

Developing a Salutogenic Food-Based Taiyaki to Strengthen Family and Community Capacity for Healthy Eating

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ABSTRACT

Background: Strengthening family and community capacity for healthy eating remains a key challenge in health promotion, particularly in Indonesia, where child stunting persists. **Objective:** This study aimed to develop a salutogenic food-based taiyaki using moringa leaves and mung bean flour and to interpret its potential role in strengthening family and community capacity for healthy eating. **Methods:** A two-phase descriptive analytic design was applied. Phase 1 involved experimental food product development through five formulation trials using partial substitution with moringa leaves and mung bean flour, followed by expert sensory evaluation and nutritional content analysis using NutriSurvey software. Phase 2 consisted of a literature-based salutogenic health promotion analysis guided by salutogenesis theory, health promotion principles, and a social marketing framework to interpret potential contributions to capacity building. **Results:** The optimized taiyaki formulation with moringa leaves and mung bean flour demonstrated good sensory acceptability by expert panelists, alongside improved nutritional content, particularly in protein, iron, zinc, dietary fiber, and selected vitamins. These findings indicate that familiar snack foods can be nutritionally enhanced using locally available ingredients without compromising their acceptability. A Salutogenic perspective showed that the product's familiar format and clear nutritional value enhance comprehensibility, the use of accessible ingredients supports manageability, and the culturally acceptable, child-friendly presentation strengthens meaningfulness. **Conclusion:** Food-based taiyaki modified with moringa leaves and mung bean flour shows potential as a salutogenic health promotion strategy to strengthen family and community capacity for healthy eating and provides a foundation for future community-based implementation.

Keywords: Food-Based Intervention, Healthy Eating, Salutogenic, Taiyaki

INTRODUCTION

Strengthening family and community capacity for healthy eating is a central concern in contemporary health promotion, particularly in settings where nutritional problems are closely intertwined with everyday practices, social norms, and local food environments. Health promotion emphasizes enabling individuals and communities to gain greater control over the determinants of health through empowerment, capacity building, and the creation of supportive environments rather than relying solely on disease prevention or clinical nutrition interventions (Charter, 1986); (Organization, 2021). Food is increasingly understood not only as a source of

nutrients but also as a medium through which healthy behaviors are formed, negotiated, and sustained in everyday life.

Despite various nutrition programs, Indonesia continues to face persistent challenges in child nutrition. The 2024 Indonesian Nutritional Status Survey (SSGI) reported that the national stunting prevalence reached 19.8%, slightly below the WHO threshold, yet still requiring consistent interventions to promote optimal growth and prevent long-term developmental impairments (Kementerian Kesehatan RI, 2024). Stunting has negative impacts, including increased morbidity and mortality, as well as suboptimal cognitive, motor, and verbal development. While stunting prevention efforts often emphasize supplementation and short-

term clinical approaches, these strategies may have limited influence on the everyday food practices of families. Eating behaviors are shaped not only by nutritional knowledge but also by habit, affordability, taste preference, and cultural meaning, highlighting the need for health promotion approaches that strengthen family and community capacity to adopt healthy eating patterns sustainably.

The salutogenic perspective conceptualizes health as a continuum shaped by the availability and effective use of health-enabling resources rather than by the absence of disease alone (Antonovsky, 1979). Central to this approach is the Sense of Coherence (SOC), which comprises comprehensibility, manageability, and meaningfulness. In the context of healthy eating, the SOC reflects whether families understand healthy food choices, perceive them as feasible within daily constraints, and experience them as meaningful in relation to cultural values and aspirations for children's well-being (Mittelmark and Bauer, 2016); (Polhuis *et al.*, 2023). Food-based strategies that align with these dimensions may function as salutogenic resources that support long-term dietary behavior change.

