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Characterization and Repellent Activity of Anti-Mosquito Briquettes from Langsat Fruit Peels Using Nutmeg and Coconut Shell Charcoal

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ABSTRACT

Waste disposal poses a serious environmental issue, but waste can be utilized as a benefit to the environment. Langsat fruit peels are a potential waste material with anti-mosquito properties. One common use of briquettes in society is as a mosquito-repellent. Langsat fruit peels can serve as an effective ingredient for mosquito-repellent briquettes. The advantage of repellent briquettes made from langsat fruit peels is that they do not interfere with respiratory health. This study aims to determine the physical characteristics of briquettes and the repellent activity of anti-mosquito briquettes made from langsat fruit peels. This research is experimental in nature and uses primary data obtained from laboratory testing. The study found that the moisture content of formulas I, II, and III was 7.89%, 9.07%, and 6.15%, respectively. The ash content of formulas I, II, and III was 3.60%, 2.35%, and 5.45%, respectively. The volatile matter content of formulas I, II, and III was 97.05%, 96.35%, and 96.97%, respectively. The calorific value of formulas I, II, and III was 6009.72 cal/g, 5670.68 cal/g, and 6352.11 cal/g, respectively. The mosquito-repellent effectiveness of formulas I, II, and III lasted for 02:44 minutes, 02:49 minutes, and 02:43 minutes, respectively. Langsat fruit peels exhibit repellent activity due to the bioactive compounds present in the peels. In the characterization tests, the moisture content of formulas I and III met the SNI (Indonesian National Standard) requirement of ≤8%. The ash content of formulas I, II, and III also met the SNI standard of ≤8%. However, the volatile matter content of formulas I, II, and III did not meet the SNI standard of ≤15%.

KEYWORDS: Langsat Fruit Peels, Briquettes, Characteristics, Repellent Activity

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INTRODUCTION

North Maluku is a region known for its superior export commodities, including nutmeg and copra. In 2019, North Maluku exported 54,470,489 kilograms of copra and 2,271,299 kilograms of nutmeg. Nutmeg consists of flesh (77.8%), mace (4%), shell (5.1%), and seeds (13.1%). While most parts of the nutmeg are effectively utilized and sold by the local community, the nutmeg shell remains underutilized (Doda and Faturrahman, 2022). Given the high export volume of these two commodities, a substantial amount of organic hard waste is generated annually. If not properly managed, this waste can lead to environmental pollution and trigger public health problems (Abdullah et al., 2023a).

Waste disposal poses a significant environmental challenge due to its potential to harm the environment and disrupt aesthetics. Utilizing waste as an energy source offers an effective solution to address pollution, disposal, and waste management issues (Wilda et al., 2024). Briquettes are an eco-friendly alternative energy source made from biomass mixed with binding agents. Commonly used briquettes include charcoal briquettes, coal briquettes, wood briquettes, and bio-briquettes (Shafiyya et al., 2022). The quality requirements for briquettes in Indonesia are outlined in SNI Standard No. 1/6235/2000. One of the uses of briquettes in society is as a mosquito-repellent (Iskandar et al., 2019).

One potential repellent that can be used as a briquette material is langsat fruit peels. This choice is made because utilizing langsat fruit peel waste has the potential to increase the economic value of the waste (Ni`mah, 2020). The advantage of repellent products made from langsat fruit peels is their natural, environmentally friendly nature (enviro-oriented), which does not interfere with respiratory health. The effectiveness of langsat fruit peels as a mosquito-

repellent is supported by their sticky sap (Mirnawaty et al., 2012).

Burnable repellent briquettes are developed as an effort to reduce air pollution caused by household mosquito-repellents containing synthetic insecticides. Repellents are substances that function as insect deterrents. They are widely available on the market and are commonly used to prevent diseases such as dengue fever. However, most repellent products contain harmful chemicals such as DEET (diethyl-meta-toluamide) and permethrin, which can pollute the environment and pose health risks. For instance, exposure to these chemicals on sensitive skin may cause irritation. This highlights the need for research and development of natural repellents derived from plants (Wahyuni and Nafi'ah, 2022).

