Milk Production in Dairy Buffalo and the Development of "Dali Ni Horbo" as a Nutrient-Rich Local Food for the Batak Toba Community

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Abstract

Dali Ni Horbo, a traditional buffalo milk-based product from the Batak Toba community in North Sumatra, represents a culturally significant and nutritionally rich food. Despite its heritage value, its traditional form limits its appeal and market potential. This study aims to develop dali ni horbo into stick snacks, offering a modern variation that retains its cultural essence and health benefits while enhancing marketability. Conducted in Toba Regency from July to November 2024, this research involved 20 micro, small, and medium-sized enterprises (MSMEs) engaged in culinary entrepreneurship. A mixed-method approach was utilized, encompassing interviews to gather perceptions of dali ni horbo organoleptic properties and innovation potential, alongside sensory evaluation to assess attributes including color, texture, and taste. The results indicate high acceptance of the new product, with texture (mean score: 4.15) and taste (3.95) identified as strengths. However, improvements are necessary in aroma freshness and saltiness to align with broader consumer preferences. The study highlights Dali Ni Horbo's potential as a nutritious snack, leveraging its high protein and calcium content to address nutritional deficiencies. Moreover, this innovation supports local economic empowerment by creating opportunities for MSMEs and fostering sustainable practices in buffalo milk processing. In conclusion, transforming dali ni horbo into stick snacks bridges traditional culinary heritage and modern innovation, offering economic, cultural, and nutritional benefits. Recommendations include optimizing flavor profiles, diversifying products, and enhancing market access through strategic partnerships with government and private sectors to scale production and expand distribution.

Keywords: Buffalo Milk, Cultural Innovation, Dali Ni Horbo, Sensory Evaluation.

INTRODUCTION

Dairy buffalo reach their peak milk production during their 4th to 6th lactations, with the highest yield occurring in the second month. However, milk production gradually decreases as the age and reproductive cycles of the buffalo increase. Overall, buffalo milk productivity remains relatively low, averaging approximately 1.2 liters per buffalo per day (Sinaga, 2020). Indonesia has numerous regions with unique foods derived from buffalo milk, though the processing methods vary widely across different areas, shaped by local knowledge, natural resources, and longstanding traditions (Nainggolan, 2024); (Fathiaturrahma, 2022).

According to data from the Central Statistics Agency (BPS), fresh milk production in North Sumatra, which encompasses buffalo milk as one of the region's characteristic livestock products, has exhibited a consistent upward trajectory. Production attained 8,745.02 tonnes in 2021, increased to 8,953.30 tonnes in 2022, and further escalated to 9,234.40 tonnes in 2023. While specific data regarding buffalo milk's contribution to total production is not delineated, it is evident that buffalo milk plays a pivotal role in supporting the local economy, particularly

within traditional agricultural communities. The Tapanuli region of North Sumatra Province possesses substantial potential in the buffalo farming sector, notably in the development of buffalo milk as a high-value local food ingredient. Key districts contributing to the region's buffalo population include Samosir District, with 24,153 buffaloes; Humbang Hasundutan District, with 10,910; and Toba District, with 10,455. Furthermore, North Tapanuli and Central Tapanuli districts each support approximately 8,096 buffaloes. This data underscores the Tapanuli region's status as a resource-rich area for buffalo husbandry (Nainggolan, 2024). The consistent growth in milk production over the past three years highlights the potential for further development and innovation in the buffalo milk sector. This upward trend emphasizes the significance of optimizing this resource for economic and nutritional benefits in North Sumatra Province.

One of the traditional cheeses that remains relatively obscure is Bagot ni Horbo, a cheese originating from Tapanuli, North Sumatra (Luthfi, 2018). Bagot ni Horbo is produced using buffalo milk combined with papaya leaf juice or pineapple juice to facilitate coagulation. This process imparts Bagot ni Horbo with its characteristic greenish-white hue. The primary advantage of traditional Bagot ni Horbo lies in its safe coagulation process, which eschews the use of chemical additives or preservatives (Simanjuntak, 2020). Buffalo milk, the principal component of Bagot ni Horbo, exhibits a higher protein content compared to bovine milk. Its more pronounced whiteness is attributed to an elevated carotene content relative to cow's milk (Pardede, 2023). Furthermore, the lipids in buffalo milk demonstrate enhanced digestibility, resulting in a softer curd that is particularly suitable for cheese production. The inherent flavor profile of Bagot ni Horbo includes a subtle bitter aftertaste; however, this can be mitigated through the application of heat and the incorporation of additional ingredients such as coffee, chocolate, or fruit flavors, which serve to enhance its organoleptic properties and textural qualities (Laila, 2021).

