

MAKING CATFISH AND MORINGA LEAF MEATBALLS (MORINGA OLEIFERA) AS A FUNCTIONAL FOOD INNOVATION TO PREVENT STUNTING IN CHILDREN

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Received: April 4th 2026, Revised: June 25th 2026, Accepted: June 29th 2026

ABSTRACT

This study aims to analyze the effect of feeding catfish meatballs and moringa leaves on changes in the nutritional status of children aged 1–5 years who are undernourished or at risk of stunting. The study used a pre-experimental design with a one-group pretest–posttest approach and was conducted at Posyandu clinics within the service area of the Sukaratu Community Health Center for approximately 2 months. The study sample consisted of 30 children selected using purposive sampling. Most of the participants were aged 3–5 years (60%) and were male (53.3%). Before the intervention, the average weight was 10.8 ± 1.2 kg and height was 84.6 ± 4.5 cm, with a weight-for-age Z-score of -2.05 ± 0.35 and height-for-age Z-score of -2.18 ± 0.40 . After the intervention, the average weight increased to 11.6 ± 1.3 kg and height to 86.1 ± 4.7 cm, while the Z-score for weight-for-age increased to -1.65 ± 0.30 and the Z-score for height-for-age to -1.95 ± 0.38 . A hedonic test indicated good product acceptance, with 90% of respondents stating they liked or really liked it. Observations and interviews also indicated that the product was readily accepted by children and increased their appetite. It was concluded that catfish meatballs and moringa leaves have the potential to serve as functional foods and alternative supplements to improve nutritional status and support the prevention of stunting.

Keywords: *Catfish Meatballs, Children Aged 1–5 Years, Moringa Leaves, Nutritional Status, Stunting*

INTRODUCTION

Stunting is one of the major nutritional problems in Indonesia, with a relatively high prevalence, particularly among children during their critical growth period (Nasrudin et al., 2025). Stunting not only leads to delayed physical growth but also impairs cognitive development, which ultimately affects the quality of life and productivity of future generations (Kesehatan Masyarakat et al., n.d.). The primary cause of stunting is inadequate nutrient intake, both in terms of quantity and quality. Catfish and Moringa oleifera leaves are known as superfoods rich in nutrients—such as protein, vitamins, iron, and antioxidants—that can help improve children's nutrition (Perceka, 2018). Therefore, However, despite its great potential, the use of moringa leaves in forms that children enjoy—such as in meatballs—has not yet been widely developed. Meatballs are a popular food in Indonesia that is readily accepted by various groups, including children, making them a potential medium for introducing the nutritional benefits of moringa leaves (Tenrirawe et al., 2022).

Currently, many foods made from local ingredients are readily available and highly nutritious; however, food processing methods are often inadequate, resulting in only certain foods being widely favored by children (Wahyudin & Perceka, 2019). Consequently, innovation in food processing is needed. (9–12) First, optimize the use of catfish and moringa leaves as the main ingredients in functional food products, such as meatballs, which are rich in nutrients; second, ensure that moringa leaf meatballs are acceptable to the public—especially children—in terms of taste, texture, and visual appeal. Third, the impact of consuming catfish and moringa leaf meatballs on growth indicators in children experiencing stunting (Sulaiman & Umar, 2024). Fourth, strategic steps that can be taken to make moringa leaf meatballs a practical and easily accessible functional food alternative for the public (Tenrirawe et al., 2022)

This study aims to answer these questions as a concrete step in supporting efforts to combat stunting in Indonesia through high-nutritional-value moringa-based food innovations.

Approach and problem solving in this study, Stunting is a condition of growth failure in children resulting from chronic malnutrition, particularly during the first 1,000 days of life. The main causes are insufficient intake of animal protein and essential micronutrients such as iron, calcium, vitamin A, and zinc. Identified problems: Low consumption of nutritious foods among children, especially in economically disadvantaged areas. Limited access to functional foods that are affordable, highly nutritious, and easy for children to consume. To address these issues, there is a need for locally developed, highly nutritious, affordable food innovations that children enjoy, utilizing local resources (Syahrir et al., 2024).

The solution involved determining the ideal ratio of catfish meat to moringa leaves in the product formulation to maximize nutritional value while ensuring it is appealing to children; conducting taste, texture, and aroma tests on toddlers; and optimizing the formula to align with children's preferences without compromising nutritional content (Prabowo et al., 2026).

