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Innovation of Canna Moringa Roll with Substitution Using Canna Flour and Moringa Leaves as a Source of Iron for Teenage Girls

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ABSTRACT

The love letter cookies in the research were made by substituting canna flour and moringa leaves. This research aimed to (1) formulate the recipe of Canna Moringa Roll; (2) select the presentation and packaging of Canna Moringa Roll; (3) identify the level of acceptance of Canna Moringa Roll products by young women; (4) identify the nutritional information of Canna Moringa Roll products; (5) identify the iron content of Canna Moringa Roll; and (6) determine the selling price and BEP of Canna Moringa Roll products. The research employed the research and development (R&D) method with the 4D model, namely the defining stage, by selecting one recipe from three reference recipes; the designing stage, by selecting the best development recipe from three development variations; the developing stage, by using the validation process for the recipe through a limited preference test of 30 panelists; and the disseminating stage, testing the level of product acceptance by 80 panelists of teenage girls. Then proximate and iron tests were carried out, and the selling price and BEP were calculated. The data were analyzed using a quantitative descriptive method with sensory tests and p-value tests. The research findings were; (1) the best formulation used a substitution of 75% ganyong flour and 5% moringa leaves; (2) a food basket container and a transparent jar were used for serving; (3) the level of acceptance increased from 4.3 in the reference product to 4.5 in the development product; (4) the product contained a total energy of 594 kcal, 18 g fat (26%), 6 g protein (10%), 102 g carbohydrates (32%); and (5) the iron content in the development product was 6 mg (35%), (6) The selling price of the product was IDR 32,000 per package, with a BEP unit of 4 and a rupiah BEP of IDR 112,500.

Keywords:
love letter cookies, canna flour, moringa leaves, iron, adolescent girls

Kue Semprong yang dibuat dalam penelitian adalah dengan melakukan substitusi tepung ganyong dan daun kelor. Penelitian ini bertujuan untuk: (1) Menentukan formulasi Canna Moringa Roll, (2) Menentukan penyajian dan kemasan Canna Moringa Roll, (3) Mengetahui tingkat penerimaan remaja putri produk Canna Moringa Roll, (4) Mengetahui informasi gizi produk Canna Moringa Roll, (5) Mengetahui kandungan zat besi Canna Moringa Roll, (6) Mengetahui harga jual dan BEP produk Canna Moringa Roll.

Penelitian menggunakan metode Research and Development (R&D) dengan model 4D yaitu Tahap define, menentukan 1 resep dari 3 resep acuan, Tahap

design , menentukan 1 resep pengembangan terbaik dari 3 variasi pengembangan, Tahap develop, proses validasi terhadap resep melalui uji kesukaan terbatas sebanyak 30 panelis, Tahap disseminate, pengujian tingkat penerimaan produk oleh 80 panelis remaja putri, selanjutnya dilakukan uji proksimat dan zat besi serta menghitung harga jual dan BEP. Data dianalisis menggunakan metode desktiptif kuantitatif dengan uji sensoris dan uji p-value. Hasil penelitian yang diperoleh adalah (1) Formulasi terbaik menggunakan substitusi 75% tepung ganyong dan 5% daun kelor, (2) Penyajian menggunakan wadah keranjang makanan dan dikemas dalam toples transparan, (3) Tingkat penerimaan meningkat dari 4,3 pada produk acuan menjadi 4,5 pada produk pengembangan, (4) Produk mengandung energi total 594 kkal, lemak 18 gr (26%), protein 6 gr (10%), karbohidrat 102 gr (32%), (5) Kandungan zat besi pada produk pengembangan sebesar 6 mg (35%), (6) Harga jual produk sebesar Rp 32.000 per kemasan dengan BEP unit 4 dan BEP rupiah Rp Rp 112.500.