Snack foods represent an important, yet often overlooked, entry point for health promotion. Snacks are deeply embedded in children's daily routines and family feeding practices. They are frequently consumed between meals and are strongly influenced by taste, appearance, and familiarity. Snacking is common, but not well understood. Snacking is an ambiguous term that can refer to different behaviors, including consuming foods that are rich in energy but poor in nutrients or eating between meals (Sisay *et al.*, 2024). Health promotion strategies increasingly focus on transforming commonly consumed snacks into healthier alternatives that remain acceptable within the existing food culture (Chagwena *et al.*, 2024).

In this context, developing taiyaki products using locally available ingredients, such as moringa leaves and mung bean flour, offers a practical and culturally grounded strategy. Moringa leaves (*Moringa oleifera*), often referred to as the "Miracle Tree" and "Mother's Best Friend," possess functional health properties and can help overcome

nutritional deficiencies. Moringa leaves are rich in iron, zinc, vitamins, and antioxidants, whereas mung bean flour provides plant-based protein and essential micronutrients that improve dietary quality (Oyeyinka and Oyeyinka, 2018); (Rani *et al.*, 2019).

This study lies not merely in the nutritional modification of a snack product but in its explicit positioning within a salutogenic health promotion framework. By interpreting taiyaki as a salutogenic resource, this study integrates product development with the theoretical constructs of comprehensibility, manageability, and meaningfulness, thereby extending the application of salutogenesis to food-based health promotion. A familiar snack format may enhance comprehensibility by making healthy food choices easier to recognize and understand, while using affordable and locally sourced ingredients may improve manageability by aligning with household resources and local food systems. These attributes are essential for supporting the sustained adoption of healthier dietary practices at the family and community levels (Seah *et al.*, 2022); (Vargas *et al.*, 2023).

The effectiveness of food-based strategies for health promotion is also influenced by how products are positioned and integrated within community contexts. Social marketing approaches support voluntary behavior change by aligning product attributes, messaging, accessibility, and stakeholder involvement with the needs and values of the target population (Fitrianto, 2022). Evidence indicates that nutritional interventions incorporating social marketing principles are more effective in influencing dietary behaviors than information-based approaches alone, particularly when community participation and empowerment are emphasized (Roger *et al.*, 2023).

Therefore, this study aimed to develop salutogenic food-based taiyaki using moringa leaves and mung bean flour and to interpret its potential role in strengthening family and community capacity for healthy eating through a literature-based salutogenic health promotion perspective. By situating food product development within everyday food practices and community contexts, this study seeks to contribute to the

advancement of food-based strategies that support sustainable healthy eating behaviors.

METHODS

This study employed a two-phase descriptive analytic design grounded in health promotion and salutogenic theory. This design was selected to align with the study objective of positioning food-based taiyaki not merely as a nutritionally improved snack but as a health-enabling resource that may support comprehensibility, manageability, and meaningfulness within everyday food practices, consistent with the salutogenic approach (Antonovsky, 1979).

Phase 1: Food Based Taiyaki Product Development and Nutritional Content Analysis

An experimental formulation approach was used to develop food-based taiyaki through five sequential formulation trials. These ingredients were selected because of their nutritional relevance and local availability, aligning with food-based health promotion principles.

Sensory acceptance testing was conducted by expert panelists, including lecturers from the Nutrition Study Program at Universitas Negeri Surabaya with expertise in food science and nutrition. The panelists evaluated four sensory attributes (color, aroma, texture, and taste) using descriptive judgment. Expert sensory evaluation was employed at this formative stage to ensure technical feasibility and product refinement prior to any community-level application, as recommended for early stage food-based health promotion interventions (Chagwena *et al.*, 2024).

The nutritional content of the best formulation was analyzed using the NutriSurvey software, focusing on energy, carbohydrate, protein, fat, zinc, iron, vitamins A and C, and dietary fiber. These nutrients were selected based on their relevance to child growth and stunting prevention in the Indonesian context (Beal *et al.*, 2018). The outcomes of Phase 1 established the technical and nutritional feasibility of food-based taiyaki as a potential health-promoting food.

