Degradation of Bioplastics from Biomass Sources Used as an Alternative for Plastic Products

Anna Armstrong, HS-EAEV-0001

Spokane, WA, United States of America

Joel E. Ferris High School

Introduction

- **Is there a way to increase the rate at which a plant starch biomass products decomposes?**
- Often, plant starch products take too long to decompose and are instead put in landfills. By accelerating the process of this decomposition, it is possible to reduce the amount of time spent with these products and the amount of waste they create. Though limited studies have been recorded, it has been hypothesized that Aspergilli fungi have polysaccharides that can increase the rate of decomposition in plant starch biomass products. With all compiled information, we can conclude that using a variety of Aspergillus fungi, a plant biomass product used as an alternative to a single-use plastic will hypothetically biodegrade at a quicker rate in a compost bin.

Methodology

- I began by constructing an enclosed compost box that would be capable of reducing spreading the fungi spores between bins. I drilled holes in the bottom for drainage and added mesh for filtration. I filled these bins with compost and added water until it was about the dexterity of a sponge. In the experimental bin I added *Aspergillus oryzae* spores. I measured and recorded the mass (in grams) of three different samples each and put them in the bin. Twice a week, I would check the bins. I weighed the cups a second time and recorded the mass and change in mass. With this methodology, I was able to compare the differences in decomposition with and without the fungi sample.

Photographs

- Figure 1: The control group cups after 5 weeks. In this photograph they are drying out to get an accurate mass when on the scale. Once the dirt was dry, it was easy to take a duster and lightly brush off the dirt to get an accurate mass without breaking the cup and compromising the project. Photo taken by Anna Armstrong.

Photographs

Figure 2: A picture of the control compost box after taking out the cups. The size ensured that none of the cups were exposed, touched each other, or were not completely immersed in the compost. Picture taken by Anna Armstrong.

Table 1: Change in Decomposition Rate in Both Control and Experimental Groups

	Large Cup	Medium Cup	Small Cup
Change in Mass (g) in Control Group	3.1g	2.4g	1.7g
Change in Mass (g) in Experimental Group	6.0g	5.4g	3.8g
Difference in Mass (g) Between Groups	-2.9g	-3.0g	-2.1g

