Comparison of Proximate Composition of Coconut Dregs Flour Produced by Dry and Wet Processes as an Alternative to Wheat Flour

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ABSTRACT

Currently, Indonesia relies on wheat imports to meet its domestic flour demand. In contrast, the country is rich in local agricultural resources, particularly coconuts. Substantial amounts of coconut dregs are discarded during the production of coconut milk and coconut oil, contributing to environmental pollution. This study explored the conversion of coconut dregs into flour using two processing methods: dry and wet. The dry method involved grating fresh coconut meat, roasting it at 80-100 °C, and pressing to extract the oil, producing coconut dregs as a byproduct. The wet method involved grating fresh coconut meat, mixing it with water, and filtering to make coconut milk, with the coconut dregs as a byproduct. Subsequently, the coconut dregs were dried by roasting (80-100 °C), then grinding and screening. Coconut dregs flour was subjected to proximate analysis to determine its water, ash, protein, fat, and carbohydrate content. In this study, a proximate analysis was conducted on wheat flour for comparison. Coconut dregs flour from the dry process contained 53.40% fat, 9.45% protein, and 32.62% carbohydrate. The wet process produced flour with a fat content of 36.47%, protein 0.36%, and carbohydrate 55.08%. The wheat flour contained 1.11-2.10% fat, 0.6-1.1% protein, and 84.28%-86.05% carbohydrate. Coconut dreg flour could be combined with other flours to create nutritious food options, thereby reducing reliance on wheat flour.

1. Introduction

Indonesia imported 5.14 million tons of wheat and meslin from January to June 2025 from various countries, including Australia, Canada, the United States, Argentina, Turkey, Ukraine, and China [1]. To enhance the protection of foreign exchange reserves, Indonesia should consider reducing imports. Wheat is not cultivated in Indonesia, so alternative options must be explored. However, Indonesia is well-endowed with a variety of local plantation crops, including coconuts, which can serve as substitutes. In 2021, the Director General of Plantations at the Ministry of Agriculture revealed that Indonesia has vast coconut plantations spanning millions of hectares. Most of this vast expanse comprises smallholder plantations, emphasizing the crucial role of local farmers in the country's coconut industry [2]. The process of extracting coconut milk produces a significant amount of coconut dregs, which are often left unutilized. Although discarded, this fibrous byproduct has potential for various applications and can support sustainable food production practices [3]. Therefore, it is necessary to find a method to process the coconut dregs into flour.

Coconut dregs flour is a unique product made from coconut dregs. This flour is not only low in trans fats and carbohydrates but also gluten-free. It is an excellent choice for those with celiac disease or gluten sensitivities, as it can be used as a versatile ingredient in their cooking and baking. Its subtle, naturally sweet flavor can enhance a wide variety of dishes, from baked goods to smoothies, making it a valuable addition to a health-conscious kitchen [4]. Coconut dregs flour, known for its high fiber content, can be effectively utilized in the production of functional foods. One notable application is the use of composite flour as a substitute for white bread [5] and cookies [6]. This innovative approach not only enhances the nutritional profile of baked goods but also aligns with the growing demand for healthier food options. This study aimed to compare the dry and wet processes for the production of coconut dregs flour and to examine the characteristics of the flour obtained from the two processes, compared with wheat flour. From this study, the characteristics of coconut dregs flour were identified, and could be implemented as an alternative to wheat flour.

2. Research Methodology

2.1. Materials

The materials comprise grated coconut and distilled water. The coconut was of old maturity and purchased from the local market in Yogyakarta, Indonesia. The distilled water was also purchased from a local chemical shop in Yogyakarta, Indonesia. The following tools were used: a grater, an expeller (press), a vacuum filter, a roaster, a Disc-mill FFC15 flour mill (equipped with an EM1S49 dynamo), a TM-946 digital thermometer with 4 probes, a moisture meter, and an ISEKI EDA 7032G grain tester.