Phase 2: Salutogenic Health Promotion Analysis and Community Capacity Interpretation

Phase 2 applied a literature-based salutogenic analysis to interpret how the food-based taiyaki product may function as a health promotion strategy for strengthening family and community capacity for healthy eating.

This phase examined the potential pathways of impact based on the established health promotion and salutogenesis literature. This approach is consistent with formative and theory-driven methods commonly used in health promotion research when field implementation is beyond the scope of product development studies (Mittelmark and Bauer, 2016); (Polhuis *et al.*, 2023). The analytical framework was guided by the following:

- Salutogenesis theory, focusing on the Sense of Coherence (SOC): comprehensibility, manageability, meaningfulness.
- Health promotion principles include empowerment, supportive environments, and community participation.
- The social marketing framework encompasses product, price, place, promotion, personnel, process, and presentation as mechanisms for facilitating voluntary behavior change.

RESULTS AND DISCUSSION

Phase 1: Food Based Taiyaki Product Development and Nutritional Outcomes

Children's snack preferences represent an important entry point for health promotion interventions aimed at improving dietary behaviors in early life. Snack foods are not merely sources of nutrients but also vehicles for shaping food-related norms, habits, and meanings within families and communities from a health promotion perspective. In this study, one such snack food that can be modified is *taiyaki*, a traditional Japanese fish-shaped cake. In Japanese, *tai* refers to fish from the Sparidae family, and *yaki* means baked or grilled. Thus, *taiyaki* refers to a cake baked in a fish-shaped mold (Delta, 2019). Therefore, the development of taiyaki with moringa

leaves and mung bean flour should be interpreted not only in terms of its nutritional enhancement but also its potential contribution to empowering families to adopt healthier eating practices in daily contexts.

Taiyaki production began with the determination of a standard recipe. In this study, five trials were conducted to modify the standard *taiyaki* recipe by adding moringa leaves and mung bean flour to the batter.

A sensory acceptance test was conducted by expert panelists to assess four attributes: color, aroma, texture, and taste. The results of the first standard recipe trial showed that the outer color was uneven, whereas the outer texture was hard and crispy. Therefore, it is recommended to improve the formulation by replacing tapioca flour with cornstarch.



Figure 1. First Standard Recipe Trial

The results of the second standard recipe trial indicated that the inner texture remained dense. Therefore, it is recommended to improve the formulation by adopting another recipe. In the modified recipe, the amount of moringa leaves was reduced to minimize the strong aroma of the moringa.



Figure 2. Second Standard Recipe Trial

The results of the third standard recipe trial showed that the shape and color were satisfactory, although the chocolate paste filling influenced the appearance as it melted during baking. Therefore, careful attention should be paid to the baking temperature and duration, as well as the timing and speed during the mixing process. In addition, several modifications to the ingredients were made in this trial, including replacing honey with melted butter, reducing wheat

flour to 70 g, and adding 30 g of mung bean flour to the modified recipe.



Figure 3. Third Standard Recipe Trial

The results of the fourth standard recipe trial indicated that the product did not rise sufficiently. Therefore, it is recommended to add 3 g of SP emulsifier and 50 g of milk powder to improve the formulation.



Figure 4. Fourth Standard Recipe Trial

The results of the fifth standard recipe trial showed that the product was satisfactory, with a soft texture, good taste, and proper expansion size.



Figure 5. Taiyaki Trial Results on The Best Formula

Based on the sensory acceptance test conducted by expert panelists, the optimal results were obtained with the addition of 5 and 7 g of moringa leaves and 30 and 35 g of mung bean flour. The following is the standard *taiyaki* recipe with the best formulation.