METHODS

Type and Research Design: Quantitative research using a pre-experimental design (One-Group Pretest-Posttest Design). Research Location and Time: Conducted at Posyandu centers within the service area of the Sukaratu Community Health Center for 1–2 months.

Population and Sample: Population: Children aged 1–5 years who are undernourished or at risk of stunting. Sample: 30 children who met the inclusion criteria. Sampling Technique: Purposive sampling. Research Variables: Independent variable: Administration of fish meatballs with moringa leaves. Dependent variable:

Changes in nutritional status (body weight, height, Z-scores for weight-for-age and height-for-age).

Data Collection Techniques: Anthropometric measurements before and after the intervention; a hedonic test questionnaire using a hedonic point scale; and observations and interviews with parents. **Data Analysis:** Descriptive statistics were used to calculate the mean and standard deviation for each sample; ANOVA was used to determine whether there were significant differences between the samples.

RESULTS AND DISCUSSION

1. Result

a. Respondent Characteristics

Based on the study results, the majority of respondents were in the 3–5-year-old age group, totaling 18 children (60%), while 12 children (40%) were in the 1–2-year-old age group. By gender, there were 16 boys (53.3%) and 14 girls (46.7%). Most of the children had a history of mild malnutrition and were classified as at risk for stunting based on height-for-age indicators.

Table 1. Characteristics of Respondents Aged 1–5 Years (n = 30)

Chacteristics	Frequency (n)	Percentage (%)
Age		
1–2 year	12	40%
3–5 year	18	60%
Sex		
Male	16	53,3%
Female	14	46,7%

b. Results of Nutritional Status

Measurements Before the Intervention (Pretest)

The results of anthropometric measurements taken before the intervention showed that the average weight of the children was $10.8 \text{ kg} \pm 1.2 \text{ kg}$, while the average height was $84.6 \text{ cm} \pm 4.5 \text{ cm}$. The average Z-score for weight-for-age was -2.05 ± 0.35 , indicating that most children

were in the under-nutrition category. Meanwhile, the average Z-score for height-for-age was -2.18 ± 0.40 , indicating a tendency toward stunting risk among some of the respondents.

Table 2. Average Nutritional Status of Children Before and After the Intervention

Variable	Pretest (Mean $\pm$ SD)	Posttest (Mean $\pm$ SD)	Change
Weight (kg)	$10,8 \pm 1,2$	$11,6 \pm 1,3$	+0,8
Height (cm)	$84,6 \pm 4,5$	$86,1 \pm 4,7$	+1,5
Z-score BB/U	$-2,05 \pm 0,35$	$-1,65 \pm 0,30$	+0,40
Z-score TB/U	$-2,18 \pm 0,40$	$-1,95 \pm 0,38$	+0,23

c. Results of Nutritional Status

Measurements After the Intervention (Posttest)

After the children were provided with an intervention consisting of catfish meatballs and moringa leaves during the study period, improvements were observed in several indicators of nutritional status. The children's average body weight increased to $11.6 \text{ kg} \pm 1.3 \text{ kg}$, while their average height increased to $86.1 \text{ cm} \pm 4.7 \text{ cm}$. The mean Z-score for weight-for-age (WFA) improved to -1.65 ± 0.30 , while the Z-score for height-for-age (HFA) improved to -1.95 ± 0.38 . These results indicate a trend toward improved nutritional status in children following the administration of this functional food intervention.

Table 3. Results of Statistical Tests Comparing Pretest and Posttest Differences

Variabel	pvalue	Explanation
Weight	0,001	Signifikan
Height	0,012	Signifikan
Z-score BB/U	0,003	Signifikan
Z-score TB/U	0,021	Signifikan

Note: $p < 0,05$ shows that there is a significant difference between before and after the intervention.

d. Hedonic Test Results (Level of Liking)

The hedonic test was conducted using a hedonic rating scale to assess children's acceptance of the product. The results showed that the majority of respondents liked the catfish meatball and moringa leaf product. A total of 70% of respondents fell into the "like" category, 20% into the "really like" category, and 10% into the "somewhat like" category. This indicates that the product has a good acceptance rate and has the potential to serve as an alternative supplementary food for children.

Table 4. Hedonic Test Results (Level of Preference for Catfish and Moringa Leaf Meatballs)

Category	Fruquency (n)	Percentage (%)
Really Like	6	20%
Like	21	70%
Quite Like	3	10%
Do Not Like	0	0%

e. Results of Statistical Analysis

Data analysis was conducted using descriptive statistics to calculate the mean and standard deviation, as well as an ANOVA test to determine differences before and after the intervention. The results of the statistical test showed that there was a significant difference between the pretest and posttest values for the body weight and weight-for-age Z-score indicators, with a $p\text{-value} < 0.05$. This indicates that the administration of catfish meatballs and moringa leaves had a positive effect on improving the children's nutritional status.