2.2. Procedures

Coconut oil was extracted using two distinct methods: the dry and wet methods. The dry method of coconut oil extraction involves the following steps: first, fresh coconut meat is grated, then roasted at 80-100 °C [7]. After roasting, the mixture was pressed to extract the oil, resulting in coconut dregs as a byproduct (Figure 1). In contrast, the wet method began similarly with grating fresh coconut meat. However, this method incorporates distilled water (the ratio of distilled water to grated coconut=1/1 w/w), allowing the mixture to be filtered (at room temperature) in order to produce coconut milk. The coconut dregs were a byproduct of this process as well. Subsequently, the dregs were dried by roasting at 80-100 °C, followed by grinding and screening (Figure 2). Coconut dreg flour was subjected to proximate analysis to evaluate its composition, specifically focusing on water, ash, protein, fat, and carbohydrate content [5]. For comparison, a similar analysis was performed on medium and high-protein wheat flour.

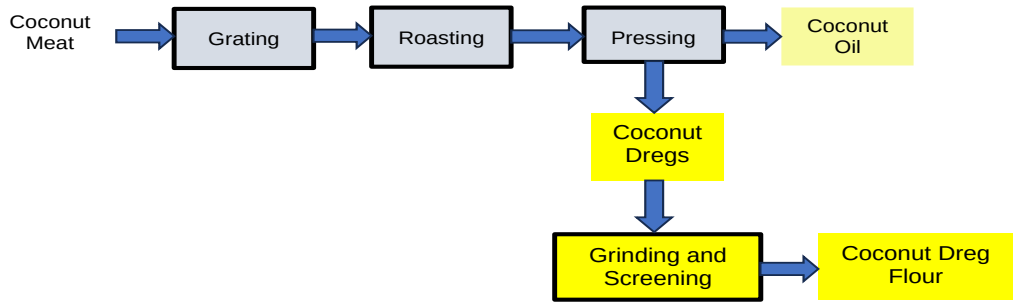

Fig. 1. The dry process for producing coconut dregs flour

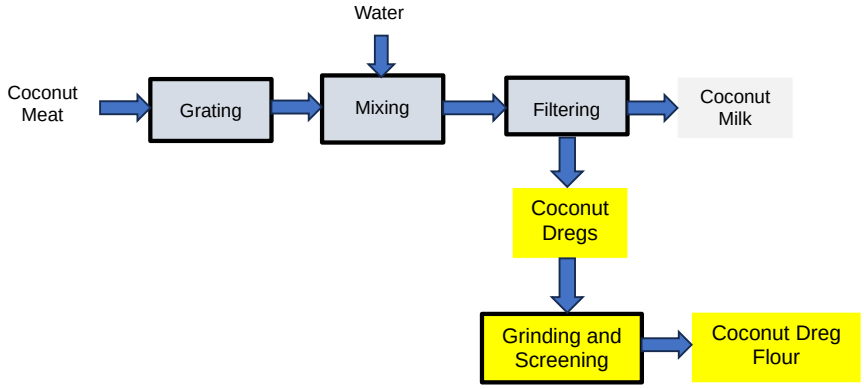

Fig. 2. The wet process for producing coconut dregs flour

3. Results and Discussion

3.1. Comparison of coconut dregs flour from the dry and wet processes

The analysis of dry-process coconut flour revealed a rich and varied nutritional profile. As shown in Figure 3, it had a notable fat content of 53.40±7.15%, which contributed to its creamy texture and flavor. The protein content was 9.45±2.01%. The protein content of this flour is relatively high, making it a good source of plant-based protein. Additionally, the water content was relatively low at 2.82±0.85%, indicating the flour's dryness and resulting in a longer shelf life. Carbohydrates accounted for the largest portion at 32.62±8.55%.