Table 1. Standard Taiyaki Recipe with the Best Formulation

No.	Material	Amount
1	Egg	120 g
2	Sugar	80 g
3	Melted Butter	10 g
4	Medium Protein Flour	100 g
5	Baking soda	2 g
6	Fine Salt	2 g
7	Vanilla Paste	3 g

8	Milk Powder	50 g
9	SP Emulsifier	3 g
10	Liquid Milk	10 g

The experimental results demonstrated that taiyaki achieved good sensory acceptability among expert panelists, particularly in terms of color, aroma, texture, and taste. In health promotion theory, sensory acceptability is a critical determinant of behavioral adoption, as individuals are more likely to engage in and sustain health-promoting behaviors when they are perceived as enjoyable and feasible (Chagwena *et al.*, 2024). Thus, the favorable sensory outcomes observed in this study support the role of modified taiyaki as a practical health-promoting food rather than a purely functional nutritional intervention.

The sensory optimization process contributes directly to strengthening the sense of coherence (SOC) at the family level from a salutogenic health promotion perspective. Acceptable taste and familiar snack formats enhance comprehensibility, as families can easily understand and relate to the product as a “normal” snack rather than as a medicalized food. This aligns with evidence indicating that health promotion interventions embedded in familiar daily practices are more likely to be internalized and maintained (Polhuis *et al.*, 2023).

The sensory acceptance test conducted by expert panelists needs to be followed up by testing the *taiyaki* product with the addition of moringa leaves and mung bean flour on the target group, namely, children. Sensory evaluation can be used to assess consumer acceptance and preference for a product. This is carried out to provide an overview of the level of acceptance or liking, which is an important consideration for consumers in deciding whether to accept a product (Rahayu and Nurosiyah, 2012).

Nutritional content analysis using NutriSurvey software showed that the selected taiyaki formula contributed to the intake of essential nutrients needed to address stunting. The following presents the results of the nutritional analysis of the best taiyaki formula without the addition of moringa leaves and mung bean flour.

Table 2. Nutritional Content of Taiyaki without the Addition of Moringa Leaves and Mung Bean Flour

No.	Nutritional Content	Amount
1	Energy	1041,9 kcal
2	Carbohydrat	157,2 g
3	Protein	33 g
4	Fat	31,2 g
5	Zinc	3,6 mg
6	Iron	6,3 mg
7	Vit. C	18,6 mg
8	Dietary Fiber	1,8 g
9	Vit. A	503,4 µg

The results of the nutritional content analysis of the best taiyaki formula with the addition of moringa leaves and mung bean flour are presented below:

Table 3. Nutritional Content of Taiyaki with the Addition of Moringa Leaves and Mung Bean Flour

No.	Nutritional Content	Amount
1	Energy	1086,6 kcal
2	Carbohydrat	165,2 g
3	Protein	36,1 g
4	Fat	31,4 g
5	Zinc	4,1 mg
6	Iron	7,3 mg
7	Vit. C	20,8 mg
8	Dietary Fiber	4,2 g
9	Vit. A	553,2 µg

The best taiyaki formula with the addition of moringa leaves and mung bean flour provided higher levels of energy, protein, iron, and zinc than the standard taiyaki recipe without these additions. While these improvements are essential for addressing stunting, their relevance to health promotion lies in how they function as enabling resources rather than as isolated nutrient targets. Health promotion emphasizes creating conditions that allow individuals to make healthy choices more easily, particularly in constrained socioeconomic environments (Organization, 2021).

Specifically, the inclusion of mung bean flour increased the protein content, whereas moringa leaves contributed to the improvement of iron and zinc levels. Moringa leaves contain essential nutrients for child growth and represent a potential food source for use as a supplement to address malnutrition or nutrient deficiencies (Rani *et al.*, 2019); Oyeyinka & Oyeyinka, 2018).

Mung beans, belonging to the legume family (Fabaceae), are a high-

protein plant-based food source with multiple benefits for daily life. They are an excellent source of protein, minerals, calcium, folate, potassium and magnesium. In addition, mung beans contain thiamine, pantothenic acid, iron, phosphorus, zinc, and copper (Sukmawati, 2019). These nutrients are important for supporting optimal growth and development in children.

