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Antioxidants Activity of Face Toner from Ethyl Acetate Fraction of Okra Seeds

Fatmawati Lubis[1*], Sovia Lenny[1], Helmina Br. Sembiring[1]

[1] Postgraduate Chemistry Program, Faculty of Mathematics and Natural Sciences, Universitas Sumatera Utara, Medan 20155, Indonesia.

ABSTRACT

This study explores the potential of okra seeds (Abelmoschus esculentus L.) as a natural face toner, using maceration extraction method. A total of 750 g of Okra was dried for 72 h using methanol solvent showed that okra seeds contain flavonoids with 5% FeCl reagent. FTIR analysis revealed a characteristic functional group profile of flavonoids, including hydroxyl (3400 cm-1), carbonyl (1722 cm-1), and aromatic ring (1591 cm-1 and 1277 cm-1) groups. The antioxidant test was selected from the ethyl acetate fraction at a wavelength of 517 nm with an IC50 value of 44.90 µg/mL, and can be categorized as a very strong antioxidant. DPPH test of toner formula with BHT, ethyl acetate extract, and control produced IC50 values of 85.67 µg/mL, 88.79 µg/mL, 105.69 µg/mL, respectively. The optimal conditions were achieved with 25, 50, and 100 ppm of ethyl acetate fractions. Future studies could expand on these findings by exploring the long-term effects and consumer acceptability of okra seed toners in broader populations.

Keyword: Antioxidant, DPPH Method, Face Toner, Flavonoid, Okra Seeds.

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* coresponding author: fatmawatilubis13@gmail.com

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INTRODUCTION

Indonesia is a growing cosmetics market, contributing significantly to the country's economy. According to the Ministry of Industry (Kemenperin), the Indonesian cosmetics industry is estimated to grow by 5.91% per year in 2021, driven by increasing demand, especially among the middle class [1]. The population of Indonesian women who use cosmetics has reached to 126.8 million, causing skin care products such as facial toners to be widely used to improve skin health and beauty [2], [3]. Face toners, which are used to cleanse and moisturize, often contain alcohol, which helps reduce oil, acts as a preservative, and increases product absorption [4], [5]. However, concerns have arisen because these products contain alcohol and other chemicals.

Excessive use of alcohol in cosmetics can result in adverse health consequences, such as dryness, irritation, and the breakdown of sebum, a vital component for maintaining skin health. Elevated sebum production can lead to the development of blackheads and acne, while prolonged use of alcohol can worsen dryness and irritation [6], [7], [8]. Cosmetic goods containing synthetic chemicals can potentially elicit negative reactions, since individual sensitivities differ. Face toners are specifically formulated to replenish the skin's moisture, regulate pH levels, constrict pores, alleviate inflammation, and function as antibacterial agents [9], [10]. An optimal toner should possess qualities such as being non-irritating, invigorating, non-adhesive, pleasant in aroma and color, and maintaining a pH 4-7. Typical toner compositions include of solvents, humectants, pH indicators, active components, preservatives, colors, and scents [11].

Cleansing the face with a high pH cleanser can cause skin irritation, leading to the development of toners that balance skin pH. Toners typically contain beta hydroxy acid (BHA) and alpha hydroxy acid (AHA) and are now formulated to include moisturizers that reduce acne and control oiliness [12]. Natural ingredients, such as okra seed extract, are being explored for their potential in skincare. Okra is nutrient-rich and contains bioactive compounds like flavonoids and polysaccharides, which have antioxidant, anti-inflammatory, and anti-cancer properties [13], [14]. Okra seeds are high in flavonoids, offering antioxidant benefits and soothing skin irritation. These qualities make okra an appealing ingredient for the cosmetic, pharmaceutical, and nutraceutical industries.

The study focuses on optimizing the extraction of polyphenol compounds from okra seeds to enhance the quality and bioactivity of the extract. Research shows that okra seeds contain significant amounts of phenolic and flavonoid compounds, making them beneficial for skin health. The antioxidant activity of okra seeds helps combat free radicals and oxidative stress, while their healthy fat content maintains skin moisture. The research aims to utilize flavonoid compounds from okra seeds in face toner formulations.

