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Evaluation of Sensory Characteristics of Rubber Tree (Hevea Brasiliensis) Sawdust and Leaves as Alternative Biofuels

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ABSTRACT: In the face of rising fuel costs and environmental concerns, the need for alternate energy sources is growing. Charcoal, generated from animal and vegetable sources, has emerged as a viable alternative fuel. Briquetting, which compresses organic materials into compact briquettes, offers an environmentally responsible solution for waste management and energy production in the Philippines. Basilan, noted for its agricultural methods, generates a substantial amount of agricultural waste, including rubberwood sawdust (RBS) and Rubber Tree Leaves which is perfect for briquette production due to its lignocellulose content. Charcoal briquettes, made of charcoal fines and binder, are an economical, smokeless, and long-lasting fuel option which may poses sustainable solution as the conventional method of charcoal manufacture, which involves tree felling, poses ecological concerns. This exploratory experimental design study investigates the viability and possibility of utilizing biocharcoal from dried leaves of rubber trees and rubberwood sawdust (Hevea brasiliensis) as an environmentally benign and cost-effective option. This study intends to create a sustainable cooking fuel alternative to standard charcoal by reusing agricultural trash. The study aims to developed briquettes and assesses their physical characteristics such durability, efficiency, kindling time, burning time, and heating quality to three identified evaluators. Overall, the positive responses from those who were interviewed shed light on the promising potential of rubber sawdust charcoal briquettes ($\bar{x} = 4.8$ (liked very much)) and rubber tree leaves ($\bar{x} = 4.23$ (liked very much)) as a viable and environmentally friendly energy source for applications involving heating and cooking. Due to limited laboratory apparatuses, researchers recommended for a further evaluation of the developed briquettes such doing proximate analysis (e.g. measuring the moisture and ash content) established strong data to support the existing data.

KEYWORDS: Briquettes, Energy, Development, Hedonic scale, Sustainable Development

INTRODUCTION

The increasing concerns surrounding fuel costs, growing energy demands, and environmental degradation have brought the search for sustainable energy solutions to the forefront of global discussions. In this vast landscape, charcoal shines as a symbol of hope, providing a different option to traditional sources of fuel. According to Kataki & Kataki (2022), briquetting is a method that compresses organic materials or biomass into compact briquettes. This technique shows great potential for waste management and energy production. According to the DOST, charcoal briquettes, which are more efficient than ordinary charcoal, burn longer, are easier to ignite, produce intense heat, and have little smoke. Compared to plain charcoal, briquettes are less messy and more accessible to handle because they are compact and uniform in size. They are also easy to ignite, burn slowly, give more intense heat per unit volume, and are almost smokeless when burning. Charcoal briquettes made from agroforest wastes may lessen the extensive charcoaling of wood, thus helping protect what is left of the country's forest resources. (Engr. Belen B. Bisana, head of DOST-FPRDI's Bio-Energy and Equipment Development Section (BEEDS).

Moreover, given the urgent demand for sustainable energy sources, researchers have shifted their focus towards agricultural waste, an abundant resource that holds immense potential. It is worth mentioning that scientists and environmentalists have shown great interest in rubber tree leaves and sawdust, which are abundant byproducts in regions like the Philippines. Shakir et al. (2023) highlight the significant lignocellulose content found in rubberwood sawdust (RBS), making it environmentally friendly and a viable option for composite materials.

In light of this context, our paper aims to assess the sensory qualities of rubber leaves and sawdust when used as charcoal briquettes. Our research is centered around examining the Durability, Efficiency, Kindling Time, Burning time and Heating quality to gain valuable insights into their potential as renewable energy sources. This research is in line with the findings of Patil et al. (2021), who suggest incorporating biomass into briquette production for power generation as a sustainable solution to waste disposal and pollution challenges.

The leaves of rubber trees and the sawdust, which are highly abundant and economically important in regions such as the Philippines, show potential as a cost-effective raw material for producing charcoal. In addition, Narzary and Das (2022) highlight the potential of using charcoal and binders to improve the physiochemical properties of briquettes, thereby increasing their effectiveness as alternative fuel sources.

We are conducting a study to assess the sensory characteristics of rubber tree both its leaves and sawdust and investigate their potential socio-economic impacts especially in our municipality, where communities impacted by limitations on wood charcoal production, we aim to support sustainable development initiatives.

We believe, that in a time marked by pressing environmental concerns and energy difficulties, the assessment of different fuel sources becomes incredibly significant. By conducting this research, this will provide foundational information in doing the briquettes and to uncover the potential of rubber leaves and sawdust as effective solutions for addressing urgent energy and waste management issues. Our findings could contribute to a more environmentally friendly and sustainable future.