1. Introduction

Iron deficiency remains an important nutritional problem among adolescent girls. Adolescence is a period of rapid physical growth and psychosocial development, which increases the need for adequate nutrient intake, including iron [1]. Iron plays an essential role in hemoglobin formation, energy metabolism, immune function, and cognitive performance. In adolescent girls, iron requirements are higher due to monthly blood loss during menstruation, making them more vulnerable to iron deficiency when daily food intake does not meet nutritional needs [2], [3]. Low iron intake may lead to fatigue, reduced concentration, decreased immunity, and lower academic performance [2].

The problem of iron deficiency among adolescent girls is closely related to dietary patterns. Many adolescents tend to choose practical, affordable, and taste-oriented foods rather than foods with high nutritional value. The consumption of iron-rich foods is still relatively low, especially when food preferences and daily eating habits limit the intake of iron-source foods [4], [5]. This condition indicates the need for food-based interventions that are not only nutritious but also practical, affordable, and acceptable to adolescent girls.

Several studies have developed local food-based products to improve nutritional value, particularly iron content. Canna flour has been used as a substitute ingredient in various food products because it contains carbohydrates, minerals, and higher iron content than rice flour [12]. Moringa leaves have also been widely studied as a nutrient-rich ingredient because they contain iron, vitamins, minerals, and bioactive compounds that may support nutritional improvement [9]. Previous studies reported that the addition of moringa leaf flour to biscuits, cookies, and other bakery products increased iron content, although excessive addition could affect color, aroma, taste, and texture [14], [15].

Product development using canna flour and moringa leaves has shown promising results, especially in improving nutritional quality while maintaining sensory acceptability. Kurniawan found that biscuits made with canna flour and moringa leaf flour had higher iron content than conventional products, but the formulation needed to be carefully adjusted to maintain consumer acceptance [13]. Santoso also reported that the use of local food ingredients and moringa leaves in cake products could improve nutritional value while preserving acceptable sensory characteristics [16]. These findings suggest that the combination of local ingredients and nutrient-dense plant materials can be applied to functional snack development.

However, previous studies have mostly focused on biscuits, cookies, and dry cakes, while the development of *semprong* as a traditional rolled snack using canna flour substitution and moringa leaves has received limited attention. *Semprong* is a traditional Indonesian snack with

a sweet taste and crispy texture that is generally accepted by many consumers, including adolescents [17]. Conventional *semprong* is commonly made from rice flour, which has relatively low iron content [8]. Therefore, replacing part of the rice flour with canna flour and adding moringa leaves may improve the nutritional value of the product while maintaining its traditional characteristics.

Canna Moringa Roll is developed as an innovative form of *semprong* using canna flour and moringa leaves as functional ingredients. This product is expected to provide an alternative iron-source snack for adolescent girls while supporting the utilization of local food resources. The product development also considers sensory quality, serving technique, packaging, nutritional information, iron content, selling price, and Break Even Point analysis so that the product can be evaluated not only from a nutritional perspective but also from consumer acceptance and business feasibility [19], [20].

Based on the limited studies that specifically combine canna flour and moringa leaves in *semprong* products, this research is significant in developing a local food-based snack that is nutritious, acceptable, and potentially useful for improving iron intake among adolescent girls. This study aims to: (1) determine the appropriate formulation of Canna Moringa Roll; (2) identify suitable serving and packaging techniques; (3) analyze the acceptability level of Canna Moringa Roll among adolescent girls; (4) determine its nutritional information and iron content; and (5) calculate the selling price and Break Even Point. This research uses a product development approach through formulation trials, organoleptic testing, proximate analysis, iron content analysis, and economic feasibility calculation [18].

2. Method

2.1 Research Design

This study used a research and development approach with the 4D model, consisting of define, design, develop, and disseminate stages. The model was applied to develop Canna Moringa Roll, a modified traditional *semprong* product made with canna flour substitution and moringa leaf addition. The study focused on product formulation, sensory acceptability, nutritional content, iron content, selling price, and Break Even Point analysis.