Based on the above background, this study focuses on the characterization and repellent activity of anti-mosquito briquettes made from langsat fruit peels using nutmeg and coconut shell charcoal.

METHODOLOGY

A. Materials

The materials used in this study include coconut shell charcoal, nutmeg shell charcoal, langsat fruit peels, tapioca flour, and water.

B. Equipment

The equipment used in this study include calorimeter (IKA, C2000, China), briquette mold, moisture analyzer (AnD, MX-50, USA), analytical balance (Fujitsu, FS-AR, Japan), oven (Memmert, Germany), magnetic stirrer (Thermo Scientific, Cimarec+, USA), and furnace (Faithful, SX3, China).

C. Formula

Table 1. Repellent Briquette Formulation

Formula	Ingredients (gram)			
	CSC	NSC	LFP	SS
Formula 1	73.5	-	31.5	95
Formula 2	-	73.5	31.5	110
Formula 3	36.75	36.75	31.5	95

CSC : Coconut Shell Charcoal
NSC : Nutmeg Shell Charcoal
LFP : Langsat Fruit Peels
SS : 4% Starch Solution

D. Procedure

Preparation of 4% Starch Solution

Weigh 4 grams of tapioca flour and dissolve it in 100 mL of water until the mixture becomes homogeneous. Once homogeneous, heat the solution until it forms a thick and clear paste. When the paste thickens, the starch solution is ready to use (Abdullah et al., 2023b).

Briquette Preparation

Briquettes are made by mixing coconut shell charcoal, nutmeg shell charcoal, and langsat fruit peels. These materials are formulated into three formulas, F1: 73.5 g coconut shell charcoal and 31.5 g langsat fruit peels. F2: 73.5 g nutmeg shell charcoal and 31.5 g langsat fruit peels. F3: 36.75 g coconut shell charcoal, 36.75 g nutmeg shell charcoal, and 31.5 g langsat fruit peels. After formulating the three formulas, each is mixed with a starch solution as a binding agent. The adhesive ensures that the briquettes do not easily break when burned. The mixed materials from each formula are molded by placing the mixture into a mold, then pressed or compacted until solid.

E. Briquette Characterization

Moisture Content

Five grams of crushed briquette are placed into the sample holder of a moisture analyzer. The briquette is heated at 115℃. Wait until the device automatically stops, and the percentage of moisture content is displayed on the screen.

Ash Content

Weigh 2 grams of crushed briquette and place it into a porcelain crucible with a known weight. Place another crucible on top as a cover and heat the sample in a furnace until the temperature reaches 950℃. Transfer the crucible with its contents into a desiccator until cool, then weigh it. The ash content percentage is calculated using the following formula:

$$\text{Ash content (\%)} = \frac{w1}{w2} \text{x } 100\ \%$$

w1 : residue weight (grams)
w2 : initial weight of the briquette (grams)

Volatile Matter

Weigh 2 grams of crushed briquette and place it into a porcelain crucible with a known weight. Heat the crucible containing the sample in a furnace at a temperature of 800–900℃ for 2 hours. Transfer the crucible with its contents into a desiccator until cool, then weigh it. The volatile matter content percentage is calculated using the following formula:

$$\text{Volatile matter (\%)} = \frac{w1 - w2}{w1} \text{x } 100\ \%$$

w1 : initial weight of the briquette (grams)
w2 : weight of the briquette after heating (grams)

Calories

Weigh 1 gram of crushed briquette and place it into the sample container. Insert the container into the bomb calorimeter chamber. Set the oxygen pressure to 30 bar. Turn on the device and wait for 15 minutes until the calorific value of the sample is displayed. Rinse the container and chamber with 25 mL of distilled water. Titrate the solution using 0.0709 M sodium carbonate (Na_2CO_3) and record the titration result. The calorific value is calculated using the following formula:

$$\text{Calories (cal/g)} = \left(\text{cal x } \frac{1 \text{ calorie}}{4.1868 \text{ J}}\right) - \left(\text{Vt x } \frac{1 \text{ calorie}}{\text{gram mL}}\right)$$

cal : measured calorie (J/g)
Vt : volume of titrant (mL)

F. Repellent Activity

The repellent activity test is conducted using mosquitoes as the test subjects. Each briquette formula is classified into three groups for testing. The briquette is ignited and placed inside a container that already contains mosquitoes. Simultaneously, the time is recorded when the briquette is introduced into the container. The test continues until the mosquitoes become immobile. At this point, the time is recorded (Susilowati and Kurniawati, 2014).

