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PRODUCT DEVELOPMENT AND SENSORY EVALUATION OF CORN *(Zea mays)* SPREAD ENRICHED WITH CARABAO'S MILK

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ABSTRACT

This study aimed to determine the degree of preference for the sensory characteristics of corn (Zea mays) spread enriched with carabao's milk using an experimental-descriptive comparative design. Three treatments—Treatment 1 (White Corn), Treatment 2 (Yellow Dent Corn), and Treatment 3 (Sweet Corn)—were evaluated in terms of appearance, aroma, taste, texture, and overall acceptability. The research involved 60 purposively selected participants from Valencia and Jagna, Bohol, including cookery teachers, senior high school students, industry practitioners, and potential consumers. Data were analyzed using the weighted mean to assess preference levels. Repeated Measures ANOVA was applied when normality assumptions were met, while the Friedman test served as a non-parametric alternative. Pairwise comparison was conducted to identify specific differences among treatments. A 4-point hedonic scale was utilized to measure preference. Results showed that Treatment 3 (Sweet Corn) spread obtained the highest grand mean (3.62), described as "Most Preferred," followed by Treatment 1 (White Corn, 3.28) and Treatment 2 (Yellow Dent Corn, 3.26). Statistical analysis confirmed significant differences among treatments, indicating that respondents did not rate the spreads equally. Nutritional analysis conducted by First Analytical Services and Technical Cooperatives (F.A.S.T.) Laboratories further highlighted the product's nutrient profile per 100g: carbohydrates (27.7g) and sugars (13.4g) as primary contributors, moderate protein (3.55g), low total fat (1.40g), and negligible trans fat. Free of added preservatives, the spread offers a wholesome, energy-boosting, healthier alternative to traditional dairy-rich spreads. Overall, Sweet Corn spread enriched with carabao's milk emerged as the most favored option, underscoring its potential for product development, community nutrition, and marketability. Moreover, the study highlights the importance of utilizing locally available food resources, particularly sweet corn and carabao's milk, to promote community-based nutrition, lessen dependence on imported dairy products, and strengthen local agricultural value chains.

I. INTRODUCTION

Bohol is one of the agricultural provinces in Central Visayas, with corn serving as a major upland crop cultivated across municipalities such as Sagbayan, Dagohoy, and Carmen. Corn farming in the region supports food security and rural livelihoods, particularly among smallholder farmers (Centino & Vista, 2018; Labonite & Jomoc, 2015). At the same time, Bohol is home to a growing carabao milk industry, especially in Ubay, where cooperatives like the Tamboan Farmers Multipurpose Cooperative produce carabao-based products such as milk, ice cream, and pastillas through the Philippine Carabao Center's Dairy Box initiative. These two sectors demonstrate the province's strong capacity for both crop production and dairy development, creating opportunities for integrated, value-added food innovation. This situation highlights a critical research gap: despite the strategic importance and abundance of corn and carabao's milk in Bohol's agriculture, they remain underutilized in the development of processed foods. Currently, no spread combines these two commodities into a single, culturally relevant, and nutritious product. The absence of such innovation is a missed opportunity to reduce reliance on imported raw materials, diversify consumer choices, and strengthen the agricultural value chain. Corn spread enriched with carabao's milk directly fills this gap. By transforming raw commodities into a higher-value processed product, such innovation can expand market opportunities for farmers, promote Bohol's agricultural identity through locally branded food, and align with current trends in functional, sustainable, and culturally rooted food development.

Accordingly, this study aimed to develop and utilize corn enriched with carabao's milk to create new food products. Through experimental product development and consumer sensory evaluation, it investigates whether corn and carabao's milk can improve taste and acceptance, and whether significant differences exist in consumer preference across three formulations. The findings are expected to contribute to food innovation by positioning corn and carabao's milk as functional, sustainable, and culturally relevant components in the Philippine spread market.

II.LITERATURE BACKGROUND

The Philippines is blessed with abundant and diverse corn varieties, cultivated across regions for both staple consumption and agricultural use. However, many of our locally grown corn varieties remain underutilized for food innovation and value-added processing. This represents a missed opportunity to promote nutrition, support local farmers, and develop sustainable, community-based food systems. This situation calls for food innovations that make meaningful use of indigenous crops while improving both nutritional value and consumer acceptance.