2.2 Research Location and Materials

The product formulation and sensory evaluation were conducted at the Culinary Laboratory and Chemistry Laboratory, Applied Bachelor Program of Culinary Arts, Faculty of Vocational Studies, Universitas Negeri Yogyakarta, Wates Campus. The large-scale acceptability test was conducted during a culinary exhibition at Universitas Negeri Yogyakarta, Wates Campus. The proximate and iron content analyses were carried out at Chem-Mix Pratama Laboratory, Bantul, Yogyakarta. The research was conducted from September 2025 to May 2026.

The main ingredients used in this study were canna flour, dried moringa leaves, rice flour, sago flour, eggs, coconut milk, margarine, powdered sugar, salt, and sesame seeds. The main equipment included a mixing bowl, whisk, sieve, *semprong* mold, gas stove, tray, ladle, and digital scale.

2.3 Product Development Procedure

The product development procedure followed the four stages of the 4D model. In the define stage, three reference recipes of *semprong* were collected, tested, and evaluated to determine the best basic formula. The formula with the highest average sensory score was selected as the reference formula.

In the design stage, the selected formula was modified through two formulation trials. The first trial substituted rice flour with canna flour at 50%, 75%, and 100%. The second trial added moringa leaves to the selected canna flour formulation at 5%, 7.5%, and 10%. Each formulation was evaluated based on sensory attributes to determine the best product formula.

In the develop stage, the selected formulation was validated by expert panelists through two validation stages. Product revision was carried out based on the suggestions obtained from the first validation. After the second validation, a limited sensory acceptability test was conducted involving 30 semi-trained panelists. This stage also determined the serving technique and packaging of the final product.

In the disseminate stage, the final product was introduced through a culinary exhibition. A large-scale acceptability test was conducted involving 80 untrained panelists, particularly adolescent girls and general consumers. The final product was then analyzed for nutritional content, iron content, selling price, and Break Even Point.

2.4 Sensory and Laboratory Analysis

Sensory evaluation was conducted using a five-point hedonic scale to determine panelists' acceptance of Canna Moringa Roll. The evaluated attributes included color, aroma, taste, texture, packaging, and overall acceptability. The scale ranged from 1 to 5, with higher scores indicating higher product acceptance.

Laboratory analysis was conducted to determine the nutritional quality of the selected product. Proximate analysis was used to determine water, ash, protein, fat, carbohydrate, and energy content. Iron content analysis was conducted to determine the Fe level of the developed product. The results were used to prepare the nutritional information of Canna Moringa Roll.

2.5 Data Analysis

The sensory evaluation data were analyzed using descriptive quantitative analysis by calculating the mean score of each attribute. The results were used to determine the best formulation and the level of product acceptability. A t-test was used to compare the sensory acceptance between the reference product and the developed product. The selling price was calculated using a cost-plus pricing approach, while Break Even Point analysis was used to determine the minimum sales volume required to cover production costs.

3. Results and Discussion

3.1 Results

a. Define Stage: Determining the Reference Recipe of Semprong

The define stage was conducted by collecting three traditional *semprong* recipes from different sources. These recipes were tested to determine the most suitable reference formulation for the development of Canna Moringa Roll. The selection of the reference recipe was based on sensory characteristics, including shape, size, color, aroma, taste, texture, and overall acceptability. The three reference recipes used in this study are presented in Table 1.

Table 1. Reference Recipes of Traditional Semprong

Ingredients	Recipe 1	Recipe 2	Recipe 3
Rice flour	250 g	225 g	300 g
Wheat flour	-	-	50 g
Sago flour	60 g	40 g	-
Eggs	3 pcs	3 pcs	1 pc
Granulated sugar	-	150 g	170 g
Powdered sugar	160 g	-	-
Coconut milk	250 ml	200 ml	330 ml
Margarine	3 tbsp	40 g	50 g
Salt	1/2 tsp	-	1/4 tsp
Sesame seeds	-	40 g	30 g
Vanilla	-	-	1/2 tsp

Source: Recipe 1 = Koleksi Resep Jajanan Pasar (2013); Recipe 2 = Wati (2013); Recipe 3 = YouTube Dapur Nana's.

