



Biscuits Formulations with Catfish Flour and Pumpkin Flour High Vitamin C as Alternative for Providing Additional Food for Pregnant Women with Anemia

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ABSTRACT

Background: Iron deficiency anemia is a common condition in pregnancy, increasing the risk of complications such as low birth weight (LBW) and stunting. Many pregnant women fail to meet their daily iron requirements due to inadequate intake. Vitamin C enhances iron absorption, making it crucial for anemic pregnant women. Pumpkin (*Cucurbita moschata*) and catfish (*Clarias* sp.) are nutrient-rich local foods that can be processed into flour and incorporated into biscuits to improve nutritional value.

Research Methods: This experimental study used a Completely Randomized Design (CRD) with four treatments substituting catfish and pumpkin flour: F0 (0%), F1 (20%), F2 (30%), and F3 (40%). Data were analyzed using ANOVA in SPSS version 26 for Mac.

Research Result: Laboratory analysis showed increasing vitamin C levels in biscuits with higher substitutions of pumpkin and catfish flour: F0 (1.2915 mg/g), F1 (1.9228 mg/g), F2 (2.0587 mg/g), and F3 (2.2588 mg/g). One-way ANOVA results indicated a significant difference ($p=0.000$).

Conclusion: The addition of pumpkin and catfish flour in biscuit production increases vitamin C content, making it a beneficial Supplementary Food (PMT) for pregnant women with anemia. The highest vitamin C level was found in formulation F3 (40%) at 2.2588 mg/g or 25.10 mg per biscuit piece. Consuming 3-4 biscuits can help meet the daily vitamin C needs of anemic pregnant women.

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1. INTRODUCTION

The most common type of anemia during pregnancy is iron deficiency anemia. Iron (Fe) plays a crucial role in the formation of the placenta and red blood cells during pregnancy. Anemia in pregnant women is a significant risk factor that can contribute to maternal and infant mortality. This condition is generally caused by nutritional deficiencies, particularly iron deficiency. A lack of iron in pregnant women can impact fetal growth and development, potentially leading to low birth weight (LBW), reduced intelligence, and an increased risk of stunting or impaired growth. According to the 2019 Recommended Dietary Allowances (RDA), the daily iron requirement for women aged 19-49 years is 18 mg. During pregnancy, this requirement increases based on gestational age. In the first trimester, the iron requirement remains at 18 mg per day, while in the second and third trimesters, it increases to 27 mg per day. However, many pregnant women in Indonesia do not meet their iron needs, primarily due to inadequate consumption of iron-rich foods, particularly heme iron from animal sources, which has an absorption rate of approximately 20-30% in the body. Based on the 2014 Total Diet Study, about half of pregnant women had insufficient protein intake (<80% of the protein adequacy rate), with higher deficiency rates in rural areas (55.7%) compared to urban areas (49.6%). To prevent anemia in pregnant women, the government has implemented a program providing 90 iron supplement tablets throughout pregnancy (Kemenkes, 2018). However, iron supplements may cause side effects such as nausea, vomiting, stomach cramps, and epigastric pain.

In a pregnant woman's diet, consuming three main meals with a total of 2500 calories per day can provide approximately 20-25 mg of iron. Meanwhile, snacks containing about 10-15% of total energy requirements (250 kcal) can contribute an average of 2.5 mg of iron. The provision of supplementary food (PMT) is also an effort to address nutritional issues during pregnancy. However, current PMT programs are only provided to pregnant women experiencing Chronic Energy Deficiency (CED) and do not yet cover those with anemia. This issue requires attention, as pregnant women with anemia also fall into the high-risk category. Therefore, future assistance programs, such as biscuit supplementation for anemic pregnant women, should be implemented to help meet their protein and iron needs.

