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Complimentary Feeding Substitutions of Pumpkin and Snakehead Fish Flour

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ABSTRACT

Background. *Malnutrition, notably underweight in infants, is a severe nutritional problem that must be addressed. To solve the problem of being skinny in toddlers by utilizing local food, complementary feeding with high protein and vitamin A levels must be offered. Pumpkin is abundant in beta-carotene, while snakehead fish is one of the animal protein sources with a high protein level. Baby porridge using snakehead fish meal and pumpkin flour as a substitute is predicted to be a complementary feeding that provides high protein and vitamin A. The goal of this study was to determine the acceptability of complementary feeding porridge and the effect of the substitution of pumpkin flour and snakehead fish on the level of nutrients and beta-carotene.*

Research Methods. *This was a randomized controlled trial with two components and three degrees of substitution treatment of pumpkin flour and snakehead fish meal in the ratios of 100g:50g, 75g:75g, and 100g:50g. Proximate and beta-carotene analyses are used to determine nutritional level. The Friedman test was used to do a statistical analysis of the preference/hedonic test.*

Research Result. *There are differences between complementary feeding made from pumpkin flour and snakehead fish and instant complementary feeding in terms of carbohydrate, protein, fat, energy, water level, ash level, and beta-carotene levels. The color and flavor of the complementary feeding are affected by the percentages of snakehead fish meal and pumpkin flour.*

Conclusion. *Formula 1, with a ratio of 100g:50g, is the most popular formula for pumpkin flour and snakehead fish meal.*

BACKGROUND

Malnourished toddlers in large numbers are a severe problem that must be addressed immediately. Being underweight is a condition in which the body does not get enough of the nutrients it needs. Underweight was present in 13.9 percent of Indonesians in 2013. Compared to the incidence in 2010, this number increased by 13.0 percent (Kemenkes RI, 2013). Underweight prevalence has risen in South Sumatra, from 10.20 percent in 2017 to 12.30 percent in 2018 (Kemenkes RI, 2018). As a result, it is critical to appropriately address the problem of underweight cases to avoid an increase in the number of malnourished children under the age of five. In Indonesia, the issue of under-five malnutrition is being addressed through food diversification based on innovation and the creation of complementary feeding formulas. Everything is done while keeping in mind kids' nutritional needs and immunity, as well as processing techniques and outstanding local food resources. The type of complementary feeding provided to toddlers varies depending on the criteria for toddler age, one of which is soft food (Kemenkes RI, 2013). Porridge is an example of soft food that can be used to supplement the diet of toddlers. When the baby is six months old, it is recommended that nutrient-dense and safe meals be introduced as complementary feeding. Because they can no longer supply the

nutritional demands of babies, babies require an additional 24-30% of their energy to meet nutritional inadequacies from breast milk (WHO, 2000).

Food intake in various quantities and nutritional levels are required for the baby's growth and development. Protein and vitamin A are two of the most critical dietary components in infancy (a form of beta-carotene). Protein is needed for cell development and maintenance in infancy, and vitamin A is vital for eye health, the immune system, and the integrity of epithelial cells covering the skin, digestive and respiratory tracts, and the interior of the mouth (Parzková, 2016; Mahan & Escott-Stump, 2008).

Beta-carotene-rich dietary items can be added to complementary feeding production. Pumpkin (Cucurbita moschata Duch.) is a native food with high carotenoid components of 285.91 mg/100 g (Manasika & Widjanarko, 2015) and beta-carotene of 1,569 g/100 g (DKPI, 2018). Pumpkin flour provides protein that is 99 percent digestible, making it safe for newborns to consume.

Protein is essential in the preservation of cells, the replacement of damaged tissue, development, and the deposit of muscular tissue in toddlers. Protein consumption will promote serum albumin production, which aids in the control of body proteins. Animal protein is high in protein digestibility and includes all of the essential amino acids that the body requires. As a consequence, animal protein is a high-quality protein. Snakehead fish is one of the high-protein meals (Ophiocephalus striatus). Fresh snakehead fish has a protein level of 11.62 ± 0.17 mg/g (Asikin & Kusumaningrum, 2017). Not only that, however, snakehead fish has a very high digestibility rate of more than 90%. Flourishing is a form of developing snakehead fish that may be used as a complementary feed for babies. The protein value of 100 g of snakehead fish meal is 76.9% (Kartika Sari et al., 2018), whereas 100 g of skim milk has only roughly 30 g of protein (Thurlow, 2008). This study aims to determine whether there is an effect of the substitution of pumpkin flour and snakehead fish on the level of nutrients, beta-carotene, and the acceptability of complementary feeding porridge.

