

The preliminary study of applications waste banana peel and egg shell filler as agricultural waste for paper applications.

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Abstract. This research investigates the use of banana peel ingredients that are removed from leftover banana peels to make paper. The paper was prepared by using hand sheet press machine. The study explores this non-starch elements' potential by thoroughly examining their characteristics in an oven setting. Despite being seen as agricultural waste; banana peels include cellulose-rich components that make them a promising resource for the manufacturing of sustainable paper. The investigation uses oven-based procedures to extract and analyse non-starch components, looking at their structural and thermal characteristics. The results show that the waste banana peel with 5g of egg shell showed the highest of tensile strength which is 0.614 MPa followed by 2g of egg shell added. The combinations of waste of waste carbon box (WCB), waste banana peel and egg shell filler as paper gives the maximum loads, deflections and tensile strength. By reusing agricultural by-products for useful purposes, this project aims to support the development of environmentally responsible methods in the paper sector via a comprehensive assessment of oven qualities.

1 Introduction

The delicious fruit known as the banana belongs to the Musaceae family and is cultivated in tropical and subtropical regions of the world. An unnecessary banana peel is the outer skin or peel of a banana that has been thrown after it has been eaten or removed. It is categorised as non-toxic waste since it biodegrades over time and decomposes spontaneously. After eating the fruit inside, people typically throw away the peels from bananas, but they may also be recycled or utilised in several other ways. Banana peel waste is often deposited in municipal landfills, adding to the present environmental problems. However, the problem may be resolved by using its valuable components, including bio-products [1]. In the context of product production or creation, a filler is an inert component or substance added to a product to increase its bulk, weight, volume, or overall size. One of the most important steps in the production of paper is the pulping of raw materials, mostly wood fibres, into pulp that

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may be used to make paper. The two major types of pulping technologies are mechanical pulping and chemical pulping.

1.1 The using of waste banana peel as potential high strength paper

1.1.1 Why banana peel

The main chemical used by plants for energy storage is starch, a complex carbohydrate. Long strands of glucose molecules make up its structure. Starch may be found in the form of granules in banana peels, just as it can in other starchy plants. Starch is an important component since it may be used in the manufacture of food, in industry, and as a starting point for the creation of biofuels, among other things.

On the other hand, banana peels also include a range of non-starchy chemicals, including cellulose, hemicellulose, lignin, pectin, and several other organic molecules. The banana peel's makeup is mostly made up of these non-starchy ingredients. Plant cell walls are structurally supported by the complex polysaccharide's cellulose and hemicellulose. Lignin is a sophisticated polymer that gives plant tissues stiffness [2]. A form of carbohydrate called pectin has qualities that let it gel and function as a natural glue.

1.1.2 Composite of Paper from Banana Peel and Eggshell Filler

It is uncommon to utilize eggshells and banana peels to make paper since cellulose fiber from trees are often used in conventional papermaking. Here are a few reasons why these unusual materials may be employed, however, if one were to think about doing. Eggshells and banana peels both contain fibrous substances that may be used as substitute sources of cellulose fiber for papermaking. Although not as accessible or plentiful as wood pulp, these materials might be employed in experimental or small-scale papermaking procedures.

In the world of materials science, the composite material made of eggshell filler and non-starch banana peel is a novel and sustainable method. By using the special qualities of two agricultural byproducts, waste may be turned into a useful resource. The banana peel, which is usually thrown away, adds organic substance to the composite by acting as a non-starch source. Eggshell filler, on the other hand, provides a mineral component that improves the mechanical characteristics and structural integrity of the material. This composite not only tackles the problem of waste management, but it also emphasises how renewable resources may be used to create new materials. These agricultural by-products may be incorporated into composite materials to provide an affordable option to traditional materials while simultaneously promoting environmental sustainability [3]. This study is a step in the right direction towards developing environmentally friendly solutions by promoting the use of agricultural waste in the hunt for more adaptable and sustainable materials for a range of uses in sectors like building and packaging.

2 Methodology

The following materials are needed to create paper: cotton box waste, banana peel as main ingredients and eggshell as a filler for paper making. Cotton box waste, banana skin powder, eggshell, beaker, stainless steel spoon, distilled water, and measuring cylinder used to observe the effects of various egg shell filler on the paper-making process. Small and medium sized businesses (SMI) gathered egg shell fillers and banana skin, while the banana skin and eggshell were collected. Eggshell was washed, dried, and powdered, and banana peels were baked in an oven for 24 hours to remove any moisture. For paper making process, the pulp of waste banana peel and egg shell were blended together for 2 minutes then proceed to paper making by using hand sheet machine. The attached of the top of the pressing machine to eliminate excess moisture. After 4 minutes, detach the top of the pressing machine and couch plate, gently separating the blotting paper from the pulp. Allow the formed paper to air dry for several hours or until it completely dry. The tensile testing towards paper are evaluated using a basic technique for evaluating the mechanical qualities of paper and paper products, tensile testing is important to the paper manufacturing sector. Using this testing technique, paper samples are stressed to the point of failure under controlled conditions. This gives manufacturers an assessment of the material's tensile strength, elongation, and other important properties. It is crucial to comprehend these characteristics to maximise paper performance and quality. This method examines paper fibres, fillers, and other components under a microscope to determine its composition and quality.

