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Sensory Evaluation of Moringa Leaf and Corn-Based Pudding as an Alternative Functional Food for Toddlers

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ABSTRACT

This study investigates the development and sensory evaluation of a layered pudding made from fresh *Moringa oleifera* leaves and sweet corn, designed as a functional complementary food for toddlers. Given the critical nutritional needs during early childhood and persistent concerns such as stunting and micronutrient deficiency, the formulation integrates bioactive-rich moringa with naturally sweet corn to enhance both nutritional value and sensory appeal. The pudding was produced in two distinct layers and assessed through organoleptic testing by semi-trained panelists evaluating color, aroma, taste, and texture. Results showed high acceptability across both formulations, with the second formulation (F2) receiving the highest preference ratings, especially for taste and overall appeal. Nutritional analysis revealed that each 25g serving contributes essential nutrients including protein, vitamin C, and beta-carotene, supporting immune function and growth. These findings suggest that the moringa–corn pudding presents a promising strategy for addressing nutritional deficits in toddlers through culturally relevant and palatable food innovation.

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CASE REPORTS

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Key Messages:

- The moringa–corn layered pudding demonstrated high sensory acceptability among toddlers, making it a viable complementary functional food with broad appeal.
- Each 25g serving delivers essential nutrients like protein, beta-carotene, and vitamin C, positioning the pudding as a promising intervention to support early childhood nutrition and prevent stunting.

INTRODUCTION

The toddler period (ages 1–5 years) represents a critical window for physical growth and cognitive development (1). During this phase, the nutritional demands of children increase substantially to support the rapid maturation of organ systems and functional capabilities (2). Inadequate intake of essential micronutrients such as iron, vitamin A, and protein poses serious health risks, including stunting, anemia, and developmental impairments (3)(4). National health surveys, including Riskesdas and the 2024 Indonesian Nutritional Status Survey (SSGI), report a stunting prevalence of 19.8% nationally, while regional data from Bone District indicate a lower rate of 4.15%. Nevertheless, these figures reflect an ongoing public health concern requiring targeted nutritional interventions (5)(6)(7).

One promising strategy to improve child nutrition is the provision of complementary foods that are nutritious, safe, and palatable. Functional food products offer an innovative approach by not only supplying basic nutrients but also incorporating bioactive compounds that promote health. These products are particularly relevant in the context of early childhood, where nutritional interventions must align with both physiological needs and sensory preferences (8)(9)

Moringa oleifera leaves are widely recognized for their nutritional value, containing high levels of protein, vitamin A, calcium, iron, and antioxidants. Despite their potential as a functional food component, their application in child-targeted products faces challenges in sensory acceptability, particularly regarding taste and aroma. Enhancing palatability is

therefore essential to increase the integration of moringa into child-friendly food formats. (10)(11)(12).

Sweet corn (Zea mays saccharata) complements moringa's nutritional benefits by offering natural sweetness, dietary fiber, and appealing color characteristics (13). When formulated as a layered pudding, the combination of moringa and sweet corn is expected to yield a functional food product that is both nutritionally rich and highly acceptable to toddlers. This study aims to evaluate the acceptability of the moringa–corn layered pudding through organoleptic testing focused on color, aroma, taste, and texture, as a potential dietary intervention to address early childhood nutritional deficits. (14)(15)

CASE DESCRIPTION

The development of this functional food product was conducted experimentally to formulate Moringa Leaf and Sweet Corn Layer Pudding by incorporating Moringa leaf extract and sweet corn extract. Organoleptic testing was performed using a hedonic test involving 25 untrained or semi-trained panelists, comprising nutritionists and staff from the Nutrition Installation Unit at UPT RSUD Datu Pacaitana Bone. The hedonic assessment employed a five-point scoring scale: 5 (very much liked), 4 (liked), 3 (slightly liked), 2 (disliked), and 1 (strongly disliked). The sensory parameters evaluated included color, aroma, taste, and texture. The results of the organoleptic test were processed descriptively using Microsoft Excel 2017. The analyzed data were presented in the form of tables and graphs, accompanied by explanatory narration.

Ingredients Overview

The pudding consists of two layers, each formulated from distinct functional food sources:

- Top Layer (Moringa-based): fresh moringa leaves (100g), egg yolks (60g), cornstarch (10g), white agar powder (5g), granulated sugar (20g), salt, coconut milk, condensed milk (30g), and water (200 ml).
- Bottom Layer (Sweet Corn-based): sweet corn kernels (200g), cornstarch (10g), granulated sugar (20g), white agar powder (5g), coconut milk (5g), salt, and water (200 ml).

Preparation Summary

- Bottom Layer (Corn): Blend the corn with water, strain, and mix the extract with sugar, cornstarch, agar, and salt. Cook until thickened and pour into mold to form the base layer.
- Top Layer (Moringa): Blend moringa leaves with water, strain, and mix the extract with sugar, cornstarch, agar, salt, egg yolk, coconut milk, and condensed milk. Cook until thickened, then layer on top of the corn base. Let it cool to set.

DISCUSSION

To evaluate the sensory feasibility of the layered pudding formulation, a hedonic test was conducted to assess panelists' responses across key parameters including color, aroma, taste, and texture. The results are summarized in Table 1 to illustrate the overall acceptability among toddler-focused respondents.