RESEARCH METHODS

Research Design

This study is an exploratory experimental design. Exploratory research is described as a type of research design in which research is conducted to learn more about a problem that isn't well defined. The researchers will only conduct a physical assessment of the briquettes and shall use survey questionnaire to obtain data. The use of Likert scale will be used to assess evaluators' satisfaction/observation towards the developed briquettes. In addition, the researchers will explore the published literature regarding briquette technology as well as affiliation of biomass that are left unused. The use of biomass is widely documented and unique procedures can be established to suit the availability of organic wastes.

Materials Used

Along with the Collected Biomass materials of Rubber Sawdusts and Rubber leaves. The study used the following materials namely, PVC pipe (28 cm), Container/bowl, Pan and Stove and Mesh Sieve 120. Graduated cyclinder, Triple beam balance. Study mainly use cornstart as a binder.

Development Procedures

The design requires the development of a process using the existing print and digital materials. During this study, the focus is on the practical implementation of the conceptualized process to determine its feasibility. This stage will involve conducting a straightforward design and trial process to develop a more practical briquette formulation. In this study, there were two different set-ups and biomass materials used. The initial recipe for Rubber Tree Leaves briquettes required 187.5 grams of Pulverized biomass, 250 ml of water, and 250 grams of Starch. This mixture could produce 17 briquettes. The second recipe consisted of 90 grams of Starch, 240 ml of water, and 120 grams of Pulverized Rubber Sawdust Charcoal, resulting in 18 briquettes. The time it takes for carbonization varies depending on the mass of biomass. For example, a batch of 2 sacks of dried rubber leaves required 2 hours of controlled fire, while 2 sacks of rubber sawdust needed 3-3.5 hours under the same conditions.

Following the carbonization process, the material is then pulverized using a 120-mess sieve. Combine the starch and water in a pan until the starch is fully dissolved. Place the wet mixture on medium heat and stir until it becomes sticky. It will take approximately 5-7 minutes for it to reach the desired consistency. Once the mixture is complete, gradually incorporate the pulverized biomass until it reaches the desired consistency, neither too dry nor too wet. Next, the compaction process involved using PVC as a molder and inserting wood to compact the carbonized biomass. Apply firm pressure with your hand to ensure proper compaction. After applying the substance, it needed to be left to dry for 10-15 hours under the heat. Below are the general steps of the briquette's development.

Figure 1. General steps in the development of charcoal briquettes

Evaluation of Sensory Characteristics of Briquettes

Three respondents will be selected by the researchers to assess the durability, efficiency, kindling time, burning time, and heating quality of the carbonized rice hull briquettes. Prior to utilizing the carbonized briquettes, the student researchers will provide an introduction to the components used in their production and subsequently offer instructions on their proper usage. Users will compare the performance of the developed briquettes with conventional charcoal and assess the acceptability level of the product using a hedonic rating scale (See table 1). a) Durability - refers to the capacity of the briquettes to withstand damage when exposed to external forces. The respondents will assess the briquettes' durability by testing how easily they disintegrate.b) Efficiency - the effectiveness of the briquette is crucial. It determines the speed at which it can bring the water to a boil. The participants would utilize the briquettes for cooking purposes and carefully monitor the speed at which the briquettes bring the food to a boil.c) Ignition Speed - this determines the rate at which the briquettes catch fire.The respondents will carefully observe the briquettes as they are lit to determine how quickly or slowly they ignite.d) Burning Time - it determines the duration of the product's burn when used. The respondents will assess the briquettes once they are ignited, including their heat production duration and longevity when in use.e) Heating Quality - it determines the level of heat produced by the briquettes. The respondents will assess the heat generated by the briquettes and determine the effectiveness of the briquettes for heating purposes.

Table 1. Scale for the Scorecard on the Acceptability Level of Each Sensory Characteristic of the developed briquettes

Scale	Interval	Degree of Response
5	4.20 - 5.00	Liked Very Much
4	3.40 - 4.19	Liked Moderately
3	2.60 - 3.39	Neither Liked nor Disliked
2	1.80 - 2.59	Disliked Moderately
1	1.00 -1.79	Disliked Very Much

RESULTS AND DISCUSSIONS

Table 2. Evaluation of Sensory Characteristics of the Rubber Sawdust Briquettes

Sensory Characteristics	Rate	Remarks
a) Durability	4	Liked Moderately
b) Efficiency	5	Liked Very Much
c) Kindling Time	5	Liked Very Much
d) Burning Time	5	Liked Very Much
e) Heating Quality	5	Liked Very Much
Average Rating	**4.8**	**Liked Very Much**

Throughout the course of the interviews, the participants consistently expressed satisfaction with their experiences using rubber sawdust charcoal briquettes, emphasizing several important qualities. However, some participants expressed concern about the perceived softness of the briquettes in comparison to traditional charcoal or other fuel sources. According to the people interviewed, they found that the briquettes had a delicate texture that made them more likely to break and fall apart when handled and transported. It was found that the fragility of the briquettes was influenced by various factors, such as the composition of the materials and the binding agents employed in the manufacturing process.

