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Macronutrient and Micronutrient Analysis of Bilih Fish-Based Finger Food as a Local Food Innovation from West Sumatra to Support the Nutrition of Pregnant Women

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Abstract

West Sumatra faces a nutritional paradox in which low birth weight prevalence (6.4%) coexists with high stunting rates (24.9%), indicating chronic maternal micronutrient deficiencies during pregnancy. This study aimed to develop a local food innovation in the form of bilih fish (Mystacoleucus padangensis)-based finger food and analyze its macronutrient and micronutrient content to support maternal nutrition. A descriptive observational design with laboratory analysis based on Indonesian National Standards (SNI) was used. The results showed that the bilih fish finger food had an energy density of 188.19 kcal/100 g, a crunchy texture, and minimal fishy aroma, making it suitable for pregnant women, including those with emesis gravidarum. The protein content reached 16.52 g/100 g, fulfilling approximately 55–80% of the additional daily protein requirements during pregnancy. Zinc content was 1.32 mg/100 g (13.22 mg/kg), higher than several other local food sources such as dadiah and eggs. In conclusion, bilih fish-based finger food has strong potential as a functional local food to address maternal micronutrient deficiencies and serve as a preventive strategy to reduce stunting risk in West Sumatra starting from the intrauterine period.

Keywords: Finger Food, Bilih Fish, Pregnant Women's Nutrition, Stunting, Local Food of West Sumatera.

INTRODUCTION

The double burden of malnutrition remains a global health challenge with a significant impact on the quality of human resources, particularly during the first 1,000 days of life (HPK). This period is a critical phase during which brain development and physical growth occur rapidly, so failure to provide adequate nutrition during this period can have permanent consequences. In Indonesia, attention to the nutritional status of pregnant women and toddlers continues to increase, but recent data reveals a paradoxical health phenomenon in West Sumatra.

According to a recent report, West Sumatra has demonstrated positive achievements in pregnancy-specific nutritional intervention indicators. Iron supplementation coverage among pregnant women reached 92.1%, with a consumption rate of 63.4%, exceeding the national average. This high level of influx is consistent with good birth outcomes, with the prevalence of Low Birth Weight (LBW) at only 6.4%. This data demonstrates that macro-scale interventions to prevent LBW have been effective (Ministry of Health of the Republic of Indonesia, 2025).

However, this success is inversely proportional to the child's subsequent nutritional status. National data shows that the prevalence of stunting in West Sumatra has reached 24.9%, far above the average (Ministry of Health of the Republic of Indonesia, 2025). The sharp disparity between the low LBW rate and the high stunting rate raises suspicions of hidden hunger or chronic micronutrient deficiencies such as zinc and calcium from infancy. These deficiencies impact newborns' nutrient stores, making them vulnerable to growth faltering when facing environmental challenges after birth (Soliman et al., 2021).

The urgency of this nutritional intervention becomes even more crucial when viewed from the perspective of fetal programming or the Barker Hypothesis. Fetuses experiencing intrauterine malnutrition will undergo physiological adaptations to survive by conserving energy (thrifty phenotype) (Jebasingh & Thomas, 2022). The long-term requirements of this metabolic programming are permanent, placing the fetus at higher risk of developing degenerative diseases such as type 2

diabetes mellitus and hypertension in adulthood (Sulyok et al., 2023; Oulerich & Sferruzzi-Perri, 2024).

Therefore, strategies to address stunting in West Sumatra need to include a nutrient-dense functional food approach for pregnant women (Pikor et al., 2024). One such approach is the utilization of local food, namely bilih fish (Mystacoleucus padangensis), a species endemic to Lake Singkarak that is rich in zinc and animal protein (Warsa et al., 2020). Previous research has shown that bilih fish extract is effective in improving nutritional status (Yuniritha et al., 2015).

Despite its significant nutritional potential, the use of bilih fish is often hampered by its fishy odor, which can trigger nausea (emesis gravidarum) in pregnant women. Developing finger food products offers a potential solution because it allows for small, frequent feeding with high nutrient density (Taufiqa & Husna, 2023). This study aimed to analyze the macronutrient and micronutrient (zinc and calcium) content of bilih fish-based finger foods as a local food innovation to support the nutrition of pregnant women.

RESEARCH METHODS

This research was a laboratory experimental study with a descriptive design to analyze the physical characteristics and nutritional content of the developed product. The research was conducted from January to December 2024. The product formulation and manufacturing processes were conducted at the Nutrition Laboratory, Faculty of Medicine, Padang State University, while proximate and micronutrient analyses were conducted at the Center for Standardization and Industrial Services (BSPJI) in Padang, West Sumatra.