RESEARCH METHODS

This was a randomized controlled trial with two components and three degrees of substitution treatment of pumpkin flour and snakehead fish meal in the ratios of 100g:50g, 75g:75g, and 100g:50g. The study took place between November 2020 and March 2021. The Food Technology Laboratory, Department of Nutrition, Poltekkes, Ministry of Health, Palembang, Laboratory of Chemistry and Agricultural Products, Sriwijaya University for protein, fat, carbohydrate, energy, and food fiber analysis, and Saraswati Genetech Laboratory Bogor for beta-carotene analysis were all involved in the production of pumpkin flour and snakehead fish meal, as well as hedonic tests.

Processing pumpkin flour and snakehead fish meal with brown rice flour and powdered sugar to provide complementary feeding are currently in the research stage. The formula is packed after all of the components have been combined with a mixer. The panelists also performed a hedonic test on the formula, which included color, scent, taste, and texture. A total of 30 semi-trained panelists were employed in this study. The sensory qualities of the complementary feeding formula, such as color, taste, scent, and texture, were evaluated by panelists in this test. The product is evaluated on a scale of 1 to 4, with 1 indicating a strong dislike, 2 indicating a dislike, 3 indicating a like, and 4 indicating a strong like. Furthermore, the Friedman test was used to evaluate the data from the hedonic test in order to assess the influence of the formula on the panelists' degree of preference.

The panelists' preferred formula was kept for laboratory testing, such as comparative and beta-carotene tests. The researcher completed the product description. The Indonesian National Standard (INS)-01-2891-1992 technique was used to determine the nutritional level, including carbohydrates, protein, fat, water, and ash. The 18-5-40/MU/SMM-SIG (HPLC) technique was used to measure beta-carotene.

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RESULTS AND DISCUSSION

Table 1. Determination of the Formula Pumpkin Flour and Snakehead Fish Complementary feeding

Material (gram)	Formula 1 (F1)	Formula 2 (F2)	Formula 3 (F3)
Pumpkin flour	100	75	50
Snakehead fish meal	50	75	100
Powdered sugar	5	5	5
Brown rice flour	10	10	10

Powdered sugar and brown rice flour are added to the snakehead fish meal and pumpkin formula. The immediately packed formula is a yellowish powder with a soft texture similar to instant porridge with a particular taste and scent derived from pumpkin flour and snakehead fish meal. The formula for instant complementary feeding porridge is divided into three sections, each with the constituent ratios shown in Table 1.

Hedonic Test

The hedonic test is a method of determining the level of preference for a formula or product by assessing taste, color, scent, and texture. The prepared formula is pre-brewed with warm water at roughly 80°C for the hedonic test. The panelists are given 50 grams of each brewed formula as a fine slurry.

The average hedonic test results for the complementary feeding formula of pumpkin flour and snakehead fish meal can be seen in the following table (Table 2).

Table 2. Hedonic Test Results Pumpkin Flour and Snakehead Fish Complementary Feeding Formula

Parameter Uji	F1	F2	F3	*p-value*
Color	2,53	1,7	1,18	0,01
Taste	2,53	2,32	1,15	0,02
Scent	2,22	1,88	1,9	0,13
Texture	2,22	1,95	1,83	0,17
Average	2,38	1,96	1,51	

Friedman's statistical test on taste showed that the average acceptance score of panelists was 1.15–2.53, indicating that the taste of the supplemental food formula for breast milk with pumpkin flour and snakehead fish was acceptable to the panelists. Compared to the F2 and F3 treatments, more panelists preferred the complementary feeding formula of pumpkin flour and snakehead fish in the F1 treatment. This is because the complementary feeding formula made of pumpkin flour and snakehead fish in the F1 treatment tastes sweeter and slightly more flavorful when compared to the complementary feeding instant porridge. The snakehead fish retained a robust fishy flavor in the F2 treatment, but the taste of the pumpkin and snakehead fish was unbalanced in the F3 treatment. This indicates that increasing the pumpkin flour in the product will produce a sweeter flavor. The addition of pumpkin flour to a product can increase its sweetness of the product (Nurjanah et al., 2020). Pumpkin fruit has a sweet flavor (Kumari et al., 2009). The number of soluble solids in the pumpkin, as well as its carotenoid concentration, determine its sweetness (Gajewski et al., 2008). The analysis showed that the proportion of complementary feeding made up of pumpkin flour and snakehead fish had a significant effect on the flavor of complementary feeding (p-value <0.05).

