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Influence of Drying Methods on Physicochemical, Functional and Sensory Properties of Flour Made from Coconut Dregs

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Abstract

Coconut dregs flour is widely used for bakery products. Various drying techniques have been introduced to the industry to preserve coconut-based products which may affecting the physicochemical, functional and sensory properties of coconut dregs flour. Hence, the objective of this study is to determine the physicochemical, functional and sensory properties of coconut dregs flour using three different drying methods. The processing of coconut dregs flour was made using three drying methods consists of oven dried (5 hours), microwave dried (15 minutes) and food dehydrator (8 hours) before undergoing physicochemical and functional analysis. Statistical analysis was done to investigate the effects of different coconut dregs flour on the physicochemical, functional and consumer acceptance towards sensory properties such as texture, aroma, taste, aftertaste and overall acceptability by using a 9-point hedonic scale sensory test. Noteworthy variations were observed in colour, with oven-dried flour appearing notably darker (L* 27.82±0.10). Water activity revealed a 15% decrease in the food dehydrator sample (0.54±0.01), indicating enhanced storage stability. Texture assessments underscored the negative impact of oven drying, with a significant decrease in texture (2.37±0.38). Minimal pH variations were noted, while moisture content varied significantly, with higher levels in microwave-dried samples (6.85±0.14). Functional properties exhibited method-dependent differences, such as bulk density (oven-dried: 0.52±0.13). Sensory evaluations unveiled distinct characteristics in aroma, taste, aftertaste, and overall acceptability, particularly in oven-dried samples. These findings highlight the pivotal role of drying methods in shaping the quality of coconut dregs flour and its food products, offering valuable insights for targeted product development aligned with consumer preferences. Further research avenues could explore specific compounds contributing to sensory disparities, facilitating refined product optimization.

1. Introduction

This study delves into the multifaceted significance of coconut, scientifically denoted as Cocos nucifera L., a versatile plant integral to various industries, particularly in the realm of food production [1]. It spotlights the underutilization of coconut residue, specifically the often-overlooked byproduct, coconut dregs, which possesses the potential to augment industrial profitability and serve as a rich source of dietary fibre [2]. According to [3], approximately 30% of coconut residue is produced during the extraction of coconut milk. Sadly, not much has been done to deal with this leftover. Usually, it is used as inexpensive animal feed or is left to rot. Despite the fact that it can lower costs and increase the value of coconut by-products, very few researchers have examined the use of coconut residue in food production [4]. The issue at hand lies in the substantial unutilized agro-industrial residue in the coconut industry, prompting environmental concerns and the need for more sustainable practices [5].

The overarching aim of this research is to conduct a comprehensive exploration of the physicochemical, functional, and sensory properties of coconut dregs flour, especially concerning the diverse outcomes of various drying methods. The objectives include the development of coconut dregs flour using three distinct drying techniques, evaluation of its physicochemical and functional attributes. This research confines its focus to locally sourced coconut dregs and employs oven drying, microwave drying, and food dehydrator drying methods. Utilizing a range of instruments for analysis, the study aims to provide insights that bridge the gap between theoretical knowledge and practical industry applications. The broader importance of this study is evident in its potential to unlock the untapped value of coconut dregs, contributing to sustainability in the coconut industry and fostering the development of functional foods while facilitating informed decision-making in the broader food industry landscape.

2. Materials and Methods

2.1 Materials

Mature coconuts were used in this study to obtain the coconut dregs (*Cocos nucifera*) was bought from a local market in Pagoh. This study was carried out between September and October.

2.2 Methods

2.2.1 Preparation of coconut dregs flour

Coconut dregs were obtained by using the matured unpeeled that are clean to ensure there are no bruises or damage. The coconut dregs were then cut, sieved, and remove the coconut milk. After extraction, the coconut dregs were filtered using a cheesecloth to remove any foreign particles. Then, the coconut dregs were kept overnight inside the freezer for before undergoing various of drying methods.