The main ingredient used was fresh bilih fish (Mystacoleucus padangensis) obtained directly from fishermen at Lake Singkarak to minimize post-catch degradation time. Additional ingredients included potatoes (as a carbohydrate source and bulking agent), chicken eggs, carrots, cornstarch, and spices (shallots, garlic, spring onions, celery, and salt). Bilih fish finger food is made from ingredients including 15 g bilih fish, 1 chicken egg, 100 g potato, 10 g carrot, 1 clove shallot, 1 clove garlic, 5 g spring onion, 3 g celery, 20 g cornstarch, 1⁄4 teaspoon salt, and oil. The process of making bilih fish finger food is presented in Figure 1.

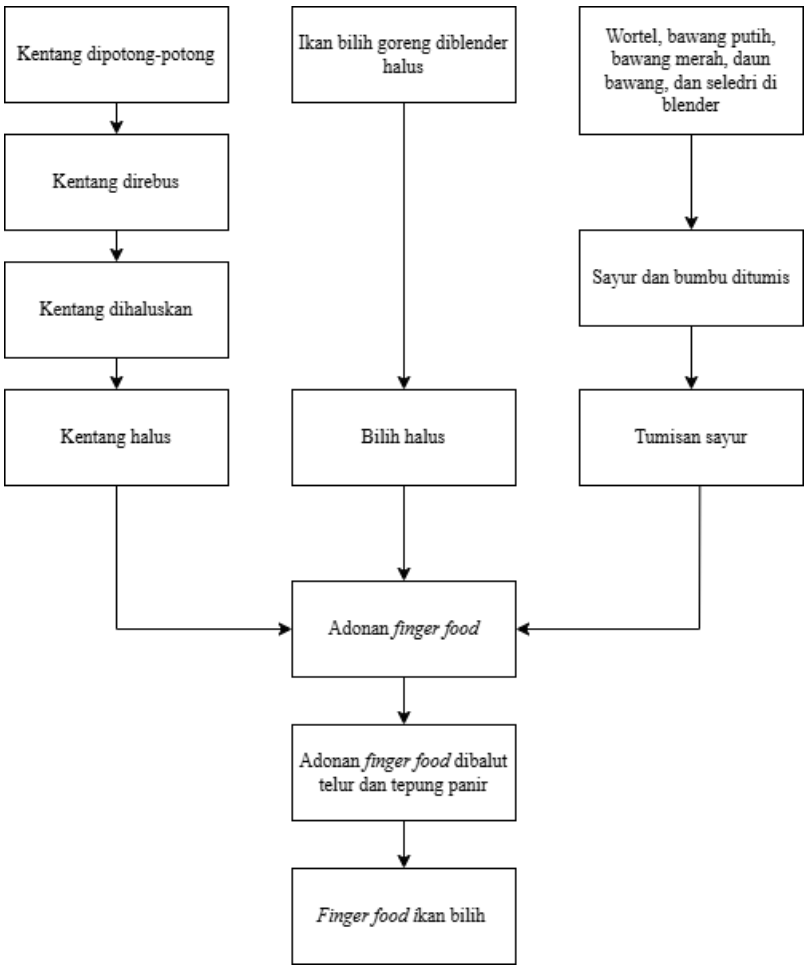

Figure 1. Flowchart for making bilih fish finger food

The production process follows hygienic Standard Operating Procedures (SOPs). The preparation stage begins with washing the bilih fish under running water three times to reduce physical contaminants. Next, the homogenization stage involves grinding the whole bilih fish, including the bones and head, using a food processor until it reaches a smooth paste consistency. This process breaks down the bone structure into edible micro calcium particles. The fish paste is then gradually mixed with mashed steamed potatoes, eggs, cornstarch, and ground spices to form a smooth dough. The dough is shaped into sticks (finger food) and coated with breadcrumbs (if coated).

The cooking stage uses a deep-frying method for 5 minutes until golden brown. This technique fixes the coating, inactivates pathogenic microbes, and creates a crispy texture. The product is then drained, rapidly cooled to room temperature to prevent condensation, and packaged in tightly sealed polypropylene (PP) containers (rigid containers) to maintain physical integrity and prevent cross-contamination.

Chemical analysis was conducted using the Indonesian National Standard (SNI) method. Macronutrient analysis included carbohydrates (Luff Schoorl method; SNI 01-2891-1992, point 9), protein (Micro Kjeldahl method; SNI 01-2891-1992, point 7.1), and fat (Soxhlet method; SNI 01-2891-1992, point 8.1). Micronutrient analysis (calcium, zinc, and iron) was conducted using the Atomic Absorption Spectrophotometry (AAS) method referring to SNI 01-2896-1998, point 5. Total sugar content was evaluated following SNI 01-2891-1992, point 3.1. Total energy was calculated using the Atwater conversion factor, which is 4 kcal/g for protein and carbohydrates, and 9 kcal/g for fat.