RESULTS

A. Moisture Content

The moisture content test results for briquettes were obtained for Formula I, Formula II, and Formula III. Each formula was prepared in three replications, and 5 grams of each replication were heated at 115°C. The results showed that for Formula I, replication 1 was 8.29%, replication 2 was 7.58%, and replication 3 was 7.79%. For Formula II, replication 1 was 9.07%, replication 2 was 9.13%, and replication 3 was 9.02%. For Formula III, replication 1 was 6.11%, replication 2 was 6.41%, and replication 3 was 5.94%. The detailed results are shown in Table 5.1 below.

Table 2. Moisture Content Results

Sample	Moisture Content (%)	**Mean** ± SD
Formula 1	8.29	7.89 ± 0.36
	7.58	
	7.79	
Formula 2	9.07	9.07 ± 0.06
	9.13	
	9.02	
Formula 3	6.11	6.15 ± 0.24
	6.41	
	5.94	

B. Ash Content

The ash content test involved weighing 2 grams of each formula replication and heating it at 950°C. The results showed the ash content for Formula I as follows: replication 1 was 3.70%, replication 2 was 4.85%, and replication 3 was 2.25%. For Formula II, replication 1 was 3.60%, replication 2 was 2.15%, and replication 3 was 1.30%. For Formula III, replication 1 was 6.50%, replication 2 was 3.90%, and replication 3 was 5.95%. The detailed results are shown in Table 5.2 below.

Table 3. Ash Content Results

Sample	Ash Content (%)	Mean ± SD
Formula 1	3.70	3.60 ± 0.81
	4.85	
	2.25	
Formula 2	3.60	2.35 ± 0.81
	2.15	
	1.30	
Formula 3	6.50	5.45 ± 2.60
	3.90	
	5.95	

C. Volatile Matter

The volatile matter test for the three formulas in three replications showed the following percentages: Formula I, replication 1 was 97.85%, replication 2 was 96.64%, and replication 3 was 96.67%. For Formula II, replication 1 was 96.22%, replication 2 was 96.41%, and replication 3 was 96.41%. For Formula III, replication 1 was 97.13%, replication 2 was 96.68%, and replication 3 was 97.11%. The detailed results are shown in Table 5.3 below.

Table 4. Volatile Matter Results

Sample	Volatile Matter (%)	Mean ± SD
Formula 1	97.85	97,05 ± 0,69
	96.64	
	96.67	
Formula 2	96.22	96,35 ± 0,11
	96.41	
	96.41	
Formula 3	97.13	96,97 ± 0,25
	96.68	
	97.11	

D. Calories

The calorific value test for the three formulas showed the following results: Formula I was 6,009.72 cal/g, Formula II was 5,670.68 cal/g, and Formula III was 6,352.11 cal/g. The detailed results are shown in Table 5.4 below.

Table 5. Calories Results

Sample	**Calories** (cal/g)
Formula 1	6009.72
Formula 2	5670.68
Formula 3	6352.11

E. Repellent Activity

The repellent activity test showed the following results: Formula I achieved mosquito mortality in 2 minutes and 44 seconds, Formula II in 2 minutes and 49 seconds, and Formula III in 2 minutes and 43 seconds. The detailed results are shown in Table 5.5 below.

