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## e-PROCEEDING

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## EarthSmart Toys: Revolutionizing Playtime with Eco-Friendly Innovations for a Greener Planet

\*Nurul Huda Mohd Noor, Nur Irina Suffiah Pairus, Nur Amira Humairah Fahrul Razi, Ahmad Solehin Ahmad Sabri, Ersalina Amni Ezuan and Muhammad Ameen Jasmari

Centre of Foundation Studies, Universiti Teknologi MARA, Cawangan Selangor, Kampus Dengkil 43800 Dengkil, Selangor, Malaysia

\*Corresponding author: [huda3632@uitm.edu.my](mailto:huda3632@uitm.edu.my)

### ABSTRACT

Plastics pollution is a pressing global concern that needs to be resolved quickly as it can cause a serious damage to the earth due to the plastics' inability to be decomposed safely. In this matter, plastic toys play a very big role as one of the main contributors in worsening this issue. In fact, plastic toys constitute 6% of all plastic found in landfills and to make things worse, even the production of it releases all sorts of toxic emissions into the atmosphere. Thus, it has led us to create this project called EarthSmart Toys. The primary goal of the making of this product is to mitigate the amount of plastic consumption and to make toys that are chemically safer for both children and environment. EarthSmart Toys will be made fully from plant-based materials, including glycerine and food wastes. Additionally, our product will also be beneficial to the nature upon disposals as it can also act as a fertilizer to the soil and reduce the impact on nature. Furthermore, this product can be mainly commercialized to the parents, kindergartens, and other child-centric establishments. In conclusion, EarthSmart Toys can be used to tackle plastic pollution as it can help to reduce plastic wastes and the emission of toxic gases to the atmosphere.

**Keywords:** EarthSmart Toys; pollution; toxic; plant-based; kids.

### 1. INTRODUCTION

Bioplastics are plastic materials produced from renewable biomass sources, such as vegetable fats and oils, corn starch, straw, woodchips, sawdust, recycled food waste, etc. Bioplastic can be made from agricultural by-products and from used plastic bottles and other containers using microorganisms. Common plastics, such as fossil-fuel plastics (also called Petro based polymers) are derived from petroleum or natural gas. Not all bioplastics are biodegradable nor biodegrade more readily than commodity fossil-fuel derived plastics. The biodegradability of bioplastics depends on the specific materials and manufacturing processes used. Some bioplastics, such as those made from polylactic acid (PLA) or polyhydroxylalkanoates (PHA), are designed to be biodegradable. However, other bioplastics, like those made from bio-based polyethylene or polyethylene terephthalate (bio-PET), may not biodegrade as readily as their fossil-fuel. Bioplastics are usually derived from sugar derivatives, including starch, cellulose, and lactic acid. As of 2014, bioplastics represented approximately 0.2% of the global polymer market (300 million tons). The use of bioplastics can reduce carbon footprint and reduction in fossil fuel dependence. Additionally, the production of bioplastics must be ensured that the additives used are safe and do not leach harmful chemicals to avoid toxicity. Furthermore, some bioplastics are derived from plant materials that could potentially cause allergic reactions. For

instance, bioplastics made from soy or nuts should be labelled appropriately to prevent allergic reactions. The objective of this innovation is to improve the usage of bioplastics by enhancing its ability where the bioplastics can be used as a fertilizer by using food wastes such as eggshells and banana peel. Additionally, banana peel is filled with calcium which can improve root growth and helps add oxygen to soil which will assist in photosynthesis. Eggshells contain minerals such as potassium, phosphorus and magnesium which can help plants to grow. The process of making our bioplastics is conducted after the procedures are arranged. The procedure starts by measuring the amount of glycerin and vinegar needed to ensure the bioplastics have strong structure. Then, we studied that the amounts of banana peel and eggshell needed to be used in the right proportions. Next, all the previously stated ingredients will be mixed and heated on a pan until a sticky mixture is produced before pouring it into the desired toy mould shape. Some experiments are conducted to test the strength and the water dissolving ability of our bioplastics. The hardness test which involves a test on a fixed minor load to a major load and then returned to a minor load has been carried out with success and the max weight it can carry shall be stated later in our report. Other than that, the experiment on our bio-plastic's water dissolvability has also been conducted and the time needed for it to dissolve completely has been received and factors affecting it such as water properties, temperature of water but unfortunately, we were only able to test a few factors due to our limited supply of the materials used. Based on the experiment conducted, it is evident that our bioplastic can bear a significant load and maintains its integrity longer than expected. Additionally, the higher the temperature of the water sample, the faster the bioplastic dissolves completely.