2.2.2 Oven Drying

The prepared coconut dregs are taken out from freezer and left at the room temperature. The coconut dregs then were weighed 1000g and spread on the oven tray. After that the coconut dregs are put inside an oven (Orimas Stainless Electric Oven 3 Layer GU-6M) to be dried at 55°C for 5 hours [6].

2.2.3 Microwave Drying

The prepared coconut dregs are taken out from freezer and left at the room temperature. The coconut dregs then were weighed 1000g and spread on the rotating glass platform. The materials are then dried using microwave (Panasonic NN-GT69J) at 70% power level for 15 min [7].

2.2.4 Food Dehydrator

The prepared coconut dregs are taken out from freezer and left at the room temperature. The coconut dregs then were weighed 1000g and spread on the dehydrator trays (COCCA 12-Tier AUA304 Stainless Steel Grade 800W) in a triple layer, leaving some space between them for air circulation. After that, the temperature and time were set at 70°C for 8 hours [8].

2.3 Determination of Physico-Chemical Properties

2.3.1 Moisture Determination

Moisture contents of the coconut dregs flour were determined according to [9], using the official method. The dishes used for the moisture determination were dried at 130°C for 1 hr in drying oven and placed in desiccators for about 30 min. The mass of each dish was measured (M1) and about 5 g of the sample was weighed in to each of the dishes (M2). The sample was then mixed thoroughly and dried at 100°C for 6 hr. After drying is completed, the mass was measured (M3). The moisture content was calculated from the equation: [9].

Enhanced Knowledge in Sciences and Technology Vol. 4 No. 1 (2024) p. 387-396

$$Moisture\ (\%\frac{w}{w}) = \frac{M2 - M3}{M2 - M1} X100 \quad (1)$$

2.3.2 pH Value

10 g of food coconut dregs samples were weighed in a 250 ml conical flask before 90 ml of distilled water is added. A pH meter was used to determine the samples' pH levels [9] The pH of coconut dregs flour was done in triplicate and the results were determined using a pH meter (Thermo Fisher Scientific, Ottawa, ON, Canada).

2.3.3 Texture

Texture measurements were carried out on a TA-XT2i Texture Analyzer coupled with the Software Texture Expert. The test velocity was 1 mm/s. The coconut dregs flour was assessed for hardness. Each samples analysis included three replications. The peak force that occurred during the initial compression was used to calculate the hardness value. [10]

2.3.4 Colour

Colour values for L* (brightness or whiteness), a* (redness to greenness), and b* (yellowness to blueness) of the dried flours were measured [10]. The flour samples were placed in a transparent container. The colorimeter was set to measure in the appropriate colour space. Then the colorimeter was adjusted settings according to the instrument's manual and the results were done in triplicate.

2.3.5 Water Activity

Water activity (aw) was determined in triplicate on finely flour samples using an Aqualab (Decagon, Pullman, WA, USA) The water activity was determined in triplicate on finely blended flour samples using Aqua Lab Lite water activity measuring unit manufactured by Decagon aw meter. Each sample of the prepared flours was half filled in a small plastic cup supplied with the instrument and inserted into the instrument. The water activity of each sample was displayed [6].

2.4 Determination of Functional Properties

2.4.1 Bulk Density

The bulk density (g/mL) was determined by getting 2 g of coconut dregs flour into an empty 10 mL graduated cylinder and placing it on a vortex vibrator for one minute. The volume was documented. Three separate measurements were collected, the bulk density value in g/ml is calculated by dividing the powder's mass by the cylinder's volume [11].

2.4.2 Water and Oil Absorption Capacity

This procedure measures water absorption capacity. Coconut dregs flour sample were weighed 1g and deposited into 50 ml centrifuge tubes (w_1) that have been pre-weighed. Inject 10 ml of distilled water or oil into a pre-weight centrifuge tube. The mixture was stirred with a vortex at maximum speed for two minutes. The sample were allowed to rest for 30 minutes at ambient temperature. The mixture was centrifuged for 25 minutes at 3000 rpm and 20°C. The clear residue was discarded and measured in a 10-ml measuring cylinder, while the sediment-filled centrifuge tube was weighed [12].

