

CORNCOB COOKIES AS A FOOD WASTE SOLUTION IN SUPPORT OF THE SUSTAINABLE DEVELOPMENT GOALS

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ABSTRACT

Corn (*Zea mays* L.) is one of the most abundant agricultural commodities in West Nusa Tenggara, Indonesia; however, the utilization of its biomass remains limited, as corncobs are routinely discarded as agricultural waste. This condition contributes to the growing food waste problem, which in Indonesia reached 20.94 million metric tons in 2020 according to UNEP data. The present study aims to examine the potential of corncob waste as a raw material for flour production and to explore its application in the development of corncob cookies as a healthy snack product. A qualitative approach employing library research was adopted to synthesize relevant literature. Results indicate that corncob contains significant levels of cellulose (44.9%), hemicellulose (31.8%), and lignin (23.3%), making it a high-fiber, low-calorie functional ingredient suitable for individuals with Diabetes Mellitus. The cookies produced from corncob flour offer a low-calorie snack alternative at approximately 33 calories per 9-gram piece while maintaining acceptable sensory qualities. This innovation aligns with SDGs Goal 9 (Industry, Innovation, and Infrastructure) and Goal 12 (Responsible Consumption and Production) by promoting circular agricultural waste management and supporting small and medium enterprises in West Nusa Tenggara.

INTRODUCTION

Corn (*Zea mays* L.) is a monocotyledonous grass crop that grows vigorously, with stems reaching between 0.6 and 3 meters in height (Sirait, 2023). The plant has a relatively short growing cycle of approximately 75 to 120 days after planting, allowing multiple harvests per year (Yasmaniar *et al.*, 2023). In Indonesia, corn holds substantial economic value and is widely consumed as a staple food. According to Nuridayanti (2011) as cited in Komariyah *et al.* (2020), corn is classified as a seasonal plant with a life cycle of approximately three months. The various parts of the corn plant, including the stalk, leaves, husk, kernels, and cob, each possess distinct utilization potential (Yasmaniar *et al.*, 2023).

Despite the broad utility of corn, the corncob is frequently overlooked and discarded as agricultural waste. According to data from Indonesia's Central Statistics Agency (BPS), the country generated 18.51 million tons of corncob waste in 2020 (Ziadi *et al.*, 2022). The accumulation of this organic waste, if left unmanaged, contributes to environmental degradation and poses public health risks. In response to this challenge, innovative approaches to valorizing corncob waste have gained increasing research attention, particularly through its conversion into value-added food products.

One promising approach involves processing corncob into flour. Data from the *Polish Journal of Food and Nutrition* indicate that corncob contains 23.3% lignin, 31.8% hemicellulose, and 44.9% cellulose (Suherman, 2022), establishing its potential as a high-fiber ingredient. Corncob flour is characterized by low caloric content and elevated fiber and protein levels, making it a suitable dietary component for individuals managing Diabetes Mellitus (DM). Building on this nutritional profile, corncob flour can be further processed into various food products, including cookies. The growing population of DM patients in Indonesia underscores the need for healthy, low-sugar snack alternatives, which this innovation seeks to address.

This study is grounded in real-world concerns regarding both agricultural waste management and public health. By transforming corncob waste into a functional food ingredient, this research addresses food waste reduction while simultaneously offering a practical dietary solution. The study is framed within the context of the Sustainable Development Goals (SDGs), particularly Goal 9 on Industry, Innovation, and Infrastructure, and Goal 12 on Responsible Consumption and Production.

1.1 Research Questions

This study seeks to answer the following questions: (1) How can corncob waste be utilized as a food waste solution? (2) What is the process for converting corncob waste into corncob flour? (3) What is the procedure for producing cookies from corncob flour?

1.2 Objectives

The objectives of this study are: (1) to investigate the potential utilization of corncob waste; (2) to describe the process of converting corncob waste into flour; and (3) to document the procedure for manufacturing cookies from corncob flour.

1.3 Benefits in Relation to SDGs

The corncob flour innovation contributes to **SDGs Goal 9** (Industry, Innovation, and Infrastructure) by introducing a new value-added product that highlights the agricultural potential of the Sumbawa region in West Nusa Tenggara. It also supports **SDGs Goal 12** (Responsible Consumption and Production) by encouraging sustainable production through collaboration with local governments and small and medium enterprises (SMEs) to develop and distribute corncob-based products as regional specialty goods.

