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The Role of Minangkabau Culinary Heritage in Advancing Nutritional Security and SDG-2 Targets: A Macronutrient Perspectives

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Abstract

Traditional foods have the ability to provide healthy food that helps individuals meet their daily nutritional demands. Consumption habits based on local foods not only represent traditional knowledge but also help to increase food security and achieve the Sustainable Development Goals (SDG-2). However, there has been no systematic research of the macronutrient content of traditional Minangkabau cuisine. The purpose of this study is to examine the macronutrient content of traditional Minangkabau foods and assess their contribution to daily nutritional needs. This is descriptive research using a cross-sectional design employing a food composition analysis method. Interviews were conducted to obtain data on ingredients, recipes, and serving sizes, which were then evaluated using the Indonesian Food Composition Table. Several traditional side dishes show a fairly good balance of macro nutrients. For example, Palai Lauak Budu has a composition of 34.1% carbohydrates, 36.11% protein, and 29.88% fat, so it can be categorized as a relatively complete source of macronutrients. A similar finding is seen in vegetable dishes, such as Gulai Pucuak Ubi Tumbuak, which contains 34.08% carbohydrates, 32.38% protein, and 33.54% fat. Meanwhile, traditional snacks such as Lapek Kunda have a dominant carbohydrate proportion of 82.04%, with a protein content of 3.81% and fat content of 14.15%. The differences in macronutrient composition among these three types of dishes demonstrate the diversity of nutritional value in traditional cuisine, which can contribute to meeting the energy and nutritional needs of the community when consumed as part of a balanced diet.

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Introduction

The Sustainable Development Goals (SDGs) aim to address various global health issues, including stunting, or impaired growth in children, which is one of the key indicators in assessing public health and nutrition. In Indonesia, stunting remains a significant challenge, with a relatively high prevalence despite a gradual decline in recent years.[1] One approach adopted to combat stunting is the utilization of local based-food. Local-based food, which refers to the use of locally available ingredients aligned with traditional culinary practices, plays a crucial role in improving nutritional status and reducing stunting rates.[2,3] These foods are typically rich in essential nutrients needed for children's growth and development. For example, foods such as tempeh, tofu, sour vegetable soup, and various types of tubers, which are easily accessible and affordable, can provide essential vitamins, minerals, and dietary fiber.[4,5]

Stunting or impaired growth in children, is a serious health issue in Indonesia, closely linked to chronic malnutrition and recurrent infections during early childhood.[6,7] Data from the Sustainable Development Goals (SDGs) and the World Health Organization (WHO) indicate that the prevalence of stunting in Indonesia reached approximately 24.4% in 2021.[8] Although this marks a decrease from 37.2% in 2013, it still exceeds the WHO standard threshold of 20%.[9] Several factors contribute to the high stunting rate, including poor nutrition, limited access to adequate healthcare and sanitation services, low levels of education, and poor family economic conditions.[10-13] The Indonesian government has made significant efforts to reduce stunting through various national programs, such as the "First 1,000 Days of Life Movement," which focuses on prevention starting from pregnancy through the child's first two years of life.[14,15]

Adequate and balanced macronutrient intake is essential to support optimal growth and development in adolescents. Macronutrients such as protein, carbohydrates, and fats are required in the right amounts to ensure the body receives sufficient energy and raw materials for various biological functions. However, many adolescents still experience macronutrient deficiencies due to unbalanced diets and a reliance on nutrient-poor processed foods. The importance of local-based foods has begun to gain more attention as part of efforts to improve nutritional status and prevent stunting. Local foods are not only rich in nutrients but also more accessible and affordable for the community. Moreover, local foods often align better with local eating habits and cultural practices, making them more acceptable to the population. They also help preserve biodiversity and safeguard rich culinary traditions, which are vital to cultural identity. The use of local based foods further promotes environmental sustainability by reducing dependence on imported foods and lowering the carbon footprint.

