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ACCEPTABILITY OF WATER HYACINTH *(Eichhornia crassipes)* STEMS AS ALTERNATIVE BIODEGRADABLE TRASH BAG

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ABSTRACT

This study aimed to determine the acceptability of Water Hyacinth stems as alternative biodegradable trash bag. This study was conducted in Mayamot National High School, District 1-D, Division of Antipolo City during school year 2019-2020 from the month of June to October. In which experimentation and testing were used to gather the needed data and to answer the objective of the study.

Varying concentrations of Water Hyacinth and paper pulp and a controlled variable of 0.0213mm for thickness and 304.8mN for tearing resistance were used to obtain the given data needed on the research study. The two concentrations were as follows; 50% Water Hyacinth - 50% Paper Pulp and 100% Water Hyacinth. The sampling distribution were particularly made in three replicates to obtain the mean of each concentrations. The acquired mean in each treatment in terms of thickness were as follows: 0.059mm and 0.017mm in treatment 1 50% PP – 50% WH, and treatment 2, 100% WH respectively. The acquired data for tearing resistance in each treatment are the following: 59.54333mN, and 353.5933 in treatment 1 50% PP – 50% WH, and treatment 2 100% WH respectively.

After the data analysis, the following features were summarized:(1) Biodegradable trash bag made out of 50% WH – 50% PP was thicker by 0.003mm in T1 replicate 2 than the commercialized biodegradable trash bag. However, was thinner by 0.0101mm and 0.0075mm in T1 replicate 1 and T1 Replicate 3 respectively, (2) Biodegradable trash bag made out of 100% WH was thinner than the commercialized biodegradable trash bag by 0.0175, 0.0159, 0.0128 in T2 replicate 1, T2 replicate 2, and T2 replicate 3 respectively, (3) Biodegradable trash bag made out of 50% WH – 50% PP has higher tearing resistance in T1 replicate 2 by 184.48mN and 10.67mN in T1 replicate 3 than the commercialized biodegradable trash bag. However, has lower tearing resistance in T1 replicate 1 by 48.77mN, and (4) Biodegradable trash bag made out of 100% Water Hyacinth has lower tearing resistance in all replicates by 267.39mN, 249.94mN, and 222.04mN in T2 replicate 1, T2 replicate 2, and T2 replicate 3 respectively. Based on the findings of the study, it was hereby concluded that (1) there is no significant difference in the measures yield from the two concentrations of 100% water hyacinth and 50% water hyacinth- 50% paper pulp in terms of thickness, (2) There is a significant difference in the measures yield from the two concentrations of 100% water hyacinth and 50% water hyacinth- 50% paper pulp in terms of tearing resistance, and (3) The biodegradable trash bag made from Water Hyacinth with a concentration of paper pulp is acceptable as an alternative biodegradable trash bag.

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INTRODUCTION

Nowadays, the production of plastics is abundant due to its many uses such as production of materials, packaging, and preservation (Bressia 2005). Mostly, the increase in the production corresponded the needed demands of a growing economy. Likewise, the use of plastic is very essential in everyday life (Wolverton 2005).

Despite of plastic's usefulness, it can affect the environment. According to Tacio (2009) the decaying rate of a single plastic could take 1-1000 years. The slow progression of its decaying rate could likely affect and make environmental problems such as: pollution from land, water ways, ocean, and could lead to the choking of animals (Lajeunesse 2009). Thus, trash bags made from plastics could intensify the prior phenomena.

On the other hand, the introduction of waste material in the Philippines is increasing rapidly, likewise, it is also responsible for economic problems (Fedepeedia 2015). One example of waste material is Water Hyacinth (*Eicchornnia crassipes)* which is known to be vigorous growers that can double its population for two weeks (Holm, Blackburn, & Wildon 2005). According to Lake Restoration Incorporated, water hyacinths are invasive and would dramatically affect the water ways, resulting to block sunlight to native submerged plants.