Table 1 shows that the three reference recipes had different ingredient compositions, especially in the use of flour, sugar, coconut milk, margarine, and additional flavoring ingredients. Recipe 1 used rice flour and sago flour with powdered sugar, while Recipe 2 used rice flour, sago flour, granulated sugar, and sesame seeds. Recipe 3 used rice flour and wheat flour with vanilla and sesame seeds. These differences affected the final characteristics of the product, particularly texture, aroma, and color.

After the recipes were tested, sensory characteristics were observed to compare the quality of each reference product. The sensory characteristics of the three reference recipes are shown in Table 2.

Table 2. Characteristics of the Three Reference Recipes

Characteristics	Recipe 1	Recipe 2	Recipe 3
Color	Golden yellow	Golden yellow	Brownish yellow
Aroma	Coconut milk aroma	Coconut milk and sesame aroma	Vanilla aroma
Texture	Crispy	Crispy	Hard
Taste	Sweet	Sweet	Sweet
Shape	Cylindrical	Cylindrical	Cylindrical
Size	14 cm	14 cm	14 cm

Based on Table 2, Recipe 1 and Recipe 2 produced a crispy texture and golden yellow color, while Recipe 3 produced a harder texture and a darker color. Recipe 1 was considered more balanced because it produced a sweet taste, crispy texture, and coconut milk aroma that matched the expected characteristics of traditional *semprong*. The documentation of the three reference products can be presented in Fig. 1.

a) b) c)

Figure 1. Documentation of reference products at the define stage: (a) R1, (b) R2, (c) R3.

The mean sensory scores of the three reference recipes are presented in Table 3.

Table 3. Mean Sensory Scores of the Define Stage

Sensory Properties	Recipe 1	Recipe 2	Recipe 3
Shape	4.4	4.4	4.4
Size	4.4	4.8	4.2
Color	4.4	4.6	4.4
Aroma	4.4	4.0	4.0
Taste	4.8	4.0	3.6
Texture	4.8	4.0	3.4
Overall	4.6	3.8	3.46

Table 3 shows that Recipe 1 obtained the highest overall score of 4.6. Recipe 1 also obtained the highest scores in taste and texture, with both attributes reaching 4.8. Therefore, Recipe 1 was selected as the reference formulation for the next development stage.

b. Design Stage: Developing the Canna Flour and Moringa Leaf Formulation

The design stage was conducted in two formulation trials. The first trial focused on substituting rice flour with canna flour at 50%, 75%, and 100%. This trial aimed to determine the highest level of canna flour substitution that could still maintain acceptable sensory characteristics. The canna flour substitution formula is presented in Table 4.

Table 4. Canna Flour Substitution Formulation

Ingredients	Reference	F1 50%	F2 75%	F3 100%
Rice flour	250 g	125 g	62.5 g	-
Sago flour	60 g	60 g	60 g	60 g
Canna flour	-	125 g	187.5 g	250 g
Eggs	3 pcs	3 pcs	3 pcs	3 pcs
Powdered sugar	160 g	160 g	160 g	160 g
Coconut milk	250 ml	250 ml	250 ml	250 ml
Margarine	3 tbsp	3 tbsp	3 tbsp	3 tbsp
Salt	1/2 tsp	1/2 tsp	1/2 tsp	1/2 tsp

The sensory characteristics of the canna flour substitution products are shown in Table 5.

Table 5. Characteristics of Canna Flour Substitution Products

Characteristics	F1 50%	F2 75%	F3 100%
Color	Brownish yellow	Golden yellow	Brownish yellow
Aroma	Coconut milk aroma	Coconut milk aroma	Coconut milk aroma
Texture	Crispy	Crispy	Crispy
Taste	Sweet	Sweet	Sweet, slightly bitter
Size	16 cm	14 cm	14 cm

Table 5 shows that the 75% canna flour substitution produced the most balanced characteristics. The product had a golden yellow color, crispy texture, and sweet taste. Meanwhile, 100% canna flour substitution produced a slightly bitter taste, indicating that excessive substitution could reduce taste acceptability. The mean sensory scores of the design stage are presented in Table 6.