The water and oil absorption capacity were measured from equation:

$$Water\ and\ oil\ absorption\ capacity = 10 - V \quad (2)$$

Where V: Volume of or water oil left unabsorbed after centrifugation.

2.4.3 Foam Capacity and Stability

10 g of coconut dregs flour was dispersed in distilled water and stirred for 20 min. The mixture was centrifuged at 4000 × g for 20 min. Supernatant obtained was filtered (Whatman No. 1) and transferred to a Waring blender and whipped for 2 min at high-speed setting. The solution was slowly poured into a cylinder, and the volume of the foam was recorded after 10 s. Foaming capacity was expressed as the volume (mL) of gas incorporated per

mL of solution. Foam stability was recorded as the time passed until the half of the original foam volume had disappeared [13].

2.4.4 Chocolate Coconut Cake formulation

The standard of chocolate coconut cake was used with different formulations of coconut dregs flour to compare the general acceptability of coconut dregs flour using three different drying methods (Table 1).

Table 1 *Chocolate coconut cake formulation*

Ingredients	Measurement (g)
Coconut flour	240
Cocoa powder	100
Castor sugar	150
Baking soda	10
Vanilla essence	21
Vegetable oil	80
Condensed milk	150
Evaporate milk	100
Eggs	200

2.4.5 Sensory Analysis

The end product went through sensory evaluation. A total of 50 semi-trained panellists were participated in the evaluation. The qualities that were assessed included general acceptability, colour, texture, and flavour. The coded samples were served on spotless plastic plates at room temperature in private booths with sufficient fluorescent lighting. The panellists will hear presentations chosen at random. Hedonic evaluations ranged from 1 for the worst and 9 for the best. The items were tasted by the panellists, who then rated them [14].

2.4.6 Statistical Analysis

For each attribute (pH, texture, moisture, water activity, colour, bulk density, water absorption capacity, oil absorption capacity, foaming capacity and foaming stability) was assessed triplicate, The Minitab 2021 software was used to conduct statistical analysis and the acceptance trial will use a randomized full block design, where the blocks serve as the participants and the treatments as the formulas. ANOVA and Tukey's comparison of the means test was used to the data ($p = 0.05$).

3. Result and Discussion

3.1 The physicochemical properties of coconut dregs flour texture were determined in table 2.

Table 2 *Physicochemical properties of coconut dregs flour*

Parameters	Control (Wheat Flour)	Oven drying	Microwave drying	Dehydrator
(L*)	95.70 ± 0.61^{b}	27.82 ± 0.10^{a}	27.10 ± 0.10^{a}	34.03 ± 0.59^{a}
(a*)	4.30 ± 0.05^{a}	-1.21 ± 0.12^{b}	-2.52 ± 0.12^{b}	-0.37 ± 0.07^{b}
(b*)	5.84 ± 0.44^{a}	-6.04 ± 0.11^{c}	-6.72 ± 0.10^{c}	-2.82 ± 0.26^{c}
Water activity	0.65 ± 0.01^{a}	0.55 ± 0.03^{b}	0.56 ± 0.00^{b}	0.54 ± 0.05^{b}
Texture	13.26 ± 1.85^{a}	2.37 ± 0.38^{c}	2.31 ± 0.37^{c}	9.56 ± 0.41^{b}
pH	5.19 ± 0.61^{a}	5.74 ± 0.01^{a}	5.87 ± 0.03^{a}	5.90 ± 0.04^{a}
Moisture	5.97±0.63^{b}	6.50 ± 0.10^{a}	6.85 ±0.14^{a}	6.23 ± 0.05^{b}

Notes: (L*) = lightness, (a*) =redness and (b*) = yellowness of hunter colour analysis. The different alphabet superscript indicates a significant difference ($p < 0.05$) between the samples.