Department of Science and Technology addressed the given problem. DOST developed water hyacinth harvesters that can lift 200 kilograms of water hyacinth within a day to decrease the continuous growth of Water Hyacinth as well as to find different uses on the given subject. According to the Metals Industry Research Development Center (MIRDC), the transparency in the information of water hyacinth harvesters is open to the people under the Executive order no.2 (s. 2016) on Freedom of Information in the Executive Branch for Water Hyacinth Harvester.

There are also existing problems in the waste segregation in the Philippines. According to the Republic act 9003 or the Ecological Solid Waste Management Act of 2000, a land mark environmental legislation of the Philippines encompasses the idea of the looming garbage, justifying that there are problems in waste segregation. Castillo (2019) stated that 35, 580 tons of garbage is generated every day in the Philippines, this includes segregated as well as unsegregated. Moreover, the total percent of solid waste that can be produced on households is at 74% which requires big amount of segregating materials such as trash bags and many more. This problem introduces alternativity towards the given problems that plastic would make. Hence, community would subject to pose an alternativity to biodegradable products such as biodegradable trash bag.

Despite the given problems, the development of biodegradable trash bag could be one of the solutions in giving aid to the said problems. According to Bressani (2010) Water Hyacinth contains high quality of leaf protein concentrate that is beneficial in paper making as well as to biodegradable materials.

In addition, Water Hyacinths' efficacy have been investigated thoroughly throughout the years, this includes making textiles, papers, and could reduce deforestation from the over usage of paper trees that can help the community (Wuenyang 2010).

This research study aims to develop and test the acceptability of water hyacinth stem as alternative biodegradable trash bag. Likewise, this research study aims to lessen the following problems that affects the environment, i.e. plastics distribution, growth of waste material, and forms of deforestation. Through this research study, the researchers can now help in the field of science. As indicated in the Philippine Constitution of article no. XIV under section X in Education, Science and Technology, Arts, Culture, and Sports.

Review of Related Literature and Studies

Various references have been utilized in order to gather information regarding this study.

RELATED LITERATURE

Water hyacinth reproduces sexually by seeds, vegetative budding and stolon reproduction. Its daughter plants sprout from the stolon and doubling times have been reported of 6-18 days. The seeds can germinate in a few days or remain dormant for 15-20 years. They usually sink and remain dormant until periods of stress (droughts). Upon re-flooding, the seeds often germinate and renew the growth cycle (Aqua plant 2015). Hence, the following characteristics could likely affect the Philippines since it is a tropical region whereas rainfalls often occur.

Literatures suggest that Water Hyacinth negative effects on the nature as well as industrial phenomena. According to Teyleger, (2009) Water Hyacinths are example of perennial aquatic plant. It was also an aggressive plant which has been a terrible

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nuisance in almost all continents. It was also considered as the fastest growing plants known, reproduces primarily by way of runners or stolon known to double population in two weeks (Barret 2015). Due to its rapid growth it is known for its invasive characteristics and was considered as one of the productive plants in the world likewise, it is also responsible for environmental problems. (Fedepeedia 2015).

In addition, according to K Preethi, Vineetha, & Mridul Umesh (2015) this weed forms dense impenetrable mats across water surface, limiting access by man, animals and machinery. Moreover, navigation and fishing are obstructed, and irrigation as well as drainage systems become blocked. They can tolerate a wide range of environmental conditions such as temperature, illumination, pH, salinity, wind, current and drought. Surely, the following conditions would not affect water hyacinth on its continuous growth and would likely cause more problems.

With the given problem, "Lots of money were used and will be used to destroy this without even knowing that there were many advantages and uses of it" (Center T. D., 1994). However, Department of Science and Technology addressed the given problem. DOST developed water hyacinth harvesters that can lift 200 kilograms of water hyacinth within a day to decrease the continuous growth of Water Hyacinth as well as to find different uses on the given subject. According to the Metals Industry Research Development Center (MIRDC), the transparency in the information of water hyacinth harvesters is open to the people under the Executive order no.2 (s. 2016) on Freedom of Information in the Executive Branch for Water Hyacinth Harvester.