Vitamin C plays an essential role in enhancing iron absorption in anemic pregnant women. As a supporting factor, vitamin C helps convert non-heme iron into a more absorbable form, thereby increasing hemoglobin levels. Research has shown that iron consumption accompanied by vitamin C is more effective than iron intake alone, even improving iron absorption by up to four times. Therefore, adequate vitamin C intake during pregnancy is highly recommended to prevent anemia (Rieny et al., 2021). Studies have revealed that the combination of iron and vitamin C supplementation significantly increases hemoglobin levels compared to iron supplementation alone. The increase in hemoglobin levels was higher in groups receiving the combination treatment than in the control group that only received iron tablets (Murtiningsih, 2020).

The World Health Organization (WHO) reported in 2014 that 52% of pregnant women in developing countries suffer from anemia. Data from the 2018 Indonesian Basic Health Research (Riskesdas) showed that the prevalence of anemia in pregnant women increased from 37.1% in 2013 to 48.9% in 2018. According to data from the Lampung Provincial Health Office, the prevalence of anemia was 22.4% in 2017, 20.7% in 2018, and increased to 23.2% in 2019 (Dinas Kesehatan Provinsi Lampung, 2019). The prevalence of anemia among pregnant

women in Metro City, based on the 2020 Metro City Health Profile, was 19.36%. According to the Nutrition Report from Banjarsari Community Health Center, the prevalence of anemia was 13.83% in 2020, 11.43% in 2021, and increased to 14.73% in 2022.

Pumpkin is a locally sourced food ingredient with high nutritional value that benefits human health. Its nutritional content includes beta-carotene, vitamin A, fiber, vitamin C, vitamin K, vitamin B3, and minerals such as iron, potassium, phosphorus, magnesium, and calcium. Pumpkin also contains folic acid, which is essential for pregnant women, as folic acid deficiency can lead to congenital birth defects. Consuming pumpkin provides a good nutritional intake for both maternal and fetal health. The vitamin C content in pumpkin is 4.7 mg per 100 grams, while its iron content is 0.57 mg per 100 grams. Physically, pumpkin flour appears in light to dark yellow colors, has a distinctive pumpkin aroma, and contains moisture levels ranging from 9.42% to 12.73%. The predominant carbohydrate found in pumpkin is starch, while the vitamin C content in pumpkin flour is 55 mg, and iron is 2.4 mg (Rohimah, 2013). Additional nutrients in pumpkin flour include carbohydrates (70 mg), calcium (48 mg), phosphorus (67 mg), beta-carotene (190 mg), and vitamin C (55 mg) (Rohimah, 2013).

Catfish is a highly nutritious food ingredient that is easy to prepare as a dish. Its nutritional content is comparable to other types of fish. Some fish, including catfish, contain vitamin C at 0.7 mg per 100 grams of fresh catfish and iron at 150 mg per 100 grams. The production of catfish flour requires a large quantity of fresh fish at an affordable price. The nutritional content of catfish flour includes 19 grams of protein, 150 mg of iron, 25 mg of phosphorus, 3 mg of calcium, and 0.05 IU of vitamin A per 100 grams of catfish flour (Rohimah, 2013).

Pumpkin and catfish are local food ingredients with the potential to serve as primary components of functional food products. Both contain energy, protein, and various essential nutrients. Additionally, pumpkin and catfish can be used as substitutes for wheat flour in biscuit production, reducing wheat flour dependency and lowering production costs. The incorporation of catfish flour and pumpkin flour as partial wheat flour substitutes in biscuit production is a promising alternative, particularly in enhancing the nutritional value of functional food products. Biscuits are a popular type of dry pastry enjoyed by people across various age groups and economic levels as snacks. Biscuits are commonly consumed by toddlers, school-aged children, and the elderly, either as snacks or meal supplements. Based on Indonesian National Standard (SNI) 2973 of 2011, biscuits are classified as dry bakery products made by baking dough containing wheat flour, with or without substitutions, along with added fat/oil and other permitted food ingredients. The average annual per capita consumption of dry pastries in urban and rural Indonesia is 0.40 kg. Generally, biscuits are made from wheat flour and contain macronutrients such as carbohydrates, protein, and fat, as well as small amounts of micronutrients like phosphorus, calcium, and iron. Therefore, the addition of pumpkin flour and catfish flour is expected to enhance the protein and iron content in biscuits.

