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Characteristics and Glycemic Index of Corn "Kipang" added by Coconut Dregs

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A B S T R A C T

This study aimed to investigate the impact of incorporating coconut dregs on the characteristics of corn kipang, identify the optimal addition level based on organoleptic and chemical tests, and determine the glycemic index of kipang products with coconut dreg additions. The research design was completely randomized (CRD) with six treatments and three replications. The treatments given in this study were A (0%), B (2% coconut dregs), C (4% coconut dregs), D (6% coconut dregs), E (8% coconut dregs), and F (10% coconut dregs). The research data were statistically analyzed using ANOVA and continued with DNMRT analysis at the 5% level. The best treatment based on chemical analysis of organoleptic tests, chemical analysis of corn kipang with the addition of coconut dregs is treatment F (addition of 15% coconut dregs) with the following average values: moisture content (8.13%), ash content (1.67 %), fat (6.90%), protein (4.04%), carbohydrates (79.27%), crude fiber (4.40%), glycemic index (56.35%) and organoleptic acceptance values with the average panelists' preference for color was 3.77 (liked), aroma 4.07 (liked), and taste 4.27 (liked), and crispness 4.10 (liked). Corn kipang products with 10% coconut dregs are classified as medium IG category (56.35), while corn kipang products without adding coconut dregs are classified as high IG category (75.31). This shows that adding coconut dregs can reduce the IG value of a product.

Contribution to Sustainable Development Goals (SDGs)
SDG 3: Good Health and Well-being
SDG 9: Industry, Innovation and Infrastructure
SDG 12: Responsible Consumption and Production

1. INTRODUCTION

1.1. Research Background

West Sumatra is one of the provinces rich in traditional food. One of the traditional foods is kipang. Kipang is a snack that is processed until fluffy, then mixed with sugar, then printed, with or without the addition of other food ingredients and permitted food additives [1}. Kipang is often used as souvenirs for the people of West Sumatra or consumed alone. Kipang is not only found in West Sumatra, but also in several regions. The naming of kipang varies by region. In Java, kipang is known by a different name, which is called jipang.

West Sumatra is one of the provinces rich in traditional food. One of the traditional foods is kipang. Kipang is a snack that is processed until fluffy, then mixed with sugar, then printed, with or without the addition of other food ingredients and permitted food additives [1]. Kipang is often used as a souvenir for the people of West Sumatra or consumed alone. Kipang is found not only in West Sumatra but also in several other regions. The naming of kipang varies by region. In Java, kipang is known by a different name, jipang.

In kipang processing, all ingredients are mixed with brown sugar, which acts as an adhesive to fuse all ingredients. The sugar used in making kipang is brown sugar that has been melted. Kipang has a characteristic square or rectangular shape, dense texture, and a sweet and crunchy taste. Corn kipang is a snack

made from corn, which is processed first until it is fluffy, and then mixed with brown sugar.

Corn is one of the sources of carbohydrates whose glycemic index is relatively low [2]. However, sugar is used in making kipang, which is known as one of the foods with a high glycemic index value. Sugar in kipang is suspected to have a high glycemic index. Therefore, a way is needed to reduce the glycemic index in kipang products. The development of food processing technology today has led people to create healthy food with a low glycemic index. One effort to reduce the glycemic index value is the addition of fiber to the diet. One source of fiber that can be utilized from local food is coconut dregs.

Coconut dregs are a by-product or residue of grated coconut flesh extract. As a country with many islands, Indonesia has the largest coconut plantation in the world, covering an area of 3,300,016 Ha. The area of coconut plantations produces a total coconut production of 2,828,870 tons [3]. In 2020, coconuts produced in West Sumatra province amounted to 78,348.00 tons [4]. The development of plantations encompasses not only plantation crop cultivation but also post-harvest handling, including food and non-food processing and marketing. The large amount of coconut production results in significant waste from coconut dregs. Coconut products produced on average reach 19.5 billion grains per year, equivalent to 12.02 billion tons of coconut meat. Every 100 kg of processed coconut meat produces pure oil and can produce as much as 19.5 kilograms of coconut dregs [5].

Coconut dregs are often discarded and underutilised. The coconut dregs used are still limited to being used as animal feed. So far, coconut dregs are still little used as a food source or substitute in food, and coconut dregs are still considered a by-product that has no value[6]. The amount of coconut dregs produced and the lack of utilization are still issues; it is necessary to use them as an additional ingredient in food products. Based on Putri [5], the crude fiber content in coconut dregs flour is 33.64%.

In preliminary research, kipang was used to find the correct corn-to-brown sugar ratio. Based on preliminary research with a 1:1 ratio of corn to brown sugar, the product obtained is kipang that does not blend and does not meet the characteristics of kipang. Furthermore, experiments were carried out with a 1:2 formulation between corn and brown sugar; the resulting product was successful and followed the characteristics of kipang. This is followed by determining the treatment, which involves adding roasted coconut dregs. The author has conducted research by adding coconut dregs in several concentrations (2%, 4%, 6%, 8%, 10%, and 12%) to increase the fibre content in corn kipang. The percentage of coconut dregs added is based on the amount of corn and brown sugar.

At 12% coconut dregs addition, the resulting kipang does not blend with coconut dregs and does not meet the characteristics of kipang. Regarding taste, kipang with 8% coconut dregs addition has an aftertaste that is uncomfortable to perceive. Based on this, the concentration of coconut dregs is limited to 10%.

1.2. Literature Review

1.2.1. Coconut Dregs

Coconut is a tropical or subtropical plant that belongs to the Arecaceae group [7]. Coconut plants are included in the monocotyledonous plants (monocots). Coconut trees have characteristics of straight, unbranched stems with a trunk height reaching 4-30 meters, with the characteristic of dark brown wood with a diameter of 40 cm. Coconut trees have compound leaves with leaf lengths ranging from 2 to 4 meters. Coconut leaves are yellowish green with leaflets measuring around 1-1.3 meters [8].