Aboul-Eneim A. M., Shanab S., Al-abd A. M., Shalaby E. A., El-shemy H. A. (2011) stated that its glossy green and leathery leaf blades were up to 20 cm long and 5-15cm wide and were attached to petioles that were often spongy-inflated, causing it to be numerous dark and well branched, its characteristic enabled water hyacinth to be useful in many ways. Thus, its physical and chemical characteristics is beneficial in making products.

In the Philippines, water hyacinth was dried and used to make baskets and matting for domestic use (Aqua Plant, 2015). Throughout the years, Water hyacinths' efficacy have been investigated thoroughly, this includes making textiles, traditional basket, papers, and could reduce deforestation from the over usage of paper trees that can help the community (Wuenyangu 2010).

On the other hand, the production of plastics is abundant due to its many uses such as production of materials, packaging, and preservation (Bressia 2005). Mostly, the increase in the production corresponded the needed demands of a growing economy. Likewise, the use of plastic is very essential in everyday life (Wolverton 2005). Despite of plastic's usefulness, it can affect the environment. According to Tacio (2009) the decaying rate of a single plastic could take 1-1000 years. Thus, trash bags made from plastics could intensify the prior phenomena.

In addition, at least 27 local government units including Los Baños in Laguna, Makati and Muntinlupa were among the first to ban the use of plastic, compelling stores and vendors to use paper bags in wrapping their wares (Valmero, 2012). Republic act 9003 or the Ecological Solid Waste Management Act of 200, A land mark environmental legislation of the Philippines encompasses the idea of the looming garbage, justifying that there are problems in waste segregation. This problem introduces alternativity towards the given problems that plastic would make. Hence, the garbage bag that was made from plastics could intensify the given problem and community would subject to pose an alternative to biodegradable products such as biodegradable trash bag.

According to Bressani (2010) Water Hyacinth contains high quality of leaf protein concentrate as well as cellulose and hemicellulose fibers that is beneficial in paper making as well as to biodegradable materials. This characteristic can present water hyacinth as an alternative biodegradable product, which could lessen the given problems in the decaying rate of petroleum-based products (Tokiwa 2015). Hence, water hyacinth stems could be produced as alternative biodegradable trash bag.

Biodegradability pertains to the rate degradation where one organic material is used. Because they're made from wood pulp, almost all paper products are biodegradable (Dublin 2017). However, some paper products like plates and cups are coated with a layer of plastic designed to make them waterproof, but that coating will also prevent or slow down decomposition. Still, paper will biodegrade according to its own ability to degrade in a short period of time (Gaanan 2015).

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Related Studies. There are numerous studies regarding the acceptability of water hyacinth stems as alternative biodegradable products. Comedis et al. (2017) concluded that water hyacinth stems can be manufactured into a biodegradable container as well as other containing products from their study Modern Eco-Friendly Containers: Transforming Water lilies into Proactive Environmental Product. The water hyacinth was dried, pressed, and wood glue was added. Plastic food packaging film was conveniently used to shape however, was not really needed in the study since it was removed after drying and could also be replaced by other material. The flattened one was cut to pieces and the plastic water hyacinth was dried. Clearly, the methods that was used was similar in paper making. In addition, shaping to contain objects were also included in the methods that was used. Hence, shaping is another valuable method in making biodegradable trash bag since biodegradable trash bag also contains.

According to the study of Lindsay, K. et al (2000), the fiber from the stems of the water hyacinth plant can be used to make rope. The stalk from the plant was shredded lengthways to expose the fibers and then left for several days. The rope making process was similar to jute rope as well as similar to the process of paper making, the finished rope was treated with sodium metabisulphate to prevent it from rotting. However, in any condition, the rope is composable as the metabisulphate is washed from the salinity or from the components in the soil. This study is similar to the means of coating the paper to gain water resistance essential in many ways. Thus, coating by waxing the paper made from water hyacinth stems could likely increase the durability of the trash bag as well as tearing resistance.