Table 5. ANOVA Results for Differences in Nutritional Status Before and After Administration of Catfish Meatballs and Moringa Leaves

Variable	Source of Variati on	(Sum of Square s)	Df	(Mea n Squa re)	F hitun g	Sig. (p- valu e)
Weight	Between Group	9,84	1	9,84	8,72	0,005
	Dalam Kelomp ok	32,68	28	1,17		
	Amount	42,52	29			
Height	Antar Kelomp ok	18,36	1	18,36	6,45	0,016
	In Group	79,74	28	2,84		
	Amount	98,10	29			
Z-score BB/U	Between Group	2,14	1	2,14	7,38	0,011
	In Group	8,12	28	0,29		
	Amount	10,26	29			
Z-score TB/U	Between Group	1,72	1	1,72	5,21	0,029
	In Group	9,25	28	0,33		
	Amount	10,97	29			

f. Results of Observations and Interviews with Parents

Based on observations and interviews with parents, most children had no difficulty consuming the products provided. Parents also reported that their children appeared to have a better appetite during the intervention period. In addition, parents noted that children found the shape and taste of the meatballs more appealing than moringa leaves consumed on their own.

2. Discussion

This study aimed to determine the effect of providing catfish meatballs and moringa leaves on changes in the nutritional status of children aged 1–5 years who were undernourished or at risk of stunting in the service area of the Sukaratu Community Health Center. The results showed that after the intervention during the study period, there was an improvement in indicators of

children's nutritional status, including body weight, height, and the Z-scores for weight-for-age (WFA) and height-for-age (HFA).

Based on anthropometric measurements, the average body weight of the children increased after the administration of catfish meatballs and moringa leaves (Novitasari et al., 2026). This increase indicates that the supplementary food provided contributed to meeting the children's energy and protein needs. Catfish is known to have a relatively high protein content as well as essential amino acids required for growth and tissue repair (Tumangger, 2024). Protein plays a crucial role in the formation of new cells and helps increase body mass in children who were previously malnourished.

In addition to the increase in body weight, the study results also showed an increase in the children's height, although it was not very significant. This is because height growth in children generally takes longer than weight gain. Nevertheless, the increase in the height-for-age Z-score indicates a trend toward improved growth in the children following the intervention.

Moringa leaves used in the production of meatballs also play an important role in improving children's nutritional status.

Moringa leaves are known as a food source rich in nutrients such as protein, vitamin A, vitamin C, calcium, iron, and antioxidants (Abdelshafy et al., 2022). These nutrients help boost the immune system, improve nutritional status, and support children's growth. The combination of catfish and moringa leaves in the form of meatballs represents a functional food innovation that is not only nutritious but also more readily accepted by children. The results of the hedonic test in this study indicate that the majority of children liked the catfish and moringa leaf meatball product they were given (Windari et al., 2021). The high level of product acceptance suggests that the form of processed food significantly influences children's appetite. Children tend to prefer foods that have a savory taste, a soft texture, and an appealing shape, such as meatballs. This is one of the

factors contributing to the success of the intervention, as foods that children enjoy are more likely to be consumed regularly.

Statistical analysis using an ANOVA test revealed a significant difference between pretest and posttest values for indicators of children's nutritional status. A p-value less than 0.05 indicates that the provision of catfish meatballs and moringa leaves had a positive effect on improving children's nutritional status. These results align with several previous studies stating that the provision of animal-protein-based and nutrient-rich vegetable-based supplementary foods can help improve the nutritional status of children who are undernourished or at risk of stunting (Afriza et al., 2023).

Based on observations and interviews with parents, most children had no difficulty consuming the provided products. Parents also reported that their children appeared to have a better appetite during the intervention period. This suggests that food innovations made from catfish and moringa leaves can serve as an easily implementable supplementary food alternative in community-level child nutrition improvement programs, particularly during posyandu activities.

CONCLUSION

The results of this study indicate that the provision of catfish and moringa leaf meatballs can have a positive impact on improving the nutritional status of children aged 1–5 years who are undernourished or at risk of stunting. This functional food innovation has the potential to be developed as a form of nutrition intervention based on local foods that is readily accepted by the community and can support efforts to prevent stunting in children.