3.1.1 Colour analysis

Table 2 contrasts coconut dregs flour colour with the control. Oven-dried appears notably darker (L* 27.82±0.10) than the control (95.70±0.61). Food dehydrator-dried (34.03±0.59) and microwave-dried (27.10±0.10) exhibit significant differences, favouring the food dehydrator. Redness (a*) values show oven-dried significantly lower (-1.21±0.12) than the control (4.30±0.05), while microwave-dried (-2.52±0.12) and food dehydrator-dried (-0.37±0.07) display no significant difference. The b* value of the control (15.84±0.44) significantly differs from oven-dried (-6.04±0.11) by 7%, whereas microwave-dried (-6.72±0.10) and food dehydrator-dried (-2.82±0.26) show no significant difference. According to Celen (2019) [15] stated that microwave and oven drying methods impact colour due to the Maillard reaction, the comparison hinges on factors like temperature, moisture, and pH. Optimal colour quality necessitates judicious selection of drying methods and parameters.

3.1.2 Water activity

Table 2 reveals water activity in coconut dregs flour (0.54 to 0.69). The control, wheat flour, has highest at 0.69±0.1. There's a 15% significant difference ($p < 0.05$) lower in the food dehydrator sample, possibly due to storage conditions impacting structure. A food dehydrator, with a fan for even air circulation, ensures uniform drying, preventing issues [16]. Oven-dried and microwave-dried coconut flours show slightly higher water activity ($a_w > 0.50$). Oven-dried (0.55±0.3) and microwave-dried (0.56±0.00) have no significant difference. Oven drying reduces moisture but may affect colour, flavour, and nutrients. According to [17] oven-dried coconut flour at 60 °C for 12 hours achieves a safe water activity of 0.35 but decreases phenolic content and antioxidant activity. According to Valadez (2016), microwave drying results in higher water activity [14]. Drying methods show no significant differences between samples, emphasizing choosing based on desired water activity, shelf life, and nutritional quality [18].

3.1.3 Texture

As shown in Table 2, the hardness of coconut dregs flour were determined. The control sample had the highest texture (13.26 ± 1.85), indicating that wheat flour has a superior texture due to more gluten and starch, providing a finer and lighter texture with less moisture and oil. Oven-dried flour (2.37 ± 0.38) showed significantly lower texture than wheat flour, suggesting that oven drying affects texture differently based on flour type and quality. Microwave-dried flour (2.31 ± 0.37) had significantly lower texture than food dehydrator-dried flour (9.56± 0.41), indicating differences in drying methods. Microwave drying may alter gluten and starch structure, affecting elasticity and smoothness, while food dehydrator drying minimally changes these properties [19]. No significant difference was found between oven-dried and microwave-dried samples. Both methods can influence flour texture, with outcomes depending on flour type and quality.

3.1.4 pH value

The pH value of flour depends on the type and quality of the raw material, the milling process, and the amount of gluten and starch in the flour. Generally, wheat flour has a fine, powdery texture that can vary in color from white to brown [20]. The pH value of control sample was 5.19±0.61 slightly lower than usual wheat flour that was caused by main components of wheat flour, as they have different effects on the pH value. The predicted result of the pH value of three different drying methods of flour are all in the same range which showed no significance difference (Table 2). 5.74±0.01 for oven dried sample meanwhile microwave dried sample which was 5.87±0.03 and food dehydrator sample has the highest pH value among them which was calculated at 5.90±0.04. In this analysis, it showed the drying methods of food dehydrator, microwave drying or oven drying did not resulted in significance difference between the samples.

3.1.5 Moisture content

The control sample had a moisture content of 6.3 ± 0.01 (Table 2). Moisture is crucial as higher levels lead to fewer dry solids and instability at room temperature due to microbial growth, affecting shelf life [21]. The oven-dried sample showed a moisture content of 6.50 ± 0.10, significantly higher ($p < 0.05$) than the control (5.97 ± 0.63), impacting stability. The microwave-dried sample had the highest moisture at 6.85 ± 0.14, significantly higher ($p < 0.05$) than the food dehydrator sample. This suggests improved stability against microbial growth [22]. Comparing moisture levels, the food dehydrator sample (6.23 ± 0.05) was closest to oven-dried flour. These findings align with other studies on coconut flour composition, influenced by component retention after coconut milk or oil extraction from dried coconut [23].