According to Palungukan [9], the composition of coconut fruit consists of 25-32% fibre, 12-13.1% shell, 28-34.9% flesh, and 19.2-25% fruit water. Mature coconuts contain high calories, namely 354 calories per 100 grams, from oil ± 33%, carbohydrates 15% and protein 3% (Agustina et al., 2020). The nutritional composition of coconut meat can be seen in Table 1.

Table 1. Composition of Coconut Flesh per 100 g

Composition	Age		
	Young	Middle Aged	Old
Energy (kcal)	68.0	180.0	359.4
Protein (g)	1.0	4.0	3.4
Fat (g)	0.9	15.0	34.7
Carbohydrates (g)	14.0	10.0	14.0
Calcium (mg)	7.0	8.0	21.0
Phosphorus (mg)	30.0	55.0	98.0
Iron (mg)	1.0	1.3	2.0
Vitamin A (SI)	0	10.0	0
Vitamin B1 (mg)	0.06	0.05	0.1
Vitamin C (mg)	4.0	4.0	2.0
Water (g)	83.0	70.0	46.0

Coconut dregs are a by-product of coconut milk extraction. As a waste product produced by industry and households, coconut dregs are a potential food ingredient that can be utilized due to their nutritional content. Coconut dregs contain many nutrients, such as protein, fat, and carbohydrates. However, the main advantage of coconut dregs is their high fiber content [10]. From 100 coconuts used in wet coconut oil processing, approximately 195 kg of coconut dregs can be produced. In addition to fibre, research conducted on coconut dregs [11] reveals that they contain protein (11.35%), crude fat (23.36%), and crude fibre (14.97%).

1.2.2. Corn

Corn (Zea mays L.) is an important source of carbohydrates, alongside wheat and rice. Corn is a multifunctional plant with many uses, and almost all parts of the plant can be utilized for various purposes. Therefore, corn is important in industrial development in Indonesia because it is a raw material for the food industry [12].

Based on Asmarani et al. [2], corn is a carbohydrate source with a relatively low glycemic index, so when consumed, it will not increase blood sugar. Corn is rich in functional food components, including dietary fiber needed by the body, essential fatty acids, isoflavones, minerals (Ca, Mg, K, Na, P, Ca and Fe), anthocyanins, beta-carotene (provitamin A), essential amino acid composition, and others [13]. So corn is good for health. Corn kernels can be extracted as oil and made into flour (cornstarch) and industrial raw materials (cornstarch or cob flour). Corn cobs contain pentoses, which can be used as raw materials for making furfural. Corn contains many minerals necessary for the body, including: phosphorus, magnesium, manganese, zinc, iron, and copper, and contains minerals such as selenium [14].

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1.2.3. Kipang

Kipang is a traditional food typical of West Sumatra, which is often used as a souvenir and consumed. This tends to be liked by children and people of mature age because it is affordable. The origin of this food is unknown, as it is found in other regions. This food has also been around in Indonesia for a long time, even though it has a different name. Different. In various other regions of Indonesia, kipang is also known as jipang or bipang. Kipang's popularity has been eclipsed by various types of modern snacks on the market, resulting in a decline in demand.

Kipang is a type of snack, made from an ingredient base of plain rice or sticky rice, corn, and pre-caramelized sugar (or caramel). The rice is first puffed with pressure and high temperatures, roasted, or fried in oil.

Table 1. Indonesian National Standard for Quality Requirements of Jipang Rice (SNI 8416:2018) [1]

No	Amount test	Unit	Condition
1.	Condition		
1.1	Smell	-	Normal
1.2	Flavor	-	Normal
1.3	Texture	-	Normal
1.4	Foreign object		nothing
2.	Water content	%	Max. 8
	Water content***	%	Max. 9
3.	Ash Content **	%	Max. 1
4.	Ash is insoluble in acid	%	Max. 0.1
5.	Pollution heavy metal		
4.1	Lead (Pb)	mg/kg	Max. 0.25
4.2	Cadmium (Cd)	mg/kg	Max. 0.05
4.3	Tin (Sn)	mg/kg	Max. 40.0
4.4	Mercury (Hg)	mg/kg	Max. 0.03
5.	Arsenic (As)	mg/kg	Max. 0.25
6.	Pollution microbes		
6.1	Total Plate Number	Colony/g	10 3 colonies/g
6.2	Enterobacteriaceae	Colony/g	10 colony/g
6.3	Salmonella	Colony/g	Negative/25 g
6.4	Staphylococcus aureus	Colony/g	10 2 colonies/g
7.	Aflatoxin*)	µg/kg	Max. 20

Description :
* = If the product is added with processed nuts
** = National Standardization Agency (1998a) regarding Sticky Rice Jipang
*** = National Standardization Agency (1998b) regarding Corn Jipang

1.3. Research Objective

This study aimed to investigate the impact of incorporating coconut dregs on the characteristics of corn kipang, identify the optimal addition level based on organoleptic and chemical tests, and determine the glycemic index of kipang products with coconut dreg additions.

2. MATERIALS AND METHODS

2.1. Materials

The ingredients used in this study were brondong corn (Zea mays everta), coconut dregs from coconut milk, cane brown sugar, margarine, and water. The chemicals used for research analysis are H_2SO_4 (Pro analysis. Smartlab), NaOH (Pro analysis. Smartlab), aquades, HCl, K_2SO_4 solution (Pro analysis. Smartlab), hexane solvents (Teksnis. Brataco), alcohol, 96% ethanol, boric acid methanol, red metal/blue metal indicator, KI solution, and $Na_2S_2O_3$.

2.2. Methods

The research design used in this study was a Complete Randomized Design (CRD) with six treatments, namely by giving six concentrations of coconut dregs and three repeats. The results of observations are analyzed statistically with the Analysis of Variance (ANOVA) test, and if the observation results differ markedly, followed by Duncan's New Multiple Range Test (DNMRT) test at a significance level of 5%.