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Corn (Zea mays) is one of the most widely cultivated cereal crops in the Philippines, second only to rice in terms of agricultural importance. It is grown across diverse agro-ecological zones and serves multiple roles as food, feed, and raw material for processed goods (Exconde, 1974; Philippine Statistics Authority [PSA], 2023). In recent years, there has been a growing interest in developing value-added corn products, particularly those that align with consumer preferences for healthier, locally sourced, and functional foods. Studies have shown that sweet corn varieties, including yellow and white corn, possess favorable sensory and nutritional properties suitable for food innovation (Canatoy, 2018). These findings highlight corn's versatility not only as a staple crop but also as a promising base for innovative food products, such as spreads, particularly when combined with nutrient-rich local resources, such as carabao's milk.

According to the Theory of Nutrition, "Food is the essence and first condition of life," highlighting how diet directly shapes health and well-being. The familiar maxim "we are what we eat" captures this truth, highlighting the impact of food choices on our bodies and minds. When we choose nutrient-dense foods over refined alternatives, we invest in long-term vitality. Whole, plant-based foods—grains, legumes, fruits, and vegetables—retain fiber, vitamins, minerals, and phytochemicals that are often lost in processing. Research consistently affirms their benefits: Hu (2003) linked plant-based diets to reduced risks of cardiovascular disease and diabetes; Slavin (2013) emphasized fiber's role in supporting gastrointestinal health and preventing obesity; and Roberfroid (2007) introduced the concept of functional foods, which deliver added value through bioactive compounds. Together, these findings connect nutrition science with practical food innovation, justifying the use of indigenous and whole-based ingredients.

Amid growing interest in diverse dairy sources and their nutritional role, carabao milk emerges as a uniquely valuable resource. Derived from the native water buffalo (Bubalus bubalis carabanensis), it carries a richer nutritional profile than cow's milk, offering higher levels of protein, calcium, and fat (Philippine Carabao Center [PCC], 2023). This makes it more than just a traditional ingredient—it is a foundation for innovation. For generations, carabao milk has been cherished in Filipino delicacies such as pastillas and kesong puti. However, despite its cultural significance, its use in modern food products has remained limited. Recent research, however, has begun to unlock new possibilities, testing its application in yogurt, ice cream, and flavored milk. The results are promising, showing not only strong consumer acceptability but also meaningful nutritional enhancement (Oliveros et al., 2018).

Within the evolving landscape of food innovation, spreads represent a category that combines convenience with versatility. They are semi-solid food products designed for easy application to bread, crackers, and other carriers, typically formulated as emulsions that may be dairy-, plant-, or composite-based. This structural design is not incidental—it reflects the need for stability, palatability, and ease of use, making spreads a staple in both traditional and modern diets. Building on the growing body of research on dairy-based spreads, scholars have emphasized the critical role of formulation in achieving both nutritional and sensory quality. Rao et al. (2021) highlighted the importance of emulsifiers, stabilizers, and milk-derived ingredients in enhancing texture, spreadability, and shelf stability. Innovations such as whey protein-based fat replacers and cereal-derived components have been explored to develop nutritionally superior, culturally relevant spread products. These findings provide a scientific foundation for understanding how ingredient interactions directly inform the texture and stability considerations of the corn–carabao milk spread.

III.THE PROBLEM

This study aimed to develop and assess the degree of preference and the sensory attributes of corn (Zea mays) spread enriched with carabao's milk, using three different corn varieties white corn, yellow dent corn, and sweet corn as base ingredients. The study was conducted in two primary settings: the food technology shop of Valencia Technical Vocational High School Cookery Students for the Academic year 2025-2026 and selected locations in the municipality of Jagna, Bohol.

Specifically, the researcher sought to answer the following questions:

1. What is the description of Corn (Zea mays) Spread Enriched with Carabaos Milk in terms of:
1.1 ingredients and costing;
1.2 tools and equipment;
1.3 procedures;
1.4 nutrient content; and
1.5 shelf life?
2. What is the sensory attributes of Corn (Zea mays) Spread Enriched with Carabao's Milk in three treatments in the aspects of?
2.1 appearance;
2.2 aroma;
2.3 taste; and
2.4 texture?
3. What is the level of preference of the respondents for the three treatments in terms of appearance, aroma, taste and texture?