METHODS

This study employs an experimental method. The research process involves the following steps:

The raw materials, consisting of palm kernel shells, were sourced from two locations near the Nusantara Capital City (IKN) area. The first sample (A1) was obtained from Long District, Paser Regency, while the second sample (A2) was collected from Muara Kembang, Kutai Kartanegara Regency. Both samples were sun-dried for approximately three days to reduce their moisture content. Sample A1 experienced a moisture reduction of approximately 0.3 kg, decreasing from an initial weight of 8.7 kg to 8.4 kg. Similarly, sample A2 showed a reduction from an initial weight of 7.9 kg to 7.7 kg, indicating a decrease of about 0.2 kg in moisture content. This demonstrates the effectiveness of the drying process in reducing the moisture content of the palm kernel shells.

The next step involves preparing an adhesive made from tapioca starch. The adhesive is created by mixing 10 g of tapioca flour with 1000 mL of water and then heating the mixture until it forms a starch glue.

Once the raw materials and adhesive are prepared, each raw material is carbonized in a furnace at a temperature of 600°C for 2 hours to produce charcoal carbon (Moeksin et al., 2017). After obtaining the charcoal carbon, the next step is to grind the material coarsely and then sieve it using a 100-mesh sieve.

The next step is mixing the charcoal carbon with a starch adhesive at a concentration of 10%, followed by molding the mixture into briquettes. After molding, the briquettes are dried in an oven at 80ºC for 48 hours (Kahariayadi et al., 2016). Once these processes are completed, proximate analysis and calorific value testing are performed on each bio-briquette sample, namely A1 and A2.

RESULTS AND DISCUSSION

The palm kernel shells that have undergone the treatment process are then subjected to analysis for each sample. Below are the results of the proximate analysis conducted on the two samples.

Table 1. Analysis Results of Palm Kernel Shells with Two Samples in the IKN Area

Samples	Output Parameters			
	Moisture Content	Ash Content	Volatile	Calorific Value
	(%)	(%)	(%)	(cal/g)
A1	10,37	6,07	13,06	4974,64
A2	8,94	5,47	11,95	5098,53
SNI*	8	8	15	5000

SNI = Indonesian National Standar (*Pdf-Sni-4931-2010-Briket-Batubara_compress*, n.d.)

Moisture Content

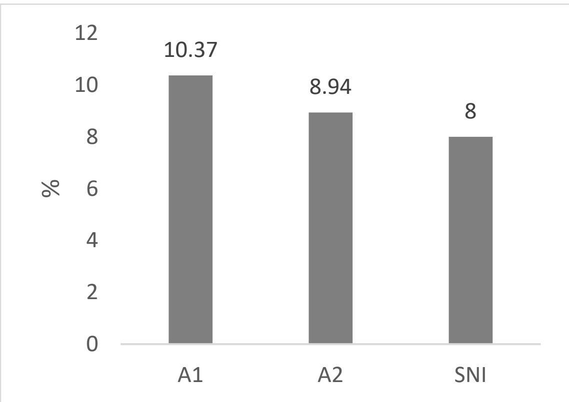

Figure 1. Comparison of Moisture Content in Bio-Briquettes

Based on Figure 1, the moisture content of the bio-briquettes does not meet the standard set by the Indonesian National Standard (SNI), which specifies a maximum value of 8%. Two tests conducted using the same raw material, palm kernel shells, showed lower moisture content in the second test, with a value of 8.94%, compared to the first test, which recorded a moisture content of 10.37%.

Moisture content significantly affects the quality of charcoal briquettes; lower moisture content leads to higher calorific value and improved combustion efficiency. During the study, the researchers used an adhesive with a relatively high water-to-starch ratio, which resulted in elevated moisture content in the produced bio-briquettes.