LITERATURE REVIEW

2.1 Food Waste

Food waste refers to edible food that is discarded either before or after its expiration date. The Food and Agriculture Organization (FAO, 2017) estimated that approximately one-third of all food produced globally each year becomes food waste (Ramadhita, 2021). In Indonesia, each individual generates approximately 300 kilograms of food waste per year (Siaputra *et al.*, 2019). According to the United Nations Environment Programme (UNEP) in 2020, Indonesia's total food waste reached 20.94 million metric tons, placing the country second globally after Saudi Arabia in food waste generation (Achten *et al.*, 2020).

Addressing food waste requires the application of recycle system management, which involves the recovery and reprocessing of discarded materials into useful products. Without proper management, unprocessed organic waste accumulates over time, becoming a source of disease for surrounding communities. The recycle system approach represents a systematic effort to convert wasted resources into commodities that benefit society, thereby reducing both environmental impact and economic losses.

2.2 Agricultural Crop Waste

Agricultural crop waste refers to the residual materials left behind following the harvest of crops. Such waste may take the form of unutilized plant matter or by-products of agricultural activities. Common examples include rice straw, fallen leaves, harvest residues, and corn-derived waste. In the case of corn, the primary waste products are the cob, husk, and silk, all of which are generally regarded as low-value materials. Based on BPS data, Indonesia produced 18.51 million tons of corncob in 2020 (Ziadi *et al.*, 2022).

Despite being classified as waste, corncob contains several biologically active compounds. Nahwi (2016) reported a composition of 4.64% crude protein, 38.99% crude fiber, and 15.80% lignin. Suherman (2022) further documented lignin content of 23.3%, hemicellulose of 31.8%, and cellulose of 44.9% in corncob. These findings affirm the corncob's nutritional and functional relevance as a food ingredient. Due to its high crude fiber content, corncob has traditionally been used as animal feed; however, it holds significant potential for human food applications, particularly after processing into flour. The flour production process begins with grinding dried corncobs, followed by sieving to achieve a consistent particle size. Subsequent production steps for cookies include creaming margarine and powdered sugar, gradually incorporating corncob flour, adding egg yolks, and mixing until a uniform dough is formed. Baking soda is added as a leavening agent, and the dough is then shaped and baked until golden brown (Yasmaniar *et al.*, 2023).

RESEARCH METHOD

3.1 Research Method

This study employs a qualitative approach using library research (*studi kepustakaan*) as the primary data collection technique. Library research involves the systematic review and synthesis of information from written documents, photographs, electronic media, and other

relevant references that support the research objectives. According to Almack, as cited in Purba *et al.* (2021), the scientific method is defined as a procedure for applying logical principles to the discovery, validation, and explanation of truth. This methodological framework is essential for producing rigorous academic work and serves as a guiding structure throughout the research process.

3.2 Materials and Equipment

Corncob Flour Production:

Equipment: knife, cutting board, container, spoon, grinder machine, sieve, pot, and stove.

Materials: corncob waste and water.

Corncob Cookie Production:

Equipment: bowl, spoon, spatula, electric mixer, oven, and baking tray.

Materials: 250 g corncob flour, 2 egg yolks, 8 sachets of Tropicana Slim sweetener, 100 g margarine, ½ teaspoon fine salt.

3.3 Procedure

Corncob Flour Production Procedure (Rufaidah, 2021):

First, prepare all required materials and equipment. Second, wash the corncobs thoroughly under running water to remove impurities and soil residue. Third, cut the corncobs into small pieces and sun-dry them until completely dry. Fourth, feed the dried corncob pieces into a grinding machine and grind until a coarse powder is obtained. Finally, sieve the ground material through a fine mesh to obtain corncob flour of uniform consistency. The flour is now ready for use.

Corncob Cookie Production Procedure (Rufaidah, 2021):

First, gather and prepare all necessary ingredients and equipment. Second, combine margarine, sweetener, salt, and egg yolks in a mixing bowl and blend until smooth using an electric mixer. Third, gradually add corncob flour to the mixture, stirring continuously until all ingredients are thoroughly incorporated. Fourth, portion the dough into individual pieces of approximately one to two teaspoons each. Fifth, flatten each portion to a uniform thickness and add desired toppings. Finally, bake the cookies in a preheated oven for 15 to 20 minutes until golden brown. The corncob cookies are ready to serve.

RESULTS AND DISCUSSION

4.1 Utilization of Corncob Waste as a Food Waste Solution

Food waste in the context of this study refers to edible food that has passed through the entire food supply chain and, despite being of good quality and safe for consumption, is ultimately discarded. According to UNEP (2020), Indonesia's food waste index reached 20.94 million metric tons. In parallel, BPS data indicates that Indonesia produced 18.51 million tons of corncob in 2020 (Ziadi *et al.*, 2022), representing a substantial volume of underutilized agricultural biomass that could be redirected toward productive use.