3.2 The functional properties of coconut dregs flour were determined in table 3

Table 3 *Functional properties of coconut dregs flour*

Parameters	Control (Wheat Flour)	Oven drying	Microwave drying	Dehydrator
BD	0.46 ± 0.03^{a}	0.52 ± 0.13^{a}	0.58 ± 0.01^{a}	0.59 ± 0.16^{a}
WAC	5.76 ± 0.15^{a}	2.41 ± 0.01^{b}	1.33 ± 0.05^{b}	2.26 ± 0.05^{c}
OAC	5.56 ± 0.15^{a}	3.36 ± 0.15^{b}	2.86 ± 0.20^{bc}	3.10 ± 0.10^{c}
FC	0.56 ± 0.01^{c}	0.74 ± 0.00^{ab}	0.77 ± 0.03^{a}	0.71 ± 0.01^{b}
FS	0.56 ± 0.02^{a}	0.66 ± 0.01^{c}	0.76 ± 0.02^{b}	0.81 ± 0.01^{a}

Where: BD- bulk density, WAC -water absorption capacity, OAC- oil absorption capacity, FC- Foam capacity, FS- foam stability; Results are mean values of triplicate determination ± standard deviation. Different alphabet superscript indicates a significant difference ($p < 0.05$) between the samples.

3.2.1 Bulk density

According to Table 3, the result of control sample was 0.46 ± 0.03 while oven dried sample 0.52±0.13, microwave dried sample 0.58±0.01 and was followed by food dehydrator which was 0.59±0.16. The lack of significant differences between control wheat flour and coconut flour under various drying methods, as indicated in the provided data, suggests that the selected drying techniques did not cause substantial alterations in certain functional properties that were measured in this study. According to Afoakwah et al (2019), control wheat flour and coconut flour may have inherently similar properties that are less sensitive to the selected drying methods. [24]

3.2.2 Water and oil absorption capacity

The water absorption capacity (WAC) is a critical parameter that reflects the ability of a flour to absorb water. the water absorption capacities for coconut flour are given as follows. Oven dried sample exhibits a significantly lower ($p < 0.05$) water absorption capacity 2.41±0.01 compared to wheat flour with 5.76±0.15 under the control conditions (Table 3). This is consistent with the typical behaviour of wheat flour, which often has good water absorption properties due to its gluten content [25]. Among the drying methods, microwave drying 1.33±0.05 shows the lowest water absorption capacity which was significantly lower ($p < 0.05$) compared to food dehydrator 0.59±0.16. Possible explanations may be caused by structural changes, drying methods may induce structural changes in coconut flour, affecting its ability to absorb water [19]. High temperatures or specific drying conditions might alter the starch or fibre structures, leading to reduced water absorption [26]. For oil absorption, oven dried sample shows a significant difference ($p < 0.05$) with 3.36±0.15 lower than control sample where it exhibits a relatively high oil absorption capacity with 5.56±0.15. Microwave drying falls between oven-dried and food dehydrator in terms of oil absorption capacity. It appears to further reduce the oil absorption capacity of coconut flour compared to oven drying with 2.86±0.20, this result portrays about 5% significance difference ($p < 0.05$) lower between microwave and oven dried. The microwave drying process may affect the coconut flour's structure differently, potentially resulting in a more porous and less cohesive product [27]. Food dehydrator, on the other hand, shows 3.10±0.10 which portrays significance difference ($p <0.05$) compared to microwave. The dehydration process used in this case may retain more of the coconut flour's original structure compared to microwave drying, contributing to its intermediate oil absorption capacity.

3.2.3 Foam capacity and stability

Coconut dregs flour, a by-product of coconut extraction, is fibre-rich and a potential functional food ingredient. Its foam capacity (FC) is vital for products like cakes. In Table 3, oven-dried flour shows a 20% higher FC (0.74 ± 0.00) than the control (0.56 ± 0.01), while microwave and food dehydrator samples differ significantly ($p < 0.05$) at 0.77 ± 0.03 and 0.71 ± 0.01, respectively. This relates to the unique protein composition of coconut dregs flour [5].