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4. Is there a significant difference in the respondents' preference levels across the three treatments in terms of appearance, aroma, taste and texture?
5. What technology guide shall be proposed based on the findings of the study?

IV. METHODOLOGY

Design

This study employed an experimental-descriptive comparative design, which combines controlled experimentation with systematic descriptive evaluation. This design was appropriate because the researcher aimed to formulate three different treatments of Corn (Zea mays) Spread Enriched with Carabao's Milk and compare them in terms of aroma, color, taste, and texture, directly addressing the research questions outlined in the Statement of the Problem. The experimental component involved preparing the three spread formulations under standardized conditions, controlling ingredient ratios, processing methods, and storage to minimize bias. The descriptive comparative component involved assessing consumer perceptions through structured questionnaires and sensory evaluation forms, providing data on acceptability and preference for each treatment.

This design aligned with the SOP of the study by allowing the researcher to determine whether significant differences exist among the three treatments and to identify which combination of corn and carabao's milk yielded the most acceptable product. By integrating experimental control with descriptive sensory assessment, the study ensured that observed differences in consumer responses could be reliably attributed to the formulation variations rather than external factors.

Environment and Participants

This study was conducted in two primary settings: the food technology shop of Valencia Technical Vocational High School in Valencia, Bohol, and selected locations in the municipality of Jagna, Bohol, where small-scale food manufacturing, such as calamay production, is operational. The school was selected for its accessibility and the availability of tools and equipment suitable for small-scale food preparation and product development. Its facilities provide a practical setting for formulating and conducting the initial evaluation of the Corn (Zea mays) Spread Enriched with Carabao's Milk. The municipality of Jagna was included to involve industry settings and potential consumer contexts, offering real-world insights into product acceptability and market relevance.The researcher employed purposive sampling to select participants for the sensory evaluation, focusing on the spread's appearance, aroma, taste, and texture. A total of 60 respondents participated in the study, consisting of senior high school TVL Food Technology students and teachers from Valencia Technical Vocational High School, as well as industry experts and potential consumers from Jagna. Participants are specifically chosen based on their background in food preparation, product evaluation, and experience with local food products.

Purposive sampling was appropriate for this study because it ensured that data were gathered from individuals with relevant knowledge, expertise, and consumer experience. School-based respondents provided informed feedback due to their training in cookery and food technology, while industry experts and potential consumers provided insights into practical applicability, sensory acceptability, and market potential. This combination allowed the study to collect consistent, credible, and comprehensive evaluations of the spread's sensory qualities, which directly support the study's objectives. The sample size was justified as sufficient to capture diverse perspectives across academic, industry, and consumer groups, ensuring reliable comparisons among treatments while remaining manageable for controlled sensory evaluation.

Instrument

The researcher utilized observation guides to monitor and record the shelf life of the formulated Corn (Zea mays) Spread Enriched with Carabao's Milk. To collect data on sensory attributes and preference levels, the researcher use a questionnaire specifically designed to assess the spread's aroma, color, taste, and texture. Respondents evaluate the product using a 4-point Hedonic Scale, allowing them to easily express their degree of preference. They are also encouraged to provide comments and suggestions for potential product improvement.

Prior to the actual data collection, the questionnaire underwent content validation by food technology and culinary experts to ensure clarity, appropriateness, and alignment with the study objectives. To further strengthen its credibility, a pilot test was conducted with 10 respondents with relevant knowledge of food preparation to assess the comprehension, usability, and clarity of the items. Following this process, the questionnaire's reliability was assessed to confirm that it consistently measured respondents' sensory preferences, thereby ensuring accurate and credible data throughout the study. The questionnaire's reliability was confirmed with a Cronbach's alpha of 0.81, indicating good internal consistency and demonstrating that the instrument reliably captured respondents' sensory preferences.