The availability of food resources is determined by the geographical conditions of an area, as these factors influence the quantity and variety of food that can be produced locally.[16,17] Elements such as altitude, climate, and distance from the coast significantly affect both the types and amounts of food that can be locally sourced.[18] This also determines the community's consumption patterns based on the availability of food in each region. West Sumatra possesses abundant and diverse natural resources, ranging from agricultural, plantation, and fishery products to horticultural commodities, all of which play a significant role in providing nutritious local food. Agricultural products such as rice, corn, and sweet potatoes supply complex carbohydrates as a primary energy source. Plantation products like coconuts, which are processed into coconut milk, serve as a source of healthy fats commonly used in traditional Minangkabau cuisine. In addition, fishery products such as freshwater and marine fish are important sources of animal protein essential for growth and development.[19,20] Ironically, despite the abundance of natural resources (NR) in various regions of West Sumatra, adolescent food consumption remains limited to only one or two types of food ingredients. In fact, the region holds tremendous potential in providing a wide variety of local foods rich in macronutrients. However, the low level of nutritional knowledge among adolescents is one of the main factors contributing to their monotonous dietary patterns, which do not reflect the richness of local natural resources. Many teenagers are still unaware of the importance of dietary diversity in meeting their daily nutritional needs. This imbalance is further exacerbated by the prevalence of instant food consumption and the habit of choosing fast food, which generally has low nutritional value.[21]

Educational interventions have been proven to significantly improve dietary practices and nutritional status among adolescents. Therefore, enhancing adolescents' understanding of the benefits of local foods and how to incorporate them into their daily diets is crucial in efforts to prevent stunting.[22] Adolescents require adequate food intake, both in quality and quantity, to support optimal growth and development. This need calls for a diverse dietary pattern to fulfill various essential nutrients such as vitamins, minerals, proteins, and essential fats. A varied diet not only helps meet nutritional requirements but also contributes to improving nutritional status, preventing malnutrition, and supporting overall health. Moreover, healthy eating habits established during adolescence provide long-term benefits, laying the foundation for a balanced lifestyle and lifelong well-being.[23]

A local-based approach to improving nutritional intake aligns with the goals of the Sustainable Development Goals (SDGs), which emphasize the importance of sustainable and community-based solutions to address global issues. Utilizing the potential of local foods is expected to enhance adolescents' nutritional status and reduce the prevalence of stunting, thereby supporting the achievement of SDG targets, particularly in the areas of health and food security. This study takes a novel approach by investigating the macronutrient potential of traditional Minangkabau foods for encouraging stunting prevention and achieving Sustainable Development Goal 2 (SDG-2), an area that has received little attention in the context of community-based nutrition interventions rooted in local food culture.

Materials and Methods

Research Design And Sample

This quantitative descriptive study used a cross-sectional approach. It was conducted in West Sumatra, Indonesia, the main area of the Minangkabau ethnic group. Data on food types was collected in areas that still preserve traditional consumption and processing practices. Traditional food samples were selected using purposive sampling for side dishes, vegetables, and traditional Minangkabau cakes based on the following inclusion criteria: (1) frequently consumed by children and families, (2) representing various food groups (animal, plant, or mixed), (3) having cultural value and being widely available in households or traditional markets.

Macronutrient Content Analysis

To ensure the authenticity of the traditional recipes, primary data were collected through a Focus Group Discussion (FGD) and semi-structured interviews. The FGD involved 16 representatives of local community leaders and cultural experts, supported by local government officials. These sessions focused on identifying authentic ingredients, traditional cooking techniques, and the cultural significance of the selected dishes. Direct observations were also conducted during the food preparation process to standardize the recipe measurements.

The macronutrient content (carbohydrates, proteins, and fats) per 100 grams of ready-to-eat food is calculated based on data from the Indonesian Food Composition Table (TKPI, 2017). Additional information is obtained from other reliable national food composition data sources if necessary. This analysis does not involve laboratory testing, but rather nutritional calculations based on raw materials, recipe measurements, and available food composition data.

Data Analysis

Nutritional content data was processed using Microsoft Excel to calculate the macro nutrient content per 100 grams of each food item. In addition, the percentage contribution of each food item to the Indonesia Recommended Dietary Allowance (RDA) calculated, based from WHO guidelines.

Results

Side Dishes

As shown in Table 1, most side dishes contain varying levels of carbohydrates, protein, and fat. Palai lauak budu shows a fairly good balance of carbohydrates (34.1%), protein (36.11%), and fat (29.88%), making it a fairly complete source of macronutrients. Rendang Tiram and Gulai Hiu also have a balanced composition of macronutrients, but in smaller amounts compared to other foods. Although each macronutrient's total value is relatively low, the proportions are balanced, categorizing both foods

as nutrient-dense in small portions. This makes them suitable as side dishes or accompaniments. Palai Lauak Asin stands out due to its high protein content (73.73%), making it an excellent source of animal protein. Punju (70.24%) are high in carbohydrates, so they are better categorized as primary energy sources than side dishes.