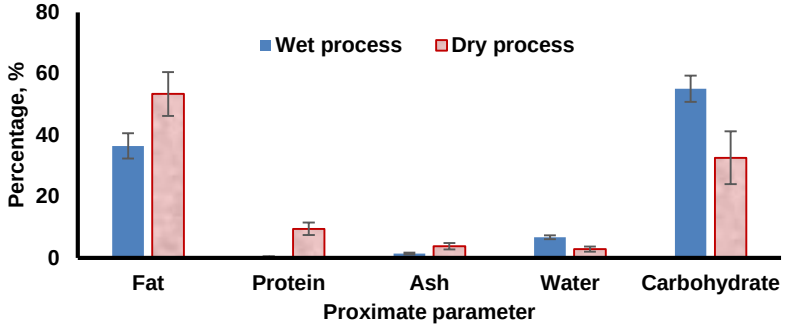

Fig. 3. Proximate analysis in coconut dregs flour

In comparison, the wet-process coconut flour presented a slightly different composition, with a fat content of 36.47±4.12%. However, the protein content dropped sharply to 0.36±0.06%, indicating a lower concentration than in its dry counterpart. The ash content was also lower, recorded at 1.39±0.31%, indicating fewer minerals, while the water content was slightly higher at 6.69±0.63%. Carbohydrates accounted for 55.08±4.31% of the wet-process flour.

The drying method and temperature can affect the fat content of coconut dregs flour. Vacuum freeze-dried coconut dregs flour has a fat content of 14.44-15.93% [3], which is lower than that obtained from roasting. The temperature for vacuum freeze-drying is maintained between -8 and -14 °C [3], whereas the roasting process is conducted at temperatures ranging from 70 to 100°C [7]. Roasting using a modified screw mixed dryer at 80 °C takes between 110 and 140 minutes [8].

Coconut dregs flour produced by the dry process has a notably higher fat and protein content than flour produced by the wet process. This production method involves thoroughly drying the coconut dregs, which effectively preserves its natural oils and nutrients. Consequently, the resulting flour not only delivers a richer flavor profile but also boasts enhanced nutritional benefits. The increased fat content contributes to moisture and richness in culinary applications, while the elevated protein levels support a more healthful dietary framework. This makes coconut dregs flour a valuable ingredient in various recipes. The process of making coconut dregs flour carried out by several researchers can be summarized in Table 1.

Table 1. Several Methods in the Production of Coconut Dregs Flour

Method	Operating Condition and Coconut Dregs Flour		
	Temperature and Time	***Result***	***References***
Roasting (dry process)	80-100 °C 80-120 min	Fat (53.40%); protein (9.45%); ash (3.82%); moisture (2.82%); carbohydrate (32.2%)	This study
Roasting (wet process)	80-100 °C 80-120 min	Fat (36.47%); protein (0.36%); ash (1.39%); moisture (6.69%); carbohydrate (55.08%)	This study
Roasting (dry process)	70-100 °C	Fat (49.91-66.42%); protein (5.7-29.03%); ash (3.00-5.11%); moisture (0.4-3.0%); carbohydrate (11.73-34.22%); fiber (32.49-49.37%)	[7]
Roasting (dry process, modified screw mixed dryer)	80-100 °C 80-140 min	Final moisture content = 0.001 g water/g dry matter	[8]
Vacuum Freeze Drying	-14 to -8 °C	Fat (14.44-15.93%); protein (3.06-4.32%); moisture (1.18-1.61%); fiber (29.73-31.21%)	[3]
Freeze Drying	-80 to -84 °C 18-48 h	Fat (12%); Protein (4.12%); moisture (0.33%); fiber (37.1%)	[9]
Oven	50 °C	From traditional market: Fat (20.28%); protein (3.91%); ash (0.3%); moisture (8.19%); carbohydrate (67.32%); fiber (57.46%) From VCO: Fat (45.37%); protein (13.26%); ash (0.35%); moisture (2.77%); carbohydrate (38.1%); fiber (31.75%)	[10]
Dehydrator	55-75 °C	Moisture < 3.0%	[11]

The roasting method (dry process, without water before entering roasting) yields coconut dregs flour with notably higher fat and protein content. This approach preserves the natural oils and nutrients, making it a valuable ingredient for a range of culinary applications [7]. In contrast, roasting with the wet method (water added before roasting) yields rich coconut milk. This process allows the extraction of fats and proteins into the liquid, thereby reducing their concentration in the remaining dregs. Therefore, while the dry-roasting technique effectively maintains the robust nutritional profile of coconut dregs flour, the wet-roasting method produces a creamy milk product, although at the expense of the nutrient density of the residue. This comparison underscores the distinct advantages and applications of each roasting technique, catering to different culinary needs.

