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# **The Innovation Breakthrough in Digital and Disruptive Era**

# Study of Flakes from Protein-Rich Flour and Essential Oils For Stunting Sufferers

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**Abstract.** The results of the Indonesian Nutrition Status Study (SSGI) in 2021, conducted by the Ministry of Health, the stunting rate in Indonesia in 2021 was 24.4 percent or decreased by 3.3 percent compared to 2019 (27.7 percent). However, when compared to countries in the ASEAN region, the prevalence of stunting in Indonesia is still higher than Vietnam (23%), Malaysia (17%), Thailand (16%) and Singapore (4%), only better than Myanmar (35%). Currently, Indonesia is experiencing what is called the triple burden of malnutrition. The triple burden of malnutrition is not just a matter of malnutrition, but also excess, and imbalance in nutritional intake. For this reason, snacks are made in the form of healthy flakes which can be used as an alternative to overcome the stunting problem in Indonesia. The purpose of this research is to produce healthy flake products rich in nutrients for stunting sufferers. The experimental design in this study consisted of two factors. The first factor was the proportion of corn flour: cowpea flour (50:50 ; 60:40 ; 70:30) and the second factor was the addition of 4% sunflower seed oil respectively. The result showed that the flake approximately has 2,46-2,88% moisture content, 1,46-1,76% ash content, 3,76-5,91% fat content, 6,87-7,24% protein content, and 81,4-84,85% carbohydrate content.

## Introduction

The results of the Indonesian Nutrition Status Study (SSGI) in 2021, conducted by the Ministry of Health, the stunting rate in Indonesia in 2021 was 24.4 percent or decreased by 3.3 percent compared to 2019 (27.7 percent). However, when compared to countries in the ASEAN region, the prevalence of stunting in Indonesia is still higher than Vietnam (23%), Malaysia (17%), Thailand (16%) and Singapore (4%), only better than Myanmar (35%).

World Health Organization stated that stunting is defined as low height-for-age. It results from persistent or ongoing malnutrition. It is frequently correlated with poverty, poor mother health and nutrition, recurrent illness, and/or improper early feeding and care. Stunting keeps kids from developing to their full physical and intellectual potential. Low weight-for-age is the definition of underweight. Children that are underweight may be weak, stunted, or both. The triple burden of malnutrition is what Indonesia is presently dealing with. Malnutrition is merely one aspect of the triple burden of malnutrition, which also includes excess and unbalanced nutrient intake. For this reason, snacks are made in the form of healthy flakes which can be used as an alternative to overcome the stunting problem in Indonesia.

Various policies have been implemented in regions across Indonesia, but with few evaluations report it is

hard to analyze how or whether these policies have successfully reduced stunting. Although Presidential Regulation 42/2013 on the National Movement to Accelerate Nutrition Improvement has resulted in the creation of a national task force<sup>2</sup> that monitors and evaluates stunting reduction efforts by local governments on a semi-annual basis, there are no official figures available about how many offices have implemented MOH 15/2013, Guidance on Breastfeeding Facilities. Studies in Central Java indicate that most government and private sector offices do not yet provide sufficient facilities for breastfeeding mothers [1], [2]. MOH 03/2014 on Community-Led Total Sanitation has reportedly accomplished 74% of its objectives, but 16 out of 34 provinces still perform below the average [3].

Further achievements by local governments executing the programs appear to be hampered by poor program planning and poor assistance at the village level [4]. For example, MOH 23/2014 on Nutrition Improvement Efforts, met with challenges in building public awareness caused by a lack of local resources on nutrition [5]. Besides the abovementioned government programs, an additional and significant factor influencing the nutrition and development of Indonesian children is food prices in Indonesia. The average inflation rate for food commodities remained relatively low at 3.2% annually in 2017 but the average Indonesian still spends the staggeringly high amount of

50% of their monthly income on food. Poor Indonesians can pay up to 75% of their income on food, making them highly vulnerable to increases in food price. In order to identify the impact of food prices on nutrition and stunted growth, this paper analyze a food bundles, consisting of rice, beef, egg, chicken meat, and fish.

Rice is a staple food for almost all Indonesians, and malnutrition occurs in regions where rice is the staple food [6], making its accessibility an important issue. Rice offers many health benefits to consumers, providing vitamin B and fiber, and is especially useful for its rich carbohydrate content, but a rice-based diet needs complementary nutrition from other food types. Suitable food items for rice are protein-based food like beef, fish, and chicken meat that provide other nutrients and complement the lack of iron and zinc in rice. While low consumption of beef, fish, and chicken has been linked to stunting in children, the consumption of meat, fish, nuts and essential fats significantly reduces stunting for children aged 12–23 months.

