

DEVELOPMENT OF DALI NI HORBO AS A NUTRITIOUS LOCAL FOOD ALTERNATIVE FOR TODDLERS AMONG MUSLIM WOMEN IN HUMBANG HASUNDUTAN REGENCY

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ABSTRACT

Nutritious local foods require processing innovations that are appropriate for young children, religious values, and household conditions. This participatory educational community engagement program aimed to develop Dali Ni Horbo, a traditional buffalo-milk-based local food, into sweet sticks, savory sticks, and cookies and to evaluate product acceptance among 40 Muslim women with children under five in Humbang Hasundutan Regency. The program included nutrition and halal-thayyib education, food-processing demonstrations, hygiene and sanitation education, observation of participant engagement, and hedonic evaluation of color, aroma, taste, and texture. All three products showed high levels of acceptance. Sweet sticks tended to receive the highest ratings for color, aroma, and taste, whereas cookies received the highest rating for texture. Participants also demonstrated active engagement through discussions, questions, and interest in trying similar food preparation at home. These findings indicate that Dali Ni Horbo diversification has potential as a caregiver-accepted local-food innovation and may support Muslim women's practical engagement in household food management. In practical terms, this approach may contribute to improving the variety and quality of foods provided to young children and thereby support efforts to maintain adequate nutritional status, although its direct effects on child nutritional outcomes require further evaluation.

Keywords: *Dali Ni Horbo, Toddlers, Local Food, Hedonic Test, Muslim Women.*

Introduction

Nutritional problems among children under five remain an important public health concern in Indonesia. Early childhood is a critical period of growth and development in which adequate and appropriate nutrition is essential to support children's health and developmental needs. Appropriate complementary feeding

practices are particularly important during early childhood because this period contributes to the establishment of healthy dietary patterns and adequate nutrient intake (World Health Organization, 2023) (Siregar, 2025). In Humbang Hasundutan Regency, the prevalence of stunting among children under five was 18.4% in 2023 (Dinas Kesehatan Provinsi Sumatera Utara,

2024). This local situation strengthens the need for food-based interventions that are accessible, culturally acceptable, and potentially sustainable at the household level (Luthfi, 2022) (Siadari, 2023).

Efforts to improve child nutritional status have frequently relied on supplementation and other health interventions. However, sustainable nutritional improvement also requires food-based strategies that make use of locally available resources. Local foods may offer advantages in terms of accessibility, affordability, cultural familiarity, and household food security (Food and Agriculture Organization of the United Nations, 2019) (Nurhayati, 2023). Nevertheless, the potential of local foods is not always fully utilized for young children. Limited product diversification, conventional processing methods, and inadequate adaptation of texture, taste, and presentation may reduce their suitability and acceptability for children under five (Widowati & Nurfitriani, 2023).

One local food with such potential is Dali Ni Horbo, a traditional Batak food made from buffalo milk. Dali Ni Horbo is a culturally significant local food in North Sumatra and has been identified as a nutrient-rich product with potential for further development into more contemporary food forms (Arrazy et al., 2024) (Yasmin, 2022). Traditionally, Dali

Ni Horbo is consumed in a relatively dense form with a distinctive taste (Garenta, 2019) (Girsang, 2023). Diversification into sweet sticks, savory sticks, and cookies therefore offers an alternative way of maintaining its local-food value while adapting its form and sensory characteristics to household preferences (Diana, 2020) (Deller, S., Canto A., 2017).

For Muslim families, food selection also involves the principles of halal and *thayyib*. Halal relates to the permissibility of ingredients and processing, whereas *thayyib* emphasizes food that is safe, clean, beneficial, and appropriate for health (Rahardja Faisol Hakim, Widya Ariasti, Heriansah Heriansah, And Udin Supriadi, 2024) (Mausufi et al., 2023). These principles are relevant to the selection and preparation of food for young children because food quality is not considered solely in nutritional terms but also in relation to safety and religious acceptability. In the context of childcare, this perspective is related to *hadhanah*, which refers to caring for young children and fulfilling their needs in ways that protect their welfare and development (Asman, 2023).