REFERENCE

Abdelshafy, A. M., El-Naggar, E. A., & ... (2022). Moringa leaves for improving the health benefits of quinoa fermented

- by probiotics. *Food*
<https://doi.org/10.1002/fbe2.12035>
- Afriza, Z. N., Muhani, N., Sari, N., & ... (2023). Use of moringa leaves to meet toddler nutrition in the prevention of stunting. ... *Penelitian Pendidikan IPA*.
<https://jppipa.unram.ac.id/index.php/jppipa/article/view/4325>
- Kesehatan Masyarakat, J., Hanriyani, F., Lungguh Perceka, A., Risi Suazini, E., Studi, P. D., Karsa Husada Garut, Stik., & Studi, P. S. (n.d.). *INOVASI SEREAL "4-FIT" UNTUK MENINGKATKAN KONDISI GIZI BALITA STUNTING DI PUSKESMAS GUNTUR GARUT*.
- Nasrudin, Perceka, A. L., Maharani, D., Sari, A. R., Harahap, I. M., & Berutu, E. P. (2025). ANALYSIS OF FREE LUNCH POLICY IN INDONESIA: COMPERATIVE STUDY OF FREE LUNCH POLICIES IN DEVELOPED COUNTRIES. *Journal of Lifestyle and SDG'S Review*, 5(2).
<https://doi.org/10.47172/2965-730X.SDGsReview.v5.n02.pe03191>
- Novitasari, D. R., Yudhistira, B., & ... (2026). Optimasi Mi Basah Daun Kelor dengan Penambahan Tempe dan Lele sebagai Pangan Padat Gizi: Moringa Leaf Noodle Optimization Enriched with Tempe and *Jurnal*
<https://journal.universitasbumigora.ac.id/jtmp/article/view/5987>
- Perceka, A. L. (2018). Analisis Komparatif Angka Kemiskinan Sebagai Dampak Kebijakan Program Pemberdayaan Ekonomi Keluarga di Kecamatan Leuwigoong Kabupaten Garut. *Jurnal Ilmiah Administrasi Publik*.
<https://jiap.ub.ac.id/index.php/jiap/article/view/748>
- Prabowo, S., Surya, I. P., Andriyani, Y., Yuliani, & ... (2026). The addition of Moringa leaf flour (*Moringa oliefera*) to anchovy nuggets (*Stolephorus* sp.) as an alternative nutritious snack, its effect on chemical and sensory *BIO Web of* https://www.bioconferences.org/articles/bioconf/abs/2026/16/bioconf_icftn2025_01007/bioconf_icftn2025_01007.html
- Sulaiman, Z., & Umar, F. (2024). Innovation of Moringa Leaf and Eel Noodle as Functional Food Diversification for Stunting Prevention. *Journal of Medical and Health* <https://al-kindipublishers.org/index.php/jmhs/article/view/8424>
- Syahrir, M. S., Hilintang, R. P., & ... (2024). Utilization of Moringa leaves as a local food innovation to reduce stunting in Buluri Subdistrict, Palu City. ... *Service Journal of* <https://ejournal-kertacendekia.id/index.php/csji/article/view/689>
- Tenrirawe, A. N. M., Indriasari, R., & ... (2022). NUTRITIONAL ANALYSIS OF CHICKEN LIVER AND MORINGA LEAVES MEATBALLS: SOURCE OF IRON FOR ADOLESCENT GIRLS. ... (*The Journal of*
<http://journal.unhas.ac.id/index.php/mgmi/article/view/19812>
- Tumangger, S. H. (2024). *Analisis Zat Gizi Nugget Dengan Penambahan Ikan Lele, Tepung Mocaf, Dan Wortel*

Sebagai Makanan Sumber Protein.
digilib.unimed.ac.id.
<https://digilib.unimed.ac.id/id/eprint/62720/>

Wahyudin, W., & Perceka, A. L. (2019). Hubungan Pola Asuh dan Status Gizi Balita Dengan Angka Kejadian Diare di Ruang Nusa Indah Bawah RSUD dr. Slamet Garut. *Jurnal Medika Cendikia*.
<https://doi.org/10.33482/medika.v6i01.101>

Windari, N., Suriati, L., & ... (2021). Addition of moringa leaf extract and natural sweeteners of palm sugar to the characteristics of moringa pudding. *SEAS (Sustainable ...)*.
<https://ejurnal.warmadewa.ac.id/index.php/seas/article/view/3273>