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Nutritional Development and Sensory Evaluation of Pumpkin and Corn Grits for Pregnant Women

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Abstract

The incidence of chronic energy deficiency (CED) in pregnant women remains high. One of the interventions is the utilization of local supplementary foods, though options such as pumpkin and corn remain limited. Purpose: This study aimed to determine the effect of adding pumpkin to the acceptability and proximate composition of pumpkin-corn grits. This was an experimental study using a completely randomized design (CRD) with 3 treatments and 3 replications. Data were analyzed using ANOVA and Duncan's multiple range test. The addition of 40g, 50g, and 60g of pumpkin significantly affected organoleptic properties, particularly taste ($p < 0.05$), with average panelist scores ranging from 3.13 to 3.68 (liked category). No significant differences were found in color, aroma, or texture. The highest values for water, ash, and protein content were observed in the F3 treatment (60g pumpkin), while the highest fat, fiber, and carbohydrate contents were found in F1 (40g pumpkin). The acceptability test showed significant differences in color, taste, aroma, and texture for the F3 formula ($p < 0.05$). The addition of pumpkin significantly improved taste and affected proximate values for ash, fat, and protein. Local governments and health programs may consider using pumpkin-corn grits as an alternative supplementary food for pregnant women.

Keywords: Corn, grits, nutritional development, pumpkin, pregnant

Introduction

As a developing country, the problem of malnutrition is still a major problem in Indonesian society. One of the problems of malnutrition in pregnant women in Indonesia is Chronic Energy Deficiency (Pastuty, 2018). Chronic Energy Deficiency (CED) is a condition in which a person experiences a long or chronic lack of nutrition (calories and protein). The way to find out the risk of Chronic Energy Deficiency in pregnant women is by measuring Mid-Upper Arm Circumference (MUAC). However, MUAC measurements cannot be used to monitor changes in nutritional status in the short term. Pregnant women with CED at the limit of 23 cm have a risk of 2.0087 times to give birth to LBW compared to mothers who have MUAC more than 23 cm (Pratiwi, 2009).

He contribution and occurrence of CED in pregnant women will affect the growth and development of the fetus, among other things, it can increase the risk of low birth weight babies (LBW). Pregnant women with CED have a greater risk of morbidity, especially in the third trimester of pregnancy which can result in low birth weight births (Fidyah, et al. 2014). Based on Basic Health Research (Riskesdas) data in 2007, the prevalence rate of CED risk in women of childbearing age was 13.6%. The prevalence of CED pregnant women in Indonesia is 21.6%,

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while the prevalence of CED pregnant women in Aceh is 14.3% (Sanjaja, 2009).

Adequacy of energy is also a nutritional problem for pregnant women in Indonesia and other developing countries. The prevalence of chronic energy deficiency (CED) in Indonesia is 41% (Ministry of Health 2003) and in developing countries the average consumption is only two-thirds of the recommended recommendation (Mora and Nestel, 2000). The diet of pregnant women is an important factor that plays a role in their health and the health of their fetus. This increased need requires intake of both macronutrients and most of the micronutrients in the second and third trimesters throughout pregnancy. Therefore, nutritional problems in pregnant women have an impact on increasing rates of premature birth, fetal growth retardation, infant morbidity and mortality. Food intake is considered important for the growth and development of the fetus. Food intake / consumption patterns can affect the health status of the mother, where poor consumption patterns can cause health problems or disease in the mother (Lestari, 2021).

PMT for Pregnant Women every 100 grams contains 520 calories. Each PMT Bumil biscuit contains 104 calories. Each serving of PMT pregnant women contains 520 calories, 56 grams of carbohydrates, 16 grams of protein and 26 grams of fat. PMT pregnant women contain 9 kinds of vitamins (A, B1, B2, B3, B6, B12, C, D and E) and 8 minerals (Folic Acid, Iron, Selenium, Calcium, Sodium, Zinc, Iodine and Phosphorus). Provisions for giving PMT Pregnant women in the first trimester of pregnancy are given 2 tablets per day. In the second and third trimesters of pregnancy are given 3 pieces per day. PMT for pregnant women is given until pregnant women are no longer in the category of chronic energy deficiency (CED) according to the examination of the upper arm circumference (MUAC). If the body weight is according to the standard, it is continued by consuming a balanced nutritional family food (Ministry of Health RI, 2016).

According to the Ministry of Health of the Republic of Indonesia, 2019 in the Laelatul Rohmah thesis, 2020, Supplementary Food for Pregnant Women is nutritional supplementation in the form of layer biscuits made with a special formulation and fortified with vitamins and minerals given to pregnant women in the category of Chronic Energy Deficiency (CED) for meet nutritional needs.