The treatment used in this study is the difference in adding coconut dregs when making corn kipang

Treatment as follows:
A = Added coconut dregs 0%
B = Added coconut dregs 2%
C = Added coconut dregs 4%
D = Added coconut dregs 6%
E = Added coconut dregs 8%
F = Added coconut dregs 10%
Note: Coconut dregs should be added based on the total weight of corn and brown sugar.

2.2.1. Determination of Material Formulation

The formula used in this study is based on the one used in the previous pre-research. The formulation of corn kipan can be seen in Table 3.

Table 3. Kipang Formulation

Bahan	Treatment					
	A (0%)	B (2%)	C (4%)	D (6%)	E (8%)	F (10%)
Coconut Dregs (g)	0	3	6	9	12	15
Popcorn (g)	50	50	50	50	50	50
Brown Sugar (g)	100	100	100	100	100	100
Water (ml)	100	100	100	100	100	100

2.2.2. Coconut Dregs Roasting

The flesh of the coconut fruit is grated using a shredder. The grated coconut is extracted to produce coconut milk. Coconut milk is separated using a sieve that produces coconut dregs. Then the resulting coconut dregs are roasted.

2.2.3. Making Corn Kipang

The stages carried out in making kipang are as follows (1) margarine is preheated in a skillet, (2) put the corn kernels in the pan, then cover the top and leave until the corn kernels crack, (3) brown sugar is dissolved with water first, then the sugar solution is cooked until it forms like caramel, (4) add the corn that has been cracked, (5) put the roasted coconut dregs little by little, (6)

All ingredients are stirred thoroughly, and then (7) the corn kipang is printed on the baking sheet.

2.2.4. Data Analysis

The analysis of raw corn involves water content analysis, which includes water content, ash content, and raw coconut dregs, as well as tests for fat, protein, and crude fibre. Additionally, brown sugar undergoes a total sugar test.

Analysis of corn kipang includes chemical analysis, glycemic index test, and organoleptic test. Chemical analysis of corn kipang involves determining the water content, ash content, fat content, protein content, carbohydrates, crude fibre content, and total sugar. Organoleptic tests with hedonic scales include color, taste, aroma, and crispness of kipang.

3. RESULT AND DISCUSSION

3.1. Raw Material Analysis

Analysis of raw materials for corn includes water content. For popcorn, the analysis includes water content and ash content. For coconut dregs, the analysis covers water content, ash content, fat, protein, and crude fibre. For brown sugar, a total sugar test is conducted. The results of raw material analysis can be seen in Table 4.

Based on the table, the moisture content of corn is 13.2%. The water content result is not significantly different from Paeru (2017) [15], which is 14%. The optimum moisture content for the explosive process is about 14%. The water content of popcorn corn obtained in the study was 3.2%. The water content obtained in this study is almost the same as the USDA standard [16] regarding popcorn, where the water content is set at 3.32%. The results of the analysis of popcorn corn ash content obtained in the study were 1.58%. The ash content of popcorn corn is not much different from that of USDA [16], where the ash content is set at 1.42%.

Table 4. Nutrition Content of Raw Material

Analysis	Popcorn	Coconut dregs	Brown Sugar
Water content %	3.2 ± 0.35	8.42 ± 0.25	-
Ash %	1.58 ± 0.17	2.25 ± 0.21	-
Protein %	5.07 ± 0.48	3.05 ± 1.17	-
Fat %	15.81 ± 0.17	29.3 ± 2.97	-
Crude Fiber %	3.31 ± 0.03	28.16 ± 0.15	-
Total Gluttony %	-	0.90 ± 0.01	99.75 ±

Water content in coconut dregs was obtained at 8.42%. The water content obtained in this study was higher than that of the study [17] of coconut dreg flour with the oven drying method 5, which obtained a water content of 5.70%. This difference is due to the drying process, which in this study used drying with roasted coconut dregs. Drying is influenced by the surface area, which is reduced in size when coconut dregs flour is ground, resulting in a larger surface area. The larger surface area of the material will react more with heat, so that less moisture content is obtained [18].

Ash content of coconut dregs was obtained at 2.25%. Ash content in this study was higher than the ash analysis in the study [19], where the results of the ash content analysis obtained were 1.2%. The results of the analysis of fat content in coconut dregs were obtained at 31.4%. The fat content of coconut dregs in this study was lower than the fat analysis [19], which was 42.6%. The crude fiber content analysis result of coconut dregs was obtained at 24%. The crude fiber content of this study was higher than the crude fiber analysis in the study[19], which was 23.2%. The results of the analysis of the dregs protein content obtained were 3.05%. The protein content obtained is not much different from the study [19], where the analysis of coconut dregs protein content was obtained at 4.2%.

The difference obtained in this study with the research of Yalegama et al. [19] is due to differences in the drying process of coconut dregs. In the study [19], coconut dregs were dried using the oven method at a temperature of 80ºC, while in this study, it was dried using a roasting process. The coconut dregs roasting process aims to remove most of the water in coconut dregs and produce a better aroma, inactivate enzymes, kill microorganisms, and produce flavors [18]. The total sugar content of brown sugar obtained in this study was 99.75%. According to Buckle et al. [20], the sucrose content in brown sugar is 99.8%.

3.2. Chemical Analysis of Corn Kipang

3.2.1. Water Content

Water content is a key property of the material that indicates the amount of water it contains. Based on the results, the addition of coconut dregs has no significant effect at the 5% level on the moisture content of the corn kipang produced. The results of moisture content analysis on corn kipang products with the addition of coconut dregs can be seen in Table 5.