The Batak Toba people have a longstanding agricultural tradition, including buffalo farming, which is deeply ingrained in their culture. Buffaloes hold cultural significance and are utilized for both symbolic purposes and for plowing rice fields. Buffalo milk is transformed into a traditional Batak Toba food product called " *dali ni horbo*," which reflects their indigenous knowledge and heritage. The Batak Toba community employs unique practices for milk processing, similar to the Minang ethnic group, who produce a similar product called “dadiah” from buffalo milk. This practice underscores the communal and cultural values of the Batak Toba people (Nainggolan, 2024).

Known also as “bagot ni horbo,” *dali ni horbo* is a traditional dish from the Batak Toba people of Tapanuli, North Sumatra, Indonesia. It is a staple food for the Batak community and is traded as a commodity in Tapanuli markets. This dish is made using buffalo milk, which contains 40% more protein than cow’s milk and twice the butterfat content (Yasmin, 2022); (Fachrial, 2023). The primary etiology of nutritional deficiencies is the prevalence of infectious diseases combined with inadequate consumption of foods rich in macronutrients and micronutrients. Additionally, one of North Sumatra's indigenous culinary offerings is *dali ni horbo,* a traditional dish originating from the Toba Samosir region (Diana, 2020).

The milk is boiled and processed into *dali ni horbo* by adding juice from pineapple or papaya leaves for seasoning. The name of the dish originates from the Batak language, with “dali” meaning milk and “horbo” meaning buffalo. *dali ni horbo* is recognized for its creamy texture and traditional preparation method, involving boiling milk and adding fruit juices to curdle it. This dish holds cultural importance within the Batak community and is often served at special events and celebrations (Damayanthi, 2014). In recent decades, the utilization of Indonesian buffalo milk has been predominantly confined to the production of traditional foods such as Dali and Dadih (a type of traditional curd), and has not been extensively developed for the production of kefir (Rizqiati, 2020).

Buffalo milk, similar to cow’s milk, contains a higher fat proportion and distinct characteristics, such as the absence of carotene, no free casein, lower nitrogen and sialic acid content, but with higher calcium and phosphorus levels (Sinaga, 2020). *dali ni horbo* is a dairy product containing proteolytic microorganisms that break down protein polypeptide bonds into amino acids, making it suitable for individuals with lactose intolerance. The active Lactobacillus bacteria in *dali ni horbo* produce vitamin B12 and lactic acid, which can eliminate pathogenic microorganisms, offering health benefits particularly for children with stunted growth (Garenta, 2019). The preparation and nutritional value of *dali ni horbo* exemplify the Batak Toba community’s profound connection to their cultural roots and their innovative use of local resources to develop healthful, traditional foods. This dish is a testament to the Batak Toba's deep agricultural heritage, showcasing how indigenous knowledge and sustainable practices contribute to community health and cultural preservation.

METHODS

This study was conducted in Toba Regency, a leading buffalo milk-producing region in North Sumatra Province, from July to November 2024. The research involved 20 micro, small, and medium-sized culinary entrepreneurs in Toba Regency. Participants were selected based

on the following criteria: classification as micro, small, or medium-sized culinary food entrepreneurs; prior consumption of buffalo milk; and a minimum of three months' experience in culinary entrepreneurship.

The preparation of palatable and nutritious *dali ni horbo* sticks necessitates several culinary implements, including a kitchen knife, large container, rolling pin, cutting board, frying pan, spatula, stove, kitchen scale, and oil strainer. The requisite ingredients comprise finely grated *dali ni horbo*, wheat flour, starch, chicken eggs, margarine, garlic powder (optional), salt, boiled water, and cooking oil for frying. The process commences with the amalgamation of wheat flour, starch, garlic powder, and salt in a large container. Subsequently, the grated *dali ni horbo* and margarine are incorporated, kneading the mixture until it forms fine granules. The eggs are then added individually, mixing thoroughly, followed by the gradual addition of boiled water until the dough attains a smooth and pliable consistency. Upon achieving the desired dough consistency, it is rolled thinly using a rolling pin on a cutting board and cut into long strips approximately 0.5–1 cm in width. The cooking oil is heated in a frying pan over medium heat, and the sticks are fried in small batches until they are evenly cooked and achieve a golden yellow hue. Following the frying process, the sticks are drained using an oil strainer and allowed to cool completely. To maintain the crispness of the sticks, they should be stored in an airtight container once cooled. These *dali ni horbo* sticks, characterized by their distinctive savory flavor, serve as an excellent snack and possess potential as a marketable product, contributing to enhanced nutrition and economic opportunities.