Tabel 6. Repellent Activity Results

Sample	Time to Mortality (minutes)
Formula 1	02:44
Formula 2	02:49
Formula 3	02:43

DISCUSSION

The moisture content test is crucial for improving combustion efficiency, as excessive moisture can lead to energy loss and reduced briquette quality. The results show that Formula 3 had the lowest average moisture content at 6.15%. This low moisture content indicates efficient moisture removal, contributing to improved briquette combustion efficiency. Formula 1, with an average moisture content of 7.89%, shows fairly good results and may be suitable for applications where stability and efficiency are important, even though it is less efficient than Formula 3. Both formulas meet the SNI standard of ≤8%. Low moisture content in briquettes increases calorific value and combustion efficiency, resulting in better energy production (Ismayana and Afriyanto, 2011). The slightly higher moisture content in Formula 1 may suggest that this formula contains more plastic raw materials, which aid in the briquette formation process. Formula 2, with the highest moisture content at 9.07%, may have reduced briquette quality, as high moisture can cause the briquettes to become brittle and reduce combustion efficiency. This indicates that proper selection of raw materials and formulation is vital to achieving optimal moisture content.

The ash content is an important parameter affecting briquette quality, as it is related to the mineral and inorganic material content left after combustion. Formula 2 showed the lowest average ash content at 2.35%. A lower ash content indicates a cleaner composition with fewer inorganic materials that do not burn. This result meets the ash content test standard of ≤8%. This aligns with research indicating that low ash content improves energy quality and combustion efficiency (Fatriani et al., 2018). Formula 3, on the other hand, had the highest ash content at 5.45%, which may be due to the raw materials used, which contained more minerals or inorganic substances. Formula 1 had an average ash content of 3.60%, which is between the values of the other two formulas. Although it is less efficient than Formula 2, Formula 1 may offer a good balance between available fuel and a reasonable ash content.

The volatile matter content shows that high volatile matter in briquettes can result in increased smoke when the briquette is ignited. This occurs due to the reaction between carbon monoxide (CO) and alcohol derivatives. The results show that Formula 1 had a volatile matter content of 97.05%, Formula 2 had 96.35%, and Formula 3 had 96.35%. The high volatile matter content in these formulas can be attributed to the inclusion of langsat fruit peel, which did not undergo a carbonization or roasting process. High volatile matter content can reduce briquette quality as it leads to lower carbon content, thus decreasing the calorific value and generating more smoke during combustion.

The calories is a key parameter for measuring biomass fuel quality, calculated based on its calorific value. The calorific value of biomass varies and increases with higher carbon content. The higher the calorific value, the better the briquette quality. The calorific value results obtained using the IKU/7.2/BC-01 tool showed that Formula 1 had a calorific value of 6,009.72 Kal/g, Formula 2 had 5,670.68 Kal/g, and Formula 3 had 6,352.11 Kal/g. This is due to the higher carbonization temperature, which increases carbon content, while moisture content decreases, leading to higher calorific value in the briquettes. The calorific value of briquettes is also influenced by raw material particle size, density, and type.

The repellent activity was conducted by exposing mosquitoes to the smoke from the briquettes. When the mosquito-repellent (briquette) is heated, the active ingredients in the repellent are released, disrupting the mosquito's respiratory system. The effectiveness of the mosquito-repellent is determined by the chemical composition (active ingredients) it contains. These active ingredients can cause a knockdown effect, where mosquitoes fall after being exposed to the insecticide for a certain period. The results showed that in Formula I, the mosquito death time was 02:44 minutes, with 6 mosquitoes dead; in Formula II, it was 02:49 minutes, with 4 mosquitoes dead; and in Formula III, it was 02:43 minutes, with 6 mosquitoes dead.

CONCLUSIONS

Briquettes are a type of fuel used to ignite and maintain fire, made from compressed coal or other soft materials that have been hardened. In this study, several briquette characteristics were tested, including calorific value, moisture content, ash content, and volatile matter content. The results of the calorific value test showed that Formula 1 had 6,009.72 Kal/g, Formula 2 had 5,670.68 Kal/g, and Formula 3 had 6,352.11 Kal/g. For moisture content, Formula 1 had 7.89%, Formula 2 had 9.07%, and Formula 3 had 6.15%. The ash content test showed Formula 1 had 3.60%, Formula 2 had 2.35%, and Formula 3 had 4.45%. The volatile matter content test showed that Formula 1 had 97.05%, Formula 2 had 96.35%, and Formula 3 had 96.97%.