Table 5. Water Content of Corn Kipang with Coconut Dregs Addition

Treatment	Water Content(%) Average ± SD
A (0% Coconut dregs Addition)	5.53 ± 1.21
B (2% Coconut dregs Addition)	6.80 ± 1.25
C (4% Coconut dregs Addition)	6.93 ± 0.80
D (4% Coconut dregs Addition)	7.19 ± 0.91
E (8% Coconut dregs Addition)	7.39 ± 0.71
F (10% Coconut dregs Addition)	8.13 ± 0.50
CV= 2.23 %	

Description: SD = Standard Deviation. CV= Coefficient of Diversity. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) 5% level

Based on the results of the water content analysis that has been carried out, the average value of corn kipang water content was obtained with the addition of coconut dregs, which ranged from 5.53 to 8.13%. Treatment F with a coconut dregs concentration of 10% has the most water content, which is 8.13%. In contrast, the lowest water content in treatment A, without the addition of coconut dregs, is 5.53%. This shows that the greater the amount of coconut dregs added, the more the water content increases. In treatment A to E, the water content value obtained in this study is under SNI 8416-2018 [1], which concerns the quality requirements of rice jipang with a maximum water content of 8%. Meanwhile, the F treatment does not follow SNI 8416-2018, but under SNI 01-4436-1998 concerning the quality requirements of corn jipang, namely the water content with a maximum of 9%.

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The content of coconut dregs used can cause an increase in the value of water content in this study. Based on the analysis of raw materials, the moisture content of coconut dregs was obtained at 8.42%, so the difference in the amount of coconut dregs added to each treatment will affect the moisture content of the product. With the addition of coconut dregs, the moisture content of the product increases. In addition, the increasing water content is also caused by high fiber content, because in crude fiber, there is cellulose, where the fibrous cellulose structure (fibrous) makes it have a high enough ability to absorb water [21].

3.2.2. Ash Content

Ash content can indicate the total minerals in a foodstuff. Ash is a food residue in the form of inorganic parts that remain after organic matter in food is destroyed, or it can be interpreted that ash is an inorganic substance from the rest of the combustion of an organic material.

Table 6. Ash Content of Corn Kipang with Coconut Dregs Addition

Treatment	Ash Content (%) Average ± SD
A (0% Coconut dregs Addition)	1.49 ± 0.25
B (2% Coconut dregs Addition)	1.51 ± 0.17
C (4% Coconut dregs Addition)	1.55 ± 0.13
D (4% Coconut dregs Addition)	1.62 ± 0.02
E (8% Coconut dregs Addition)	1.66 ± 0.28
F (10% Coconut dregs Addition)	1.67 ± 0.29
CV= 2.25 %	

Description: SD = Standard Deviation. CV = Coefficient of Diversity. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) at 5% level.

Based on the table above, the results of various fingerprints show that at the level of 5% corn kipang, the addition of coconut dregs does not significantly affect the ash content of kipang. Based on the results of the ash content analysis that has been carried out, the average value of corn kipang ash content with the addition of coconut dregs ranges from 1.49 to 1.67%. The highest ash content was found in treatment F with the addition of 10% coconut dregs, which is 1.67%. In comparison, the lowest ash content in treatment A, which is without adding coconut dregs, is 1.49%. The ash content value obtained from each treatment does not follow SNI 8416-2018 concerning the quality requirements of rice jipang, namely, ash content with a maximum of 1%. The ash content obtained is higher than the provisions of SNI 8416-2018.

Based on the raw materials analysis, the ash content of coconut dregs was obtained at 2.25% and the ash content of popcorn corn was 1.58%. The high ash content in coconut dregs and corn affects the high ash content in corn kipang products. This is also due to differences in materials used in corn jipang, according to SNI 01-4450-1998. In this study, the manufacture of kipang used margarine, while SNI 01-4450-1998 did not use margarine. Based on the composition of margarine, there is sodium content in margarine, where sodium is a mineral. Minerals are inorganic substances that remain in the ash of leftover materials after organic food material is burned [22].

3.2.3. Protein Content

Protein is a compound primarily composed of nitrogen. Protein is also a source of amino acids containing elements C, H, O, and N that carbohydrates and fats do not have [12]. Based on the protein analysis results, adding coconut dregs has a significant effect at the 5% level on the protein content of corn kipang produced. The results of moisture content analysis on corn kipang products with the addition of coconut dregs can be seen in Table 7.

Table 7. Protein Content Of Corn Kipang with Coconut Dregs Addition

Treatment	Protein Content (%) Average ± SD
A (0% Coconut dregs Addition)	2.00 ± 0.00 a
B (2% Coconut dregs Addition)	2.69 ± 0.04 b
C (4% Coconut dregs Addition)	2.95 ± 0.03 c
D (6% Coconut dregs Addition)	3.04 ± 0.01 d
E (8% Coconut dregs Addition)	3.33 ± 0.01 e
F (10% Coconut dregs Addition)	4.04 ± 0.05 f
CV= 0.18%	

Description: SD = Standard Deviation. CV = Coefficient of Diversity. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) at 5% level.

Based on the protein content analysis results, the average protein content in corn kipang ranges from 2.00 to 4.04%. The highest protein content was obtained in treatment F with 10% coconut dregs, which is 4.04%. In contrast, the lowest protein content was obtained in treatment A without adding coconut dregs, which was 2%. This shows that as more coconut dregs are added, the product's protein content increases.

The protein content of corn kipang products is influenced by the addition of coconut dregs, which, based on the analysis of raw materials, contain a protein content of 3.05%. According to another research [23], substituting coconut dregs in bread increases protein levels. In addition, the value of protein content is also influenced by the corn used in the product. According to[13], the protein value of popcorn-type corn is 13.7%. High corn protein content can affect the value of the product's protein content.

3.2.4. Fat Content

Based on the results of fat content analysis, it is shown that adding coconut dregs has a significant effect at the level of 5% on the fat content of corn kipang produced. The results of the fat content analysis in corn kipang products with the addition of coconut dregs can be seen in Table 8.

Based on the fat content analysis, the average value of corn kipang fat content with the addition of coconut dregs ranges from 3.1 to 6.9%. The highest fat content was obtained in treatment F with 10% coconut dregs, which is 6.9%. In contrast, the lowest fat content was obtained in treatment A without adding coconut dregs, which was 2%. This shows that as more coconut dregs are added, the fat content of the product increases.