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Procedure

The study was conducted in sequential phases. First, formal permission to conduct the research was secured from the Campus Director, the Dean of the School of Advanced Studies, the District Supervisor of Valencia District, and the school head of Valencia Technical Vocational High School. Respondents were ethically accessed, with informed consent obtained from adult participants and both parental consent and student assent secured for minors. A total of 60 respondents—including senior high school TVL Food Technology students, teachers, industry experts, and potential consumers—were selected through purposive sampling based on their background in food preparation and product evaluation. Ingredients, tools, and equipment were then prepared, and three treatments of Corn (*Zea mays*) Kernel Spread enriched with Carabao's Milk were formulated using white corn, yellow dent corn, and sweet corn. Standardized preparation involved husking, washing, grating, blending with carabao's milk, cooking with sugar, honey, glucose syrup, and lemon, and finally transferring the mixture into sterilized jars for storage.

The experimental formulations were observed for texture, consistency, and aroma, followed by shelf life monitoring under room and chilled conditions to document changes in quality. Laboratory analyses were conducted to determine nutritional composition, including protein, fat, carbohydrate, sugar, calories, sodium, and moisture content. Finally, the three treatments were presented to the 60 respondents for sensory evaluation. Using a structured questionnaire, participants assessed the products' appearance, aroma, taste, and texture under controlled testing conditions, with results collected and analyzed to determine preference and acceptability.

Statistical Treatment

To assess the degree of preference for the Corn (Zea mays) Spread enriched with Carabao's Milk, the study used two distinct scales: one to evaluate sensory attributes (appearance, aroma, taste, and texture) and another to measure overall preference for the three treatments. The respondents evaluated the spread's appearance, aroma, taste, and texture using a 4-point Hedonic Scale. The weighted mean formula was applied to determine the degree of preference for each attribute.

To determine significant differences in preference among the three treatments, the study applied Repeated Measures ANOVA when the data met the assumption of normality. When the data were not normally distributed, the Friedman test was used as the non-parametric alternative. If a significant difference was detected in the overall analysis, post hoc pairwise comparisons were conducted to determine which treatments differed. Since the data were nonparametric and involved related samples, the Friedman test was used as the omnibus test, followed by Durbin–Conover pairwise comparisons to identify specific sources of variation. This approach ensured that sensory attributes and overall preference were analyzed separately, providing a clear understanding of differences among treatments and guiding conclusions on the most acceptable formulation.

V. RESULTS AND DISCUSSION

After the data were gathered, analyzed, and interpreted accordingly, the researcher came up with the following:

Table 1.1. ***Ingredients and Cost***

Item No.	Qty.	Unit	Ingredients	Unit Cost	Price/Unit	T1 (White corn) Total Cost	T2 (Yellow Dent Corn) Total Cost	T3 (Sweet Corn) Total Cost
1	250	g	Corn kernels	P150.00 / 1000g	P0.15	P37.50	P45.00	P45.00
2	180	g	Carabao's milk	P350.00 / 1000g	P0.35	P63.00	P63.00	P63.00
4	25	g	Sugar	P32.47 / 500g	P0.06	P1.62	P1.62	P1.62
5	15	g	Honey	P400.00 / 500g	P0.8	P12.00	P12.00	P12.00
6	15	g	Glucose Syrup	P150.00 / 750g	P0.2	P3.00	P3.00	P3.00
7	5	g	Lemon (zest and juice)	P25.00 / 60g	P0.41	P2.08	P2.08	P2.08
			Total Cost of Ingredients			**P119.2**	**P123.7**	**P123.7**
			Operating Expenses x.10			**P11.92**	**P12.37**	**P12.37**
			Cost of Labor x.10			**P11.92**	**P12.37**	**P12.37**
			Total Cost of Product			**P143.04**	**P148.44**	**P148.44**
			Mark up x.20			**P23.84**	**P24.74**	**P24.74**
			Packaging			**P25.00**	**P25.00**	**P25.00**
			Total Yield			**1/250 g**	**1/250 g**	**1/250 g**
			Selling Price			**P191.88**	**P198.18**	**P198.18**

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As presented in Table 1.1, the three treatments had only slight differences in selling price despite uniform yields and packaging. The White Corn Spread (Treatment 1) was lowest at ₱191.88 per 250-gram unit, while both the Yellow Dent Corn (Treatment 2) and Sweet Corn Spread (Treatment 3) were higher at ₱198.18. Though Treatments 2 and 3 cost the same, their distinction lies in the corn variety, which may affect flavor and consumer preference.