The hedonic test for color showed that Formula 1, with an average score of 2.45, was the most preferred formulation of pumpkin flour and snakehead fish. Because the color was brighter than the other formulas, most panelists preferred the F1 treatment. This is because F1 has more pumpkin flour than F2 and F3. The product with a darker yellow color will be favored if there is a higher amount of pumpkin in it (Nurjanah et al., 2020). The pumpkin's yellow color is due to the presence of carotene. The concentration of yellow to orange color in pumpkins is associated with carotenoids (Wahyuni & Widjanarko, 2015). According to the findings, the proportion of complementary feeding consisting of pumpkin flour and snakehead fish had a significant impact on the color of complementary feeding.

The test results on the scent produced by the complementary feeding formula of pumpkin flour and snakehead fish showed that formula 1 has the highest average score for panelist acceptability. The scent of pumpkin and snakehead fish complementary feeding is a mixture of pumpkin flour and snakehead fish. The F1 treatment was chosen because it smelled like yellow pumpkins and was less fishy than the other formulas. Pumpkin has particular features as well as a distinct scent. Consumers would prefer the scent of instant baby porridge with pumpkin flour added. Pumpkin flour has a unique scent, making it easy to recognize, and I prefer instant baby porridge (Sunarjo & Ramayulis, 2012).

According to the hedonic test findings on the textural characteristics provided by the complementary feeding of pumpkin flour and snakehead fish, formula one was preferred because the texture was more balanced and just slightly grainy. All raw materials utilized have a significant impact on a product's texture. A 60-mesh sieve was used to sift the snakehead fish meal and pumpkin flour. Pumpkin flour, on the other hand, has a finer texture than snakehead fish meal since pumpkin flour is already entirely satisfactory. Flour products are often required to have a minimum fineness of 80 mesh. The texture of the porridge will be affected by adding pumpkin flour. Because pumpkin flour has high gelatinization qualities, it may be used to make a dough of good consistency (Sunarjo & Ramayulis, 2012). At least 90% of the flour must pass through an 80-mesh sieve, which is one of the standards for optimum flour quality.

In comparison, SNI 01-3751-2006 specifies that wheat flour must have a fineness of at least 95% and pass through an 80-mesh sieve. In addition, semi-solid textured food is recommended for babies beyond six months. As a result, the specification indicates that when mixed with water, complementary feeding instant powder produces a smooth porridge texture with no lumps and a thickness that allows it to be served with a spoon. Furthermore, complementary feeding instant should be significant enough particles to encourage the infant to chew (SNI, 2005).

The results showed that different panelists' acceptability outcomes were achieved after adding pumpkin flour and snakehead fish with varying additions. Formula 1 (F1) had the highest overall preference score, which included 100 grams of pumpkin flour and 50 grams of snakehead fish meal. It is well known that the greater the proportion of pumpkin flour in the overall complementary feeding, the higher the preference for it. The formula's color, taste, scent, and general texture all impact this.

The p-values for color and taste (0.05) are 0.01 and 0.02 for statistical tests with a significant level (α) of 0.05, indicating that the proportion of complementary feeding of pumpkin flour and snakehead fish meal had a significant effect on the color and taste of complementary feeding (Table 2).

Proximate and Beta-carotene Test

After the panelists completed the hedonic test, formula one was chosen as the most preferred. Furthermore, comparative tests, such as protein, carbohydrate, fat, water, and ash level, as well as beta-carotene level analysis, were conducted for formula 1. Table 3 shows the nutritional values of complementary feeding when pumpkin flour and snakehead fish meal are replaced with INS instant porridge complementary feeding. Table 3 compares nutritional values when pumpkin flour and snakehead fish meal complementary feeding are replaced with INS instant porridge.

Table 3. The Nutritional Composition of Pumpkin Flour and Snakehead Fish Complementary Feeding and INS Instant Porridge (SNI 01-7111.4-2005) Complementary feeding

Composition	Complementary feeding **Formula 1**	Instant porridge Complementary feeding (SNI)
Protein (gr)	22.10 %	8 – 22 %
Fat (gr)	2.80%	6 – 15 %
Carbohydrate (gr)	35.80%	<30 %
Water level (gr)	22.20%	4 %
Ash level (gr)	7.01 %	< 3,5 %
Beta carotene (mg)	9.29%	0.25-0.35%

Protein Content

Pumpkin flour and snakehead fish complementary feeding have a protein value of 29.58 percent, which is more than the INS guideline for instant porridge. Adam et al.'s research (2020) stated that the more snakehead fish meal added to food products, the higher the protein level (Adam et al., 2020). The protein level of complementary feeding instant porridge can be increased using a snakehead fish meal. This is because snakehead fish has a high protein level, which allows it to replace part of the protein in complementary feeding instant porridge made from skim milk, which has less protein than snakehead fish protein. High-quality protein is required for a baby's growth and development. Six months and above are critical because newborns' development is quick, and they become highly dependent on other food (Siolimbona et al., 2016). Snakehead fish meal is the protein source utilized in complementary feeding instant porridge. It is a higher-quality animal protein source than vegetable protein, with a protein level of 84.77 percent in snakehead fish meals (Christian Dewantara et al., 2019).