Compared with raw materials, coconut dregs have a high fat content of 29.3%, affecting the increase in kipang products' fat content. The fat content in corn kipang is also influenced by the margarine used in making corn brondong. This is because

margarine contains high fat. According to Winarno (2004), margarine contains 80% fat.

Table 8. Fat Content of Corn Kipang with Coconut Dregs Addition

Treatment	Fat Content (%) Average ± SD
A (0% Coconut dregs Addition)	3.90 ± 0.90 a
B (2% Coconut dregs Addition)	4.10 ± 0.70 a
C (4% Coconut dregs Addition)	4.70 ± 0.90 a
D (6% Coconut dregs Addition)	5,40 ± 0,80 ab
E (8% Coconut dregs Addition)	5.70 ± 1.90 b
F (10% Coconut dregs Addition)	6.90 ± 0.70 b
CV= 3.48%	

Description: SD = Standard Deviation. CV = Coefficient of Diversity. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) at 5% level.

3.2.5. Crude Fibers Content

Crude fibers are compounds that alkalis or acids cannot hydrolyze. Based on the crude fiber content analysis, adding coconut dregs has a real effect of 5% on the crude fiber content of corn kipang produced. The results of the analysis of crude fiber content in corn kipang products with the addition of coconut dregs can be seen in Table 9.

Table 9. Crude Fibers Content of Corn Kipang with Coconut Dregs Addition

Treatment	Crude Fibers Content (%) Average ± SD
A (0% Coconut dregs Addition)	3.16 ± 0.03 a
B (2% Coconut dregs Addition)	3.26 ± 0.04 b
C (4% Coconut dregs Addition)	3.40 ± 0.00 c
D (6% Coconut dregs Addition)	3.62 ± 0.03 d
E (8% Coconut dregs Addition)	3.89 ± 0.02 e
F (10% Coconut dregs Addition)	4.40 ± 0.09 f
CV = 0.20%	

Description: SD = Standard Deviation. CV = Coefficient of Diversity. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) at 5% level.

The average value of crude fiber content of corn kipang with the addition of coconut dregs ranges from 3.16 to 4.40%. The highest crude fiber content is treatment F, with the addition of 10% coconut dregs, which is 4.40%. In comparison, the lowest crude fiber content is found in treatment A, which is 3.16% without adding coconut dregs.

The increase in crude fiber value is due to the high fiber value of coconut dregs. Based on the raw materials analysis, the crude fiber value of coconut dregs was obtained at 24%. As more coconut dregs are added, the crude fiber content in corn kipang products increases. This is based on research[16], namely, the more substitutions of coconut dreg flour there are, the higher the crude fiber content in the product. Corn has a crude fiber content of 2.50% [15], which also affects the crude fiber content in the product.

According to Winarno [12], crude fiber is one of the constituents of cell walls in the form of cellulose, a very difficult material that is resistant to hydrolysis. Besides being very durable and resistant to hydrolysis, cellulose is also resistant to damage and not easily decomposed if exposed to heat. Coconut dregs contain fiber in the form of cellulose, which is high enough to play a role in physiological processes in the body. Although digestive enzymes cannot break down cellulose, it plays an important role in the digestive system because it can slow down the movement of food waste[24].

3.2.6. Carbohydrate Content

Carbohydrate levels are calculated with the "by difference" method, so that the levels will be influenced by water, ash, fat, and protein content. Based on the results of the variety analysis, adding coconut dregs has a significant effect at the 5% level on the carbohydrate content of corn kipang produced. The results of the analysis of carbohydrate levels in corn kipang products with the addition of coconut dregs can be seen in Table 10.

Table 10. Carbohydrate Content of Corn Kipang with Coconut Dregs Addition

Treatment	Carbohydrates Content (%) Average ± SD
F (10% Coconut dregs Addition)	79.27 ± 1.11 a
E (8% Coconut dregs Addition)	82.07 ± 0.23 ab
D (6% Coconut dregs Addition)	82.71 ± 0.23 bc
C (4% Coconut dregs Addition)	83.88 ± 0.58 bc
B (2% Coconut dregs Addition)	84.74 ± 1.53 cd
A (0% Coconut dregs Addition)	87.08 ± 0.96 d
CV= 1.49%	

Description: SD = Standard Deviation. CV = Coefficient of Diversity. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) at 5% level.

Based on the carbohydrate levels that have been carried out, the average value of corn kipang carbohydrates with the addition of coconut dregs ranges from 79.27 to 4.40%. The highest carbohydrate content was found in treatment F with 10% coconut dregs, which is 79.27%. In comparison, the lowest carbohydrate content is found in treatment A, which is without the addition of coconut dregs, at 87.08%. This indicates that increasing the amount of coconut dregs results in lower carbohydrate levels in corn kipang products. The value of water content, ash content, protein content, and fat content influences carbohydrate content. The greater the amount of coconut dregs in the product, the higher the values of water content, ash, protein, and fat, which in turn causes carbohydrate levels to decrease.

3.2.7. Total Sugar

Total sugar is a mixture of reduced and non-reduced sugar, resulting from starch hydrolysis. Reducing sugars are a group of sugars (carbohydrates) that can reduce electron-accepting compounds, such as glucose and fructose. The end of a reducing sugar is the end containing an aldehyde group or a free ketone. All monosaccharides (glucose, fructose, galactose) and disaccharides (lactose, maltose) except sucrose and starch (polysaccharides), are included as reducing sugars. [25]. Based

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on the results of the variety analysis, the addition of coconut dregs has a significant effect at the 5% level on the total sugar content of corn kipang produced. The results of the analysis of total sugar content in corn kipang products with the addition of coconut dregs can be seen in Table 11.