In addition, water hyacinth fibers are certainly applicable for making a good quality papers that can be used many ways (Ferreras, C., Fuentabella, V., & Gaanan, G. 2015). According to their study entitled Quality Papers from Water Hyacinth Fibers with its suitable properties for Paper Bag Industry, different fibers from water hyacinth could vary the given strength, thickness, and tearing resistance of a paper. The 100% concentration of water hyacinth fibers and 50% water hyacinth & 50% paper pulp exceeds the standard paper as well as paper bags in each store. Its solubility and durability made a remarking result, the pure water hyacinth fibers were concluded to be high resistant to water and would only loose its resistance after long period of time yet, would disintegrate easily if presented in unnatural conditions. It was also concluded that it can hold certain amount of weight. Overall, these characteristics enable the water hyacinth stems as alternative biodegradable trash bag since resistance to water should also be prioritized for trash bag contains different waste that could likely affect good qualities of the paper product produced using water hyacinth.

Moreover, According to Popa et al (2011). The fibers from water hyacinth as well as all the plants have cellulose fibers and hemicellulose that is essential in paper making. According to their study entitled Biodegradable Materials for Food Packaging Applications, a purified cellulose fiber from water hyacinth grading an average fiber length of 60 μm (microns) and an average fiber width of 20 μm (microns) was used. The thickness was measured to be exactly >99.5% and an aspect ratio of ca. 3 9 (in caliper). Hence, it is acceptable as paper since the standard measure for board papers are 2.589. Their study also concluded that solubility is favorable in water hyacinth. Their study is similar to the corresponding studies, suggesting that water hyacinth is suitable as alternative biodegradable trash bag.

According to Ahmed, Ahmed & Halla (2018), Papers have different disintegration despite having the same biodegradability characteristics. According to their study, four different types of paper were buried to the soil. The following papers are dug consecutively in days to observe the changes that occur in the papers using tensiometer to measure the tension between them. It was concluded that the fastest one to disintegrate is the recycled one which could only take 6 days to finally decompose. On the other hand, the slowest one to disintegrate are the papers that was produced from pure raw material, taking 21 days to disintegrate. However, despite taking days to disintegrate, only an average of 2.1% rate of decomposition is required compared to plastics that could take 1000 years to disintegrate. Thus, papers were still considered as biodegradable materials and essential in making biodegradable trash bag.

Dumapao (2017) stated that biodegradable materials have their own brittleness in compare to the flexibility of plastics. However, have more durability in terms of horizontal penetrations or sharp objects that penetrates the paper. The study used different methods to examine the tearing resistance of paper

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bag industries. Using caliper method as well as using the variable time of penetration to determine the rate of tearing through the paper bag. It was concluded that papers have more rate to resist the tearing resistance in pointing phase by 22%. Hence, alternative trash bag made from the water hyacinth stems are durable enough to withstand any unnatural force.

According to the study of Dublin (2017) entitled Water hyacinth Stems (Eichhornia crassipes) and Rice (Oryza satica L.) Straws as an alternative biodegradable trash bag. Trash brags made out of paper are more durable when a raw material is combined with one another. the study enunciated water hyacinth stems and rice straw fibers concentrations in making board paper that was shaped as biodegradable trash bag. Mainly, the methods that was used in making board papers are the collection of fiber, boiling of water hyacinth, rinsing of water hyacinth, cutting of rice straws, paper pulp making, mixing of the fibers paper pulp and glue, straining, pressing, drying, and lastly shaping. The study used three concentrations such as: 100% water hyacinth, 100% rice straws and 50% water hyacinth & 50% rice straw. The study was concluded to be effective and acceptable, with an alternative significant difference in thickness and tearing resistance. This study is essential in the current study since the process that will be utilized is paper making using water hyacinth.