According to Girija et. al, (1984) in the journal Chandradewi, 2015, Supplementary feeding (PMT) can be given with a high intake of energy and protein as well as balanced energy and protein. Porridge is a food with a soft texture that is easy to digest. Porridge can be seen from rice, green beans, brown rice, or from several constituent mixtures. Porridge processing is done by cooking the constituents of water, (rice porridge), mixing coconut milk, (green bean porridge), and mixing milk, (milk porridge) (Larasati, 2011).

Corn is a food crop that has a strategic role and has economic value and has the opportunity to be developed. Corn is also the main source of carbohydrates and protein after rice, besides that corn also acts as a raw material for the food industry, feed industry, and fuel (Siregar, 2009). By increasing iron in third trimester pregnant women, it is recommended for mothers to consume boiled chicken eggs (free-range chicken) because boiled chicken eggs (free-range chicken) contain 3.3 mg of iron and will affect changes in hemoglobin levels in third trimester pregnant women. III (Wulandari, 2021)

Pumpkin pumpkin (Cucurbita moschata Duschenes) is also known as waluh (Java), pumpkin parang (West Java), red pumpkin and sweet pumpkin. Yellow pumpkin is one of the local food ingredients that has high nutritional value and is good for the human body, which contains lots of beta carotene, vitamin A, fiber, vitamin C, vitamin K, and Niacin or vitamin B3. It also contains

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minerals such as potassium, iron, phosphorus, magnesium and potassium (Meiranty, 2018).

Consumption of pumpkin porridge combined with chicken meat is considered beneficial in improving the nutritional status of malnourished infants. This is due to the vitamin A content in pumpkin, which influences protein synthesis found in chicken meat, thereby supporting cellular growth. Vitamin A in pumpkin also plays a crucial role in regulating the immune system; hence, vitamin A deficiency may lead to increased susceptibility to infections (Hurul, 2015).

In pregnant women, the need for folic acid increases significantly to support both maternal health and fetal development. To fulfill this need, it is important to consume foods rich in folic acid, such as sweet corn (Martini et al., 2014). Folic acid offers several health benefits for pregnant women, including the prevention of congenital abnormalities in the fetus, participation in protein metabolism, promotion of red blood cell formation, and reduction of homocysteine levels—an amino acid associated with increased risk of cardiovascular disease (Martini, 2014).

Methods

Design, place and time

This study was experimental with a completely randomized design (CRD) with 3 treatments and 3 replications. This research was conducted in August at the food laboratory of the Poltekkes Kemenkes Aceh for organoleptic tests and proximate tests at the Laboratory of Nutrition and Feed Technology, Faculty of Agriculture, Department of Animal Husbandry, Syiah Kuala University, Banda Aceh.

Research Steps

This research consists of two stages, namely preliminary research and main research. Preliminary research aims to find the right formulation or concentration of Yellow Pumpkin addition to corn grits. The concentration of the addition of pumpkin is Formulation I 20 gr, Formulation II 30 gr, Formulation III 40 gr, Formulation IV 50 gr, Formulation V 60 gr. Of the five samples that have been tested, the most preferred is Formulation III 40 gr, Formulation IV 50 gr, Formulation V 60 gr.

Data analysis

Data analysis in this study used a Completely Randomized Design (CRD) with 3 treatments and 3 replications. Data processing and analysis was carried out with the SPSS application using ANOVA. The treatment results that had a significant effect were followed by a Duncan test multiple tests to find out the differences in each treatment. The follow-up test used was the DMRT test at a 95% level of confidence (=0.05)

Result

Organoleptic Properties of Pumpkin-Corn Grits

The organoleptic evaluation was conducted to assess the sensory attributes of pumpkin-corn grits with different levels of pumpkin addition (40g, 50g, and 60g). The attributes evaluated included color, flavor, scent, and texture, using a hedonic scale ranging from 1 (dislike very much) to 5 (like very much). The mean scores from panelists' assessments for each formulation are presented in Table 1.

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Table 1.. Mean Organoleptic Scores of Pumpkin-Corn Grits by Formulation

Formulation	Color	Flavour	Scent	Texture
F1 (40g pumpkin)	3,65	3,17	3,31	3,38
F2 (50g pumpkin)	3,70	3,13	3,41	3,15
F3 (60g pumpkin)	**3,82**	**3,68**	**3,47**	**3,45**

Note: Scores are based on a hedonic scale from 1 (dislike very much) to 5 (like very much).

In the hedonic test, selecting the best product is by looking at the highest mean value of various attributes (color, taste, aroma, and texture). Based on the organoleptic test, the F3 formulation with 60g of pumpkin had the highest average scores in all attributes, particularly flavor (3.68), indicating a higher level of acceptance compared to F1 and F2.