Flake is type of food cereals that can be developed as functional food to increase nutritional value such as protein and fat. High starch content of corn in flakes, can be added with cowpea flour that has high proteins and enriched with sunflower seed oil that has high essential fatty acid content. [7] 100 grams of cowpea contain 24.4 g of proteins Protein content has important role in growth and [8] protein in the diet is essential for the functioning of enzymes and the transport of biochemicals across cellular membranes in addition to providing energy. [9] that Essential fatty acids are fatty acids that the body needs for healthy tissue growth and function but cannot produce on its own. Vegetable oil named sunflower seed oil has a high linoleic acid content ranging up to 61.1% [10]. The purpose of this study was to determine how the proportions of corn flour, cowpea flour, and sunflower seed oil enrichment affected the proximate contents of the flakes product.

## Material and Methods

Corn, cowpea, salt, sugar, and water which are obtained from the market in Taman, Sidoarjo. Sunflower seeds were obtained from online stores. Those materials were used as ingredients for cereal flakes production.

The equipment that used in the corn flour and cowpea flour production are digital scales, knives, blender, grinders, ovens, 60 and 80 mesh sieves. Intelligent electric oil press are used as the tools for oil press. The equipments in making flakes are stainless steel knives, blenders, baking sheets, extruders, measuring glass, analytical scale, spoons, and oven.

The equipment that used for the analysis process including Kjeldahl unit, Soxhlet unit, beaker glass, measuring glass, furnace, analytical digital scale, oven (Mettler), fume hoods, burettes, desiccators, measuring pipettes, and stoves. Aquades, NaOH (SAP Chemicals), HCl (SAP Chemicals), H<sub>2</sub>SO<sub>4</sub> (Sigma Aldrich), Na<sub>2</sub>S<sub>2</sub>O<sub>3</sub> (Merck), CH<sub>3</sub>OH (Merck), n-hexane (SAP Chemicals) were used for chemical analysis.

## Research Design

The experimental design in this study consisted of two factors. The first factor was the proportion of corn flour: cowpea flour (50:50 ; 60:40 ; 70:30) and the second factor was the addition of 4% sunflower seed oil respectively.

The processing of corn and cowpea cereal flakes started with the production of corn flour, the production cowpea flour, sunflower seed extraction, and the production of cereal flakes. The full process explanation is as follows:

### 1. Vegetable Oil Extraction

The sunflower seeds were extracted, sorted, and cleaned before being heated in an oven at 80°C for 30 minutes to prepare them. A smart electric oil press was used to press the oil from the seeds. The filtrate was taken.

### 2. Corn Flour Making Process

Corn kernels were sorted and peeled to remove the outer shell. Four hours were spent soaking corn kernels in water. Corn kernels that had been soaked were cleaned, drained, and then dried in a cabinet dryer for eight hours at 40°C. A flour mill or other grinder was used to process the dried corn kernels. The created corn flour was filtered via an 80 mesh sieve.

### 3. Cowpea Flour Making Process

Cowpeas were cleaned and sorted before being steamed for around 10 minutes. Cowpeas that have been steamed and soaked for 6 hours in a mixture of 1:3 cowpeas to water before being peeled Eight hours were spent drying peeled cowpeas at 60 degrees. The dried cowpeas were blended and passed through an 80 mesh sieve after being mashed.

### 4. Flakes Production Process

Corn flour and cowpea flour (50:50 ; 60:40 ; 70:30) were combined with other supplementary ingredients (sugar 20% (w/w), salt 1% (w/w), 70% water (v/w), and 4% sunflower seed oil addition. The components were well combined. A grinder with a thickness of 1 mm was used to flatten the dough after it had been steam-cooked for 15 minutes. The flakes dough was then cooked for 25 minutes in an oven at 125°C.

## Analysis Methods

The parameters were tested for proximate levels such as moisture content, ash content, proteins, fats [11] and carbohydrates with by different methods.

## Result and Discussion

### Moisture Content

The chemical characteristics of corn flour from previous research found that the water content was 8.43%; ash content 0.32%; protein 9.81% fat 4.12% and starch 77.32% and the characteristics of the cowpea flour used in this research has a moisture content of 8.48%; ash 2.33%, protein 32.95%; fat 1.993% and starch 54.51% [12]. That in 100 grams of

cowpea there is a high protein content of 24.4 grams [13]. The protein content in corn flour is lower of [14], which is 8.78%.

Moisture content is a measurement of the total water content in a food product, usually expressed as a weight percent of a wet basis. To avoid microbial growth, the moisture content and water activity must be kept below approximately 10% and 0.60–0.65, respectively, depending on the type of food [15]. The results of the analysis of the moisture content of flakes with flour proportions (corn flour: cowpea flour) and the addition of 4% sunflower seed oil is approximately 2.47% - 2.80%.

Table 1. The moisture content of nutritions rich flakes

Flakes Formulations		Moisture content
Corn flour : cowpea flour proportion	Sunflower seed oil addition	
50:50	4%	2.47%
60:40	4%	2.56%
70:30	4%	2.88%

The moisture content of the flakes is significantly higher when there is a higher proportion of corn flour and a lower proportion of cowpea flour, as shown in **Table 1**. It might be a result of corn flour's high starch content. This is related statement [16] that starch is quickly bind to water and easily release water. It follows that the product's water content will increase as the quantity of corn flour increases. Additionally, [17] starch swiftly absorbs water. this is due to the hydroxyl groups on starch molecules, which enable starch granules to absorb more water.