Statement of the Problem

This study aimed to determine and develop the acceptability of water hyacinth stem as alternative biodegradable trash bag in the school year 2019-2020.

Specifically, the study sought to answer the following query:

1. What are the measures of Water Hyacinth as alternative biodegradable trash bag in concentrations of 50% Water Hyacinth – 50% Paper Pulp and 100% Water Hyacinth in terms of:
   1.1. Thickness; and
   1.2. Tearing Resistance?
2. Is there a significant difference in the measures yield from the two concentrations of 50% Water Hyacinth – 50% Paper Pulp and 100% Water Hyacinth in terms of:
   2.1. Thickness; and
   2.2. Tearing Resistance?
3. How do the measures yield from different concentrations of 50% Water Hyacinth – 50% Paper Pulp and 100% Water Hyacinth as alternative biodegradable trash bag be compared to commercial biodegradable trash bag?

Hypotheses

The study pursued these hypotheses:

1. Water Hyacinth stems is not acceptable as alternative biodegradable trash bag in terms of Thickness and Tearing Resistance.

2. There is no significant difference between the two measures of 50% water hyacinth stems – 50% Paper Pulp and 100% water hyacinth stems in terms of Thickness and Tearing Resistance.

METHODOLOGY

This study used the experimental research design in determining the acceptability of alternative biodegradable trash bag from Water Hyacinth stems.

The following procedures were conducted**:**

Collecting the Fibers. To begin the alternative biodegradable trash bag, the fibers of the water hyacinth were cut to remove the skin. Then, boiled with one kilo of caustic soda and one liter of water. Rinsed with water and then soaked with baking soda. After 30 minutes, the fibers were rinsed with water.

Mixing of fibers, glue and paper pulp. Then, the resulting fibers were filtered to remove unwanted objects. Next, cut or tear the paper to be recycled in to 3.5 cm. Then, boil the paper for 30 minutes. Cool and put in an improvised pulp maker machine until fine pulp was formed. Pour water in a vat or container and add the pulp. Lastly, add the fibers together with the paper pulp and concentration of 100 ml of glue and 900ml of water.

Straining the fibers. At this point, a mold and deckle will be submerged inside a vast that contains the fine pulp and fibers. The mold was covered with a deckle and filled with a paper pulp before it removed from the vat to drain off the water. The draining process was facilitated by gently rocking the mold and deckle back and forth. Once the water has drained off, the deckle was removed and the wet sheet was placed onto a very coarse piece of cloth or felt resting on a wet sponge.