Charcoal has a high capacity to absorb moisture from the surrounding air. This absorption capability is influenced by the surface area and porosity of the charcoal, as well as the fixed carbon content in the briquettes. The lower the fixed carbon content in the charcoal briquettes, the greater their ability to absorb moisture from the surrounding air. This moisture content is further affected by the high moisture levels in the adhesive used during production (Kahariayadi et al., 2016).

Ash Content

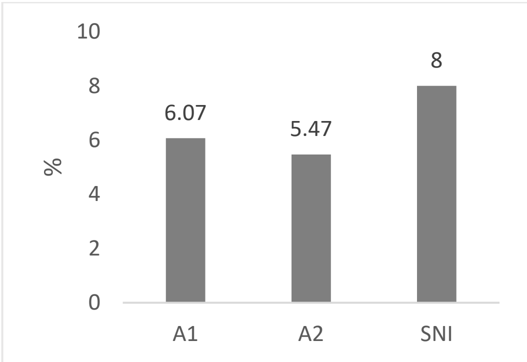

Figure 2. Comparison of Ash Content in Bio-Briquettes

Ash refers to the mineral content in solid fuels that remains non-combustible after the combustion process. Ash is the residue left when solid fuel (such as wood) is heated to a constant weight (Martynis et al., 2012). The ash content represents the amount of residue left in the briquette after heating in a furnace at a temperature of 900°C.

The ash content in briquettes affects their combustion efficiency. Higher ash content reduces the burning time of the briquettes. All briquettes contain inorganic substances, the quantity of which can be determined by the weight of the residue after complete combustion. This residue is referred to as ash. Briquette ash originates from materials such as clay, sand, soil, and various other mineral substances. Briquettes with high ash content are considered undesirable as they can form crusts during use, reducing their efficiency and usability. (Arbi et al., n.d.).

To determine the ash content in the briquettes, laboratory testing is conducted using a furnace heated to 900°C for approximately 2 hours. During this process, 1 gram of briquette is weighed and then converted into ash. The resulting ash is weighed again, and its ash content is calculated using a specific formula. This method allows for precise measurement of the ash content present in the briquettes.

According to Arbi et al. (n.d.), higher carbonization temperatures result in a greater amount of material being burned and converted to ash during the carbonization process. Additionally, the ash content is influenced by the amount of inorganic material present in the raw materials and the tapioca flour used.

In Figure 2, it can be observed that the lowest ash content in the bio-briquette tests was recorded in the second test at 5.47%, while the first test showed a higher ash content of 6.07%. Based on the above data, it is evident that in both tests, the bio-briquettes made from palm kernel shells meet the standards specified in SNI 01-6235-2000.

The standard for ash content, as specified by SNI, requires a maximum of 8%. Both sample tests have met this standard.

Volatile Matter

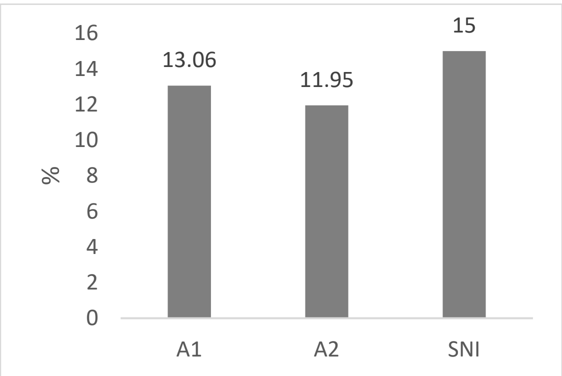

Figure 3. Comparison of Volatile Matter Content

According to Purba and Sirajuddin (2021), the volatile matter content is a key factor in determining the quality of a bio-briquette. Higher volatile matter content enhances combustion, as indicated by a longer flame. During the carbonization process, significant amounts of smoke are released due to combustion. Moreover, the volatile substances decrease as the heating process accelerates. (Tambaria & Serli, 2019).