Table 1. Overall Acceptance of Moringa Leaf Corn Layer Pudding

Category	F1 (n=60)	F2 (n=60)
Really Like	22 (36.67%)	20 (33.33%)
Like	26 (43.33%)	28 (46.67%)
Somewhat Like	12 (20.00%)	12 (20.00%)
Dislike	0 (0.00%)	0 (0.00%)
Really Dislike	0 (0.00%)	0 (0.00%)

The hedonic test results revealed a high acceptance rate for both formulations of Moringa Leaf Corn Layer Pudding. Formulation F2 received the highest "Like" rating (46.67%), while F1 had a marginally higher "Really Like" response (36.67%). No negative responses were recorded for either product. These findings suggest that both formulations are highly acceptable and suitable as complementary functional foods for toddlers, with potential to meet both nutritional and sensory expectations.

Table 2. Nutritional Composition of Corn Layer Pudding per Serving (25g) **Nutrient**	**Amount per Serving (25g)**
Energy	41.03 kcal
Protein	1.32 g
Fat	1.13 g
Carbohydrate	7.07 g
Calcium	12.77 mg
Iron	0.39 mg
Zinc	0.165 mg
Beta-carotene/Vitamin A	61.6 µg
Vitamin B1 (Thiamin)	0.04 mg
Vitamin B2 (Riboflavin)	0.055 mg
Vitamin B6	0.065 mg
Vitamin C	11.96 mg

The nutritional analysis of the Corn Layer Pudding per 25g serving reveals its potential as a functional food designed for toddlers. It provides moderate energy and essential nutrients including protein (1.32 g), calcium (12.77 mg), and iron (0.39 mg). The pudding also contains a notable amount of beta-carotene (61.6 µg), vitamin C (11.96 mg), and dietary fiber (0.45 g), contributing to immune support and digestive health. Despite its relatively small serving size, the product presents a nutrient-dense profile suitable for complementary feeding in early childhood.

The American Dietetic Association (ADA) defines functional foods as whole, fortified, enriched, or enhanced foods that offer potential health benefits when consumed regularly and in effective amounts as part of a varied diet. Functional foods may be either natural or processed (16). Pudding, traditionally a soft dessert made from thickeners, milk, eggs, and flavorings, has evolved to include diverse ingredients such as fruit, coconut milk, and even coffee, often presented in appealing molds for ease of consumption and visual interest.

Moringa leaves, widely available in South Sulawesi, are known for their high protein and phytochemical content, making them suitable for food innovations (17). Their nutritional value surpasses that of eggs and milk, aligning with National Nutrition Day goals that emphasize protein-rich supplemental foods. In this formulation, milk serves as a source of animal protein, while moringa enhances the pudding's overall nutrient density. Additionally, moringa contributes natural antioxidants, fiber, and pigments, serving dual roles as a nutritional and natural coloring agent (18)

To assess product acceptability, organoleptic testing was performed using a hedonic scale, evaluating color, aroma, taste, and texture by semi-trained panelists comprising nutritionists. The addition of moringa and sweet corn extracts positively impacted the pudding's color, with green chlorophyll providing a pleasant visual impression. Panelists responded favorably to both formulations (F1 and F2), especially in terms of color, indicating that condensed milk addition did not detract from visual appeal.

Aroma and taste also received high acceptability scores (19). The formulation method, which included blending moringa extract with egg yolk, cornstarch, sugar, and condensed milk, mitigated the strong raw moringa odor. Taste evaluation revealed a preference for F2, where the creamy profile subdued the natural moringa flavor, with panelists comparing it to matcha. In terms of texture, the combination of agar and cornstarch yielded a soft and silky consistency, consistent with sensory expectations and previous findings.

Overall, panelists preferred formula F2, prompting a nutritional analysis per 25g serving. The pudding provides 41.03 kcal, 1.32g protein, and notable levels of vitamins and minerals, including vitamin C (29.9%) and beta-carotene (15.4%) of the daily recommended intake for toddlers aged 1–3 years. To meet around 10% of the daily protein requirement, a recommended serving of two portions per day is suggested, highlighting the product's potential as a functional complementary food in early childhood nutrition.

The study conducted by Mia Srimiati and Lina Agestika revealed that substituting pudding ingredients with fresh Moringa leaves and Moringa leaf powder significantly impacted both sensory acceptance and nutritional value. While pudding with 5% Moringa leaf powder (FMP1) achieved the highest overall acceptability among panelists, the formulation using 30% fresh Moringa leaves (FML2) provided superior nutritional benefits, including higher protein, fat, carbohydrate, and calorie content. These findings suggest that although fresh Moringa leaves may slightly affect texture and aroma, they offer a promising strategy for enhancing dietary quality at the household level (14)

Public Health Implications: Preventing Stunting in Bone District. The moringa–corn layered pudding developed in this study offers substantial public health potential by providing essential nutrients including protein, vitamin C, and beta-carotene that support growth and immune function in toddlers. This product serves as a promising local nutritional intervention to maintain and further reduce stunting rates. Utilizing locally available ingredients like moringa and sweet corn, the pudding is culturally relevant, cost-effective, and suitable for integration into community health programs such as *posyandu* or household-level complementary feeding strategies. These findings support broader efforts to meet SDG targets for child health and nutrition through functional food innovation.

CONCLUSION

The layered moringa and sweet corn pudding showed high acceptability among panelists and offered significant nutritional benefits for toddlers. Each 25g serving contributed meaningfully to daily intake of protein, vitamins, and minerals, with F2 being the preferred formulation. This product presents a promising functional food intervention to support early childhood nutrition and help prevent stunting.

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