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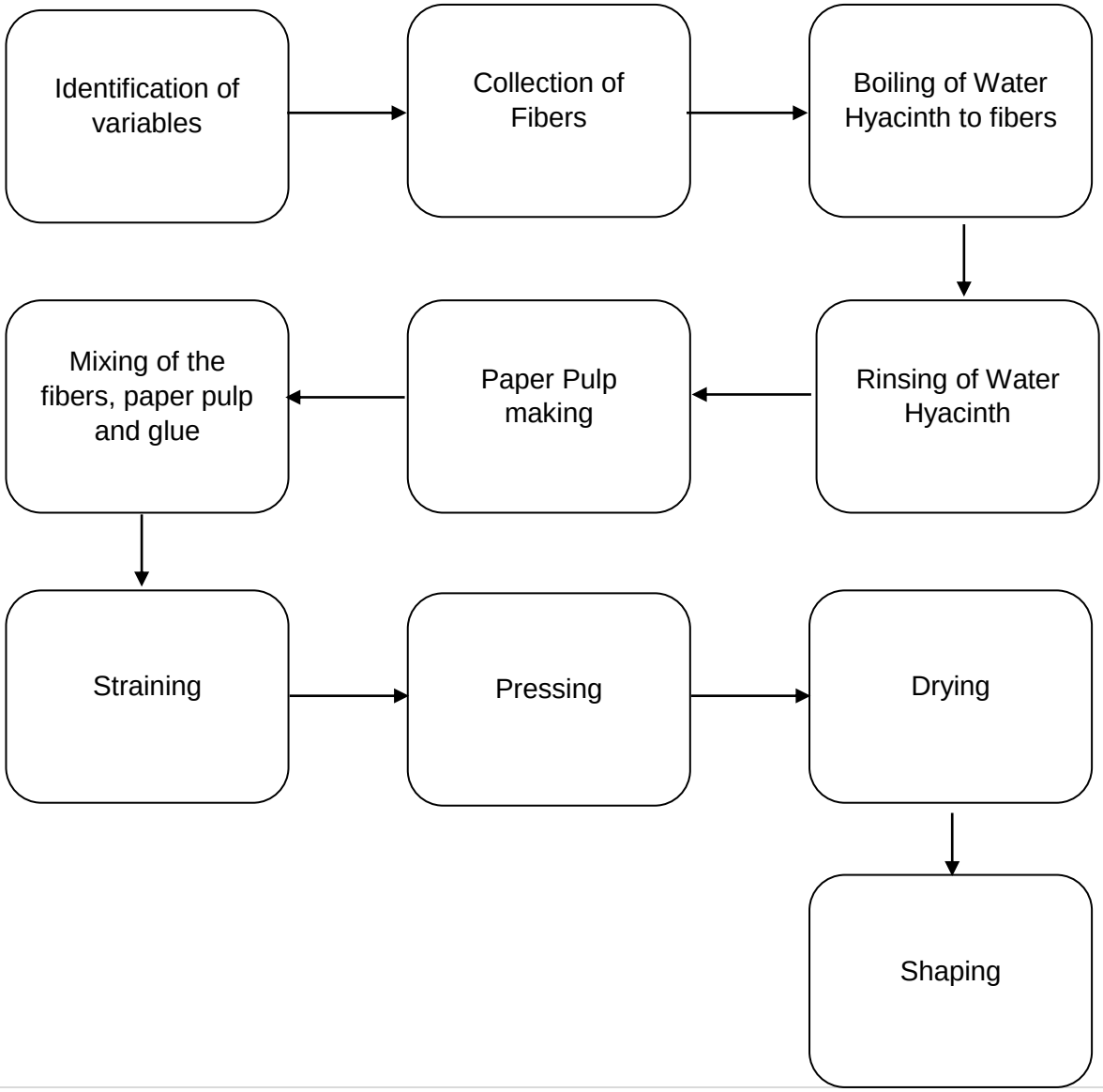
Pressing and drying. Put another cloth on top of the paper then remove the sponge as the paper was pressed between two boards on the pressing machine for 10 minutes. Once pressed and water removed, the sheet was removed. Finally, the sheet was hanged to dry.

Shaping. The method shaping will be utilized to form a designated size in storing and containing.

Testing. The following qualities of paper were tested in order to determine the acceptability of the trash bag produced from Water Hyacinth stems. The final product was tested on Anvil Group Corporation in terms of Thickness and Tearing resistance.

Thickness and Tearing Resistance. The biodegradable trash bag made form 50%WH – 50%PP and 100%WH were measured.

Flow Chart
Water Hyacinth (*Ecchornia crassipes*) Stems as alternative biodegradable trash bag



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RESULTS AND DISCUSSION

Table 1
Quantitative Results of Water Hyacinth Stems as Alternative Biodegradable Trash Bag in terms of Thickness and Tearing Ressitance

Treatment	Thickness (in caliper mm)			Tearing Resistance (mN)		
	R1	R2	R3	R1	R2	R3
Treatment 1 50% PP- 50% WH	0.0112	0.0216	0.0138	256.03	489.28	315.47
Treatment 2 100% WH	0.0038	0.00554	0.0085	37.41	54.86	86.26
Control	0.0213			304.8		

The table 1 presents the quantitative results of Water Hyacinth Stems as alternative Biodegradable trash bag in terms of Thickness and Tearing Resistance. The Tear propagation resistance in which trouser tear was utilized by single-method conveys that only the ratio 50% WH – 50% PP in replicate two as it obtained 0.0216mm wherein it passed the thickness of 0.0213mm of the controlled variable. However, the 100% WH did not reach the standard thickness of a biodegradable trash bag.