According to Ministry of Health Regulation No. 51 of 2016, 100 grams of Supplementary Food (PMT) for pregnant women contains 10.75 grams of protein and 14.17 mg of iron. The daily serving size of PMT biscuits for pregnant women is 60 grams (approximately three pieces). Research by Rohimah (2013) demonstrated that biscuits made with 40% pumpkin flour and catfish flour per 100 grams (approximately ten pieces) contained 32 grams of protein and 46.67 mg of iron. This formulation effectively increases both macronutrient and micronutrient levels in biscuits, meeting the nutritional standards set by SNI 01-2973-2011.

Based on the trial conducted on October 21, 2023, the optimal temperature and duration for the production of catfish flour and pumpkin flour were determined to be 90°C with a

roasting time of 12 hours. The resulting catfish flour exhibited a yellowish-brown color with a fine texture, while the pumpkin flour displayed a yellow color with a smooth texture characteristic of flour. These findings align with data from the Women's Farming Group (Kelompok Wanita Tani, KWT) and the Dapur Dashat (Healthy Kitchen for Stunting Prevention) program in Banjarsari Subdistrict, which had previously produced carrot flour using a similar method. Conversely, in the second trial conducted on November 30, 2023, using a temperature of 60°C and a roasting duration of 6 hours, the resulting flour had a coarser and more moist texture. This was due to insufficient drying of the catfish and pumpkin caused by the lower roasting temperature and shorter processing time. Additionally, trials were conducted on biscuit formulations incorporating catfish flour and pumpkin flour with varying compositions, specifically formulas F2 and F3. Formula F2 contained 30% catfish flour and pumpkin flour (37.5 grams), while formula F3 consisted of 40% catfish flour and pumpkin flour (50 grams). An organoleptic test, evaluating color, aroma, and texture, was conducted with 10 pregnant women from the maternal health class in Banjarsari Subdistrict. The results indicated that formula F2 (30%) was preferred over F3 in terms of color, aroma, and texture.

2. METHODS

This study is an experimental research employing a Completely Randomized Design (CRD) method. The experiment involved the addition of catfish flour and pumpkin flour in biscuit production with four treatment variations: F0 (0%), F1 (20%), F2 (30%), and F3 (40%) , with two repetitions. The research was conducted from December 2023 to January 2024 in the Culinary Laboratory. The equipment used for biscuit production in this study included a Wirastar brand cake oven, a Nankai brand food scale with a precision of 2 grams, a knife, mixing bowls/containers, a gas stove, a flour grinder, a flour sieve, a mixer, a spoon, cookie molds, a cutting board, a spatula, and a measuring glass.

Table 1. Composition of Ingredients in the Formulation of Pumpkin Flour and Catfish Flour Biscuits

Ingredients	Formula			
	F0 (0%)	F1 (20%)	F2 (30%)	F3 (40%)
Wheat flour	125 g	75 g	50 g	25 g
Pumpkin flour	-	25 g	37,5 g	50 g
Catfish flour	-	25 g	37,5 g	50 g
Cornstarch	10 g	10 g	10 g	10 g
Butter	100 g	100 g	100 g	100 g
Powdered sugar	125 g	125 g	125 g	125 g
Baking powder	½ tsp	½ tsp	½ tsp	½ tsp
Egg yolk	2 egg	2 egg	2 egg	2 egg
Milk powder	25 g	25 g	25 g	25 g
Salt	½ tsp	½ tsp	½ tsp	½ tsp
Water	50 ml	50 ml	50 ml	50 ml

2.1. Production of Pumpkin Flour

The pumpkin is washed and then peeled by dividing it into eight parts. It is then sliced thinly or cut into small pieces using a knife. After that, the pumpkin is dried using a roasting oven at a temperature of 90°C for approximately 12 hours. Once dried, the pumpkin becomes brittle. Next, it is ground using a blender until it turns into fine yellow powder. Finally, the

powder is sieved using an 80-mesh sieve.