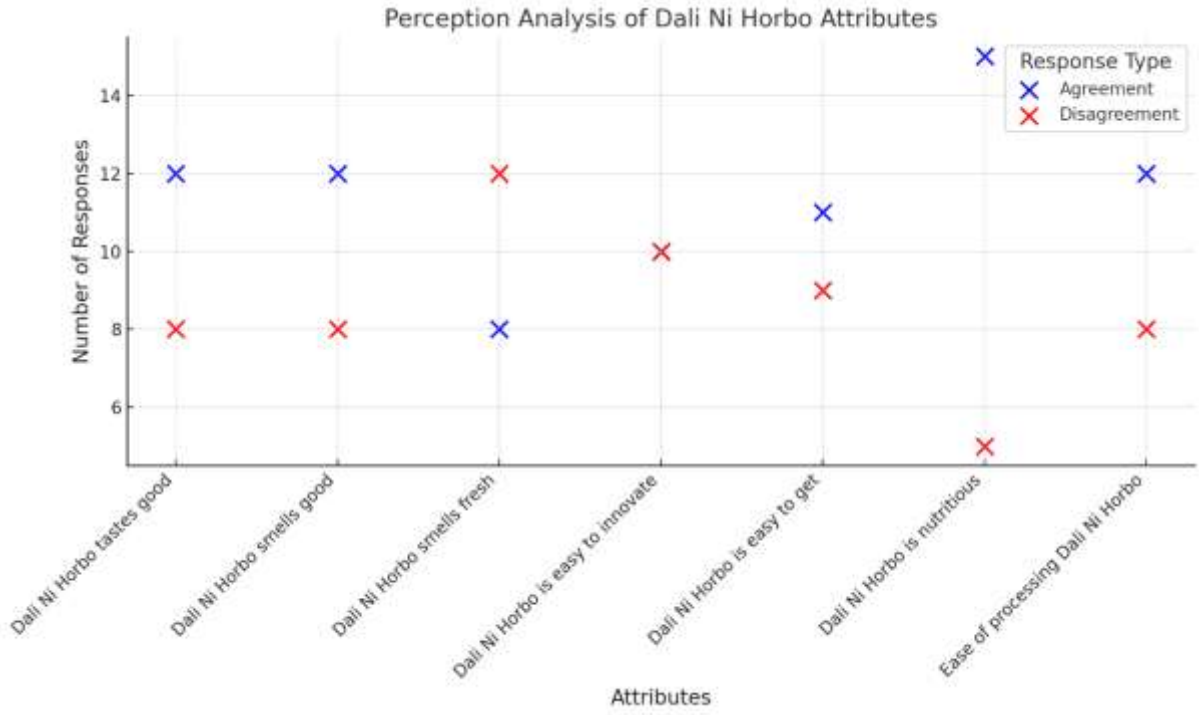
The study aims to explore culinary entrepreneurs' perceptions of *dali ni horbo* (a traditional buffalo milk product) across several dimensions, including taste, aroma, potential for innovation, availability, nutritional value, and ease of processing. Data collection was conducted through interviews to capture these perceptions comprehensively. Additionally, the study developed *dali ni horbo* into *dali ni horbo* stick snacks and performed organoleptic tests to evaluate the new product. These tests assessed the sticks based on their color, aroma, taste, and texture, providing insights into their potential acceptance and marketability.

The transformation of *dali ni horbo* into stick form represents an effort to innovate and modernize this traditional food, making it more appealing and accessible to a broader audience. *dali ni horbo* sticks likely involve shaping the curdled buffalo milk into stick-like forms, which may be further processed—such as frying, baking, or seasoning—to enhance their taste, texture, and shelf life. These sticks may cater to the growing demand for snackable, ready-to-eat products while preserving the unique characteristics of *dali ni horbo*, such as its nutritional value and distinct flavor profile.

Data analysis was conducted to evaluate culinary entrepreneurs' perceptions of *dali ni horbo* and the organoleptic properties of its stick variant, specifically examining color, aroma, taste, and texture. These analyses yielded significant insights into the potential acceptance and marketability of the product. The data were analyzed and visualized utilizing JASP data software version 19, with graphical representations facilitating a more comprehensive understanding of the findings and supporting the assessment of Dali Ni Horbo's prospects in the culinary market.