Table 11. Total Sugar of Corn Kipang with Coconut Dregs Addition

Treatment	Total Sugar (%) Average ± SD
A (0% Coconut dregs Addition)	61.95 ± 0.26 a
B (2% Coconut dregs Addition)	62.20 ± 0.13 a
C (4% Coconut dregs Addition)	62.85± 0.30 b
D (4% Coconut dregs Addition)	63.09 ± 0.16 b
E (8% Coconut dregs Addition)	63.98 ± 0.17 c
F (10% Coconut dregs Addition)	64.76 ± 0.31 d
CV= 0.06%	

Description: SD = Standard Deviation. CV = Coefficient of Diversity. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) at 5% level.

Based on the total sugar content analysis, the average total sugar content of corn kipang with the addition of coconut dregs ranges from 61.95 to 63.98%. The highest total sugar content was in treatment F with the addition of 10% coconut dregs, which is 64.76%. In comparison, the lowest total sugar content is found in treatment A, without adding coconut dregs, at 61.95%.

The total sugar results show that the greater the amount of coconut dregs added, the more total sugar there is in kipang products. According to Yalegama et al. [19], the sugar content found in coconut dregs is 7.1%. The sugar content in the coconut dregs affects the product's total sugar value. The sugar content also influences the total sugar content in brown sugar. Based on the raw materials analysis, the total sugar in brown sugar was obtained at 99.75%.

The increase in sugar content in the product is thought to be due to starch in the coconut dregs used. The starch in coconut dregs is suspected to undergo hydrolysis when making products. Starch hydrolysis is the breakdown of amylum molecules into their constituent simple parts or components such as dextrins, maltotriose, maltose, and glucose[19]. Starch is one of the constituents of carbohydrates. According to Yalegama et al. [19], the carbohydrate content in coconut dregs is 19.2%.

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3.3. Organoleptic Test

The organoleptic test carried out in this study is the hedonic test or favorability test. This test was conducted to determine panelists' level of acceptance of corn kipang products with the addition of roasted coconut dregs. Organoleptic tests were carried out by 30 panelists with parameters including color, aroma, texture, and taste. The hedonic scale is carried out using five numerical scales, namely very like (5), like (4), ordinary (3), dislike (2), and very dislike (1). Here are the results of corn kipang products with the addition of coconut dregs. The appearance of the Corn Kipang product with Coconut Dregs Addition can be seen in Figure 1.

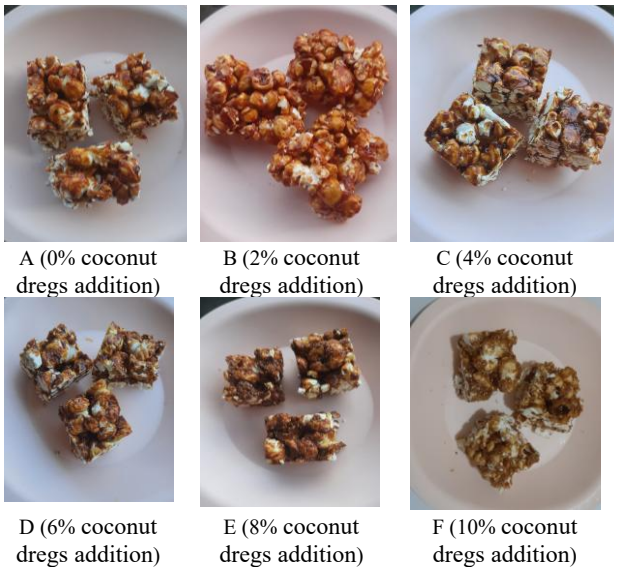

Fig 1. Corn Kipang with Coconut Dregs Addition.

3.3.1. Color

Colour is the fastest thing to impress consumers or panellists, but it is also the most difficult to measure, making colour measurement very subjective [22]. The level of acceptance of the color of corn kipang with the addition of coconut dregs can be seen in Table 12.

Based on Table 12, the average organoleptic value of corn kipang colour with the addition of coconut dregs ranges from 3.77 to 4.40%. The highest average value given by the panellists was in treatment A without adding coconut dregs, which was 4.40%, indicating that the panellists liked the colour of corn kipang. The colour of corn kipang, which has the lowest average value, is found in treatment F with the addition of 10% coconut dregs, resulting in a value of 3.77%, indicating it remains in the "like" level category.

Based on the ANOVA results, adding coconut dregs to corn kipang significantly affects the panellists' acceptance of its colour at a 5% level. The more coconut dregs added to corn kipang

products, the more their color fades. The fading color in corn kipang is caused by the large amount of coconut dregs added to corn kipang products. Coconut dregs added to kipang products absorb brown sugar during mixing, causing the product's colour to fade from deep brown to a lighter shade.

Table 12. The Level of Acceptance of The Color of Corn Kipang with Coconut Dregs Addition

Treatment	Average Score ± SD
F (10% Coconut dregs Addition)	3.77 ± 0.62 a
E (8% Coconut dregs Addition)	3.93 ± 0.60 ab
D (6% Coconut dregs Addition)	3.97 ± 0.66 abc
C (4% Coconut dregs Addition)	4.20 ± 0.58 bcd
B (2% Coconut dregs Addition)	4.30 ± 0.61 cd
A 0% Coconut dregs Addition)	4.40 ± 0.68 d
CV= 15.32%	

Description: SD = Standard Deviation. CV = Coefficient of Diversity. Note: 1 = very dislike, 2 = dislike, 3 = ordinary, 4 = like, 5 = very like. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) at 5% level.

3.3.2. Aroma

Aroma is one of the important factors in determining the level of consumer acceptance of a food product. The aroma determines the deliciousness of a food ingredient; a person can usually judge whether or not a food is delicious from the aroma it causes. The formation of volatile compounds causes the emergence of aroma in food. The aroma released by each food is different. Aroma is the second factor affecting the taste of food or beverages[20]. The level of acceptance of the aroma of corn kipang with coconut dregs addition can be seen in Table 13.