The focus on Muslim women is particularly relevant because food selection for young children within Muslim households involves not only nutritional considerations but also attention to halal

ingredients, processing methods, cleanliness, and food safety. Although Dali Ni Horbo is derived from buffalo milk, its diversification into processed products may involve additional ingredients and preparation stages that require attention to halal-thayyib principles. Mothers who are directly involved in selecting ingredients and preparing family food therefore play an important role in ensuring that these principles are maintained in everyday household practice. (Fachrial, 2023) In this study, Muslim women were selected not merely as a demographic group, but as key household actors whose food decisions connect child nutrition, local food practices, and religious considerations.

Women remain closely involved in food selection, preparation, and feeding practices in many households. In the Batak socio-cultural context, women may perform domestic, caregiving, and productive roles while also participating in household decision-making (Firmando, 2021b) (Alfian, 2023). Their involvement in local-food innovation is therefore relevant to the practical implementation of family nutrition programs.

This involvement also reflects the gendered organization of household care, in which women frequently combine food preparation and childcare with other domestic and productive responsibilities. Previous studies have shown that women

often carry a disproportionate share of food-related and caregiving work, and that this workload can influence household food practices and the ability to provide optimal nutrition for children (Mkandawire et al., 2022; Renzella et al., 2020).

Consequently, decisions regarding what foods are purchased, prepared, and served to young children are shaped not only by nutritional knowledge but also by the time, resources, and practical workload available to mothers. Halal considerations may further become part of these everyday food decisions, particularly when mothers are directly involved in selecting ingredients and preparing food for their children. Therefore, interventions aimed at improving child nutrition should consider women's available time and household responsibilities and should avoid transferring additional unpaid care work to mothers, as nutrition-related programs that rely heavily on women's participation may increase their time burden (Margolies et al., 2023).

At the same time, this involvement should not be interpreted as placing the entire responsibility for child nutrition on women. Strengthening women's knowledge and practical capacity should instead support informed household food practices within a shared family responsibility.

Accordingly, local-food innovations intended for household use should be nutritionally relevant, sensorially acceptable, and practical to incorporate into daily family routines. Diversifying Dali Ni Horbo into familiar snack forms provides an opportunity to introduce a traditional food through products that may be more acceptable to caregivers and more adaptable to contemporary household food practices.

Based on these considerations, the development of Dali Ni Horbo into more practical and acceptable food forms is relevant to support local-food utilization for young children and household nutrition. This community engagement activity therefore aimed to develop Dali Ni Horbo into sweet sticks, savory sticks, and cookies and to evaluate their sensory acceptance among Muslim women with children under five in Humbang Hasundutan Regency. The activity also integrated nutrition education, food safety, and halal-thayyib principles to support the practical use of local food within Muslim households.

Method

This community engagement program was conducted in Humbang Hasundutan Regency, North Sumatra, using a participatory educational approach. The program involved 40 Muslim women with children under five years of age. Participants were involved because of their

important role in household food selection and preparation, as well as the relevance of halal considerations in family food management. The activity focused on introducing and strengthening the practical use of Dali Ni Horbo as a nutritious local food for young children.

The activity consisted of nutrition education, introduction to Dali Ni Horbo as a local food, demonstrations of processing Dali Ni Horbo into sweet sticks, savory sticks, and cookies, and product acceptance evaluation. Educational materials covered child nutrition, local food utilization, food hygiene and sanitation, and halal-thayyib principles. The sessions were conducted interactively through presentations, discussions, question-and-answer sessions, and product demonstrations.

Product acceptance was evaluated using a five-point hedonic scale covering four sensory attributes: color, aroma, taste, and texture. The assessment was conducted after participants had been introduced to and tasted the three Dali Ni Horbo-based products. The participating women served as sensory evaluators because the activity focused on caregiver acceptance and the potential household use of the developed products. A hedonic questionnaire and observation sheet were used to record product preferences as well as participant responses, enthusiasm, and involvement during the activity.