REFERENCES

I. Abdullah, A., Disi, M.Z.A., Yusuf, M.F.R.H., 2023a. Pemberdayaan Masyarakat melalui Pembuatan Briket Palapa (Cangkang Pala dan Batok Kelapa) di Kelurahan Sulamadaha, Kota Ternate. Martabe J. Pengabdi. Masy. 6, 3741–3747. https://doi.org/10.31604/jpm.v6i10.3741-3747

II. Abdullah, A., Muhammad Zulfian A. Disi, Yusuf, M.F.R.H., Mutmainnah, 2023b. Potential Renewable Energy Source from Nutmeg-Coconut Shell Waste in North Maluku, Indonesia. Asian J. Chem. Sci. 13, 164–169. https://doi.org/10.9734/ajocs/2023/v13i6270

III. Doda, N., Faturrahman, 2022. Pengaruh Abu Cangkang Pala sebagai Subtitusi Filler terhadap

Campuran Lapisan AC-WC. Radial J. Perad. Sains, Rekayasa, dan Teknol. 10, 106–119. https://doi.org/10.37971/radial.v10i1.263

IV. Fatriani, Sunardi, Arfianti, 2018. Kadar Air, Kerapatan, dan Kadar Abu Wood Pellet Serbuk Gergaji Kayu Galam (Melaleuca cajuputi Roxb) dan Kayu Akasia (Acacia mangium Wild). EnviroScienteae 14, 77–81.

V. Iskandar, N., Nugroho, S., Feliyana, M.F., 2019. Uji Kualitas Produk Briket Arang Tempurung Kelapa Berdasarkan Standar Mutu SNI. Momentum 15, 103–108. https://doi.org/10.36499/jim.v15i2.3073

VI. Ismayana, A., Afriyanto, M.R., 2011. Pengaruh Jenis dan Kadar Bahan Perekat ada Pembuatan Briket Blotong sebagai Bahan Bakar Alternatif. J. Tek. Ind. Pertan. 21, 186–193.

VII. Mirnawaty, Supriadi, Jaya, B., 2012. Uji Efektivitas Ekstrak Kulit Langsat (Lansium domesticum) sebagai Anti Nyamuk Elektrik terhadap Nyamuk Aedes aegypti. J. Akad. Kim. 1, 147–152.

VIII. Ni`mah, L., 2020. Pembuatan Briket dari Kulit Buah Langsat. Bul. Profesi Ins. 3, 103–108. https://doi.org/10.20527/bpi.v3i2.75

IX. Shafiyya, J.V.A., Kusumasari, H.S., Praharsiwi, I.M., Mujiburohman, M., 2022. Pengaruh Kondisi Operasi dan Jenis Perekat terhadap Karakteristik Briket Ampas Teh. J. Energi Baru Terbarukan 3, 249–258. https://doi.org/10.14710/jebt.2022.14930

X. Susilowati, S., Kurniawati, F.V., 2014. Uji Aktivitas Repellent Fraksi Kloroform Ekstrak Etanol Daun Mimba (Azadirachta indica A. Juss)terhadap Nyamuk Aedes aegypti. J. Ilmu Farm. dan Farm. Klin. 11, 39–46. https://doi.org/10.31942/jiffk.v11i1.1287

XI. Wahyuni, D., Nafi'ah, S., 2022. Uji Efektivitas Repellent Ekstrak Daun Jeruk Purut (Citrus hystrix DC) terhadap Nyamuk Aedes aegypti. J. Pharma Bhakta 1, 20–29.

XII. Wilda, S., Umam, H.I., Pambudi, T., 2024. Optimalisasi Pemanfaatan Limbah Sekam Padi sebagai Bahan Briket Melalui Kegiatan Workshop dan Analisis Nilai Ekonominya. Reswara J. Pengabdi. Kpd. Masy. 5, 291–300. https://doi.org/10.46576/rjpkm.v5i1.4001