RESULT

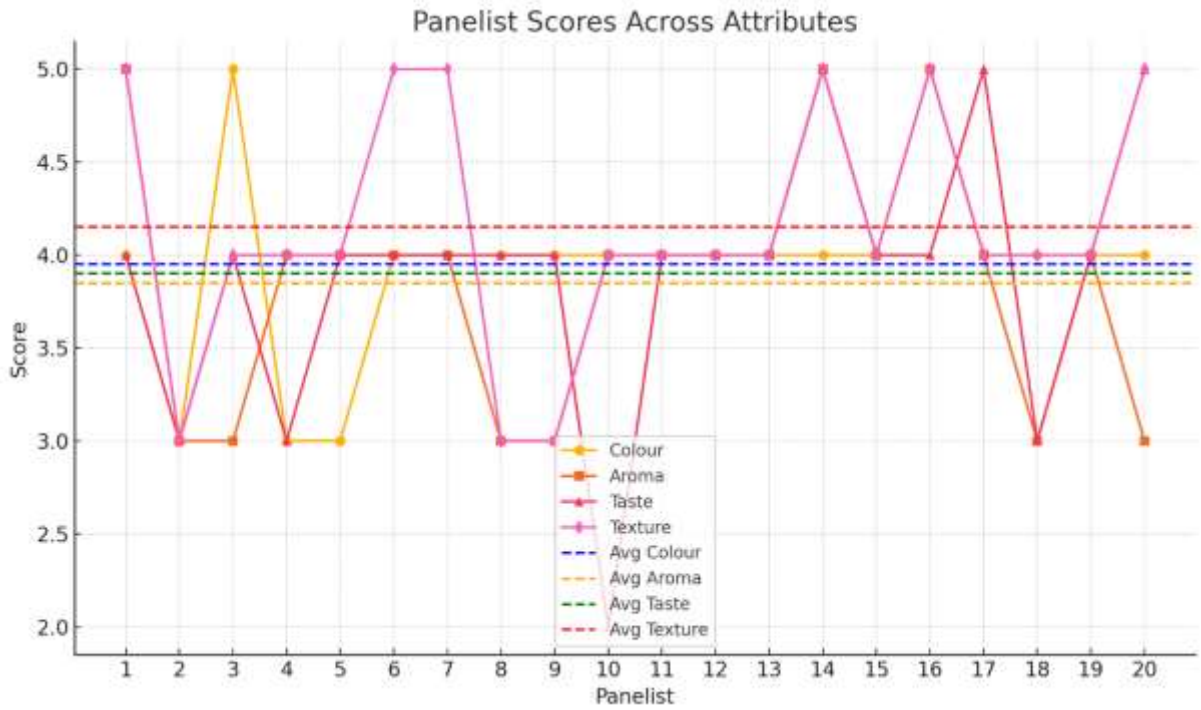
These tests assessed the sticks based on their color, aroma, taste, and texture, providing insights into their potential acceptance and marketability.



Graphic 1. Perception analysis of *dali ni horbo* attributes

The scatter plot elucidates valuable insights regarding the perception of various attributes of *dali ni horbo*. Concerning taste, the majority of respondents (12) concurred that *dali ni horbo* possesses a favorable flavor, while only 8 disagreed, indicating that taste constitutes a significant strength and could serve as a compelling selling point. Similarly, 12 respondents affirmed that the product emits a pleasant aroma, though a notable portion (8) disagreed. However, when evaluating the perceived freshness of the aroma, the response was less favorable, with only 8 agreeing and 12 disagreeing. This suggests that while the overall aroma is appreciated, there

may be a need to enhance the perception of freshness through improved packaging or quality communication. Regarding the attribute of ease of innovation, opinions were evenly divided, with 10 respondents agreeing and 10 disagreeing. This reflects heterogeneous perceptions about whether *dali ni horbo* can be readily innovated, suggesting potential opportunities for creative product development, though challenges in this area may need to be addressed. Concerning accessibility, 11 respondents agreed that it is easily obtainable, while 9 disagreed, indicating a generally positive perception but with room for improvement in distribution strategies. The most prominent attribute of *dali ni horbo* is its nutritional value, with 15 respondents affirming that it is nutritious and only 5 disagreeing. This establishes the product's health benefits as its most widely recognized strength. Finally, the ease of processing also garnered a favorable response, with 12 agreeing and 8 disagreeing, highlighting its convenience as an appealing factor for consumers. In conclusion, *dali ni horbo* 's taste and nutritional value emerge as its greatest strengths, rendering them key features to emphasize in marketing efforts. Meanwhile, areas such as aroma freshness, ease of innovation, and accessibility require attention and improvement. To enhance its market appeal, strategies could include improving the freshness perception, exploring innovative product diversification, and optimizing distribution networks to address accessibility concerns. These efforts would contribute to solidifying *dali ni horbo* 's position as a desirable product in the market.