Table 6. Mean Sensory Scores of Canna Flour Substitution

Sensory Properties	Reference	F1 50%	F2 75%	F3 100%
Shape	4.0	4.0	4.6	4.0
Size	4.0	3.8	4.0	4.0
Color	3.8	4.2	4.0	3.6
Aroma	4.2	4.0	3.8	3.8
Taste	3.8	3.8	4.4	4.2
Texture	4.0	4.2	3.8	4.0
Overall	4.04	4.22	4.24	3.90

Based on Table 6, F2 with 75% canna flour substitution obtained the highest overall score of 4.24. This formulation was selected for the second design stage, namely the addition of moringa leaves. The documentation of canna flour substitution products can be presented in Fig. 2.

a) b) c)

Figure 2. Documentation of canna flour substitution products at the design stage: (a) F1 50%, (b) F2 75%, (c) F3 100%.

The second formulation trial was conducted by adding moringa leaves to the selected 75% canna flour formulation. The levels of moringa leaves used were 12.5 g, 25 g, and 37.5 g. The formulation is presented in Table 7.

Table 7. Moringa Leaf Addition Formulation

Ingredients	Reference	F1	F2	F3
Rice flour	250 g	62.5 g	62.5 g	62.5 g
Sago flour	60 g	60 g	60 g	60 g
Canna flour	-	187.5 g	187.5 g	187.5 g
Moringa leaves	-	12.5 g	25 g	37.5 g
Eggs	3 pcs	3 pcs	3 pcs	3 pcs
Powdered sugar	160 g	160 g	160 g	160 g
Coconut milk	250 ml	250 ml	250 ml	250 ml
Margarine	3 tbsp	3 tbsp	3 tbsp	3 tbsp
Salt	1/2 tsp	1/2 tsp	1/2 tsp	1/2 tsp

The sensory characteristics of products with moringa leaf addition are presented in Table 8.

Table 8. Characteristics of Moringa Leaf Addition Products

Characteristics	F1	F2	F3
Color	Brownish yellow	Brownish yellow	Brownish yellow
Aroma	Moringa aroma	Moringa aroma	Moringa aroma
Texture	Crispy	Crispy	Crispy
Taste	Sweet, slight moringa taste	Sweet with moringa taste	Dominant moringa taste
Size	14 cm	14 cm	14 cm

Table 8 shows that the addition of moringa leaves affected the color, aroma, and taste of the product. A higher amount of moringa leaves produced a stronger moringa aroma and a more dominant taste. Therefore, the formulation required further adjustment during the validation stage to reduce the strong aroma and bitter taste.

The mean sensory scores of moringa leaf addition products are shown in Table 9.

Table 9. Mean Sensory Scores of Moringa Leaf Addition

Sensory Properties	Reference	F1	F2	F3
Shape	4.0	3.8	4.0	4.0
Size	4.0	4.0	4.0	4.2
Color	4.2	4.0	4.0	4.0
Aroma	4.2	3.4	3.4	3.8
Taste	4.2	3.8	4.0	3.8
Texture	4.2	4.2	4.2	4.0
Overall	4.4	4.1	4.0	3.8
Mean	-	3.90	3.94	3.94

Table 9 shows that F2 and F3 obtained the same mean score of 3.94. However, F2 with 25 g moringa leaves was initially selected because it produced a more balanced sensory profile than F3. Since the moringa aroma and taste were still considered strong, the formulation was further improved in the development stage. The documentation of moringa leaf addition products can be presented in Fig. 3.

c. Development Stage: Validation and Final Formulation of Canna Moringa Roll

The development stage was conducted through expert validation. The selected formulation from the design stage was evaluated by two trained panelists. In the first validation, the experts suggested reducing the amount of moringa leaves because the product still had a strong moringa aroma and a slightly bitter taste. Roasted sesame seeds were then added to improve aroma, taste balance, and product acceptability.