Nutritional Composition of Pumpkin-Corn Grits

An analysis of the nutrient content was carried out to compare the macronutrient profiles of the three formulations of pumpkin-corn grits. Each formulation varied in the amount of pumpkin added (40 g, 50 g, and 60 g). The nutrient parameters measured included energy, carbohydrate, protein, fat, fiber, ash, and water content. This assessment helps determine the most nutritious and acceptable formulation as a supplementary food for pregnant women. The results are summarized in Table 2.

Table 2. Nutritional Composition of Pumpkin-Corn Grits

Nutrient	**Formulation I**	**Formulation II**	**Formulation III**
Energy (kcal)	195,8	198,7	201,6
Carbohydrate (g)	33,1	33,8	36,3
Protein (g)	6,4	6,6	6,7
Fat (g)	4,1	4,2	5,03
Fiber (g)	0,3	0,3	0,3
Ash Content (g)	4	4,5	5

The nutrient content analysis of the three formulations revealed variations in energy and macronutrient levels as the amount of pumpkin increased. Formulation III, which contained the highest amount of pumpkin (60 g), demonstrated the highest energy content (201.6 kcal), carbohydrate (36.3 g), protein (6.7 g), fat (5.03 g), and ash (5 g). In contrast, Formulation I (40 g pumpkin) had the lowest values across most parameters. Despite these differences, fiber content remained constant at 0.3 g in all formulations. These findings indicate that increasing the amount of pumpkin contributes positively to the overall nutritional value of the product, particularly in enhancing energy, protein, and mineral (ash) content.

DISCUSSION

Organoleptic Test Result

Color

The average result of the organoleptic test was different for each treatment. The average result of the organoleptic test on the color of pumpkin corn grits was 3.65-3.82 with the rather like category, the most preferred formulation for the panelists was treatment F3 with the addition

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of 60 grams of pumpkin. The results of the ANOVA analysis showed that the treatment of adding pumpkin to corn grits had no significant effect on the color of corn grits, with an F calculated value of 0.632 with a significant level (P value) 0.534 > 0.050, so it can be concluded that the treatment of adding pumpkin to corn grits had no significant effect on the color of the resulting corn grits.

According to research by Stefania, et al. 2021) The increasing addition of pumpkin, the color produced by pumpkin corn grits shows a darker color. This is due to the presence of beta-carotene which will produce a yellow color. The color of pumpkin corn grits in this study was different for each treatment. Pumpkin grits in this study were different for each treatment. F1 pumpkin grits with the addition of 40 gr pumpkin has a slightly bright yellow color. F2 pumpkin grits with the addition of 50 gr pumpkin has a bright yellow color, F3 pumpkin grits with the addition of 60 gr pumpkin has a slightly darker yellow color.Carotenoids are the yellow, red and orange pigments in plants. Carotenoids can function as vitamin A precursors and antioxidants. These high carotenoids can be removed through extraction. (Dyah, et al. 2015).

Aroma

The average results of the organoleptic test did not differ much between the 3 treatments. The aroma ofpumpkin corn grits had an average value of 3.31-3.47 in the rather like category, the formulation that the panelists liked the most was F3 with the addition of 60 gr pumpkin. The results of the ANOVA analysis showed that the treatment of adding pumpkin to corn grits had no significant effect on the aroma of pumpkin corn grits, with an F calculated value of 0.556 with a significant level (P value) 0.576 > 0.050, so it can be concluded that the treatment of adding pumpkin to corn grits was not significant effect on the aroma of the resulting corn grits. The aroma of food determines the delicacy of the food, therefore aroma is a factor in determining quality. Winarno (2004), a distinctive and attractive aroma can make food more preferred by consumers so it needs to be considered in processing a food ingredient. The higher the addition of pumpkin corn grits, the lesslikely the smell of eggs in pumpkin corn grits is.

Pumpkin grits with the addition of pumpkin 40 gr (F1), 50 gr (F2), 60 gr (F3) in this study had the samearoma for 3 treatments, namely the distinctive aroma of corn and fishy eggs.

Texture

The average results of the organoleptic test did not differ much between the 3 treatments. The textureof pumpkin corn grits had an average value of 33.15-3.45 in the rather like category, the formulation that the panelists liked the most was F3 with the addition of 60 gr pumpkin. The results of the ANOVA analysis showed that the treatment of adding pumpkin to corn grits had no significant effect on the texture of corn grits, with an F calculated value of 1.237 with a significant level (P value) 0.295 > 0.050, so it can be concluded that the treatment of adding pumpkin to corn grits had no significant effect on the texture of the corn grits produced, which means that it can be said that all treatments have the same texture, namely soft. It can be concluded that the difference in the addition of pumpkin does not significantly affect the degree of softening. According to (Sakti, 2018) Texture is the size and arrangement (network) of parts of an object or food. Texture can be seen directly using the sense of sight, namely hard, soft, smooth, rough, whole, solid, liquid, dry, moist, tough, crunchy, soft, and chewy (Ela, 2020).