For foam stability, coconut dregs flour (0.66 ± 0.01) surpasses wheat flour (0.56 ± 0.02), with microwave and food dehydrator samples having the highest values (0.76 ± 0.02 and 0.81 ± 0.01, respectively). Food dehydrator exhibits a 6.58% increase ($p < 0.05$) compared to microwave, highlighting the impact of drying methods. Food dehydrator, offering a controlled and gentle approach, is crucial for foam-forming ingredients sensitive to high temperatures. The choice of drying method should align with specific product requirements [28].

3.3 The sensory evaluation of chocolate coconut cake from various drying methods were determined in Table 4.

Table 4 *Sensory evaluation of chocolate coconut cake*

Codes	Texture	Aroma	Taste	Aftertaste	Overall Acceptability
457	7.26 ±1.33^{a}	7.26 ± 1.39^{a}	7.12 ±1.40^{a}	6.94 ± 1.40^{a}	7.16 ± 1.26^{a}
657	6.56 ± 1.34^{a}	5.98 ± 1.65^{ab}	5.22 ± 1.38^{bc}	4.96 ± 1.68^{c}	5.26 ± 1.53^{bc}
271	7.32 ± 1.07^{a}	7.02 ± 1.22^{a}	7.10 ± 1.75^{a}	6.76± 1.76^{a}	7.36 ± 1.35^{a}
192	6.64 ± 1.13^{a}	6.08 ± 1.30^{ab}	5.26 ± 1.63^{c}	5.10 ± 1.69^{c}	5.52 ± 1.47^{bc}

457 (wheat flour), 657 (coconut dregs flour from oven drying), 271 (coconut dregs flour from microwave drying) and 192 (coconut dregs flour from food dehydrator). Different alphabet superscript indicates a significant difference ($p < 0.05$) between the samples.

3.3.1 Aroma

Aroma scores for chocolate coconut cakes made from various flours (wheat, coconut dregs with oven drying, food dehydrator, and microwave drying) were consistently similar, indicating minimal impact on chocolate coconut cake aroma. The aroma of coconut flour can be influenced by drying methods microwave, oven, or food dehydrator, each affecting flavour and aroma differently [29]. The control sample (wheat flour) scored 7.26 ± 1.33, suggesting a well-liked aroma. Coconut dregs flour with oven drying scored slightly lower at 6.56 ± 1.34, possibly due to unique characteristics and the oven drying process introducing subtle changes in flavour and aroma. The food dehydrator sample (192) scored 7.32 ± 1.07, comparable to wheat flour, indicating that the gentle and controlled drying process of the food dehydrator may have preserved or enhanced the natural aroma of coconut [5]. The microwave-dried sample (271) scored 6.64 ± 1.33, lower than the food dehydrator sample, suggesting that the rapid evaporation characteristic of microwave drying may have introduced distinguishable differences in aroma [30].

3.3.2 Texture

Texture variations in coconut chocolate cakes, influenced by ingredients and baking methods, were observed across drying techniques [30]. The wheat flour control (457) scored 7.26 ± 1.39, signifying an appealing texture with consistent positive perception. It significantly differed ($p < 0.05$) from other samples. Oven-dried sample 657 scored lower at 5.98 ± 1.65, 19.3% less than the control, with a higher standard deviation (1.65) indicating mixed preferences ('a' and 'ab'). Microwave-dried sample 271 scored close to the control at 7.02 ± 1.22, significantly preferred over the oven-dried sample. Food dehydrator-dried sample 192 scored 6.08 ± 1.30, statistically significant ($p < 0.05$) and preferred over oven-dried by 1.66%, though not as much as microwave-dried. In summary, oven drying seems to negatively impact texture, influencing cake preferences. According to Mior (2019), the drying method significantly affects baked product texture, guiding optimization for consumer expectations [31].