Table 1.2. ***Tools and Equipment***

Quantity	Unit	Tools/Materials /Equipment	Purpose
1	Piece	Wok/Carajay	Used to heat and cook the corn mixture with other ingredients.
1	Set	Measuring cups	Ensures accurate measurement of liquid and dry ingredients.
1	Set	Measuring spoons	Provides precise measurement of small quantities of ingredients.
3	Pieces	Mixing bowls	Used for combining, mixing, and holding ingredients during preparation.
1	Piece	Wooden ladle	For stirring, folding, and scraping mixtures to avoid waste.
1	Piece	Knife	Used for cutting and preparing solid ingredients such as lemon peel.
1	Piece	Chopping board	Provides a clean surface for slicing and chopping ingredients.
3	Pieces	Sterilized jars and lids	For storing the finished spread hygienically and extending shelf life.
1	Piece	Food tong	Used to safely handle hot jars or ingredients during preparation.
1	Piece	Grater	For finely grating Corn and lemon to enhance aroma and flavor.
1	Unit	Blender	Used to homogenize the mixture, ensuring a smooth texture.
1	Unit	Gas Stove	Used as the primary heat source for cooking and simmering the corn mixture with other ingredients, ensuring proper thermal processing to achieve the desired consistency and flavor while maintaining food safety standards.
1	Unit	Refrigerator	Provides cold storage to maintain product quality and prolong shelf life.

Table 1.2 presents the tools, materials, and equipment used to prepare corn spreads enriched with carabao's milk. Each item was carefully selected to ensure accurate measurement, efficient processing, and hygienic standards throughout product development.

Table 1.3. ***Procedure***

Step	Procedure
1	Begin by collecting young corn cobs, husking them, and washing them thoroughly with clean water.
2	Grate the kernels and measure them according to the set formulation.
3	Blend the grated corn kernels and carabao's milk together to form a smooth base mixture.
4	Pour the mixture into a wok, then add sugar, honey, glucose syrup, and lemon zest and juice.
5	Stir continuously over low heat until the mixture reaches a spreadable consistency.
6	Once the desired consistency is achieved, the mixture was removed from heat and allowed to cool slightly.
7	Transfer the spread into sterilized jars, allow to cool before sealing, and store under refrigeration to maintain quality.

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Table 1.3 presents the preparation of corn (Zea mays) spreads enriched with carabao's milk, which was carried out through a standardized process to ensure hygienic quality, product consistency, and food safety. All three treatments followed the same procedure, differing only in the corn variety used, allowing a comparative evaluation of sensory qualities and shelf-life stability.

Table 1.4. ***Nutritional Analysis***

Analysis	Unit	Test Method	Results	Recommended Dietary Allowance
Moisture	g/100 g	Vacuum Oven Drying	66.5	-
Ash	g/100 g	AOAC 923.03, Ignition	0.823	-
Total Fat	g/100 g	Mojonnier with Acid Hydrolysis	1.40	50–77 g
Crude Protein (N x 6.25)	g/100 g	AOAC 2001.11 AOAC 21st Ed, Kjeldahl Method	3.55	56–71 g
Carbohydrates	g/100 g	By Computation	27.7	310–400 g
Calories	g/100 g	By Computation	138	Women: 1,870–2,100 kcal Men: 2,200–2,530 kcal
Total Sugar	g/100 g	Munson-Walker	13.4	≤50 g (10% of kcal)
Sodium	g/100 g	Flame AES	25.1	≤2,000 mg (upper limit)
Saturated Fat	g/100 g	Gas Chromatography (FID)	0.401	<20 g (10% of kcal)
Trans Fat	g/100 g	Gas Chromatography (FID)	Less than 0.000374**	As low as possible