Table 13. The Level of Acceptance of The Aroma of Corn Kipang with Coconut Dregs Addition

Treatment	Average Score ± SD
E (8% Coconut dregs Addition)	3.90 ± 1.11
D (6% Coconut dregs Addition)	3.93 ± 0.23
A (0% Coconut dregs Addition)	3.97 ± 0.23
F (10% Coconut dregs Addition)	4.07 ± 0.58
B (2% Coconut dregs Addition)	4.10 ± 1.53
C (4% Coconut dregs Addition)	4.17 ± 0.96
CV= 14.87%	

Description: SD = Standard Deviation. CV= Coefficient of Diversity. Note: 1 = very dislike, 2 = dislike, 3 = ordinary, 4 = like, 5 = very like. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) 5% level.

Based on the Table 13, the average organoleptic value of corn kipang aroma with the addition of coconut dregs ranges from 3.90 – 4.17%. The highest average aroma value, assessed by the panellists, was in treatment C, which added 4% Coconut Dregs, resulting in a value of 4.17%. This indicates that the panellists liked the aroma of corn kipang. The aroma of corn kipang, which has the lowest average value, is obtained in treatment E without the addition of coconut dregs, at 3.90%, indicating it still falls within the like value category.

Based on the results of the variety analysis, it was found that adding coconut dregs to corn kipang had no significant effect on the panellists' favorability value for the aroma of corn kipang with the addition of coconut dregs at a 5% level. The aroma of corn kipang products is influenced by the caramelization process in the cooking of brown sugar. The heating of sugar will increase the breakdown of molecules and the formation of aroma, namely caramel aroma [21].

3.3.3. Taste

Taste is a sensation felt by the taste buds when they mix different ingredients into the food dough. Taste is also an important parameter in determining whether or not a product is accepted by panelists[26]. The formulation of such products largely determines the taste of food. Taste is judged by the presence of chemical stimulus responses by the tongue. The level of acceptance of the taste of corn kipang with coconut dregs addition can be seen in Table 14.

Table 14. The Level of Acceptance of The Taste of Corn Kipang with Coconut Dregs Addition

Treatment	Average Score ± SD
A (0% Coconut dregs Addition)	3.73 ± 0.03 a
B (2% Coconut dregs Addition)	3.77 ± 0.04 a
C (4% Coconut dregs Addition)	3.83 ± 0.00 a
D (6% Coconut dregs Addition)	3.90 ± 0.03 a
E (8% Coconut dregs Addition)	4.10 ± 0.02 ab
F (10% Coconut dregs Addition)	4.27 ± 0.09 b
CV = 16.88%	

Description: SD = Standard Deviation. CV = Coefficient of Diversity. Note: 1 = very dislike, 2 = dislike, 3 = ordinary, 4 = like, 5 = very like. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) at 5% level.

Based on Table 14, the average organoleptic value of corn kipang taste with adding coconut dregs ranges from 3.73 to 4.27%. The highest average score given by the panelists was found in treatment F with the addition of 10% coconut dregs, which is 4.27%, meaning that the panelists liked the taste of corn kipang. The taste of corn kipang, with the lowest average value, is found in treatment A without coconut dregs, which is 3.73%, indicating it still falls within the like value category.

Based on the ANOVA results, the addition of coconut dregs to corn kipang has a significant effect at the 5% level on the panellists' favorability of the corn kipang taste with coconut dregs. The sugar and fat from coconut dregs influence the taste of corn. Brown sugar gives sweetness to the product. Based on [23], the cause of increased savory taste of a product is determined by the large amount of fat and protein content. This shows that coconut dregs can add a savory taste to corn kipang products.

3.3.4. Crispiness

Crispiness is a texture valued based on ease of biting and involves the five senses of hearing. The level of acceptance of the crispiness of corn kipang with the addition of coconut dregs can be seen in Table 15.

Based on Table 15, the average organoleptic value of corn kipang crispiness with adding coconut dregs ranges from 3.60 to 4.10%. The highest average value given by the panelists was in

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treatment F with the addition of 10% coconut dregs, which is 4.10%, meaning that the panelists liked the crispiness of corn kipang. Although the crispiness of corn kipang with the lowest average value, treatment A, which does not add coconut dregs, has a value of 3.60%, it still falls within the "like" category.

Table 15. The Level of Acceptance of The Crispiness of Corn Kipang with Coconut Dregs Addition

Treatment	Average Score ± SD
A 0% Coconut dregs Addition)	3.60 ± 0.03 a
B (2% Coconut dregs Addition)	3.63 ± 0.04 ab
C (4% Coconut dregs Addition)	3,67 ± 0,00 ab
D (6% Coconut dregs Addition)	3.70 ± 0.03 abc
E (8% Coconut dregs Addition)	4.03 ± 0.02 bc
F (10% Coconut dregs Addition)	4.10 ± 0.09 c
CV= 19.69%	

Description: SD = Standard Deviation. CV = Coefficient of Diversity. Note: 1 = very dislike, 2 = dislike, 3 = ordinary, 4 = like, 5 = very like. Numbers in the same column are followed by lowercase letters; those that are not the same are significantly different according to *Duncan's New Multiple Range Test* (DNMRT) at 5% level.

Based on the results of the variety analysis, adding coconut dregs to corn kipang has a significant effect at the 5% level on the panellists' favorability value for the crispiness of corn kipang with the addition of coconut dregs. Based on the analysis results, the more coconut dregs used, the higher the panellists' assessment of crispiness. This may be due to the fat content in coconut dregs, which gives treatment product F a higher crispiness than treatment product A.

3.4. Glycemic Index

Glycemic Index testing is an in vivo test because it uses humans as subjects. The glycemic index provides clues to the effect of food on blood sugar levels and insulin response [27]. Foods assessed for glycemic index include corn kipang without coconut dregs (control) and F treatment corn kipang with 10% coconut dregs (best). The standard food used is pure glucose, with a weight of 50 g, whereas the weight of the test food is listed in Table 16.