Table 1: Macronutrient Composition Of Side Dishes

Types of Food	Carbohydrates (%)	Protein (%)	Fat (%)
Gulai Langkitang	22.36	47.50	30.14
Rendang Lokan	38.56	27.84	33.60
Samba Karambia	39.33	16.64	44.03
Randang Ayam Pucuak Ubi Kayu	9.82	35.80	54.38
Gulai Lobak Paik Limbek Sala	27.60	27.50	44.90
Gulai Sabo-Sabo	22.09	42.43	35.48
Gulai Ayam Rungu-Rungu	16.09	31.46	52.45
Gulai Limbek Kampuang	5.42	52.86	41.72
Pangek Ikan Gariang Kacang Panjang	11.00	39.48	49.52
Palai Lauak Budu	34.01	36.11	29.88
Panggang Pacak	28.65	26.72	44.62
Rendang Tiram	35.61	26.32	38.07
Goreng Kepah	10.67	23.01	66.32
Palai Lauak Asin	3.33	73.73	22.94
Lamang-lamang Ikan	0.00	67.51	32.49
Pongek Tali-tal	29.38	67.30	3.32
Punju	70.24	15.32	14.44
Goreng Bilalang	8.44	86.01	5.55
Limbek Alin	18.82	50.85	30.33
Gulai Hiu	28.92	32.60	38.48

Vegetables

Of the six types of curry made from local ingredients, gulai pucuak ubi tumbuak has a relatively balanced composition of macronutrients. This means that the carbohydrate, protein, and fat content of this curry is balanced, thereby contributing to an adequate daily energy intake. Gulai durian mudo has the highest carbohydrate content at 72.77%, followed by gulai pisang with 69.20%. The highest protein and fat content is found in gulai paku at 53.63%.

Traditioanal Cake

Based on the data, Lapek kundua has the highest macronutrient content compared to other foods, with 82.05 % of carbohydrates, 3.81% of protein, and 14.15 % of fat, making it the main source of energy in this group. Sarang balam and tongkang have the lowest fat content, at only 20.79% and 0.88%, respectively, and also have low protein content, at 1 g and 2.04 g, respectively.

Table 2: Macronutrient Composition of Vegetables

No	Types of Food	Carbohydrates(%)	Protein (%)	Fat (%)
1	Gulai durian mudo	72.77	9.66	17.57
2	Gulai umbuik pisang	37.41	15.55	47.03
3	Gulai umbuik sawit	41.64	11.15	47.21
4	Gulai paku	19.37	27.00	53.63
5	Gulai Pisang	69.20	14.82	15.97
6	Gulai pucuak ubi tumbuak	34.08	32.38	33.54

Table 3: Macronutrient Composition of Traditional Cakes

No	Types of Food	Carbohydratest (%)	Protein (%)	Fat (%)
1	Lapek kundua	82.05	3.81	14.15
2	Kolak pepaya	79.22	8.02	12.76
3	Sarang balam	96.59	2.62	0.79
4	Lapek sukun	87.11	5.27	7.62
5	Tongkang	94.53	4.59	0.88
6	Panggang pisang	86.30	3.10	10.60

Discussion

An analysis of the macronutrient composition of various traditional Minangkabau foods shows that the local diet, passed down through generations, has great potential to support daily nutritional needs. During critical growth periods, especially during the first 1,000 days of life, adequate intake of macronutrients, particularly protein, fat, and carbohydrates, plays a crucial role in supporting biological processes such as tissue growth, brain development, immune system function, and overall metabolism.[6,24–27]