In the oven method, the fat content of market coconut dregs flour is 20.28%, indicating a moderate richness. In comparison, Virgin Coconut Oil (VCO) coconut dregs flour exhibits a significantly higher fat content of 45.37%, making it a more indulgent choice. When evaluating protein levels, market coconut dregs flour provides a modest protein content of 3.91%. Conversely, VCO coconut dregs flour is distinguished by a remarkable protein content of 13.36%, rendering it an excellent option for individuals seeking nutritional benefits. The lower protein content in market coconut dregs flour is attributable to its production method, which involves two pressing processes to extract coconut milk. During these processes, valuable proteins are also extracted along with the milk, resulting in a reduced protein level in the remaining coconut dregs. Furthermore, it is noteworthy that VCO coconut dregs flour complies with the rigorous SNI 01-3751-2006 standards set for wheat flour, which stipulate a minimum protein content of 7.0%. This adherence not only underscores the nutritional quality of VCO coconut dregs flour but also positions it as a reliable alternative for health-conscious consumers seeking substitutes for traditional flours [10].

3.2. Comparison of coconut dregs flour and wheat flour

Figure 4 presents a detailed analysis of the coconut dregs and wheat flours.

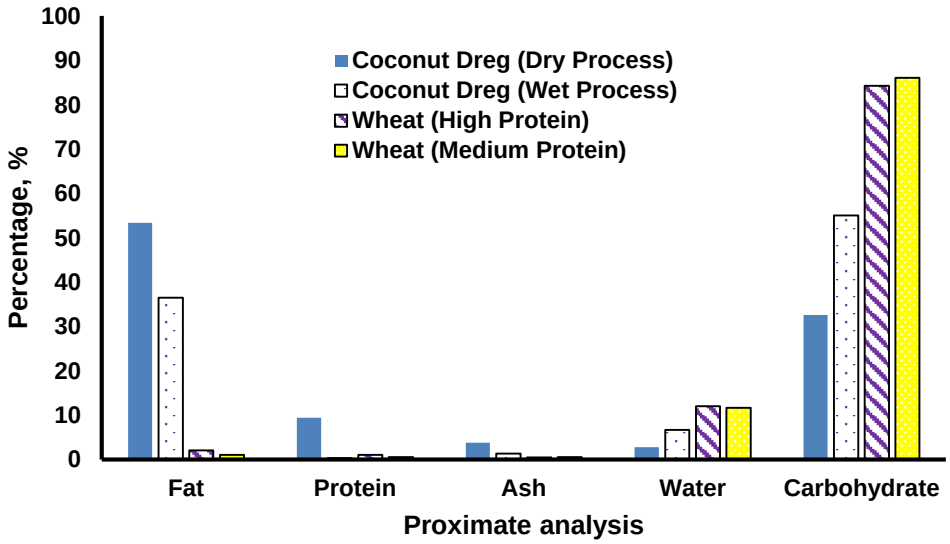

Fig. 4. Comparison of coconut dregs flour and wheat flour

The high-protein variant of wheat flour contains 2.10% fat and 1.1% protein. The values were significantly lower than those of coconut dreg flour from both dry and wet processes. The ash content reflects a mineral content of 0.51%. This flour has a moisture content of 12.01%, which is higher than that of coconut dregs flour. Additionally, it has a carbohydrate content of 84.28%, making it a significant source for baking and cooking applications. In comparison, the medium-protein wheat flour variant contained 1.11% fat, 0.6% protein, 0.54% ash, and 11.7% water. This flour comprises 86.05% carbohydrates. Wheat flour contains gluten, while coconut dregs flour is gluten-free. This characteristic makes coconut dregs flour an advantageous alternative for individuals with gluten allergies. Coconut flour contains 32% to 49% dietary fiber, making it a functional ingredient [7].

Coconut dregs flour is often blended with other flours to effectively replicate the properties of traditional wheat flour. This combination enhances the texture and flavor profile of baked goods, making it a valuable alternative for gluten-free and health-oriented recipes. By using coconut dregs flour, derived from the fibrous byproducts of coconut milk extraction, bakers can introduce a mild sweetness and a rich nutritional profile into their products while maintaining a consistency similar to that of wheat flour. Coconut dregs flour is combined with wheat flour or other flours in the processing of processed foods, as shown in Table 2.