Fat Content

The fat content in the complementary feeding of pumpkin flour and snakehead fish was 2.10 percent. This indicates that the fat level of the product is still below the SNI (6-15 percent). This is because the fat level of the raw material used to make porridge is still low. As a result, it must be adjusted again, or extra ingredients must be added to increase the fat level—long-chain omega-3 fatty acids (EPA and DHA) in fish benefit growth. Although adding snakehead fish meal to instant porridge complementary feeding can raise the fat level by 0.23–0.6 g, the complementary feeding fat level has not yet achieved the required level.

Carbohydrate Content

Carbohydrates are essential in determining meals' flavor, texture, color, and other aspects. Carbohydrate content is determined by the reduction factor, which is a 100 percent reduction in water, ash, fat, and protein levels (Winarno, 2004). The carbohydrate levels in pumpkin flour and snakehead fish complementary feeding were 59.07 percent, somewhat higher than the SNI instant porridge levels. The primary source of energy for babies is carbohydrates. Carbohydrate consumption must provide at least 52-54 percent of total energy requirements (Parizkova, 2016). Gumolung (2019) states that pumpkin flour has a high carbohydrate level of 83.18 percent, whereas snakehead fish meal has a carbohydrate content of 1.99 percent (Christian Dewantara et al., 2019). The carbohydrate level of fish meals is fairly considerable compared to raw fish. This is due to the loss of a significant quantity of water and fat during the steaming and drying of the fish, increasing carbohydrate levels.

Water Content

The water content of pumpkin flour and snakehead fish complementary feeding was 22.20 percent in the analysis. Therefore, this formula's water level exceeds the regulatory limit of 4%. This is supposed to be induced by the high water level of snakehead fish meal and pumpkin flour, which are used to make instant porridge for complementary feeding. Furthermore, the protein level of the flour used to make complementary feeding is higher. Flour with a higher protein level absorbs water more readily than flour with a lower protein level (Noor Hakim et al., 2013). Therefore, commercial supplementary feeding instant porridge is considered to have a lower shelf life than water content that exceeds complimentary feeding INS. As a result, it is thought that instant baby porridge has a shorter shelf life than baby porridge that meets SNI criteria.

Ash Content

The findings of the ash content analysis in pumpkin flour and snakehead fish complementary feeding were 7.01 percent, above the standard of 3.5 percent. Pumpkin flour, skim milk, and snakehead fish meal, each containing 5.29 percent ash, 5.99 percent ash, and 5.96 percent ash, contribute to the high ash level of the complementary feeding instant porridge.

Beta Carotene Content

The beta-carotene content of pumpkin flour and snakehead fish for complementary feeding was 9.29 percent, above the regulatory limit of 0.25-0.35 percent. Because the amount of pumpkin flour used in each formulation varied, the beta-carotene level also varied. The beta-carotene content of instant porridge MP-ASI increases with the amount of pumpkin flour formulation utilized. Beta-carotene is involved in various physiological processes, including eyesight, cell differentiation, immunity, growth and development, reproduction, and cancer and heart disease prevention. Beta-carotene is an antioxidant that supports growth and development, eyesight, and the immune system. It also helps preserve epithelial cells' integrity (Sunarjo

& Ramayulis, 2012). Because beta-carotene is converted to vitamin A (retinol) in the body, it serves as a precursor. As a result, eyesight, cell differentiation and proliferation, reproduction, growth, and the immune system benefit from vitamin A (Parzková, 2016).

CONCLUSIONS

The most chosen formula by the panelists after producing complementary feeding porridge with the substitution of pumpkin flour and snakehead fish was F1 with a pumpkin flour and snakehead fish ratio of 100 g to 50 g. According to the findings, the proportion composition of pumpkin flour and snakehead fish significantly influenced the color and flavor of the complementary feeding porridge (p-value<0.05). Formula 1 pumpkin flour and snakehead fish complementary feeding had 2.8 percent fat, 29.58 percent protein, 35.80 percent carbs, 22.10 percent water level, and a 7.01 percent ash level. The complementary feeding formula's beta-carotene level of the pumpkin flour and snakehead fish was 9.29 percent. The beta-carotene level was more significant than the complementary feeding INS instant porridge.

SUGGESTIONS

More study is needed to improve the use of pumpkin flour and snakehead fish in the production of complementary feeding so that the criteria for instant porridge INS may be satisfied.

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