Banana Peduncle Waste Conversion: Investigating the Feasibility of Charcoal Briquettes for Sustainable Energy Production

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ABSTRACT

Considering the escalating demand for fossil fuels and the depletion of natural resources, the imperative for environmental sustainability has never been more pressing. In response to this need, innovative solutions for repurposing waste materials have garnered attention for their potential to address environmental concerns while providing alternative energy sources. Meanwhile, there is still a lack of exploration into using banana by-products like its peduncle. By turning waste materials such as banana peduncles into charcoal can address waste problems that can harm the environment as well as contribute to an additional source of energy. This study aims to produce a briquette utilizing the banana peduncle as well as to test its effectiveness in its flammability. The researchers tested the peduncle briquette in terms of its (1) characterization of peduncle briquettes, (2) ignition time, and (3) burning rate. The researchers made the banana peduncle briquette by drying the peduncle, crushing, molding, pressing, and leaving it to sun-dry for 24 hours. When the peduncle briquette was successfully made, the researchers then proceeded to test its flammability through boiling water. After testing, the researchers came to conclude that banana peduncle can be an effective material for briquette and can burn enough to use it for cooking. The results of this research highlight the promise of banana peduncle briquettes as a practical substitute for fossil fuels. These briquettes not only tackle waste management issues by repurposing agricultural byproducts but also provide a sustainable energy option that helps reduce the environmental impact linked to conventional fuel usage. As the quest for sustainable energy alternatives intensifies, leveraging agricultural waste for charcoal briquette production emerges as a hopeful avenue toward a more eco-friendly and sustainable tomorrow.

Keywords: *banana peduncle, briquette, sustainable, waste conversion*

INTRODUCTION

In the face of growing concerns over fossil fuel depletion and environmental degradation, the urgency of adopting sustainable practices has become increasingly evident. The search for innovative solutions that address these challenges has led to a promising area of research: the repurposing of waste materials into alternative energy sources. Among the myriad of possibilities, banana by-products—specifically the banana peduncle—have emerged as a notable candidate for exploration.

Banana peduncles, the thick stalks that support banana clusters, are often discarded as agricultural waste. However, their potential as a raw material for sustainable energy solutions warrants closer examination. This study focuses on transforming banana peduncles into charcoal briquettes, aiming to evaluate their effectiveness as an alternative energy source. By processing the peduncle through drying, crushing, molding, pressing, and sun-drying, the researchers produced briquettes and assessed their flammability through rigorous testing.

The research objectives were threefold: to characterize the peduncle briquettes, determine their ignition time, and measure their burning rate. The findings revealed that banana peduncle briquettes can effectively ignite and sustain combustion, making them a viable substitute for conventional fuels. This approach not only addresses the issue of waste management by repurposing agricultural by-products but also contributes to a reduction in environmental impacts associated with fossil fuel use.

As the global community intensifies its search for sustainable energy solutions, the use of agricultural waste for charcoal briquette production presents a promising and eco-friendly alternative. This study highlights the potential of banana peduncle briquettes to support environmental sustainability and offers a pathway toward a more sustainable energy future.

LITERATURE REVIEW

Environmental sustainability is paramount to improving the quality of life and this world's future generations. While the demand for fossil fuels increases in society, a decrease in natural resources has been a significant problem (Anggono, 2017). Fossil fuels also have negative effects that cause potential harm to the environment which makes renewable energy more desirable (Firoz, 2017). Additionally, the continuity of non-renewable energy poses a threat and a challenge in conservation (Kpalo, 2020). Biomass briquettes will not only be an innovative source of energy, but it also deals with conserving energy and decreasing solid waste, and briquettes can be a good source of income (Aishwariya, 2018). Biomass briquettes, mostly made of green waste and other organic materials, are commonly used for electricity generation, heat, and cooking fuel. They are the perfect replacement for wood logs (Khater, 2017). Briquettes are denser and more compact than loose biomass, resulting in a higher specific density and bulk density. This means they contain a concentrated form of energy compared to firewood or charcoal (Nguyen, 2023). The waste from Banana peduncles contributes to unsustainability and environmental pollution. According to Christmastuti Nur (2017), a banana chip and cake business produces 10- 50 kg of peduncle waste in Central Java, Indonesia. In addition to peduncles potentially harming the environment, these have no market value (Balajii, 2020). Every year, the Philippines generates approximately 2.3 million metric tons of banana peduncle, and these are either utilized as compost or put to waste (Dr. Tavanlar, 2020). This waste can be reused as briquettes to address the concern of diminishing sources of energy as well as the harmful effects of banana peduncle waste on the environment. The demand for producing briquettes has consistently remained constrained, indicating a persistent lack of production (Obi, 2022). Additionally, exploring more innovative purposes for banana peduncles is to be considered (Padam, 2014). The study aims to obtain a new and alternative energy source from agricultural waste. This will contribute to various researchers, environmental organizations, academic institutions, and the agricultural community. Thus, the production and flammability of the banana peduncle as a briquette will be investigated.