Table 1.7 presents the proximate composition of the Sweet Corn (Zea mays saccharata) Spread enriched with Carabao's milk. The moisture content was 66.5%, typical of corn-based products, and as Onwuka (2018) noted, high moisture can shorten shelf life by affecting microbial stability. Ash was 0.823%, reflecting the presence of minerals important for labeling and consumer health (Pearson, 1991). In terms of macronutrients, protein was modest at 3.55 g per 100 g, compared to the RDA of 56–71 g, indicating a limited contribution, while fat was very low at 1.40 g, against the 50–77 g requirement, consistent with James' (1995) view that fat influences flavor and texture. Carbohydrates reached 27.7 g, yielding 138 kcal, which accounts for about 5–7% of daily energy needs, underscoring FAO's (2003) emphasis on carbohydrates as key energy sources. For sweetness, sugar was 13.4 g per 100 g, already about 27% of the daily limit, while sodium was only 25.1 mg, far below the 2,000 mg threshold, aligning with modern dietary guidance. Saturated fat was minimal at 0.401 g, and trans fat was negligible, both favorable for cardiovascular health. Overall, the spread is carbohydrate-rich, low in fat and sodium, and modest in protein, making it an energy-providing food best paired with protein-rich, nutrient-dense foods to balance the diet.

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Table 1.5. ***Shelf Life***

Length of storage	Sensory characteristics	Room Temperature			Chilled Temperature		
		T1	T2	T3	T1	T2	T3
Day 1-7	Appearance	light yellow and creamy, with glossy appearance	light yellow and creamy, with glossy appearance	bright yellow and creamy, with glossy appearance	light yellow and creamy, with glossy appearance	light yellow and creamy, with glossy appearance	bright yellow and creamy, with glossy appearance
	Aroma	It has a pleasant aroma	It has a pleasant aroma	It has a pleasant aroma	It has a pleasant aroma	It has a pleasant aroma	It has a pleasant aroma
	Taste	It has a moderately Sweet and creamy taste	It has a moderately Sweet and creamy taste	It has Sweet and creamy taste	It has a moderately Sweet and creamy taste	It has a moderately Sweet and creamy taste	It has Sweet and creamy taste
	Texture	moderately smooth with slight unevenness texture	moderately smooth with slight unevenness texture	smooth, glossy with a uniform consistency texture	moderately smooth with slight unevenness texture	moderately smooth with slight unevenness texture	smooth, glossy with a uniform consistency texture
Day 8-14	Appearance	No changes observed	No changes observed	No changes observed	No changes observed	No changes observed	No changes observed
	Aroma	No changes observed	No changes observed	No changes observed	No changes observed	No changes observed	No changes observed
	Taste	No changes observed	No changes observed	No changes observed	No changes observed	No changes observed	No changes observed
	Texture	No changes observed	No changes observed	No changes observed	No changes observed	No changes observed	No changes observed
Day 15-21	Appearance	Molds started to appear	Molds started to appear	Molds started to appear	No changes observed	No changes observed	No changes observed
	Aroma	It has a slightly pleasant aroma	It has a slightly pleasant aroma	It has a slightly pleasant aroma	No changes observed	No changes observed	No changes observed
	Taste	It started to taste sour	It started to taste sour	It started to taste sour	No changes observed	No changes observed	No changes observed
	Texture	Not smooth and slight	Not smooth and slight	Not smooth and slight	No changes observed	No changes observed	No changes observed

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		unevenness texture	unevenness texture	unevenness texture			
Day 22-28	Appearance	Watery and molds increase	Watery and molds increase	Watery and molds increase	Molds started to appear	Molds started to appear	Molds started to appear
	Aroma	Aroma fading, pungent smell	Aroma fading, pungent smell	Aroma fading, pungent smell	It has a slightly pleasant aroma	It has a slightly pleasant aroma	It has a slightly pleasant aroma
	Taste	Flavor declined	Flavor declined	Flavor declined	It started to taste sour	It started to taste sour	It started to taste sour
	Texture	Becomes starchier	Becomes starchier	Becomes starchier	Not smooth and slight unevenness texture	Not smooth and slight unevenness texture	Not smooth and slight unevenness texture
Day 28-34	Appearance	Watery and greenish appearance	Watery and greenish appearance	Watery and greenish appearance	Watery and molds increase	Watery and molds increase	Watery and molds increase
	Aroma	Off smell	Off smell	Off smell	Aroma fading, pungent smell	Aroma fading, pungent smell	Aroma fading, pungent smell
	Taste	Off flavor	Off flavor	Off flavor	Flavor declined	Flavor declined	Flavor declined
	Texture	Spoiled	Spoiled	Spoiled	Becomes starchier	Becomes starchier	Becomes starchier