3 Results and discussion

The egg shell, waste banana peel and waste carton box mixed as labelled WBP/WCB/ES with different ratio. The texture of paper is smooth, and its colour is dark brown, which indicates that it is a well-balanced blend of four grams of waste cardboard, banana peel and egg shell fillers. It is quite unlikely that this paper can be used since its thickness is extremely superficial. This came about because recycled paper is produced using fibres that are removed from old box material. This helps contribute to the preservation of natural resources and decreases the effect that recycled paper has on the environment [4]. Since fibres may be recycled and used in the manufacturing of paper, there are many recycling cycles that are now conceivable. As a result of the fact that various types of paper are manufactured using a variety of components, the appearance and feel of the fibres in each sample are distinct from one another [5]. The recycle fibre mixture that is put to this paper serves the purpose of maintaining the sample's texture, which is necessary to raise the pressure that is provided by the pneumatic sheet press.

Eggshell (ES), waste banana peel (WBP), and waste carton box (WCB) are only a few examples of the materials whose mechanical characteristics are described in depth in the data that has been supplied. The figure of paper prepared using carbon box and waste banana peel as in Figure 1.



Fig. 1. The paper prepared from carton box (5g), WBP (4g) and Eggshell (4g)

With a consistent pace of twenty millimetres per minute, we were able to determine the tensile strength of each sample. A consistence of WCB by using 5g of WCB were combine with different ratios of WBP and ES. There are 7 sample which are divided by WCB with egg shell and WCB with WBP and ES. The thickness of paper was 0.17mm. It was determined that the mixture containing 5 grams of WCB was prepared, combined with varying proportions of WBP and ES. Seven samples were prepared, categorized into groups of WCB with eggshell and WCB with WBP and ES. The paper thickness was measured at 0.17 mm. It was found that the 5g WCB sample deflected by 1.2857 mm under a maximum force of 5.9282 N.

The tensile strength of the material was determined to be 0.614 N/mm, indicating its resistance to the applied forces. When 2 grams of WBP were added to the 5 grams of WCB, the maximum load decreased to 3.6941 N, and the deflection increased to 2.1323 mm. This change introduced a new balance between strength and flexibility. The results of the tensile tests are shown in Table 1. Adding 4 grams of ES to 5 grams of WCB increased the maximum load to 3.3928 N and reduced the deflection to 1.5423 mm, achieving a similar balance between load resistance and flexibility [6]. The various combinations of 5g WCB with 4g WBP and 2g ES, as well as with 4g WBP and 4g ES, exhibited a broad spectrum of mechanical properties, including maximum loads, deflections, and tensile strengths [7] [8]. These findings underscore the importance of selecting material compositions tailored to the specific requirements of an application, as each combination offers a distinct set of mechanical characteristics.

Table 1. Results of tensile testing

Sample	Speed (mm/min)	Maximum Load (N)	Deflection At Maximum Loads (mm)	Tensile Strength (MPa)
5WCB	20	5.9282	1.2857	0.614
5WCB2ES	20	1.7005	0.7222	0.176
5WCB4ES	20	3.3928	1.5423	0.351
5WCB2WBP	20	3.6941	2.1323	0.382
5WCB4WBP	20	4.8119	1.4524	0.498
5WCB4WBP 2ES	20	4.9880	1.5754	0.517
5WCB4WBP 4ES	20	3.0965	1.3889	0.321

4 Conclusion

Research on creating paper from non-starch byproducts like banana peel and eggshell has led to greener, more sustainable papermaking methods. Systematic research has shown that these non-traditional raw resources are good for papermaking. Fibrous banana peel and eggshell structural components improve paper quality. The novel technique eliminates waste management issues and helps the paper sector adopt sustainable business practices. Various mechanical behaviours were found while analysing eggshell (ES), carton box (WCB), and banana peel (WBP) waste materials. The findings show that altering these components' proportions considerably impacts composite samples' tensile strength, maximum load, and deflection. WBP and WCB were combined to balance the material's strength and flexibility, showing its potential for custom qualities. ES also altered deformability, highlighting the importance of application demands. Each combination's mechanical properties underline the need to customise material compositions to applications. This research emphasises the need of knowing and controlling material combinations to attain mechanical properties for long-term, adaptable industrial processes like papermaking.

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