METHODS

This study utilized an experimental design to investigate the effectiveness of banana peduncle as a raw material for briquette production, intending to maximize enhanced quality and discover a new renewable energy source. A posttest-only control group was used in the study, considering that the approach was advantageous in testing (Bhattacherjee, 2012).

The study utilized banana peduncle to test whether it is an effective resource for briquette production. The banana peduncle was obtained free of charge from a fruit vendor in Silang, Cavite. The corn starch acted as the binder of the briquette was purchased from the local store near the research site. The researchers' materials such as basins, PVC pipes, empty cans, weighing scale, and containers were provided by the researchers. Upon receiving the ERB, the researchers proceeded to perform the experimentation while following a procedure. The researchers assessed the effectiveness of the banana peduncle briquette in terms of its characterization, ignition time, and burning rate of briquette while boiling 500ml of water. The researchers went through the experiment while following a procedure. The experiment was conducted in the residence of the researchers and adviser located in Silang, Cavite. The research adviser facilitated the investigation after the Ethics Review Board approved the study. Once approved, the materials were gathered to produce briquettes.

The peduncles were chopped into small pieces for faster dehydration. This is to ensure that no water is left in the peduncle. The researchers used an oven to dry the chunks for 1 hour and 30 minutes to a maximum of 2 hours. The heat was set to 300 degrees then after 1 hour, it was set to 190 degrees. After, the charred peduncle is placed in a container. The researchers then proceed with grinding the peduncle into smaller bits, until it becomes powdered charcoal. The researchers obtained 100 grams of powdered charcoal placing it in a container to add 2 tablespoons of cornstarch, then add water until proper consistency, enough to allow mixing. Cornstarch was used since it is a good binder for briquettes (Chinyere, 2014). Once the mixture is ready, the researchers then proceed to mold the briquette, using a 5 x 16 cm PVC pipe, a thick stick, a small stick, and 2 round rubber. The mixture was placed inside the molder and then pressed to squeeze out the excess water in the mixture. Then it was flipped to squeeze the opposite side. Finally, the briquette is left to be sun-dried for 24 hours. The testing was conducted in a researcher's backyard. The test was done with placing the briquette inside a Stainless-steel cage. The researchers had set up chopped wood to be placed below the steel cage on top to avoid the grass from potentialy catching fire. A fire was ignited on the briquette to test its burning rate and ignition time. The researchers observed the physical appearance of the peduncle briquette to record its characterization. After the peduncle briquette was sun-dried, the researchers proceeded to conduct a flammability test. The burning rate was measured by recording the initial and final weight of the briquette with burning. The ignition time was based on the time the briquette took to burn until the fire from the peduncle ran out. All of the data were recorded in Google documents.