Table 16. Amount of Test Food Equivalent to 50 grams Carbohydrates

Test Products	Carbohydrates (%)	The number of samples is equivalent to 50 grams of carbohydrates (g)
Kipang Control	87.08	57
Kipang Perlakuan 10%	79.27	63

Information:

Number of samples = $\frac{50\ g}{Kadar\ Karbohidrat} \times 100$

As a comparison, the standard food used in the test is pure glucose. Each ingredient must contain 50 g of carbohydrates, which can be determined from the carbohydrate content of the product.

3.4.1 Blood Glucose Level

The average blood glucose results of respondents to the administration of pure glucose, control corn pangs, and corn pangs with the addition of coconut dregs can be seen in Table 17.

Table 17. The Blood Glucose Level (mg/dL)

Test Products	Time (minutes)				
	0	30	60	90	120
Glucose murni	74.1	130.3	123.6	107.6	86.3
Kipang Control	78.2	135	109.6	81.2	73.1
Kipang (10% coconut dregs)	71.2	122.1	94.4	81.5	67.2

The blood glucose levels obtained are plotted as a curve, with the X axis representing the time of blood collection and the Y axis representing the blood glucose levels, as shown in Fig. 2.

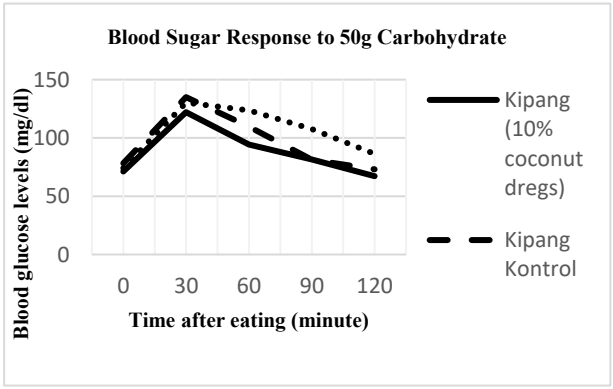

Fig 2. Graph of Blood Sugar Subject Response After Consumption of Corn Kipang with Addition of Coconut Dregs, Control Kipang, and Standard Glucose

Based on Fig. 2, it can be seen that the peak of the rise in blood glucose levels occurs in the 30th minute after eating the product. At the 60th-minute, blood glucose decreases gradually. The peak increase in blood sugar levels decreases with the addition of coconut dregs in corn kipang products, so that the addition of coconut dregs in corn kipang affects the decrease in the glycemic index of the product.

3.4.2 Glycemic Index of The Corn Kipang

The glycemic index value of corn kipang without the addition of coconut dregs obtained is 75.31, and in corn kipang with the addition of coconut dregs as much as 10%, which is 56.35 (Table 18). Based on the IG value obtained, the control corn kipang (A formulation) has a high IG category. Meanwhile, corn kipang, with the addition of coconut dregs, is categorized as 10%, which is a medium category, where the IG value is almost close to the low IG category. This shows that the addition of coconut dregs can reduce the IG of the product.

Foods with low IG will be slowly overhauled and absorbed into the bloodstream to lower blood sugar levels. Conversely, foods with high IG will be quickly broken down and absorbed into the bloodstream to increase blood sugar levels[29].

Table 18. Glycemic Index of Corn Kipang With The Addition Of Coconut Dregs

Test Products	Luas Area	Glycemic index	Category*
Kipang Control	28325	75,31	High
Kipang (10% coconut dregs)	25082,5	56,35	Medium

Information:
*Category: low IG (<55), medium IG (55-70), high IG (>70)

The decreasing IG value of the product is due to the high fibre content of coconut dregs. Consequently, increasing the concentration of coconut dregs added to corn kipang increases the fibre content of kipang. The IG of kipang will decrease as the fibre content of kipang increases. Fiber can act as a physical barrier to digestion when fiber is present in an intact state, resulting in a lower IG. In the digestive tract, the density or thickness of the food mixture is thickened by coarse fiber. This can cause the passage of food in the digestive tract to be slowed down and the movement of enzymes inhibited. More viscous foods will slow down the process of emptying the stomach and cause slow digestion of food. Slow digestion can lead to decreased absorption of nutrients, including glucose. Slowed gastric emptying and slow digestion can provide a longer feeling of fullness and a decrease in food intake. A decrease in glucose absorption and food intake will lower blood glucose levels [29].

Food products with high fat content tend to slow down the rate of gastric emptying, thereby slowing down the rate of digestion of food in the small intestine. One of the key characteristics of protein is its ability to trigger insulin secretion without increasing blood glucose. This can occur because insulin secretion triggered by the presence of protein is relatively weaker compared to that triggered by carbohydrates. In addition, protein digestion can also trigger the release of hormones (cholecystokinin), which can increase satiety[30] to keep blood glucose levels normal and under control. Therefore, foods with higher fat and protein content usually have lower IG than foods with lower fat and protein content[31].

4. CONCLUSION

Based on the results of research, the results showed that the addition of coconut dregs can have a significant effect on the level (α=5%) on the analysis of levels, fats, proteins, crude fiber, carbohydrates, and total sugars, as well as organoleptic color, taste, and crispness in corn kipang with the addition of coconut dregs produced. In comparison, there was no significant effect on the level (α= 5%) of moisture, ash, and aroma content values. Based on the results obtained, treatment F (addition of coconut dregs 10%) as the best product with the average parameters of panelists' liking for color 3.77 (likes), aroma 4.07 (likes), taste 4.27 (likes), and crispiness 4.10 (likes) with the results of analysis of water content (8.13%), ash (1.67%), fat (6.90%), protein (4.04%), carbohydrates (79.27%), crude fiber (4.40%), and total sugar (64.76%).

Product F is acceptable to the panelists, so Product F is declared the best product. Based on the glycemic index classification, corn kipang products with the addition of coconut dregs are classified as medium IG category at 56.35, while corn kipang products without adding coconut dregs are classified as high IG category at 75.31. This shows that adding coconut dregs can reduce the IG value of a product.

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