The use of locally available moringa leaves and mung bean flour enhances manageability, a core component of the SOC, by ensuring affordability and accessibility. When nutritious foods can be produced using familiar and locally sourced ingredients, families are better equipped to integrate healthy options into their everyday routines without excessive financial or logistical burdens (Seah *et al.*, 2022). This finding reinforces the role of taiyaki as a health-promoting resource that reduces structural barriers to healthy eating.

Moreover, the integration of nutrient-dense ingredients into a child-friendly snack format supports behavioral maintenance, a key outcome of health promotion. Evidence suggests that repeated exposure to acceptable nutritious foods during early childhood increases the likelihood of long-term healthy eating patterns by influencing food preferences and diet quality later in life (Nansel *et al.*, 2024). Therefore, this modified taiyaki has the potential not only to improve short-term nutrient intake but also to contribute to sustained dietary behavior changes at the family level.

Phase 2: Salutogenic Health Promotion Analysis and Community Capacity Interpretation

Antonovsky asserts that health is viewed as a continuum determined by the extent to which individuals and communities perceive life as comprehensible, manageable, and meaningful (SOC). The salutogenic approach emphasizes strengthening community resources, including access to nutritious food, social support, and nutritional literacy, as the basis for creating health (salutogenesis). Therefore, transforming a product into an effective intervention requires attention to the process of meaning-making and community engagement, not just the technical aspects of the product.

Community interpretation was analyzed through literature-based reflection. Recent evidence provides strong insights into how families and communities understand, value, and adopt local food innovations within a salutogenic framework (Chan *et al.*, 2025); (Šostar, Joy and Ramanathan, 2025).

Comprehensibility

The familiar snack form and use of locally recognized ingredients may enhance comprehensibility, a core component of Sense of Coherence (SOC). Health promotion studies indicate that families are more likely to understand and accept nutrition messages when they are embedded in familiar foods and everyday practices rather than being delivered as abstract health information. This modified taiyaki, presented as a common snack rather than a therapeutic food, may therefore facilitate a clearer understanding of healthy eating within family contexts.

Manageability

Manageability refers to the perceived feasibility of engaging in healthy behavior. The use of affordable, locally available ingredients, such as moringa leaves and mung bean flour, enhances manageability by minimizing economic and access barriers. Evidence from health promotion research suggests that interventions are more likely to be adopted when they align with household resources and local food systems (Seah *et al.*, 2022). In this regard, modified taiyaki functions as an enabling resource that supports families in making healthier food choices without imposing additional burdens.

Meaningfulness

Meaningfulness is a key motivational dimension of SOC that influences the sustainability of healthy behaviors. Co-creation and participatory nutrition studies have shown that families are more motivated to adopt food innovations when they perceive them as culturally relevant and aligned with their aspirations for their children's well-being (Vargas *et al.*, 2023); (Morales-Garzón *et al.*, 2023). The child-friendly fish shape and local identity of modified taiyaki may therefore enhance emotional and social meaning, encouraging

continued engagement with healthy eating practices.

Strengthening Family and Community Capacity through Social Marketing

The literature-based community reflection highlights the relevance of modified taiyaki in strengthening meaningfulness, another essential SOC dimension. Health promotion research consistently shows that interventions perceived as culturally meaningful and aligned with community values generate stronger engagement and ownership (Vargas *et al.*, 2023); (Morales-Garzón *et al.*, 2023). As a modified yet familiar snack, modified taiyaki can be framed as a symbol of local innovation and collective commitment to child health, thereby reinforcing the shared responsibility within communities.

This process contributes to community coherence, a recognized outcome of effective health promotion in which collective understanding and coordinated action support health goals. When families, community health workers, educators, and local MSMEs consistently promote and utilize modified taiyaki, the product transcends its nutritional function and becomes part of a broader health-promoting environment.

The application of social marketing principles further strengthens the connection between the study's findings and health promotion outcomes. Social marketing facilitates voluntary behavior change by aligning product attributes with audience needs, cultural norms, and perceived benefits (Chatterjee, Bryła and Ciabiada-Bryła, 2025). In this study, the seven-element social marketing framework ensured that modified taiyaki was positioned not only as a nutritious snack but also as an accessible, acceptable, and meaningful choice for families.

