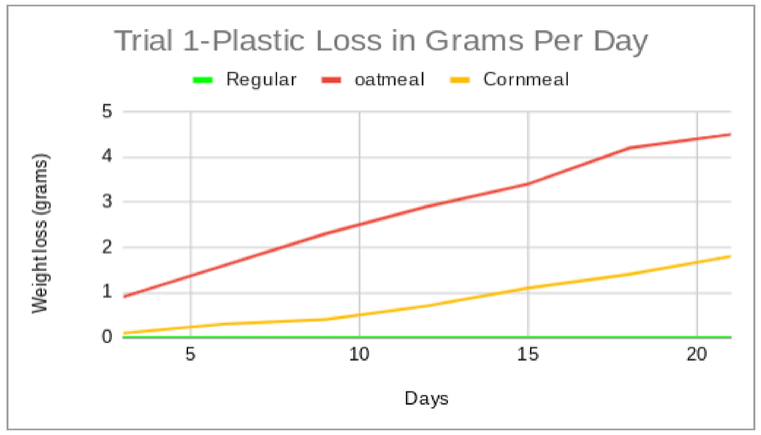
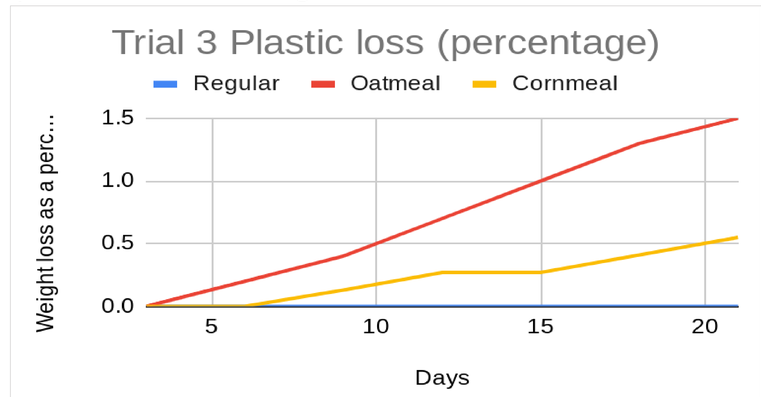


Figure 3- Above, this graph displays the daily loss of plastic in grams for trial one.

Figure 4 -Below, this graph shows the percent loss of the plastic over time during trial three.



Discussion

Based on our results from trials 1 and 3, one can conclude that our hypothesis was supported. The plastics with integrated grains were consumed at a faster rate than plastic without integrated substances. These results make sense, as mealworm farms use cornmeal and oatmeal as food sources for the worms. The only difference between this experiment and what was previously researched in the literature review was that plain polyethylene was consumed in other studies, but there was no change in plain polyethylene weight recorded in our experiment. For future experimentation, it would be ideal to test if we could integrate the same substances (oatmeal, cornmeal) into other types of plastic such as polystyrene. Additionally, we deemed the data we collected during trial two invalid, because of inconsistencies in the scales used to measure the weight of the plastics. If degradation by mealworms was to be implemented in our society, the process would be most practical if we also incorporated oatmeal into the plastics when they are being manufactured.

Results

Our trial one results displayed that the oatmeal plastic lost the most weight, at a 6.37 % weight loss, cornmeal at 2.37%, and plain with a 0% change. Out trial 3 results were similar in order, with oatmeal at 1.5%, cornmeal at .55%, and plain once again at 0%. We deemed our Trial 2 results invalid due to unpredicted changes in variables.

Days	Regular	Oatmeal	Cornmeal
0	56.5	74	73.2
3	56.5	74	73.2
6	56.5	74	73.2
9	56.5	74.1	73.1
12	56.4	73.8	73
15	56.7	73.9	73
18	57	74	73
21	57	74	73
Trial 3			
Days	Regular	Oatmeal	Cornmeal
0	56.5	74	73.1
3	56.5	74	73.1
6	56.5	73.8	73.1
9	56.5	73.7	73
12	56.5	73.5	72.9
15	56.5	73.2	72.9
18	56.5	73	72.8
21	56.5	72.9	72.7

Figure 5- This was our data table for trial one and three. It displays the plastic loss in grams for each plastic over time. As one can see, oatmeal had the greatest overall loss in mass.

Conclusion

All in all, our research has shown that the oatmeal and cornmeal plastics were degraded at a faster rate than the plain polyethylene. Our research has contributed to our field of mealworm plastic degradation and plastic pollution management by showing that oatmeal was the most efficiently consumed substance when mixed with plastic. This information can be used in the future during the process of plastic creation. Oatmeal would be ground up and mixed with plastics while being created, so if it ends up reaching a landfill, mealworms will be able to consume this modified plastic. If our findings are later implemented into plastic production, this would mean a cleaner and healthier world for all.

Resources

•Corbett, E. (2018, May 27). How worms can help recycle plastic. Retrieved October 12, 2019, from https://fortune.com/2018/05/27/plastic-crisis-worms/

•Brookshire, B. (2016, June 21). Teens use science to worm through plastic waste. Retrieved October 9, 2019, from Science News for Students website: https://www.sciencenewsforstudents.org/article/teens-use-science-worm-through-plastic-waste