After revision, the final formulation used 75% canna flour substitution, 12.5 g moringa leaves, and 12.5 g roasted sesame seeds. The final formulation of Canna Moringa Roll is presented in Table 10.

Table 10. Final Formulation of Canna Moringa Roll

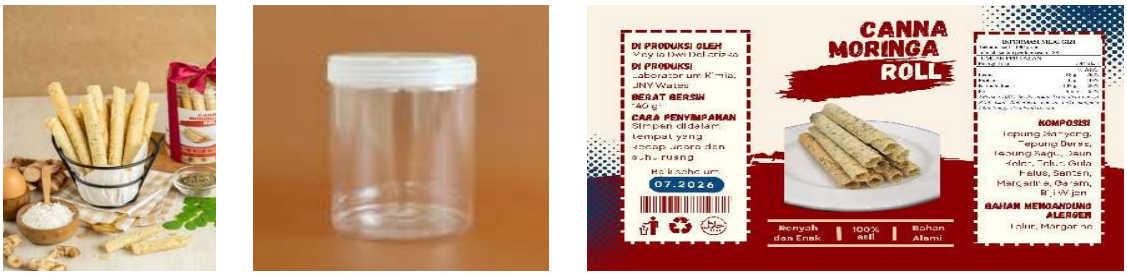
Ingredients	Amount
Rice flour	62.5 g
Sago flour	60 g
Canna flour	187.5 g
Moringa leaves	12.5 g
Roasted sesame seeds	12.5 g
Eggs	3 pcs
Powdered sugar	160 g
Coconut milk	250 ml
Margarine	3 tbsp
Salt	1/2 tsp

The sensory validation results of the final product are presented in Table 11.

Table 11. Sensory Test Results of the Validation Stage

Sensory Properties	Reference	Category	Canna Moringa Roll	Category
Shape	4.0	Like	4.5	Like
Size	4.0	Like	4.5	Like
Color	4.0	Like	4.5	Like
Aroma	4.0	Like	4.5	Like
Taste	4.0	Like	4.0	Like
Texture	3.5	Slightly like	4.0	Like
Overall	4.0	Like	4.5	Like
Mean	3.92	Slightly like	4.30	Like

Table 11 shows that Canna Moringa Roll obtained a mean score of 4.30 and was categorized as liked. This result indicates that the reformulation successfully improved product acceptability, especially in aroma, color, texture, and overall evaluation. The final product, serving presentation, and packaging can be presented in Figure 3.



a) b) c)

Figure 3. Final product, serving presentation, and packaging of Canna Moringa Roll: (a) final product, (b) serving presentation, (c) packaging and label.

Canna Moringa Roll was served in a food basket lined with white paper to maintain cleanliness and improve visual appearance. The product was packaged in a transparent 750 ml cylindrical jar with a net weight of 140 g. The packaging was completed with a label containing product identity, composition, nutrition information, and net weight.

d. Dissemination Stage: Consumer Acceptance of Canna Moringa Roll

The dissemination stage was conducted through a large-scale preference test involving 80 untrained panelists, particularly adolescent girls and general consumers. The test was carried out during the Wonderoots 2025 culinary exhibition at Universitas Negeri Yogyakarta, Wates Campus. The panelists evaluated the reference product and the developed product using a five-point hedonic scale. The results are presented in Table 12.

Table 12. Large-Scale Preference Test Results

Sensory Properties	Reference Product	Canna Moringa Roll	p-value	Description
Taste	4.3 ± 0.62	4.4 ± 0.59	0.129	Not significantly different
Aroma	4.3 ± 0.64	4.4 ± 0.61	0.114	Not significantly different
Texture	4.3 ± 0.61	4.5 ± 0.50	0.001	Significantly different
Color	4.3 ± 0.62	4.5 ± 0.54	$p < 0.001$	Significantly different
Overall	4.3 ± 0.56	4.5 ± 0.52	0.007	Significantly different