Table 2. Combination of Coconut Dregs Flour and Other Flour in The Production of Processed Food

Processed Food	Combination of Flour		
	Coconut dregs flour (%)	***Other Flour (%)***	***References***
White bread	10-25	Wheat flour: 75-90	[5]
Cookies	25-75	Wheat flour: 25-75	[6]
Putu bamboo cake	26.67-44.44	Rice flour: 44.44-62.22; tapioca: 11.11	[12]
Steamed brownies	15-60	Wheat flour: 40-85	[13]
Steamed brownies	39-78	Modified cassava flour: 22-61	[14]
Rice analogue	10-30	Taro flour: 70-90	[15]
Biscuit	10-40	Wheat flour: 30; Sweet potato flour: 30-60	[16]

Processed Food	Combination of Flour		
	Coconut dregs flour (%)	*Other Flour (%)*	*References*
Sponge cake	5-20	Wheat flour: 80-95	[17]
Pancake	10-30	Wheat flour: 70-90	[18]
Beef Sausage	50-80	Black potato flour: 20-50	[19]
Snack bar	10-30	Soybean Dregs: 10-30; *Kepok* banana: 40	[20]

Based on the data in Table 2, coconut flour can reduce wheat flour use in various food products, thereby saving on wheat flour. In the production of sponge cake, the inclusion of fat is essential to achieve a pleasantly soft, airy texture, as it effectively captures carbon dioxide (CO_2) gas released during mixing. However, when margarine is utilized as the fat source, it may lead to a firmer texture due to margarine's limited ability to incorporate air—an important characteristic for creating a light and fluffy sponge [17]. Conversely, the fat in coconut dregs flour not only enhances the cake's flavor profile but also reduces the need for additional margarine. It yields a spongy cake that is both tender and subtly infused with coconut flavor.

Coconut flour offers a practical solution for reducing reliance on wheat flour in a variety of food products. By integrating coconut flour into formulations, it is possible to achieve noteworthy cost savings on wheat flour while simultaneously enhancing the nutritional value of these products. This approach not only promotes healthier food options but also supports sustainable sourcing of ingredients, ultimately enriching consumers' overall culinary experience.

4. Conclusion

Coconut dregs flour made by the dry process has a higher fat, protein, and ash content than that made by the wet process. The flour produced by the dry process has lower water content and carbohydrate levels than that produced by the wet process. This distinction may be important when considering the suitability of each method for specific applications. Coconut dreg flour can be blended with other flours to create nutritious food options, thereby reducing reliance on wheat flour.

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References

[1] I. Fadhlurrahman, Indonesia Impor 1 Juta Ton Gandum dan Meslin pada Juni 2025, https: databoks. katadata.co.id, 21 Agustus 2025.

[2] Ministry of Agriculture, The National Plantation Leading Statistics 2020-2022. Directorate General of Plantation, Jakarta, 2021.

[3] I. Purnamasari, M. Zamhari, and S. Putri, "Production of High Fiber Flour from Coconut Dregs by Vacuum Freeze Drying", J. Kinetika, Vol. 12, No. 01, pp. 45-50, 2021.

[4] J.B. Adeloye, H. Osho, and L.O. Idris, "Defatted Coconut Flour Improved the Bioactive Components, Dietary Fiber, Antioxidant and Sensory Properties of Nixtamalized Maize Flour". J. Agriculture and Food Research Vol 2, 100042, 2020.

[5] N. Kumolontang, "Coconut Flour as Partial Substituents in Making of White Bread", J. Penelitian Teknologi Industri, Vol. 6 No. 2, pp. 63-79, 2014.

[6] L. Diasultra, and A. Thamrin, "Effect of Coconut Dreg (Cocos nucifera L) Substitution on Fiber Content and Nutritional Value of Cookies", J. Riset Pangan, Vol. 3, No. 3, pp. 327-335, 2025.