The findings of this study align with the growing evidence that nutrition interventions integrating social marketing principles, such as attention to product appeal, perceived benefits, and contextual relevance, tend to achieve greater improvements in dietary behaviors than approaches relying solely on information provision. Systematic reviews and recent syntheses suggest that strategies addressing motivational and environmental factors are more effective

in supporting sustained dietary change than educational interventions alone (Roger *et al.*, 2023); (Chatterjee, Bryła and Ciabiada-Bryła, 2025). Thus, the integration of social marketing strategies in the interpretation of modified taiyaki reinforces its role as a health promotion intervention that supports empowerment, participation, and sustainability.

The modified taiyaki product with the best formulation, as determined by expert panelists, was then reviewed using a social marketing approach through seven elements: product, price, place, promotion, personnel, process, and presentation.

In social marketing strategies, in addition to the traditional 4 Ps (Product, Price, Place, and Promotion), three additional elements Personnel, Process, and Presentation need to be included (Kotler, Roberto and Lee, 2002); (Pudjiastuti, 2016). Studies have shown that many social marketers experience failure because they neglect to address the extended marketing mix of the three Ps. The following presents a review of the modified taiyaki product using a social marketing approach:

Table 4. Review of Taiyaki Product through a Social Marketing Approach

Elements	Strategies
Product	Taiyaki
Price	The price was set to be affordable so that it could be accessed by lower-to middle-income communities, particularly
Place	Distribution was carried out through community health posts
Promotion	Promotion focused on nutrition education through the message
Personnel	The parties involved included community health post
Process	The product development process included recipe trials, sensory testing by expert panelists, and nutritional analysis using NutriSurvey. The distribution process also took into account food safety (PIRT/halal certification) and production quality management. Social communication activities were carried out repeatedly to

	build awareness and acceptance.
Presentation	The product was presented attractively with the distinctive fish shape of

In social marketing, practitioners must understand the target audience and design offerings accordingly. Social ideas need to be “packaged” in a way that is attractive to the intended audience and encourages adoption. While commercial marketing focuses on goods and services, social marketing primarily offers ideas, concepts, and behavioral changes (Craig Lefebvre and Flora, 1988).

Within the social marketing framework, promotional activities must be aligned with the behavior being promoted, the perceived price, distribution channels, and the characteristics of the target audience (Sommariva *et al.*, 2025). In practice, promotional efforts are often inconsistent with the product or behavior being offered, which can lead to resistance among the target audience. When promotion is applied effectively and appropriately, social marketing programs are more likely to operate efficiently and achieve their intended objectives (Craig Lefebvre and Flora, 1988)el.

CONCLUSION

This study demonstrates that the development of food-based taiyaki modified with moringa leaves and mung bean flour is technically feasible and nutritionally superior, while remaining acceptable in terms of sensory quality according to expert panelists. The use of nutrient-rich and locally available ingredients enhances key nutritional components relevant to child growth, including protein, iron, zinc, dietary fiber, and selected vitamins. These findings indicate that familiar snack foods can be transformed into healthier alternatives without compromising acceptability, making them a practical entry point for health promotion within everyday family meal practices.

From a salutogenic perspective, the modified taiyaki functions as a health-promoting resource rather than merely a nutrient-rich product. The familiar snack format supports comprehensibility, the use of affordable and locally sourced ingredients enhances manageability, and the child-friendly, culturally acceptable

presentation strengthens meaningfulness. The integration of social marketing principles further positions modified taiyaki as a viable health promotion strategy by aligning product attributes, accessibility, and messaging with community needs and values. Although this study is formative and theory-based, its findings provide a strong foundation for future community-based implementation and evaluation. Further research is recommended to assess acceptance among children and caregivers, behavioral adoption, and the long-term impact on dietary practices.

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