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UTILIZATION OF BANANA FIBRE (*MUSA FIBRE)* AS PAPER TOWEL TISSUE

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Of the Holy Cross College of Calinan, Inc.

By

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The Researchers

ABSTRACT

Paper towel tissues are everyday item, frequently used to dry hands, cleaning surfaces, and more. However, the production of paper towel tissues causes deforestation and habitat loss. The purpose of the study was to find an alternative raw material for the production of paper towel tissues that can lessen the negative impact on the environment. Banana fibre *(Musa fibre)*, a natural byproduct of banana cultivation, offers several advantageous properties such as high tensile strength, good absorbent, and biodegradability. The study evaluated the ability of banana stem fibers to absorb liquid and resist tension. Although they exhibited impressive tensile strength and absorption properties, their texture was incompatible with the desired softness for paper towel tissues. Adding baking powder somewhat helped them to soften but reduced their strength without significantly enhancing their capacity for absorbing liquids. Given these results, using unaltered banana fiber alone appears not suitable in creating paper towel tissues that meet specifications hence further research is needed to discover alternative processing methods that enable sufficient softness whilst maintaining a satisfactory balance between liquid absorbency and tensile strength.

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INTRODUCTION

Background of the Study

Paper towel tissues are everyday items and are frequently used to dry hands, cleaning surfaces, and more. However, the production of paper towels utilizes non-renewable resources such as trees and water. Thus, its production causes habitat loss, deforestation, and an increase in carbon emissions from the industry (Kamprad, 2023). According to Vijayaraghavan V. (2021) and Rosenberg L. (2023), most of the paper towels are made from virgin paper. Also in manufacturing approximately 118 paper towel rolls, it needs 1,176 gallons of water. At present, the demand for disposable paper products like tissue and paper towels is growing but instead of incorporating more recycled content into their products, many paper companies are clearcutting forests for virgin wood fiber. Therefore, the carbon footprint of paper towels became a global concern, as the production and transportation of them require energy and release greenhouse gases.

Banana fiber *(Musa fiber)* which is commonly cultivated in tropical and subtropical areas globally, it has unique physical, chemical, and many other qualities that make it a fine-quality fiber. One of the chemical components of banana fiber is cellulose with a significant capacity to absorb moisture. Therefore, it qualifies as an eco-friendly fiber because it is biodegradable and has no negative impact on the environment (Textile Value Chain, 2021).

Hence, a study assessing the Banana Fibre as a potential fiber for the production of paper towel tissue was pursued. This study evaluates the fiber properties of banana in terms of a liquid absorption and tensile strength.

Statement of the Problem

This study aims to determine the feasibility of the Banana fiber *(Musa fiber)* as a potential raw material for the production of Paper towel tissue. It seeks to answer the following questions:

1. Can Banana fiber (*Musa fiber)* be a promising fiber source for the production of paper towel tissue?
2. Is there a significant difference between the two setups, controlled and experimental in terms of:
    2.1 liquid absorption; and
    2.2 tensile strength?

Hypothesis

Paper towel tissues made with Banana Fibre *(Musa Fibre)* will display greater tensile strength and liquid absorption compared to traditional wood pulp towels, offering an eco-friendly alternative.

METHODS AND MATERIALS

This study is composed of three phases: Phase I – Collection and Preparation of Banana Fibre, Phase II – Experimentation of the Making of Banana Fibre, and Phase III – Data Collection and Analysis. Experimentation was done at Holy Cross College of Calinan INC.

Phase I – Collection and Preparation of Banana Fibre

The Banana Fibre (*Musa Fibre)* was collected from Cadalian Baguio District. After harvesting the banana stem procured as a raw material, it is then peeled up to the inner sheath and cut into small pieces. After cutting the banana stem into small pieces, it is then soaked in the water for 2-3 days to soften them whilst changing the water daily to avoid stench. The following materials were used in the production of the by-product:

Banana (*Musa)* stem

Silkscreen

Blender

Baking powder

Measuring cup

Large basin

Phase II – Experimentation of Banana Fibre

There are two setups, the controlled and the experimental. The controlled group is only blended with water, while the experimental group is also blended with water but baking powder is added in the process. Soak the banana stem pieces for 2-3 days, it is then peeled and weighed 0.5kg for each setup and blended with 1 $^{1}/_{2}$ cup of water added, one with baking powder and one without. The blended banana stem pulp is then poured into a large basin, in addition, 5,000ml of water is added, the silk screen is then dipped inside followed by the second. After letting it sit outside the sun for 10 minutes, the blended pulps are then patted by a cloth to press out the excess water. It is then left to dry overnight or 1-2 days so it can be completely dry.

Step 1 – Banana stems are weigh 0.5kg for each set-up

Step 2 – The controlled group is then blended with 1½ cup of water; the experimental group receives the same measurement of water, but with ½ cup of baking soda.