Hedonic data were analyzed descriptively using mean, standard deviation, minimum, and maximum values. The Friedman test was used to examine differences in preference among the three products for each sensory attribute, followed by mean-rank interpretation to identify preference tendencies. Observation data were analyzed descriptively to illustrate participant responses and engagement during the educational and demonstration activities. Participation was voluntary, and the activity was implemented with respect for social, religious, and halal-thayyib principles.

Results

Participant Engagement and Process Findings

All 40 participants took part in the educational activities and sensory evaluation. During the sessions on child nutrition and Dali Ni Horbo, participants showed active engagement through discussions and questions, particularly regarding the health benefits of Dali Ni Horbo and its potential use in family meals.

The product-processing demonstrations also attracted considerable interest. Participants were introduced to the preparation of Dali Ni Horbo-based sweet sticks, savory sticks, and cookies, including the selection of ingredients, processing stages, and product packaging. Several

participants expressed interest in trying to develop similar products at home, indicating that the activity encouraged practical consideration of Dali Ni Horbo beyond its traditional form.

Participants also received guidance on food hygiene and sanitation, including the cleanliness of raw materials, equipment, the processing environment, and personal hygiene. This topic received particular attention because many participants were involved in household food preparation. The activity therefore provided not only product exposure but also practical information related to safe food handling for family consumption, particularly for children under five. The nutrition and Dali Ni Horbo educational session with participating women is shown in Figure 1.



Figure 1. Nutrition and Dali Ni Horbo education session with participating women.

Following education, participants observed demonstrations of Dali Ni Horbo processing and completed the organoleptic evaluation of the products. Figure 2

illustrates the evaluation process and the developed stick and cookie products.



Figure 2. Caregiver organoleptic assessment and Dali Ni Horbo-based products.

Caregiver Sensory Acceptance

All three products obtained high mean scores across color, aroma, taste, and texture. Sweet sticks had the highest mean values for color, aroma, and taste, whereas cookies had the highest mean value for texture. The savory sticks remained within the liked range but consistently received slightly lower scores than the other products, especially for texture.

Table 1. Mean caregiver preference scores for Dali Ni Horbo-based products

Attributes	Sweet Sticks	Savory Sticks	Cookies
Color	4.88	4.75	4.85
Aroma	4.80	4.70	4.63
Taste	4.83	4.60	4.75
Texture	4.68	4.48	4.85

Differences in Preference between Products

The Friedman test showed no statistically significant difference between the products for color, aroma, or taste. Texture was the only attribute with a statistically significant difference. This

result indicates that texture, rather than color, aroma, or taste, most clearly differentiated caregiver acceptance among the three product formats.

Table 2. Friedman test of preference by sensory attribute

Attributes	Chi-Square	p-value	Remarks
Color	2.333	0.311	Not significant
Aroma	2.000	0.368	Not significant
Taste	5.375	0.068	Not significant
Texture	12.500	0.002	Significant

Mean-rank results were consistent with the descriptive pattern. Sweet sticks ranked highest for color, aroma, and taste, while cookies ranked highest for texture. The convergence of the mean score and mean-rank findings supports the interpretation that sweet sticks and cookies were the most favorably received formats for different sensory reasons.

Table 3. Mean-rank preference by product and sensory attribute

Product	Color	Aroma	Taste	Texture
Sweet sticks	2.08	2.11	2.15	2.00
Savory sticks	1.89	1.98	1.83	1.75
Cookies	2.04	1.91	2.03	2.25

Table 3 shows that sweet sticks had the highest mean ranks for color (2.08), aroma (2.11), and taste (2.15), indicating a tendency for participants to prefer sweet sticks for these sensory attributes. Cookies had the highest mean rank for texture (2.25), followed by sweet sticks (2.00) and savory sticks (1.75). Savory sticks

generally showed lower mean ranks across the evaluated attributes.