[7] I.D. Kumalasari, I. Santosa, and E. Sulistiawati, "Coconut Oil Production with Various Roasting Temperatures and Dried Grated Coconut as A By-Product, IOP Conf. Ser: Earth Environ. Sci. **515,** 012026

[8] I. Santosa, E. Sulistiawati, and A. Aktawan," Mathematical modeling of drying behavior of coconut grate in a modified screw mixed dryer", IOP Publishing: Materials Science and engineering 674.

[9] M. Yulvianti, W. Ernayati, Tarsono, and M. Alfian R, "Pemanfaatan Ampas Kelapa Sebagai Bahan Baku Tepung Kelapa Tinggi Serat dengan Metode Freeze Drying", Jurnal Integrasi Proses, Vol. 5 No (2) 101-107, 2015.

[10] D. Widiastuti, A. Mulyati, and M. Septiani, "Karakteristik Tepung Limbah Ampas Kelapa Pasar Tradisional Dan Industri Virgin Coconut Oil (VCO)", Ekologia, Vol. 15 No (1) 29-34, 2015.

[11] S. Mutiar, M. Anggia, Khofifah, "Characteristics of Coconut Palm Flour at Various Drying Temperatures", Jurnal Penelitian dan Kajian Ilmiah, Vol.18, No. 1, pp.1-8, 2024.

[12] A. Callista, and M. Afriani, "Nutritional content and organoleptic test of coconut flour substitution in making of putu bamboo cake", J. Food Technology and Nutrition, Vol. 24, No.2, pp. 130-138, 2025.

[13] R.I. Fitransyah, D.S. Saragih, Y. Cucikodana, M.D. Syafrullah, M.A. Mazdalifah, D. Swari, and D.S.Y. Aurora, "Determination of the Optimal Coconut Dregs Flour Substitution on the Sensory and Chemical Quality of Steamed Brownies", J. Sains dan Teknologi Pangan, Vol. 10, No.6, pp. 8982-8991, 2025.

[14] E. Sulistiawati, I. Santosa, and A. Aktawan, "Substitusi Tepung Cococaf pada Pembuatan Brownies Kukus Sebagai Alternatif Pengganti Terigu", Prosiding SNTT 4, UM Purwokerto, 2016.

[15] N. Kumolontang, and M. Edam, "The Level of Acceptance and Fiber Content of Rice Analogue Made from Taro and Coconut Flour Mixture", J. Penelitian Teknologi Industri, Vol. 12 No. 1, pp. 11-18, 2020.

[16] H.K. Muchtar, T. Koapaha, and Y. Oessoe, "Effect of Mixing Purple Sweet Potato Flour (Ipomoea batatas) and Coconut Dregs Flour on Physicochemical and Organoleptic Characteristics of Biscuit", J. teknologi Pertanian, Vol. 13, No.2, pp. 95-104, 2022.

[17] S.O. Pusungulena, E.J.N. and J.R. Assa, "The Effect of Substitution Coconut Dregs Flour (Cocos nucifera L) on Food Fiber, Level Development, Chemical Characteristics, and Level of Sponge Preference", J. Teknologi Pertanian, Vol. 14, No. 1, pp. 43-56, 2023.

[18] E.J. Seilatuw, Y.Y.E. Oessoe, J.C.E. Lamaega, "The Effect of Mixing of Coconut Dregs Flour and Wheat Flour on the Physical Properties, Organoleptic, and Fiber Content of Coconut Dregs Pancakes", J. Teknologi Pertanian Vol. 14, No.2, pp. 119-126, 2023.

[19] A.H.A. Manaf, H. Rahmah, and M.N. Hidayatullah, "The Effect of Coconut Drain Flour and Black Potato Flour Substitution on Fiber Content and Organoleptic of Beef Sausage", J. Teknologi Pangan dan Ilmu Pertanian, Vol. 7, No. 2, pp. 9-16, 2025.

[20] Rahmayuni, E. Rossi, and E. Sumantri, "The Use of Composite Flour from Kepok Banana, Soybean Dregs Flour, and Coconut Dregs in Snack Bar Production", J. Teknologi Pertanian, Vol. 12, No. 1, pp. 1-12, 2025.