## 2. METHODOLOGY

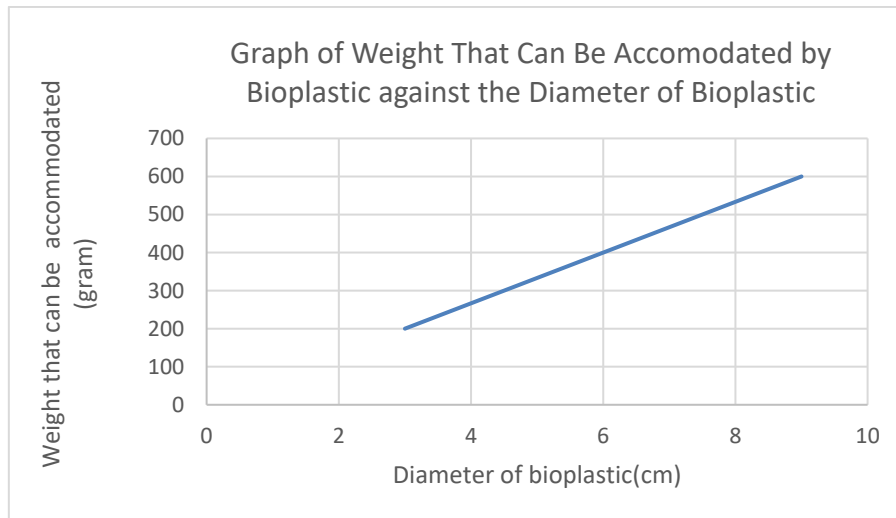
First, the eggshells and banana peel were cut into smaller pieces and then washed. The smaller pieces of eggshells and banana peel are dried under the hot sun for 30 minutes. The eggshells and banana peels are grinded in a blender separately. After that, the pan was heated, and 10 mL of glycerine was added. The mixture of eggshells and banana peel poured into the pan. The mixture was stirred until it forms into jelly-like looking fluid. Then, 2 mL of pure water, 2 teaspoon of tapioca starch and sodium bicarbonate are added. The mixture was stirred until the substances completely dissolved. Then, the heat was turned off and the mixture was left to cool down for 2 minutes. Next, the mould plate was prepared. The mixture was poured into the mould plate. The mixture was scattered until uniform thickness is achieved. The mould plate was placed under the sun and was left until it become dry for a few days. After that, the bioplastic would take its shape and it is taken out of the mould plate. Then, the bioplastic is placed on the table to be tested for its hardness. A block of 50g was used and placed on top of the bioplastic. The experiment was repeated with 100g, 150g, 200g, 250g and 300g. After that, the bioplastic is put into a 50ml beaker filled with water. The beaker was placed on top of the heating plate. The temperature of the heating plate is set 90°C. Record the time for the bioplastic to fully dissolve.

## 3. RESULTS AND DISCUSSION

### 3.1 Figures and Images

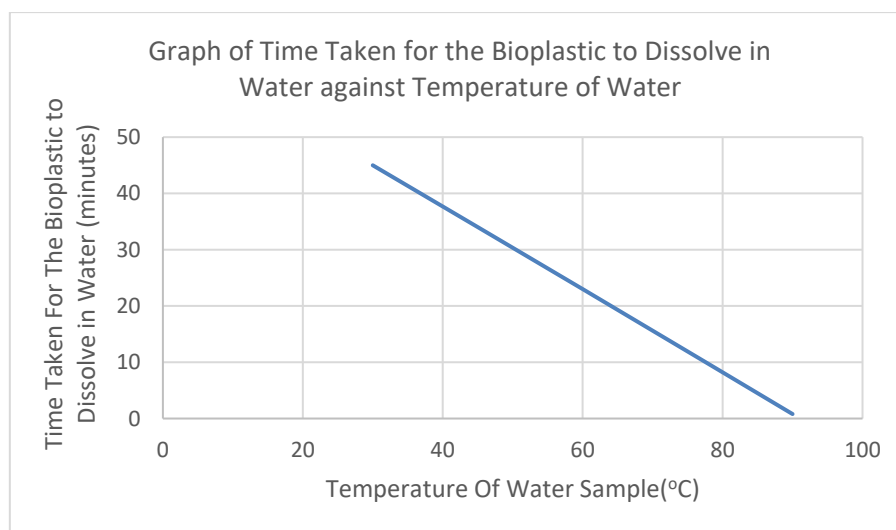
Based on Hardness Test, a test carried out to know the exact weight a bioplastic with different diameter can handle before it starts to crumble, we can conclude that the maximum weight our bioplastic can handle is around 200g for each 3 cm diameter bioplastic before it starts to break

and buckle.



**Figure 1.** Graph of Weight That Can Be Accommodated by Bioplastic against the Diameter of Bioplastic

Based on water solubility test, which was a test for the shortest time needed for the bioplastic to fully dissolve in water is 10 minutes at 90°C. It can be said that the higher the temperature of the water sample, the shorter the time it takes for the bioplastic to dissolve completely.



**Figure 2.** Graph of Time Taken for the Bioplastic to Dissolve in Water against Temperature of Water

### 3.2 Tables

**Table 1.** Hardness Test

Diameter of bioplastic (cm)	Weight that can be accommodated (g)
3	200
6	400
9	600

Based on the data obtained from Hardness Test, it is shown that the weight that can be accommodated by the bioplastic increases when the diameter of the bioplastic increases.

**Table 2. Water Solubility Test**

Water Samples	Temperature (°C)	Time taken to dissolve (minutes)
A	30	45.7
B	60	23.4
C	90	10.5

Based on the data obtained from water solubility test, it is shown that the water sample A took the most time for the bioplastic to dissolve compared to water sample B and C respectively. This is due to the low temperature of the water which causes the molecule bond inside the components of the bioplastic to break up and separate a lot slower than the other bioplastics inside higher temperature water baths.

#### 4. CONCLUSION

All in all, the maximum weight the bioplastic with different diameter can withstand is about 1000g before breaking and the time needed for bioplastic to completely dissolve in water in the highest temperature of water sample that is 90oC is 10 minutes. Furthermore, it is important to further improve its strength, flexibility, and durability of bioplastics to make them suitable for a wider range of applications, including packaging and durable goods. Moreover, the commercial potential for bioplastics is significant and is growing rapidly due to environmental concerns, regulatory pressures and corporate sustainability initiatives.

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