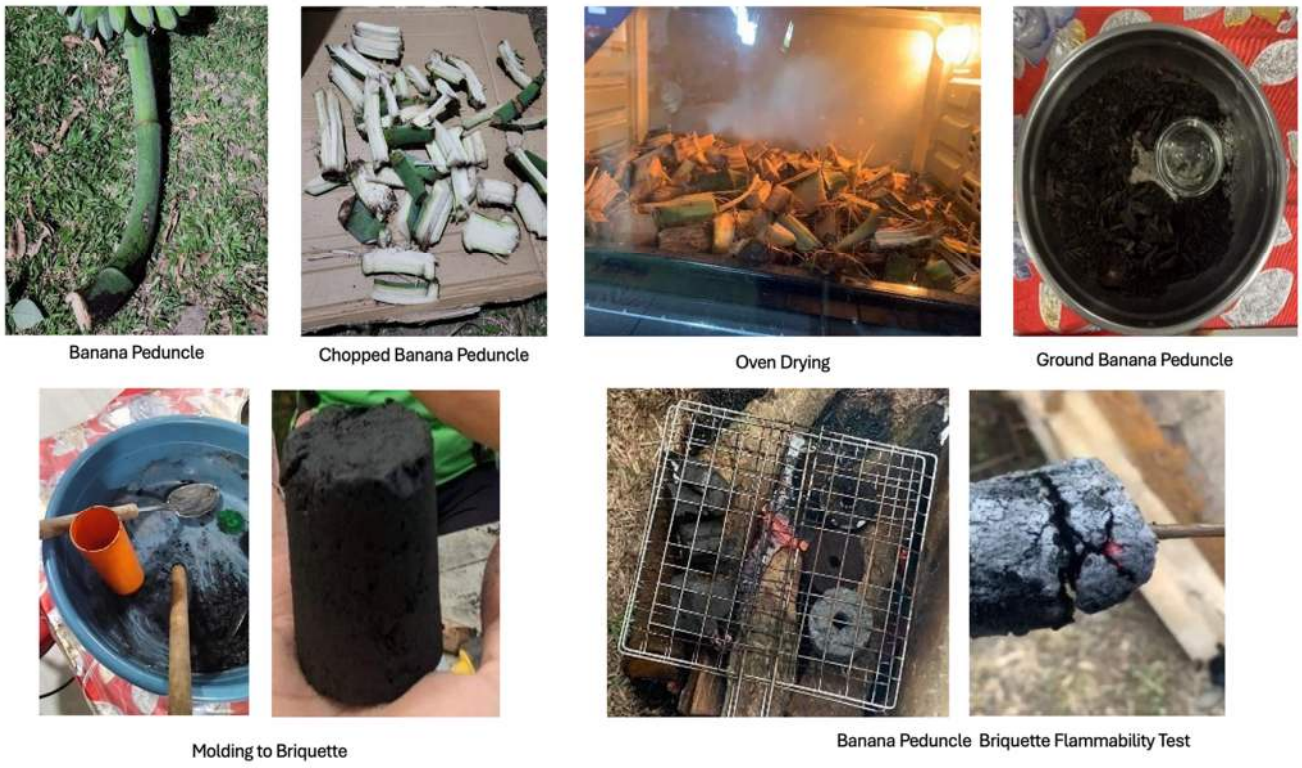

Figure 1. **From Banana Peduncle to Briquette**

RESULTS AND DISCUSSION

The briquettes produced by the peduncle of the banana had a black appearance with smooth edges. The peduncle briquette also has a rough surface. As it underwent burning, cracks began to emerge in the peduncle, looking like veins across its surface. White spots had also begun to scatter, making the dark hue slowly disappear.

Table 1

Burning rate and Ignition time of Peduncle Briquettes

	Initial weight before burning (g)	Final weight after burning (g)	Total Burning Time of the Briquette
Banana Peduncle Briquette	280 g	90g	1 hr & 9 mins

The study was evaluated and based on the experimentation and observation conducted by the researchers. The measurements used for each briquette are listed in Table 1. data on the table shows that the peduncle briquette's weight decreased compared to its initial weight. Out of 280g of peduncle briquettes, 90g was left after boiling 500g of water. About 67.86% of peduncle briquettes were consumed, leaving 90g of briquettes that can be reused once again. A total

duration of 1hr and 9 mins elapsed before the peduncle briquette completely lost its fire. The test was done with the burning rate at the same time.

CONCLUSION, IMPLICATION, SUGGESTION, AND LIMITATIONS

The results show that banana peduncle briquette can be a novel source of energy. The researchers accomplished their goal of converting banana peduncle waste into usable material. Knowing that banana peduncles can be made into briquettes can help a lot since waste can be reduced, and it can be good for the environment and health. The briquette has also been shown to have flammable properties. In short, banana peduncles emerge as an effective and environmentally friendly alternative for briquettes, with the potential to curtail the reliance on fossil fuels, particularly coal.

Future researchers may further expand this study. The banana peduncle briquette could be tested with other trustworthy sources to assess the briquette's performance for cooking scenarios and industrial applications.

Furthermore, future studies about banana peduncle briquette could explore additional aspects to gain a more comprehensive understanding of its properties. Various properties such as the heat output, ash production, and its cost-effectiveness. Additionally, the use of banana peduncles could be explored further.

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