Step 3 – The blended Banana stem pulp is then poured in a large basin, in addition, 5,000 ml of water is added. The silk screen is the dipped after.

Step 4 – Letting it sit outside for 10 minutes. After, it is then patted with cloth to press out excess water.

Phase III – Data Collection and Analysis

The researchers will analyze the difference between the controlled and experimental group liquid absorption and its tensile strength.

RESULTS

This study determined the effectiveness of utilizing Banana fiber (*Musa fiber)* as a raw material for paper towel tissue. On this sector the findings are presented in tables.

Research Question #1: Can Banana fiber (Musa fiber) be a promising fiber source for the production of paper towel tissue?

Banana fiber can possibly be a promising fiber source for the production of paper towel tissue because of its chemical component, cellulose, that helps in absorbing moistures and gives a high quality of tensile strength. Base on the result, paper towel tissues made from banana fiber is a good absorbent, however, the commercial paper towel tissue absorbs more and has a soft texture.

Research Question #2: Is there a significant difference between the two setups, controlled and experimental in terms of:

2.1 liquid absorption; and

2.2 tensile strength?

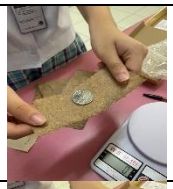
Table 1: Comparison of Liquid Absorption

Set-ups		Time
Controlled		0.01 seconds
Experimental		7 seconds

The data in table 1 illustrates comparison between the two set-ups. In the controlled group, where banana fiber pulp was blended with water without any other additives. The paper towel tissue produced were effective liquid absorbent. Upon application of liquid, the tissue quickly absorbed the moisture, leaving minimal surface wetness.

In the experimental group, where banana fiber pulp was blended with water and baking powder. The paper towel tissue is still effective liquid absorbent, but it has some difference from the controlled group. There was a noticeable increase in surface wetness and the water took almost 7 seconds to absorb.

Table 2: Tensile Strength Analysis

Object	Mass	Set-ups	
Coin	(8g)	Controlled	
Hand watch	(35g)		
Phone	(228g)		
Coin	(8g)	Experimental	
Hand watch	(35g)		
Phone	(228g)		

The data in table 2 shows their different abilities. In the controlled group of the study, where only water was added to the banana fiber pulp, the paper towel tissues demonstrated good tensile strength across different weight tests. For a light weight of 8 grams (coin), the tissues could handle such light stress without issues. When subjected to a moderate weight of 35 grams (hand watch), the tissues still shows resilience under slightly higher stress. With a heavy weight of 228 grams (phone), the tissues has robust strength and the ability to withstand considerable force without tearing.

In the experimental group where baking powder was added to the banana fiber pulp, the tensile strength of the paper towel tissues was significantly reduced compared to the controlled group. At a low weight of 8 grams (coin), the tissues were somewhat effective but showed early signs of strain. With a moderate weight of 35 grams (hand watch), the tissues needed development, as they stretched and began tearing. At a high weight of 228 grams (phone), the tissues were ineffective and tore under the weight.

DISCUSSION

The results of the study revealed that adding baking powder to the banana fibre pulp did not significantly affect the paper towel's tissue absorbency and strength. As researched by (Carullo et al., 2020), baking powder creates carbon dioxide gas bubbles. The presence of these gas bubbles creates air pockets within the paper towel tissue. This air reduces the surface area available for water absorption, making the paper towels less absorbent. It also disrupts the durability of the fibers, with air pockets interrupting the fiber connections, the overall structure becomes weaker and more prone to tearing compared to the controlled group with only water added. As discussed by (Subagyo & Chafidz, 2018), banana pseudo-stem fibers already has a good modulus of elasticity, tensile strength, and stiffness, which makes it a promising fiber material, in other words adding baking powder is unnecessary. These findings align where paper towel tissue sheets made with baking powder does not enhance water absorption and became more fragile and tore more easily.

CONCLUSION & RECOMMENDATION

Banana fibre (Musa fibre) as a stand-alone raw material possesses commendable tensile strength and liquid absorption, however, its inherent hard texture makes it unsuitable for the soft and absorbent nature of paper towels. In an experiment by making paper towel tissues softer by adding baking powder, the modification did indeed achieve the desired softness. However, this modification came at the cost of significantly weakening their strength and did not substantially improve their ability to absorb liquid.

After conducting thorough experimentation and data analysis, it has become evident that the results obtained do not support the researcher hypothesis. Therefore, the researchers reject the hypothesis that paper towel tissues made with banana fiber (*Musa fiber*) would display greater tensile strength and liquid absorption compared to traditional wood pulp towels.

The researchers recommend adjustments for future investigations based on the study's findings. They suggest reducing the amount of baking powder used, prioritizing beating banana fibers before blending, and increasing water content during blending. These changes aim to enhance paper towel tissue quality and maximize banana fiber's potential as a sustainable material.

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