2.2. Production of Catfish Flour

The catfish is washed and then steamed for approximately 30 minutes. After steaming, the fish meat is separated from the skin and bones, followed by pressing to remove oil and water. The next step is grinding using a blender and drying in an oven at 90°C for 12 hours. Once dried, the catfish is ground again using a blender and then sieved with an 80-mesh sieve.

2.3. Biscuit Production

The ingredients, including pumpkin flour, catfish flour, wheat flour, cornstarch, egg yolk, butter, powdered sugar, baking powder, powdered milk, salt, and water, are mixed. The next step is shaping the dough into biscuits and baking them at a temperature of 180°C for 15-20 minutes.

2.4. Vitamin C Content Analysis

The vitamin C test is conducted at the Agricultural Product Technology Laboratory of Politeknik Negeri Lampung (POLINELA) using the titration method. The testing process involves weighing 5-10 grams of the finely ground sample or liquid sample. The sample is then placed in a 100 ml volumetric flask and mixed with distilled water up to the calibration mark. Next, the mixture is filtered using filter paper or centrifuged to obtain the filtrate. A volume of 5-25 ml of filtrate is taken using a pipette and placed into a 100 ml Erlenmeyer flask. (For dark-colored samples, distilled water may be added to reduce color intensity.) Then, 2 ml of 1% soluble starch solution is added as an indicator. The solution is titrated with 0.01 N standard iodine solution until a light blue color is obtained. The calculation is as follows: 1 ml of 0.01 N iodine = 0.88 mg of ascorbic acid.

$$\text{Vitamin C} = \frac{\text{ml titrasi} \times 0,88 \times \text{FP}}{\text{g sampel}} \text{ mg/g}$$

The data was then analyzed using SPSS version 26 for Mac with an ANOVA test. This was followed by Duncan's Multiple Range Test (DMRT) at a 95% confidence level to determine in detail the differences in vitamin C content among the treatments.

3. RESULTS AND DISCUSSION

In this study, biscuit production consisted of two main ingredients: catfish flour and pumpkin flour, which were added to the biscuit dough. The production of catfish flour used raw materials in the form of 7 kg of fresh catfish. After cleaning, 4.9 kg of catfish was prepared for steaming. Once processed into flour, the resulting catfish flour weighed 430 g. Meanwhile, from 7 kg of pumpkin, the weight after peeling was 5.3 kg. After processing into flour, the yield of pumpkin flour was 420 g. Each formulation containing catfish flour and pumpkin flour produced approximately 330 g of biscuits, equivalent to around 30 pieces, with an average weight of 11 g per piece.

Table 2. The Average Results of Vitamin C Analysis in Biscuits Made from Pumpkin Flour and Catfish Flour

Parameter	Result (mg/g)				P value
Vitamin C	F0	F1	F2	F3	*0,000
	1,2915	1,9228	2,0587	2,2588	

* one-way ANOVA test

Laboratory analysis of vitamin C content in the biscuits per 100 g (approximately 9 pieces) showed an increase in vitamin C levels with the addition of pumpkin flour and catfish flour in each formulation. The vitamin C content in each formulation was as follows: F0 (0%) = 1,2915 mg/g (129,15 mg/100 g), F1 (20%) = 1,9228 mg/g (192,28 mg/100 g), F2 (30%) = 2,0587 mg/g (205,87 mg/100 g), and F3 (40%) = 2,2588 mg/g (225,88 mg/100 g). The one-way ANOVA test results indicate a significant difference in vitamin C levels ($p=0,000$). The results of Duncan's multiple range test at the 5% significance level revealed that each biscuit formulation (F0, F1, F2, and F3) fell into a distinct homogeneous subset. This indicates that the differences in vitamin C content among all treatments were statistically significant. The formulation with the highest vitamin C content was F3 (40%), containing 25,85 mg of vitamin C per biscuit. The vitamin C requirement for pregnant women in the first to third trimesters, according to PMK No. 28 of 2019 (Kemenkes, 2019), is 85 mg per day. However, for pregnant women with anemia, the vitamin C requirement may exceed 85 mg per day, depending on the severity of anemia and individual needs. If there is no anemia, pregnant women can consume 3 to 4 pieces of biscuits to meet their daily requirement.