### Ash Content

The mineral content of a product's substance has an impact on the ash content. The amount of minerals in a food product is inversely correlated with its ash content [18]. Flakes with corn flour:cowpea flour ratios and 4% sunflower seed oil added have an ash content analysis result of approximately 1.72%–1.76%.

Based on the analysis of variance, it shows that the concentration of sunflower seed oil has no significant effect on the ash content parameter. [18] the ash content is related to the composition of minerals in a material. The ash content will be higher along with the high mineral content in the food.

Table 2. The ash content of nutritions rich flakes

Flakes Formulations		Ash
Corn flour : cowpea flour proportion	Sunflower seed oil addition	
50:50	4%	1.76%
60:40	4%	1.65%
70:30	4%	1.47%

**Table 2** showed that the ash content produced is decreasing as the quantity of corn flour increases and

the proportion of cowpea flour decreases. This might occur because corn flour has less ash than cowpea flour. [19] Cowpea ash concentration is higher at 3.64% compared to corn flour's 1% level [20]. The higher the addition of corn flour and the lower the addition of cowpea flour can cause a decrease in the ash content of the flakes.

### Protein Content

Our general health and welfare depend on the kind and caliber of protein we eat. In addition to serving as a source of energy, protein in the diet is necessary for the activity of enzymes as well as the transport of biochemicals across cellular membranes [8]. Flakes with corn flour:cowpea flour proportions and 4% sunflower seed oil enrichment provide a protein content analytical result of around 20.61%–21.72%.

Table 3. The protein content of nutritions rich flakes

Flakes Formulations		protein
Corn flour : cowpea flour proportion	Sunflower seed oil addition	
50:50	4%	21.72%
60:40	4%	21.18%
70:30	4%	20.61%

The results of the protein content of flakes in **Table 3** show that there was a significantly higher protein content of the flakes with a higher proportion of cowpea flour and a smaller proportion of corn flour. [13] The cowpeas had a high protein level of 24.4 grams per 100 grams, and [21] who estimated the protein content of corn at 8.78%. Those protein level of corn flour is lower at compared to cowpea flour's.

### Fat Content

A fat content analytical result of corn and cowpea flour proportion flakes with 4% sunflower seed oil enrichment ranges from 3.76% to 5.92%.

Sunflower seed oil has fatty acids which are very good for the body, including 61.1% linoleic acid (omega 6) (% Mole by Gas Chromatography), according to research by [10] Fat has an important role in the body, such as a source of energy, transports fat-soluble vitamins, and a source of essential fatty acids.

Table 4. The fat content of nutritions rich flakes

Flakes Formulations		fat
Corn flour : cowpea flour proportion	Sunflower seed oil addition	
50:50	4%	3.76%
60:40	4%	3.88%
70:30	4%	5.92%

**Table 4** showed that the fat content of flakes increased significantly as the proportions of corn flour were increased and cowpea flour were decreased. This is due to the raw material's fat content, specifically the fat level of corn flour, is larger than that of cowpea flour. The concentration of sunflower seed oil also had a

significant effect on the fat content of the flakes. This can be happen because almost the entire content of sunflower seed oil is fat. Sunflower seed oil contains fatty acids that are very beneficial for the body, one of which is an essential fatty acid, namely linoleic acid. The chemical properties of flakes products can be affected by the formulation of corn flour and oil content [12]. According to [10] [research, sunflower seed oil contains linoleic acid (omega 6) by 61.1% (Mol% by Gas Chromatography).

### Carbohydrate Content

Results of the study of carbohydrate content of flakes with flour proportions (corn flour: cowpea flour) and 4% sunflower seed oil enrichment approximately from 81.4 to 84.85%.

Table 5. The carbohydrate content of nutritions rich flakes

Flakes Formulations		carbohydrate
Corn flour : cowpea flour proportion	Sunflower seed oil addition	
50:50	4%	84.77%
60:40	4%	84.85%
70:30	4%	82.86%

Analyses of carbohydrates on **Table 5** revealed that the ratio of corn flour to cowpea flour and the amount of sunflower seed oil had a big impact on the quantity of carbohydrates in flakes. Proximate components including water content, ash content, protein, fat, and other substances might have an impact on the carbohydrate concentration. Conversely, when levels of proximate and other nutritional components are high, the carbohydrate content is low, and likewise when levels are high, the carbohydrate content is low.

### Conclusion

The ratio of corn flour to cowpea flour, as well as the addition of sunflower seed oil, have an impact on the properties of flakes, including their water, ash, protein, and fat contents. The proportion of corn flour had a considerable impact on the water and fat contents, whereas the amount of cowpea flour had a big impact on the ash and protein contents. The fat content of the flakes can be raised by increasing the amount of corn flour and enriching the sunflower seed oil.

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