The bio-briquettes produced in this study are expected to have low volatile matter content, minimizing the amount of smoke generated during the use of solid fuel. In the two tests conducted, both samples nearly met the standard set by the Indonesian National Standard (SNI), which specifies a maximum volatile matter content of 15%.

Volatile matter content is always expected to be low in bio-briquette quality standard tests. This is because a high volatile matter content can lead to increased emissions, which may contribute to environmental pollution (Purba & Sirajuddin, 2021).

As the combustion temperature increases, the release of volatile matter also rises. Higher pyrolysis temperatures result in a reduced amount of charcoal formation and an increased release of volatile matter (Purba & Sirajuddin, 2021). Consequently, during the quality analysis of bio-briquettes, the volatile matter content becomes lower due to its release during combustion. The carbonization process provides an opportunity to evaporate as much volatile matter as possible.

As a result, the testing yielded low volatile matter content. The two tests conducted both met the SNI 01-6235-2000 standard, which specifies a maximum of 15%.

Calorific Value

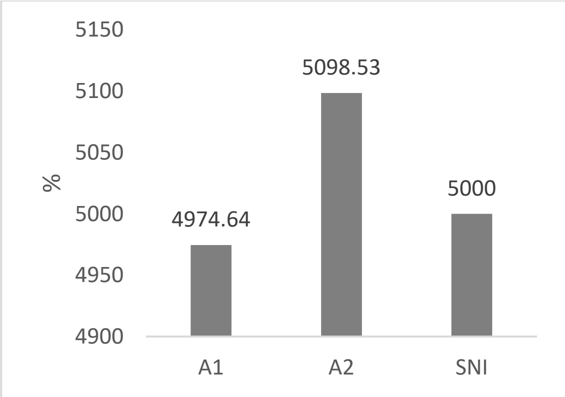

Figure 4. Comparation of calorific value

The calorific value is one of the most important parameters in the production of bio-briquettes. A higher calorific value indicates a higher quality of the bio-briquette produced. The raw material or biomass used for bio-briquette production significantly influences the calorific value. According to the Ministry of Energy and Mineral Resources of Indonesia (Kementerian ESDM RI), there are four categories of coal quality based on calorific value:

1. Quality I: Coal with a calorific value of 6,000 kcal/kg or higher.
2. Quality II: Coal with a calorific value between 5,600 kcal/kg and less than 6,000 kcal/kg.
3. Quality III: Coal with a calorific value between 4,700 kcal/kg and less than 5,600 kcal/kg.
4. Quality IV: Coal with a calorific value below 4,700 kcal/kg.

From the analysis results shown in Figure 4.4, it is evident that the calorific values obtained meet the standards set by the Ministry of Energy and Mineral Resources (ESDM) for both tests. However, for the SNI 01-6235-2000 standard, which requires a minimum calorific value of 5000 kcal/g, one of the tests did not meet the requirement. The first test recorded a calorific value of 4974.64 kcal/g, while the second test achieved 5098.53 kcal/g.

The low calorific value is partly attributed to the tapioca flour adhesive used, which still contains relatively high moisture and ash content. Lower moisture and ash content would increase the calorific value of the briquettes. This is because, during combustion, some of the briquette's heat is used to evaporate the remaining water, while the silica in the ash, being non-combustible, obstructs airflow during the burning process (Nugraha et al., n.d.). The calorific value is a critical determinant of the quality of charcoal briquettes. The higher the calorific value, the better the quality of the produced charcoal briquettes. Conversely, higher moisture and ash content in the charcoal briquettes reduce the calorific value of the briquettes produced.

CONCLUSION

The proximate analysis conducted on two repetitions of testing bio-briquettes made from palm kernel shells revealed that only the moisture content did not meet the SNI 01-6235-2000 standard, as it remained above 8%. However, the other three parameters tested met the SNI standards: ash content was below 8%, volatile matter was below 15%, and calorific value fell within the Ministry of Energy and Mineral Resources (ESDM) Category 3 range of 4700–5600 kcal/g, as well as the SNI 01-6235-2000 minimum requirement of 5000 kcal/g.

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