Table 12 shows that Canna Moringa Roll obtained higher mean scores than the reference product in all sensory attributes. Taste and aroma were not significantly different, indicating that the addition of canna flour, moringa leaves, and roasted sesame seeds did not reduce the acceptability of these attributes. Significant differences were found in texture, color, and overall acceptability. The higher score of the developed product shows that the final formulation was acceptable to consumers and had better sensory quality than the reference product in several attributes.

e. Composition Analysis and Nutritional Information of Canna Moringa Roll

The reference product and Canna Moringa Roll were analyzed through proximate analysis and iron content testing at Chem-Mix Pratama Laboratory. The analysis included water, ash, protein, fat, crude fiber, carbohydrate, energy, and iron content. The results are shown in Table 13.

Table 13. Proximate Analysis and Iron Content Results

Component	Reference Product	Canna Moringa Roll	p-value	Description
Water (%)	3.44	3.34	0.185	Not significantly different
Ash (%)	2.04	1.60	0.114	Not significantly different
Protein (%)	4.17	4.43	0.073	Not significantly different
Fat (%)	10.54	12.65	0.063	Not significantly different
Crude fiber (%)	3.09	4.72	0.027	Significantly different
Carbohydrate (%)	76.68	73.21	0.065	Not significantly different
Energy(kcal/100 g)	408.49	415.36	-	-
Iron (mg/100 g)	1.41	4.48	0.029	Significantly different

Table 13 shows that Canna Moringa Roll had higher protein, fat, crude fiber, energy, and iron content than the reference product. The most important improvement was found in crude fiber and iron content. Crude fiber increased from 3.09% to 4.72%, while iron content increased from 1.41 mg/100 g to 4.48 mg/100 g. The increase in iron content indicates that the use of canna flour and moringa leaves contributed to improving the nutritional value of the product.

The nutrition information per 140 g serving is presented in Table 14.

Table 14. Nutrition Information of Canna Moringa Roll per 140 g Serving

Nutrient	Reference Product	% RDA	Canna Moringa Roll	% RDA
Total energy	585 kcal	-	594 kcal	-
Fat	15 g	22%	18 g	26%
Protein	6 g	10%	6 g	10%
Carbohydrate	107 g	33%	102 g	32%
Iron	2 mg	11%	6 mg	35%

Note: RDA percentage was calculated based on the reference values of 67 g fat, 60 g protein, 325 g carbohydrate, and 18 mg iron per day.

Table 14 shows that one 140 g serving of Canna Moringa Roll contains 594 kcal of energy, 18 g of fat, 6 g of protein, 102 g of carbohydrate, and 6 mg of iron. The iron content contributed approximately 35% of the daily iron requirement. This result supports the potential of Canna Moringa Roll as an alternative iron-source snack for adolescent girls.

Table 15. Nutritional Information of development products

NUTRITIONAL VALUE INFORMATION		
Serving size : 140 grams		
Number of servings per package : 28 grams		
AMOUNT PER SERVING		
Total Energy	594 kcal	
		% AKG
Fat	18 gr	26%
Protein	6 gr	10%
Karbohidrat	102 gr	32%
Fe	6 mg	35%
**Percent AKG based on energy needs is 2150 kcal. Your energy needs may higher or lower.*		

f. Selling Price and Break-Even Point Analysis of Canna Moringa Roll

The selling price of Canna Moringa Roll was determined based on production cost and profit margin. One production batch produced three jars of Canna Moringa Roll. The summary of selling price and Break Even Point analysis is shown in Table 15.

Table 16. Selling Price and Break Even Point Analysis of Canna Moringa Roll

Component	Value
Production yield	3 jars
Total production cost	IDR 73,535
Production cost per jar	IDR 24,511
Profit margin	30%
Calculated selling price	IDR 31,864
Final selling price	IDR 32,000 per jar
Break Even Point unit	4 jars
Break Even Point sales	IDR 112,500

Based on Table 15, the production cost of Canna Moringa Roll was IDR 24,511 per jar. By applying a 30% profit margin, the calculated selling price was IDR 31,864 and was rounded to IDR 32,000 per jar. The Break Even Point analysis showed that the product needs to be sold at a minimum of four jars, equal to IDR 112,500 in sales, to cover production costs. These results indicate that Canna Moringa Roll has economic potential as a marketable snack product because the selling price can cover production costs while still providing profit.