These findings indicate that sweet sticks were relatively more favored for color, aroma, and taste, whereas cookies were more favored for texture. However, based on the Friedman test, the difference was statistically significant only for texture, while differences in color, aroma, and taste represented preference tendencies rather than statistically significant differences.

Discussion

Dali Ni Horbo as a Caregiver-Accepted Local Food Innovation

The central finding is that Dali Ni Horbo can be diversified into familiar snack formats that are well accepted by participating caregivers. This supports the broader direction of Dali Ni Horbo innovation reported in North Sumatra, where product development has sought to retain the value of buffalo-milk-based local food while adapting form and sensory characteristics to contemporary consumers (Arrazy et al., 2024; Luthfi, 2022). The strong ratings across all three products are important because household adoption depends not only on nutritional rationale but also on whether the person who selects, purchases, prepares, and serves food considers the product acceptable.

The result should nevertheless be located at the correct level of inference. The study did not analyze the nutrient

composition of the final sticks and cookies and did not measure growth or nutritional status after consumption. Therefore, it demonstrates caregiver sensory acceptance of products developed from a nutritionally promising local ingredient, not a clinical effect on stunting, wasting, or underweight. The practical implication is that these products can be taken forward to the next stage of testing: nutrient analysis, child acceptance, portion suitability, and repeated household use. This staged interpretation is consistent with previous research positioning Dali Horbo as a local-food resource for child nutrition while recognizing the need for specific product evaluation (Maisyaroh, 2023).

Texture, Child Development, and Feeding Safety

Texture was the only sensory attribute that significantly differentiated the three products, with cookies receiving the highest caregiver rating. From a product-development perspective, this identifies the cookie format as a promising candidate for refinement. This diversification approach emphasizes texture adaptation, food safety, and preservation of local-food value.

The high adult texture rating must not be equated with toddler safety. Children's chewing and swallowing capacities change rapidly across infancy and early childhood, and WHO guidance recommends adjusting texture and

consistency to developmental ability (World Health Organization, 2023). Because age-appropriate feeding safety was not directly assessed, caregiver preference for cookie texture should not be interpreted as evidence that the product is suitable for every child under five.

This distinction is also methodologically supported by Indonesian sensory research with infant and young-child foods, where caregiver perception and child acceptance were treated as related but separate outcomes (Sutrisna et al., 2017). A future Dali Ni Horbo trial should therefore record both caregiver evaluations and direct child outcomes such as willingness to taste, refusal, amount consumed, chewing difficulty, and any adverse feeding event.

From a household perspective, the cookie format may also offer practical advantages because a dry product can potentially be prepared in batches, stored more conveniently, and carried as a snack when caregivers are engaged in work or activities outside the home. However, storage stability and shelf-life were not measured in the present activity; therefore, claims regarding prolonged storage require further testing. For young children, an appropriately formulated cookie texture may provide opportunities to practice chewing as oral feeding skills develop. Nevertheless, ease of chewing and swallowing, as well as suitability for

different age groups, cannot be inferred from caregiver sensory ratings alone and should be evaluated directly in children with attention to texture hardness, choking risk, and age-appropriate feeding safety.

Women's Participation and Household Feasibility

The activity also demonstrated active participation among Muslim women. Participants engaged in discussions about the nutritional benefits of Dali Ni Horbo, its use in family menus, and the processing of sticks and cookies. Several participants also expressed interest in trying similar products at home. These responses indicate that product demonstrations can provide practical exposure to new ways of utilizing local food and encourage its potential application at the household level (Persynaki et al., 2017). However, the feasibility of food innovation should also be considered within women's everyday responsibilities. Women in Batak households may perform domestic, caregiving, and productive roles simultaneously (Firmando, 2021a, 2021b). Therefore, innovations in child nutrition should support women's knowledge and practical capacity without unnecessarily increasing their domestic workload. Sweet and savory sticks require frying, whereas cookies require baking equipment, but both forms may offer greater practicality in storage and preparation in batches than

fresh Dali Ni Horbo (Nainggolan, 2024). However, actual household replication may vary depending on access to equipment, ingredient costs, available time, and the extent to which food preparation responsibilities are shared within the household. Future community programs should therefore consider the availability of household equipment, preparation time, affordability, and the involvement of other family members so that child nutrition is understood as a shared household responsibility.