In addition to being nutrient-dense, many traditional foods exhibit a balance between carbohydrates, proteins, and fats, which is close to the basic principles of balanced nutrition.[28] This pattern is important in the context of meeting daily nutritional needs comprehensively, rather than focusing solely on one type of nutrient. However, there are also side dishes that are predominantly rich in one macronutrient, such as high in fat or high in protein alone, so a varied consumption approach is highly recommended to achieve optimal balance. Traditional vegetables such as Gulai Paku, Gulai Umbuik, and Gulai Pucuk Ubi also contribute significantly to macronutrient intake, particularly due to the use of ingredients like coconut milk, anchovies, and shrimp, which enhance protein and fat content.[29–31] Although they are categorized primarily as vegetable-based dishes, their nutritional contribution extends beyond micronutrients and dietary fiber due to the incorporation of complementary ingredients. For instance, the frequent use of coconut milk provides not only a distinct flavor profile but also a considerable source of dietary fat, particularly medium-chain triglycerides, which are efficiently metabolized as an energy source. Similarly, the addition of anchovies and shrimp enriches these dishes with high-quality animal protein and essential amino acids, thereby enhancing their role as building nutrients. This synergistic combination of plant-based components with animal-derived and fat-rich ingredients results in dishes that are not only culturally significant but also nutritionally dense. Consequently, these traditional foods exemplify how local culinary practices inherently promote a more comprehensive macronutrient balance.

Fat and protein are essential for growth and development, particularly throughout infancy and adolescence when growth is rapid.[32] Fat serves as a stable source of energy for physical activity and metabolic processes[33,34] and it aids in the absorption

of fat-soluble vitamins such as A, D, E, and K, which are essential for immunity, bone formation, and tissue health.[35–37] Meanwhile, protein is the primary component of all biological tissues, including muscles, skin, enzymes, and hormones.[38,39] Adequate protein consumption is required for proper cell regeneration and organ development.[40] Thus, traditionally cooked local vegetables not only provide micronutrients and fiber but also significantly support the fulfillment of macronutrient needs. Meeting fat and protein demands plays an essential role in stunting prevention since both help children develop appropriately for their age.[41–43] Children who consume animal protein sources such as eggs, fish, meat, and milk, as well as good fats from nuts and vegetable oils, have a better chance of reaching their full height and growth.[44] In other words, appropriate fat and protein nutrition from a young age can be a strategic step toward ending the cycle of stunting in society.

Traditional cakes such as Lapek, Kolak, Tongkang, and Sarang Balam are dominated by carbohydrates and serve as an additional source of energy. Although relatively low in protein, these cakes are important in meeting daily energy needs, especially in conditions where consumption of staple foods is less than optimal. Local carbohydrate-based snacks can be a practical solution for increasing energy intake in the context of daily consumption. Overall, traditional Minangkabau cuisine reflects a local food system that is both nutritionally rich and culturally significant. Based on ingredients like freshwater fish, coconuts, bananas, cassava, and local vegetables, this cuisine strengthens family food security, reduces dependence on processed or imported foods, and contributes to the sustainability of the regional food system. This aligns with the Sustainable Development Goals (SDGs), particularly SDG 2: Zero Hunger, which emphasizes ending hunger and all forms of malnutrition by utilizing nutritious, sustainable foods. Integrating traditional foods into community nutrition programs, family education, and community-based food policies strengthens government interventions aimed at addressing malnutrition. Additionally, this culture-based approach tends to be more widely accepted by the community and is more sustainable in the long term.

Conclusion

This study demonstrates that traditional Minangkabau foods, including side dishes, vegetables, and local snacks, possess a diverse range of macronutrients with significant and balanced profiles. Interpretation of these findings suggests that this culinary heritage is a scientifically-grounded nutritional resource. The practical implications of this study highlight that utilizing these nutrient-dense local foods can serve as a strategic solution for stunting prevention interventions and daily nutritional fulfillment, providing a basis for public health policies to achieve SDG-2 targets. However, this study is limited to macronutrient analysis; further research is required to explore micronutrient profiles and their bioavailability.

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This research does not involve any clinical trials.

Permission to Reproduce Material from Other Sources

Not Applicable

Author Contributions

- **Kasmita:** Conceptualization, Research Mapping, Supervision, And Initial Draft Writing, Methodology Design and Formal Data Analysis, Conducted The Final Review and Performed Language Editing and Manuscript Refinement.
- **Nabila Tasrif:** Original Draft, Writing, Provided Critical Review and Editorial Refinement of the Manuscript.
- **Titen Darlis Santi:** Curated and Organized the Dataset.
- **Wiwik Gusnita:** Contributed to The Initial Drafting and Data Curation.
- **Nurul Huda:** Conducted The Final Review and Performed Language Editing and Manuscript Refinement.

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