For thickness, the acquired data on the 50% PP – 50 % WH in T1 replicate one in terms of thickness is 0.00112 which is lower than the standard thickness of 0.0213. In T1 replicate two, the acquired data is 0.0216 which is above the standard thickness of 0.0213. In T1 replicate 3, the acquired data is 0.0138, which is lower than the standard thickness of 0.0213. The acquired data on 100% WH in T2 replicate one is 0.0038 which is lower than the standard thickness of 0.0213. In T2 replicate two the acquired data is 0.0054 which is lower than the standard thickness of 0.0213. In T2 replicate three, the acquired data is 0.0085, which is lower than the standard thickness of 0.0213.

For tearing resistance, the controlled variable of biodegradable trash bag obtained was 304.8 mN. T1 replicate two and T1 replicate three exceeded the following standard for thickness such as 489.28 and 315.47 respectively. However, the rest of all the replicates in each treatment did not exceed the tearing resistance standard.

For 50% PP – 50% WH T1 replicate one, the acquired data for tearing resistance is 256.03, which is lower than the standard tearing resistance of 304.8. In T1 replicate 2, the acquired data is 489.28 which passed the standard tearing resistance of 304.8. In T1 replicate 3, the acquired data is 315.47, which passed the standard tearing resistance of 304.8. The data acquired on 100% WH in T2 replicate one is 37.41 which is lower than the standard tearing resistance of 304.8. In T2 replicate 2, the data acquired is 54.86, which is lower than the standard tearing resistance of 304.8. In T2 replicate 3, the acquired data is 86.36 which is lower than the standard tearing resistance of 304.8.

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Table 2
Quantitative Results of the One-Way Anova Used to Determine the Significant Difference of 50% Pp – 50% WH and 100% WH in terms of Thickness and Tearing Resistance

Trash Bag Properties	Concentrations	Mean	F- Value	P-value	Ho	VI
Thickness	50% PP – 50% WH	0.059	5.432771	0.080349	Accept Ho	Not Significant
	100% WH	0.017				
Tearing Resistance	50% PP – 50% WH	59.54333	16.94635	0.014653	Reject Ho	Significant
	100% WH	353.5933				

The table 2 presents the computed significant difference, interpretation, and significant value in terms of thickness and tearing resistance from the statistical treatment One-way ANOVA. The data shows that for thickness the P-value exceeds the 0.5 level of significance which is 0.080349. Hence, the verbal interpretation for the null hypothesis is accepted and not significant. On the other hand, the data shows that for tearing resistance, the p-value does not exceed and lower than the level of significance 0.05 which is 0.014653. Hence, the verbal interpretation for the null hypothesis is rejected and significant.

CONCLUSIONS

Based on the findings of the study, it was hereby concluded that:

1. There is no significant difference in the measures yield from the two concentrations of 100% water hyacinth and 50% water hyacinth- 50% paper pulp in terms of thickness.

2. There is a significant difference in the measures yield from the two concentrations of 100% water hyacinth and 50% water hyacinth- 50% paper pulp in terms of tearing resistance.

3. The biodegradable trash bag made from Water Hyacinth with a concentration of paper pulp is acceptable as an alternative biodegradable trash bag.

Recommendations

For a more improved study, the following was hereby recommended:

1. Grind the Water Hyacinth solidly to open a possibility to a much stronger paper.

2. Fortify the acceptability of the product by trying several different concentrations of the two variables.

3. Make a separate research study about Water Hyacinth together with other variables.

4. Fortify the process used in making the alternative biodegradable trash bag.

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