This consideration is particularly relevant because women in this activity were not positioned merely as recipients of nutritional information. They participated in discussions, observed processing techniques, evaluated products, and considered possibilities for household application. In this sense, the activity supports women's practical engagement and capacity in household food management, although it should not be interpreted as a measured increase in women's empowerment or agency (Sinaga, 2020) (Sinaga, 2020).

Halal-Thayyib, Hadhanah, and Maqashid al-Shariah

The integration of halal-thayyib gives the intervention a specifically Muslim family-health dimension. Halal assurance concerns permissible ingredients and processes, while thayyib directs attention to

cleanliness, safety, nutritional value, and suitability (Mausufi et al., 2023). In this sense, teaching hygiene, ingredient selection, and appropriate processing is not an additional religious message placed beside nutrition; it is part of the practical meaning of thayyib. The same logic aligns with hadhanah, in which care for young children includes fulfilling daily needs in ways that protect their welfare (Asman, 2023).

This perspective can also be connected with *Maqashid al-Shariah*. Efforts to provide safe and nutritious food reflect hifzh al-nafs, or the protection of life and health, while supporting children's growth and future well-being relates to hifzh al-nasl, or the protection of future generations (Rahman & Arranury, 2026). This framework strengthens the rationale for combining public-health education with religiously meaningful food practices rather than treating them as competing domains.

The concept of *al-ummu madrasatul ula*, which recognizes mothers as an important first source of learning for children, is also relevant to the educational nature of this activity (Pratiwi & Ladamay, 2023). Mothers can influence early eating habits, food choices, and health practices within the family. Nevertheless, this concept should not place the entire responsibility for child nutrition on women. Strengthening women's knowledge and

practical food-processing skills should instead be accompanied by shared family support and community involvement.

The activity demonstrates that Dali Ni Horbo diversification is not only a product-development strategy but also a potential community-based approach to nutrition education and local-food utilization. Combining practical demonstrations, sensory evaluation, food-safety education, and halal-thayyib values can make local-food promotion more relevant to Muslim households. Further implementation can involve *Posyandu* (integrated community health post), Family Welfare Development (PKK), health services, and Muslim women's organizations to strengthen the sustainable use of Dali Ni Horbo for family nutrition.

Conclusions

Dali Ni Horbo diversified into sweet sticks, savory sticks, and cookies was well accepted by the participating Muslim women at the caregiver level. Sweet sticks showed the strongest acceptance in terms of color, aroma, and taste, while cookies were most favorably perceived for texture. Participants' active engagement during the educational and product-processing activities, together with their interest in preparing similar products at home, indicates that Dali Ni Horbo has potential to be developed as a practical household-based local food option for young-child

nutrition. The integration of nutrition education, food hygiene and sanitation, and halal-thayyib principles also strengthens its relevance for Muslim households.

These findings should be interpreted at the level of caregiver acceptance and practical household potential rather than as evidence of direct improvement in child nutritional status. Further development should therefore include direct evaluation of children's acceptance, age-appropriate texture and feeding safety, nutrient composition, storage stability, affordability, and the feasibility of household preparation. Implementation should also consider women's available time, access to equipment, and unpaid care workload, while encouraging shared family responsibility for child nutrition. With these considerations, Dali Ni Horbo diversification may provide a culturally relevant and practically adaptable approach to strengthening local-food utilization for young-child nutrition without placing disproportionate responsibility on women.

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