3.7 Discussion

The development of Canna Moringa Roll showed that canna flour and moringa leaves can be applied in traditional semprong products, although the formulation must be adjusted to maintain sensory quality. The 75% canna flour substitution produced the best characteristics because it maintained the crispy texture and sweet taste, while 100% substitution reduced acceptability due to a slightly bitter taste and less balanced sensory properties [11], [12].

The addition of moringa leaves improved the nutritional value, especially iron content, but excessive amounts caused darker color, stronger aroma, and bitter taste [14], [15], [16]. Therefore, the final formulation was adjusted by reducing moringa leaves to 12.5 g and adding 12.5 g roasted sesame seeds to improve aroma and taste balance.

Sensory evaluation showed that the product was generally accepted by consumers. After formula adjustment, the large-scale test showed better acceptance in taste, aroma, texture, color, and overall acceptability. The results indicate that proper formulation can reduce the negative sensory effects of moringa leaves while maintaining desirable product characteristics [16].

Nutritional analysis confirmed that Canna Moringa Roll contained higher crude fiber and iron than the reference product. The iron content increased from 1.41 mg/100 g to 4.48 mg/100 g, contributing approximately 6 mg of iron per 140 g serving, or about 35% of the daily iron requirement [7]. The higher fiber and mineral content were associated with the use of canna flour and moringa leaves [8], [9], [13].

Packaging and labeling also supported product acceptance. The transparent 750 ml jar and nutrition label improved product presentation and consumer information [19]. Economically, the selling price of IDR 32,000 per jar was considered feasible and supported by BEP analysis, indicating the product has potential for small-scale business development [20].

Overall, Canna Moringa Roll can be developed as an innovative traditional snack with improved iron content and acceptable sensory quality. The study highlights the importance of balancing nutritional improvement with taste, aroma, texture, color, packaging, and price to increase consumer acceptance.

4. Conclusions

This study shows that Canna Moringa Roll can be developed as an innovative traditional *semprong* product using canna flour substitution and moringa leaf addition. The final formulation consisted of 75% canna flour substitution, 12.5 g moringa leaves, and 12.5 g roasted sesame seeds. This formulation was selected because it produced acceptable sensory characteristics, especially in terms of taste, aroma, texture, color, and overall acceptability. The addition of roasted sesame seeds helped balance the distinctive aroma and slightly bitter taste of moringa leaves, making the product more acceptable to consumers.

The developed product obtained higher mean sensory scores than the reference product in the large-scale acceptability test. Taste and aroma were not significantly different from the reference product, while texture, color, and overall acceptability showed significant differences. These findings indicate that the substitution of canna flour and the addition of moringa leaves did not reduce consumer acceptance and even improved several sensory attributes of the product.

Nutritional analysis showed that Canna Moringa Roll had higher crude fiber and iron content than the reference product. The iron content increased from 1.41 mg/100 g in the reference product to 4.48 mg/100 g in the developed product. In one 140 g serving, Canna Moringa Roll provided approximately 6 mg of iron, contributing about 35% of the daily iron requirement. This result supports the potential of Canna Moringa Roll as an alternative iron-source snack for adolescent girls.

The selling price and Break Even Point analysis also indicated that Canna Moringa Roll has potential to be developed as a small-scale marketable food product. The product was priced at IDR 32,000 per jar, with a Break Even Point of four jars or IDR 112,500 in sales. Overall, this research contributes to local food diversification by developing a traditional snack with improved nutritional value and acceptable sensory quality. Further studies are recommended to evaluate product shelf life, iron bioavailability, consumer acceptance among a larger adolescent population, and the effectiveness of regular consumption in supporting iron intake.

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