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Flavor

The average results of the organoleptic test were somewhat different between the 3 treatments. The taste of pumpkin corn grits had an average value of 3.13-3.68 in the rather like category, the formulation that the panelists liked the most was F3 with the addition of 60 gr pumpkin. The results of the ANOVA analysis showed that the treatment of adding pumpkin to corn grits had a significant effect on the taste of corn grits, with an F calculated value of 6.117 with a significant level (P value) 0.003 <0.050, so it can be concluded thatthe treatment of adding pumpkin to corn grits had a significant effect on the resulting grits taste.

The increasing addition of pumpkin will affect the taste of the resulting pumpkin corn grits. This is in accordance with the statement from Winarno (2004), that the texture and consistency of the material will affect the taste elicited by the material. Changes in the texture or viscosity of the material can be caused by these materials, which can change the smell and taste.

Nutrient Content

Carbohydrate

Carbohydrate formulation of pumpkin corn grits with the addition of pumpkin showed that the carbohydrate content of pumpkin corn grits ranged from 19.73% to 20.56%. the highest carbohydrate content value of 20.56% was found in the treatment of adding 50 gr pumpkin (F2), while the lowest carbohydrate content value of 19.73% was in the treatment of adding 60 gr pumpkin (F3). Based on the results of the ANOVA test, the addition of different pumpkins did not significantly affect corn porridge carbohydrates, withan F calculated value of 0.193 with a significant level (P value) of 0.829 > 0.050, so it can be concluded that the addition of pumpkin in the three treatments had no significant effect on carbohydrate levels.

Proteins

Test analysis of protein content in the three different treatments between the F1, F2 and F3 treatments. The highest water content value of 3.25% was found in treatment F2 with the addition of 50 gramsof pumpkin, while the lowest protein value was 42.11% in treatment F1 with the addition of 40 grams of pumpkin. Protein levels in this study ranged from 2.11% -3.25% protein levels in the F2 and F3 treatments were significantly different from the F1 treatment. Based on the results of the ANOVA test, the addition of different pumpkins had a significant effect on the protein content of corn grits, with an F calculated value of 35.962 with a significant level (P value) of 0.000 <0.050. so that it can be concluded that the addition of pumpkin to the three treatments had a significant effect on the protein content of the resulting pumpkin corn grits.

Fat

The fat content of pumpkin corn grits with the addition of pumpkin showed that the fat content of pumpkin corn grits ranged from 4.08% - 5.53% and the highest average value of the fat content test was F1 with the addition of 40 gr pumpkin. Based on the results of the ANOVA test, the addition of different pumpkins had a very significant effect on the fat content of corn grits, with an F calculated value of 19.619 with a significant level (P value) 0.002 <0.050. It can be concluded that the addition of pumpkin in the three treatments had a significant effect on the fat content of porridge. the resulting pumpkin corn.

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Fiber

The fiber content in pumpkin corn grits with the addition of pumpkin showed that the fiber content of pumpkin corn grits ranged from 2.39% -3.36%. the highest fiber content value of 3.36% was found in the treatment of adding 50 gr pumpkin (F2), while the lowest fiber content value of 2.39% was in the treatment ofadding 60 gr pumpkin (F3). Based on the results of the ANOVA test, the addition of different pumpkins did not significantly affect the fiber content of corn grits, with an F calculated value of 2.573 with a significant level (P value) of 0.156 > 0.050, so it can be concluded that the addition of pumpkin in the three treatments had no significant effect on the levels of the resulting fiber.

Ash Content

The ash content of the pumpkin corn grits formulation with the addition of pumpkin showed that the ash content of the pumpkin corn grits ranged from 0.64% -1.48% and the highest average value of the ash content test was F3 with the addition of 60 gr pumpkin. Based on the results of the ANOVA test, the addition of different pumpkins had a very significant effect on the ash content of corn grits, with an F calculated value of 461.761 with a significant level (P value) of 0.000 <0.050. so that it can be concluded that the addition of pumpkin to the three treatments had a very significant effect on the ash content of pumpkin corn grits produced by carbohydrates.

Conclusion

This study concludes that pumpkin and corn grits have potential as an alternative supplementary food for pregnant women. The addition of 40 g, 50 g, and 60 g of pumpkin significantly affected the organoleptic characteristic of taste, without significantly influencing color, aroma, or texture. Furthermore, the addition of pumpkin had a significant effect on the proximate composition, particularly increasing ash, fat, and protein contents, while having no significant effect on moisture, fiber, and carbohydrate levels. The acceptability test indicated that the F3 formulation, which contained 60 g of pumpkin, showed the highest scores in color, taste, aroma, and texture, making it the most preferred formulation.

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