Line Graph

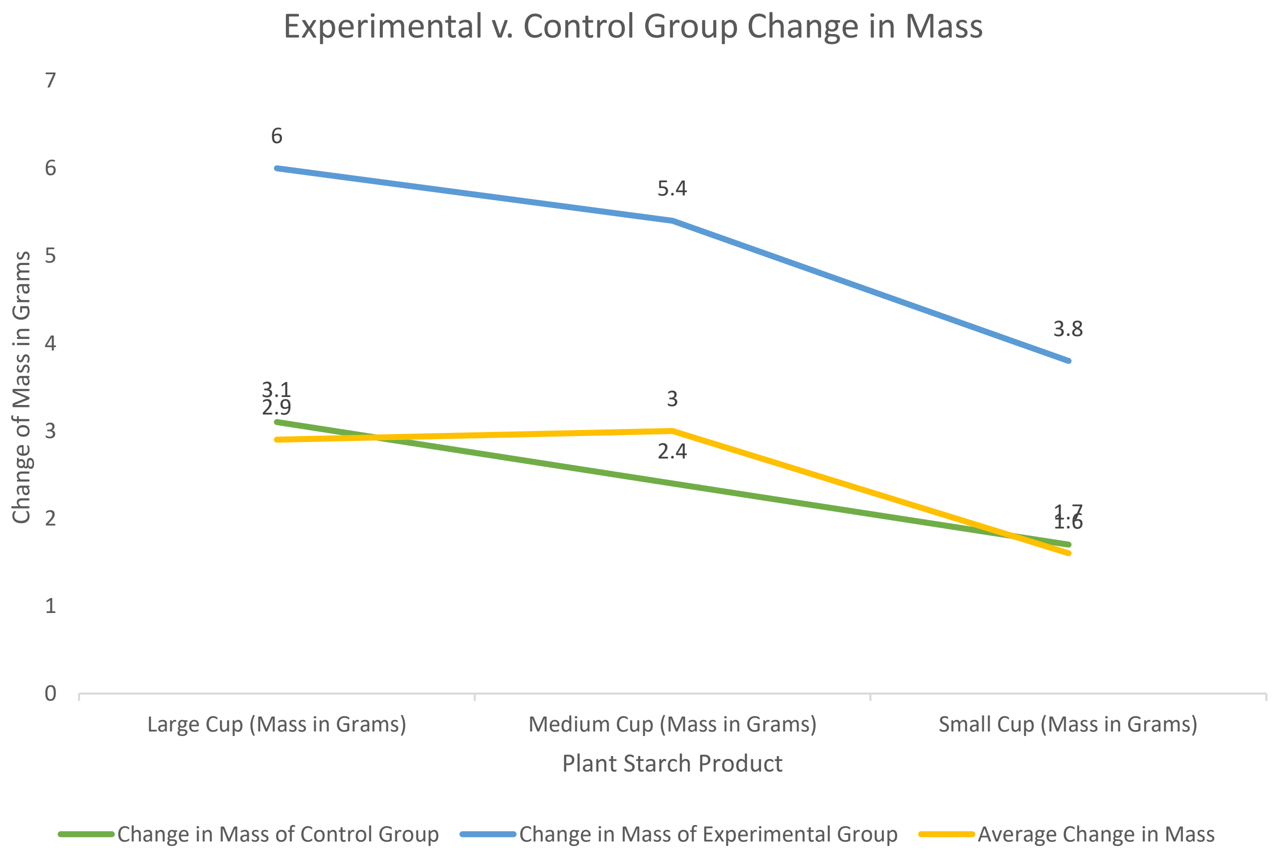

Figure 3: Line graph by Anna Armstrong. The graph shows a large numerical difference between the changes in mass in the experimental (compost and fungi) and control (just compost) group, insinuating the experimental group was decomposing at a faster rate. The yellow line (average change in mass) has a slight bump at the medium cup where there was a change in the average mass difference. Other than this, the graph proves a relative rate at which the decomposition of these cups is largely affected by the addition of fungi in the compost bin, seen through the numerical difference in mass lost through composition in the experimental group being much larger.

Data Analysis

- Hypothesis: Adding a sample of *Aspergillus oryzae* to a compost bin will accelerate the decomposition of a plant starch plastic product.
- Null Hypothesis: Adding a sample of *Aspergillus oryzae* to a compost bin will have no effect on the decomposition rate of a plant starch plastic product.
- The data was analyzed using a two-tailed p-value test, calculating this value to be 0.0258. With four degrees of freedom, this puts the t-value at 3.4587. The confidence interval of this data is 95%. This difference is statistically significant. Because of this, I failed to prove the null hypothesis and must reject it. I accept the hypothesis confirming that adding a sample of A. Oryzae to a compost bin will accelerate the decomposition of a plant starch plastic product.

Discussion

- As hypothesized, the results indicate that the fungi increased the rate of decomposition for plant starch products. These results match with the hypothesis of many researches stating that the enzymes in Aspergilli fungi perpetuate depolymerization and make the rate of decomposition increase. I worry about basic differences reducing confidence of my results. Because compost is a heterogenous mixture, one bin could be slightly more carbon based with the other being more nitrogen based. Varying temperatures also play a role in decomposition, and because they weren't directly next to each other it is very possible that one bin was slightly warmer or colder. Lastly, there is very little variety in the samples, meaning the tests were only conducted on plant starch cups and not other products like utensils or Styrofoam.

Conclusion

- A good amount of “environmentally-friendly” and compostable products are marketed to the public but fail to serve their actual purpose. Products such as plant starch plastics don’t have a quick enough rate of decomposition and end up in landfills. In these landfills, these plant starch products do not have the environment they need to decompose. A reasonable solution to this is to accelerate the decomposition of these products. Though there is limited research currently on the subject, I hypothesized that *Aspergillus oryzae* can increase the decomposition rate of these plant starch plastic alternatives hence solving the time-sensitive aspect of this potentially environmentally conscious products.

Application

- To apply this research, it is important to alienate the enzyme that assists in depolymerization of the plant biomass products. With confirmation that it works, this data insinuates many application in assistance of reducing the carbon footprint of plant biomass products.

References

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