3.3.3 Taste

Taste scores reveal insights into coconut chocolate cake flavours. The wheat flour control (457) scored 7.12 ± 1.40, well-received compared to oven-dried (657) at 5.22 ± 1.38, significantly lower by 30.78% ('bc' notation). Sample 271 scored 7.10 ± 1.75, comparable to the wheat flour control, with an 'a' notation indicating no significant taste difference, suggesting microwave-dried coconut dregs flour is well-liked. Sample 192 scored 5.26 ± 1.63, lower than wheat flour and microwave-dried. The 'c' notation indicates a significant taste difference, suggesting food dehydrator-dried coconut dregs flour has distinct taste characteristics. In summary, drying method significantly influences taste scores. Oven-dried has a distinct taste, while both microwave-dried and food dehydrator-dried samples are well-liked, with some variations. According to Youyou (2023). further research is needed to explore specific flavours contributing to taste differences and to determine optimal formulations aligning with consumer preferences [32].

3.3.4 Aftertaste

Based on the Table 4, Aftertaste scores of coconut chocolate cakes from different flour types reveal insights into their flavours. The wheat flour control (457) scored 6.94 ± 1.40, indicating a well-liked aftertaste. Oven-dried sample 657 scored 4.96 ± 1.68, significantly lower by 33.36%, suggesting a distinct aftertaste. Sample 271 scored 6.76 ± 1.76, comparable to the wheat flour control, with an 'a' notation indicating no significant difference in aftertaste. This suggests microwave-dried coconut dregs flour has a well-liked aftertaste. Sample 192, food dehydrator-dried, scored 5.1 ± 1.69, lower than both the wheat flour control and microwave-dried. The 'c' notation indicates a significant aftertaste difference, suggesting distinct characteristics. In summary, drying method significantly influences aftertaste scores [33]. Oven-dried has a distinct aftertaste, while both microwave-dried and food dehydrator-dried samples exhibit well-liked characteristics, with some variations.

3.3.5 Overall acceptability

Overall acceptability scores for coconut chocolate cakes reveal preferences. The wheat flour control (457) scored 7.16 ± 1.26, widely liked. Oven-dried sample 657 scored lower at 5.26 ± 1.53, differing significantly by 30.61%. The 'bc' notation suggests a notable overall acceptability difference. Sample 271 scored 7.36 ± 1.35, higher than the wheat flour control, surpassing overall acceptability. The 'a' notation indicates no significant difference compared to the control. Sample 192 scored 5.52 ± 1.47, lower than both the wheat flour control and microwave-dried. The 'bc' notation suggests a significant overall acceptability difference, indicating distinct characteristics for food dehydrator-dried sample [33]. In summary, drying method significantly influences overall liking. Oven-dried has a distinct overall acceptability, while microwave-dried surpasses even the control, indicating effectiveness in achieving a well-liked sensory experience.

4. Conclusion

In conclusion, the study comprehensively explored the physicochemical, functional, and sensory aspects of coconut dregs flour subjected to various drying methods, providing valuable insights into product quality. Drying techniques significantly influenced colour, water activity, texture, pH, and moisture content, with oven-dried flour displaying darker colour and lower texture, while microwave drying increased water activity. Food dehydrator drying consistently demonstrated superior colour and texture. Functional properties, including bulk density, water and oil absorption capacity, and foam characteristics, were impacted by drying methods, emphasizing the need for a nuanced approach in method selection based on intended applications. Sensory evaluation of coconut chocolate cakes revealed distinct influences on aroma, texture, taste, aftertaste, and overall acceptability, with food dehydrator drying emerging as promising for aroma retention and overall liking. Overall, the findings underscore the critical role of choosing appropriate drying methods to optimize both functional attributes and sensory appeal in coconut dregs flour-based products. Further research is encouraged to delve into specific flavour components and texture attributes contributing to observed preferences, aiming to meet consumer expectations and preferences effectively.

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Conflict of Interest

Authors declare that there is no conflict of interests regarding the publications of the paper.

Author Contribution

The authors confirm contribution to the paper as follows: ***study conception and design:*** *Nur Afiqah Shariman, Fazleen Izzany Abu Bakar:* ***data collection:*** *Nur Afiqah Shariman:* ***analysis and interpretation of results:*** *Nur Afiqah Shariman:* ***draft manual preparation:*** *Nur Afiqah Sharimann, Fazleen Izzany Abu Bakar. All authors reviewed the results and approved the final version manuscript*

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