One viable strategy to reduce the contribution of corncob to food waste is the implementation of a recycle system approach, which involves reprocessing discarded agricultural materials into value-added products. In this study, the proposed innovation is the production of corncob flour from corncob waste. Based on data published in the *Polish Journal of Food and Nutrition*, corncob is classified as a high-fiber food containing approximately 15% lignin, 45% cellulose, and 35% hemicellulose (Hambali and Mukaromah, 2023). In addition to its fiber-rich composition, corncob is considered safe for human consumption, making it a promising raw material for functional food development.

4.2 Processing of Corncob Waste into Corncob Flour

The conversion of corncob waste into flour constitutes the core innovation proposed in this study. The overall process can be divided into four main stages: raw material preparation, drying, grinding, and sieving (Yasmaniar *et al.*, 2023). The initial step involves washing the corncobs thoroughly to remove adhering soil and impurities, followed by cutting them into smaller pieces to increase the surface area and promote uniform drying.

Sun-drying is employed to significantly reduce the moisture content of the corncob pieces prior to grinding. This step is critical because elevated moisture content in corn-based materials has been shown to promote the growth of mold and bacteria, potentially leading to mycotoxin formation and a drastic reduction in product quality (Tanggasari and Jatnika, 2023). Effective drying is capable of reducing the moisture content of the material to below 14%, which is considered the safe threshold for the processing and storage of corn-based products (Tanggasari and Jatnika, 2023). This threshold is consistent with the quality parameters established by the National Standardization Agency of Indonesia in SNI 01-3920-1995, which designates moisture content as a key indicator of post-harvest corn quality.

Following drying, the corncob pieces are ground using a mechanical grinder and the resulting powder is passed through a fine sieve to remove coarser particles. Sieving ensures that the final flour product has a uniform and consistent texture, making it suitable for use in food manufacturing. According to Suherman (2022), corncob flour produced through this process contains 23.3% lignin, 31.8% hemicellulose, and 44.9% cellulose, establishing it as a high-fiber ingredient with considerable nutritional potential. The overall production process is relatively straightforward, requires no complex technology, and can be implemented by community groups or SME operators with commonly available equipment, thereby contributing to the development of a sustainable local food industry in accordance with SDGs Goal 9.

4.3 Benefits of Corncob Cookies

Corncob cookies offer several noteworthy nutritional advantages owing to their corncob flour base, which is characterized by low caloric density. Each 9-gram piece of corncob cookie contains approximately 33 calories (Anneru, 2021), making them an appropriate snack for individuals with Diabetes Mellitus who require careful caloric management. The recipe substitutes conventional sugar with Tropicana Slim, a low-calorie sweetener, to further reduce the glycemic load of the product.

Beyond its caloric profile, each serving recommendation is aligned with dietary guidelines for DM patients: one package of cookies contains four pieces per snack session, a portion informed by nutritionist-approved consumption guidance. This packaging and portioning approach serves an additional educational function, helping consumers understand appropriate intake levels for DM management. Given the continuously increasing prevalence of Diabetes Mellitus in Indonesia, the development of accessible, palatable, and nutritionally suitable snack alternatives is both timely and socially significant. The corncob cookie is positioned not merely as a food product, but as a vehicle for community health education and sustainable agricultural waste utilization.

CONCLUSION

This study demonstrates that corncob, a widely available agricultural by-product in West Nusa Tenggara, holds considerable potential as a functional food ingredient. Through a relatively simple processing procedure, corncob waste can be converted into flour characterized by high fiber content, specifically 44.9% cellulose, 31.8% hemicellulose, and 23.3% lignin, with low caloric density. This flour can be further developed into a range of food products, including corncob cookies that serve as a healthy snack alternative for individuals with Diabetes Mellitus.

The large volume of corncob waste generated annually in Indonesia, documented at 18.51 million tons in 2020, presents both an environmental challenge and a substantial opportunity for value creation. This innovation directly supports SDGs Goal 9 by promoting local agricultural resource utilization and providing new product development opportunities for SMEs in Nusa Tenggara Barat. It also contributes to SDGs Goal 12 by encouraging responsible consumption patterns and sustainable production practices through the reduction of agricultural food waste.

Future research is recommended to examine the shelf life of corncob cookies, explore additional product variants that can be derived from corncob flour, and identify effective waste management strategies that simultaneously enhance the economic value of this agricultural residue.

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