Graphic 2. Panelist Score Based on Taste, Aroma, Colour, Texture *dali ni horbo* Stick.

This study provides an in-depth analysis of the sensory attributes of Product *dali ni horbo*, evaluated by a panel of 20 participants. Utilizing a structured sensory assessment protocol, we measured panelists' ratings for four vital sensory dimensions: color, aroma, taste, and texture, with average scores revealing notable insights into product acceptability. Color received an average score of 3.95, indicating favorable perceptions across most panelists. The majority of panelists assigned a score of 4, suggesting that the product's color was generally well-regarded. However, two panelists awarded the highest score of 5, indicating that the color closely approached an ideal standard for some individuals. With an average score of 3.85, Aroma received the lowest rating among the evaluated attributes. Scores ranged from 3 to 5, highlighting considerable variance in individual responses. This variation suggests that while most panelists found the aroma acceptable (with a majority scoring it a 4), there remains potential for enhancement to better align with consumer preferences. Taste achieved an average score of 3.9, demonstrating moderate favorability among the panel. Taste scores spanned from 2 to 5, reflecting some divergence in panelists' satisfaction with this attribute. Despite this, the majority awarded a score of 4, implying that the product's taste meets general expectations, though specific improvements might yield higher satisfaction levels. Texture emerged as the most positively rated attribute, with an average score of 4.15. This high score suggests that the product's texture is of substantial quality, with most panelists rating it between 4 and 5, signaling high approval. Overall, with average scores above 3.8 across all sensory attributes, Product X demonstrates strong sensory appeal, particularly in texture. However, targeted improvements could further enhance consumer satisfaction, especially regarding aroma and taste.

DISCUSSION

Developing Buffalo Milk into *Dali Ni Horbo* Sticks as a Nutritious and Delicious Local Food

Dali ni Horbo contains protein-degrading microbes capable of breaking down protein polypeptides into amino acids, allowing direct absorption in the small intestine (Yasmin, 2022). This makes it suitable for individuals with lactose intolerance. During the fermentation process, active *Lactobacillus* bacteria produce vitamin B12 and form lactic acid, which helps eliminate pathogenic microbes. These benefits make *dali ni horbo* an excellent dietary option for children experiencing stunted growth (I R R Siburian, 2021).

This aligns with previous findings by Girsang, (2023), who also identified *dali ni horbo* as an effective supplementary food alternative for combating stunting. Buffalo milk, as the primary ingredient in *dali ni horbo*, provides a valuable source of animal protein in local

supplementary foods for young children and pregnant women. Therefore, integrating *dali ni horbo* into stunting prevention programs offers a promising approach to enhance the nutritional support available to children (Sinaga, 2020).

Dali ni Horbo is a traditional Batak Toba culinary product, rich in cultural and nutritional value. While traditionally consumed as a local dish, it is now being developed into modern food innovations such as *dali ni horbo* sticks. Using buffalo milk, rich in protein and calcium, these sticks offer a healthy snack alternative that holds significant potential for promoting nutritious local food consumption in Toba Regency (Nainggolan, 2024) .

Toba Regency, with its abundant local buffalo resources, holds tremendous potential to develop *dali ni horbo* sticks as a signature product. This innovation not only adds value to local products but also contributes to economic empowerment by promoting sustainable buffalo milk processing (Luthfi, 2022).

For instance, small business groups in Toba have successfully produced *dali ni horbo* sticks on a small scale, sourcing raw materials directly from local buffalo farmers. This creates a beneficial economic ecosystem for farmers and producers (Saragih, 2022). Despite the numerous advantages of *dali ni horbo* sticks, challenges remain, particularly in processing technology and market reach. However, with regional government support and training for small and medium enterprises (SMEs), this product has significant potential to enter regional and national markets as a healthy local snack (Kamaluddin, 2023). Moreover, the growing public awareness of the importance of healthy and nutritious foods presents a promising opportunity for *dali ni horbo* sticks to become a leading choice in modern snack markets (Diana, 2020).