RESULTS AND DISCUSSION

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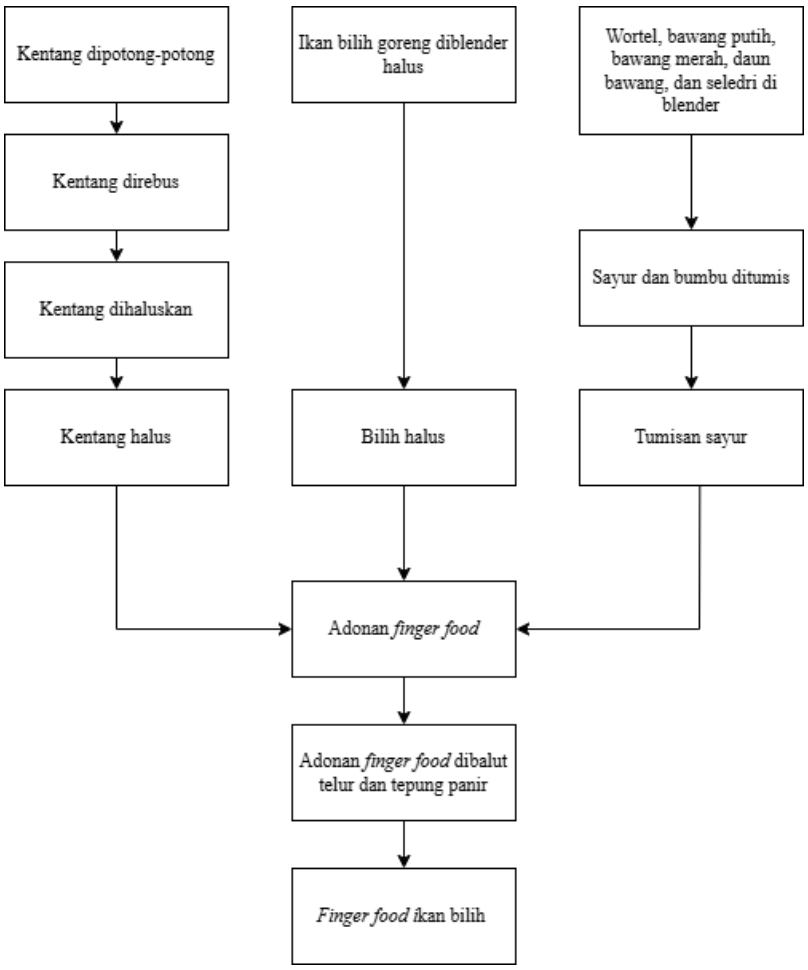

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CONCLUSIONS

This research has successfully developed bilih fish finger food as a functional food innovation based on local wisdom from West Sumatra that meets safety and nutritional quality standards for pregnant women. Based on the comprehensive analysis, several strategic conclusions can be drawn:

First, in terms of nutrient density, bilih fish finger food has proven to be a superior source of protein and micronutrients. Its protein content of 16.52% (16.52 g/100 g) can supply up to 80% of the daily protein requirements of pregnant women, which are crucial for blood volume expansion and placental growth. The most significant advantage lies in its zinc content of 13.22 mg/kg, which far exceeds comparable foods such as dadiah and eggs. The high zinc content, supported by the essential amino acid profile (lysine and methionine) of bilih fish, creates a Meat Factor mechanism that increases mineral bioavailability, making it an effective intervention for addressing hidden hunger and preventing intrauterine stunting from the organogenesis phase.

Second, from a clinical and acceptability perspective, the finger food formulation with its crunchy texture and non-fishy aroma has proven to be adaptive to the physiological conditions of pregnancy. This innovative dosage form specifically addresses the dietary management challenges of pregnant women with emesis gravidarum (nausea and vomiting) and hyperosmia. The energy density of 188.19 kcal/100 g in a small serving volume allows for the implementation of a small, frequent feeding pattern, effectively preventing maternal catabolism without burdening gastric capacity. This positions bilih fish finger food not simply as a snack but as a modality of medical nutrition therapy to prevent Chronic Energy Deficiency (CED).

Third, from a food technology and safety perspective, the processing process involving controlled-temperature frying and frozen storage has proven effective in maintaining product quality. Although there is a decrease in micronutrient quantity due to the formulation's dilution effect, the retention of macronutrients remains high. Furthermore, the use of bilih fish from Lake Singkarak, which has a lower risk of mercury contamination compared to predatory marine fish, ensures neurotoxicological safety for fetal development.

Thus, bilih fish finger food represents a synergy between local economic empowerment and public health interventions. By utilizing the endemic commodity Mystacoleucus padangensis, this innovation not only offers a cost-effective and easily accessible nutritional solution for the people of West Sumatra but also has the potential to stimulate the local fisheries sector economy. The integration of bilih fish finger food into the national priority program for accelerating stunting reduction is recommended as a sustainable upstream preventive strategy, breaking the chain of malnutrition from within the womb to create quality and competitive human resources free from stunting.

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