The significance of optimizing the sawdust-to-binding-agent ratio is highlighted by this discovery. It is crucial to achieve maximum compactness and hardness in order to ensure that the briquettes are durable and can withstand handling and transport. Improving the structural integrity of the briquettes could greatly enhance their practicality and increase user satisfaction.

Despite this problem, the interviewees were generally pleased with how well the briquettes performed in other aspects. The exceptional ability of the briquettes to quickly boil water was highly praised. This feature emphasizes the briquettes' ability to heat up quickly and boil water faster, making it a valuable option for those looking for efficient heating solutions. The briquettes were highly regarded for their fast ignition and consistent flame, making them an ideal option for outdoor heating and cooking, like camping or picnics, thanks to their impressive efficiency.

In addition, the interviewees mentioned the briquettes' ability to burn for a longer period of time and generate high levels of heat. These enhancements not only enhanced the overall user experience but also offered practical advantages in terms of ease, effectiveness, and ecological friendliness. With a longer burn time, refueling becomes less frequent, making it easier to use and reducing the total amount of fuel used. The high heat generation is beneficial for cooking and heating, ensuring consistent and reliable performance. Nevertheless, the feedback received from the individuals interviewed highlights the promising potential of rubber sawdust charcoal briquettes as a sustainable and eco-friendly energy source for heating and cooking purposes. Although there is potential for enhancing durability, the overall advantages of these briquettes make them a compelling choice for individuals in search of sustainable and efficient fuel alternatives.

Table 3. Evaluation of Sensory Characteristics of the Rubber Leaves Briquettes

Sensory Characteristics	**Rate**	**Remarks**
a) Durability	4.66	Liked Very Much
b) Efficiency	4.33	Liked Very Much
c) Kindling Time	4.33	Liked Very Much
d) Burning Time	3.66	Liked Moderately
e) Heating Quality	4.33	Liked Very Much
Average Rating	**4.23**	**Liked Very Much**

The respondents shared positive experiences regarding the use of charcoal briquettes made from rubber tree leaves, highlighting several important characteristics. Based on the respondents' findings, they noted that the burning period of the briquettes was a highly significant aspect. Although the respondents found several positive aspects of the briquettes, they mentioned that the burning time did not meet their expectations when compared to traditional methods.

This feedback brought attention to an important area that could be improved. Throughout the burning time test, a total of 187.5 grams of biomass briquettes, which is equal to 17 briquettes, were burned for a duration of 47 minutes and 14 seconds. The burn duration of this is shorter compared to that of sawdust briquettes. The main factor contributing to this variation is the composition and texture of the briquettes. Charcoal briquettes made from rubber tree leaves have a smoother texture compared to sawdust. The finer texture of the material allows for a faster ignition and burning process, leading to a shorter overall burn time.

These observations highlight the importance of fine-tuning the composition of the briquettes to improve their burning duration. One possible approach is to modify the combination of materials in order to find the right balance between ignition efficiency and sustained burning. By tackling this problem, we can greatly enhance the practicality and user satisfaction of charcoal briquettes made from rubber tree leaves. This would make them a much more feasible option compared to conventional fuel sources.

CONCLUSIONS AND RECOMMENDATIONS

The results of the survey suggests that biomass from rubber tree such as sawdust and leaves can utilize as alternative biofuel as briquettes. The transformation of rubberwood sawdust and leaves into charcoal briquettes offer a promising solution for sustainable and renewable energy sources. This innovative process not only provides a renewable energy option but also

addresses environmental concerns such as deforestation, waste utilization, greenhouse gas emissions, and energy efficiency. General results found that both rubber sawdust charcoal briquettes and rubber tree leaf charcoal briquettes received generally positive feedback. This suggests that these fuel sources have the potential to be sustainable and efficient for cooking purposes. The briquettes' quick ignition, steady flame maintenance, strong heat production, and long burning period were all appreciated by the participants. Some issues were brought up regarding the durability and vulnerability of the rubber sawdust briquettes during handling and transport, as well as the shorter burning time of the rubber tree leaf briquettes due to their fine texture.

In order to improve the performance and user satisfaction of both types of briquettes, it is advised to optimize the ratio of sawdust to binding agent for the rubber sawdust briquettes. This will help enhance their compactness and hardness, ultimately reducing the likelihood of breakage. For both kinds, improving the fixed carbon content, reducing the moisture content, and lowering the ash content will improve the heat production and burning efficiency. It is also suggested to explore methods for prolonging the burning time of rubber tree leaf briquettes, such as making adjustments to the material composition and density. By consistently incorporating user feedback and conducting thorough durability testing, we can ensure that the briquettes meet the practical demands.

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