Buffalo Milk Processed into Dali Ni Horbo Sticks

The organoleptic test is a sensory evaluation method used to assess the quality of food products based on human perception of characteristics such as color, aroma, taste, and texture. This test is aimed at measuring consumer acceptance of a food product to ensure quality standards prior to marketing. An acceptability test of *dali ni horbo* sticks was conducted with 20 panelists, focusing on sensory attributes such as taste, aroma, color, and texture. The results indicate a high level of preference among the panelists. The average scores were as follows: taste (3.95), aroma (3.85), color (3.90), and texture (4.15). Based on these averages, it can be concluded that all panelists had a favorable response to the *dali ni horbo* sticks.

Evaluating food requires practice and concentration due to its complex nature. Factors like gender, genetics, health status, and experience influence objective evaluation. Sensory

evaluation of pastry products involves all five senses: gustation, olfaction, tactile perception, audition, and vision (Figoni, 2011)v.

Color is one of the first parameters evaluated by consumers, as it often reflects the product's quality and freshness. The yellow-brown hue achieved through frying serves as an indicator of proper processing for *dali ni horbo* sticks. An overly dark color may indicate overcooking, while a pale color could suggest insufficient cooking (Maisyaroh, 2023). The golden-yellow color, derived from the combination of buffalo milk and corn flour, was rated highly by respondents, who found the color visually appealing as it conveys crispness and stimulates the appetite (Siadari, 2023).

Aroma significantly impacts product acceptance. The savory aroma of buffalo milk in *dali ni horbo* sticks is one of the main appeals. Additional ingredients or spices can influence the final aroma profile (Hasibuan, 2023). Unpleasant or rancid odors may indicate fat degradation or improper storage. The aroma of *dali ni horbo* sticks was a positive attribute, with the use of local spices such as garlic and andaliman adding complexity and appeal. However, some respondents suggested that the raw buffalo milk aroma could be minimized to appeal to modern consumers. One suggested improvement is using natural deodorizing agents, like lime juice, to enhance aroma preference (Diana, 2020).

Taste is a primary factor in organoleptic testing, directly influencing consumer acceptance. The natural savory taste of buffalo milk, combined with spices or seasonings, was evaluated in the *dali ni horbo* sticks. Achieving a balance between salty, sweet, and savory is essential for broader appeal. The distinct taste of buffalo milk gives the product a unique identity, although some respondents recommended reducing the saltiness to better align with broader consumer preferences (Rizqiati, 2020); (Damayanthi, 2014).

Texture relates to the mouthfeel of a product upon consumption. For *dali ni horbo* sticks, a crunchy texture is the desired outcome of an optimal frying process. A texture that is too hard or too soft detracts from the enjoyment of the product. Texture emerged as a key element in consumer enjoyment, with the ideal texture being crispy without excessive hardness. This balance provides an enjoyable sensory experience that aligns with consumer expectations for a snack. In summary, the positive acceptability scores across all sensory attributes demonstrate that *dali ni horbo* sticks hold strong potential as a nutritious and culturally significant snack with broad consumer appeal. While the initial findings are promising, optimizing certain attributes, such as aroma and saltiness, could further enhance the product's market potential (Alfian, 2023).

CONCLUSION

dali ni horbo holds significant potential as a nutritious local food that can contribute to meeting the community's nutritional needs while preserving the unique Batak culinary heritage. The acceptability test conducted on *dali ni horbo* sticks showed a positive response from panelists in terms of taste, aroma, color, and texture. This product was well-received due to its unique qualities while maintaining the traditional flavors that define Batak cuisine.

The development of this product can focus on flavor innovation and variation, such as incorporating local spices or flavors to attract a broader consumer base. Small and medium enterprises should leverage digital platforms for marketing, utilizing social media and online marketplaces to reach consumers beyond Balige and boost sales. Promoting *dali ni horbo* sticks as a signature product of Balige through culinary events or local food festivals can strengthen its product identity and support local economic growth. These activities not only stimulate the local economy but also play a crucial role in preserving Batak's rich culinary heritage.

Collaboration with government agencies and private institutions for access to financing and marketing support would also be immensely beneficial in scaling up production and expanding market reach. By forming strategic partnerships and tapping into additional resources, SMEs can enhance the growth potential of *dali ni horbo* and solidify its position as a prominent local food product.

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