The higher the proportion of pumpkin flour and catfish flour used, the greater the vitamin C content in the biscuits. This is likely due to the high vitamin C content in pumpkin flour, which is approximately 55 mg per 100 g. Research has shown that substituting pumpkin flour in biscuit production can increase the vitamin C content in the final product. Pumpkin (*Cucurbita moschata*) is known to contain vitamin C, although the exact amount varies depending on processing methods (Putri, Yulifianti, Setyaningsih, 2023). However, it should be noted that processing techniques, such as drying and baking, may affect the vitamin C content in pumpkin flour and the final biscuit product. Therefore, while pumpkin flour substitution can enhance the vitamin C content in biscuits, the extent of this increase depends on various factors, including processing methods and substitution proportions.

Vitamin C plays a crucial role in enhancing iron absorption in pregnant women with anemia. It facilitates the absorption of iron, which is essential in preventing iron deficiency anemia. Additionally, research by Kurniawan and Wibowo (2021) revealed that consuming iron in combination with vitamin C is more effective in increasing hemoglobin levels compared to iron intake alone. This finding is supported by a study conducted by Devani and Pratiwi (2015), which found a positive correlation between adequate vitamin C intake and increased hemoglobin levels in pregnant women with anemia. Based on these findings, it is recommended that pregnant women with anemia increase their intake of vitamin C-rich foods to optimize iron absorption and prevent complications associated with anemia.

Supplementary Feeding (PMT) for pregnant women with anemia aims to increase iron and vitamin C intake to support hemoglobin formation. Research indicates that substituting catfish flour and pumpkin flour in biscuits can enhance their protein and iron content. In the formulation with a 40% substitution (F3), the protein content reached 14.34%, fulfilling 100% of the PMT requirement, while the iron content reached 0.0115%, meeting 46% of the PMT

requirement. This makes these biscuits a potential alternative for supplementary feeding for pregnant women with anemia (Artina et al., 2024).

Vitamins in a product can contribute to its general characteristics. Vitamin C functions as an antioxidant that can help increase hemoglobin levels, especially in pregnant women with anemia. As an antioxidant, vitamin C protects red blood cells from oxidative damage and aids in the absorption of non-heme iron in the body. Studies have shown that sufficient vitamin C intake enhances the effectiveness of iron supplementation, leading to a more optimal increase in hemoglobin levels compared to iron intake alone. Additionally, research has revealed that pregnant women with adequate vitamin C intake tend to have higher hemoglobin levels than those with vitamin C deficiency (Sari et al., 2020). Therefore, combining iron-rich foods with sources of vitamin C, such as biscuits made from pumpkin flour and catfish flour, can serve as an effective nutritional intervention to prevent and manage anemia in pregnant women.

4. CONCLUSION

This study shows that the substitution of catfish flour and pumpkin flour in biscuit production can increase vitamin C content, which is beneficial as a Supplementary Food (PMT) for pregnant women with anemia. The higher the proportion of pumpkin flour and catfish flour in the biscuit formulation, the higher the vitamin C content, with the highest level found in formulation F3 (40%) at 2,2588 mg/g or 25,85 mg per biscuit piece. Consuming at least 3 to 4 pieces of biscuits can meet the vitamin C requirements for pregnant women with anemia.

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