Table 1.5 shows the shelf life of corn (Zea mays) spreads enriched with carabao's milk under room temperature and chilled storage. At room temperature, all treatments (T1, T2, T3) retained desirable qualities—light yellow appearance, pleasant aroma, and creamy taste—for the first 7–14 days. By day 15, mold growth and a sour taste appeared, progressing to a watery consistency and a pungent odor by day 22–28, and to complete spoilage with off-flavor and greenish discoloration by day 28–34. This indicates that ambient storage accelerates microbial growth, limiting shelf life to about 15–20 days. In contrast, under chilled conditions, the spreads remained stable in appearance, aroma, taste, and texture up to day 28. Only on days 29–34 did a starchier consistency and a pungent odor emerge, signaling spoilage. Thus, refrigeration nearly doubles product acceptability, slowing microbial and enzymatic changes.

Table 2. ***Sensory evaluation as rated by the respondents among the three treatments of Corn (Zea mays) Spread Enriched with Carabao's Milk***

Sensory Attributes	**Treatments**								
	T1			**T2**			**T3**		
	Mean	**Description**	**Rank**	**Mean**	**Description**	**Rank**	**Mean**	**Description**	**Rank**
Appearance	2.97	Moderately light yellow and creamy with a slight glossy appearance	3	2.98	Moderately light yellow and creamy with a slight glossy appearance	2	3.63	Extremely bright yellow and creamy, with a glossy appearance	1

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Aroma	3.27	Extremely pleasant aroma	2	3.22	Extremely pleasant aroma	3	3.48	Extremely pleasant aroma	1
Taste	3.43	Extremely sweet and creamy taste	3	3.47	Extremely sweet and creamy taste	2	3.68	Extremely sweet and creamy taste	1
Texture	3.43	Extremely smooth, glossy with a uniform consistency	2	3.35	Extremely smooth, glossy with a uniform consistency	3	3.67	Extremely smooth, glossy with a uniform consistency	1
Overall	3.28		2	3.26		3	3.62		1

The sensory evaluation of corn (Zea mays) spreads enriched with carabao's milk showed that Treatment 3 (Sweet Corn) consistently outperformed Treatments 1 (White Corn) and 2 (Yellow Dent Corn) across all attributes. For appearance, T3 scored highest (3.63), described as extremely bright yellow, creamy, and glossy—supporting the idea that visual appeal strongly shapes consumer preference. Aroma followed the same trend, with T3 (3.48) slightly ahead of T1 (3.27) and T2 (3.22), highlighting the role of pleasant scent in overall flavor perception. Taste results confirmed T3's superiority (3.68), noted as extremely sweet and creamy, compared to the slightly lower scores of T1 and T2. Texture also favored T3 (3.67), described as smooth, glossy, and uniform, while the other treatments were acceptable but less preferred. Taken together, overall acceptability placed T3 first (3.62), while T1 (3.28) and T2 (3.26) alternated behind it. These findings emphasize that Sweet Corn spread offered the most appealing combination of appearance, aroma, taste, and texture, making it the most preferred treatment among consumers.

Table 3. ***Preference level for sensory characteristics of the three treatments***

Sensory Attributes	Treatments								
	T1		Rank	T2		Rank	T3		Rank
	Mean	Description		Mean	Description		Mean	Description	
Appearance	3.63	Most Preferred	2	3.52	Most Preferred	3	3.77	Most Preferred	1
Aroma	3.48	Most Preferred	2	3.47	Most Preferred	3	3.68	Most Preferred	1
Taste	3.62	Most Preferred	2	3.58	Most Preferred	3	3.75	Most Preferred	1
Texture	3.50	Most Preferred	3	3.53	Most Preferred	2	3.72	Most Preferred	1
Overall Mean	3.56		2	3.53		3	3.73		1

Table 3 presents the preference levels for the sensory characteristics of the three corn spread treatments. The preference test showed that all three corn spread treatments were well accepted, but Treatment 3 (Sweet Corn) consistently ranked highest across appearance, aroma, taste, and texture. With mean scores between 3.68 and 3.77, it was firmly in the "Most Preferred" category and achieved the top overall score of 3.73. Treatment 1 (White Corn) followed with 3.48–3.63 and an overall mean of 3.56, while Treatment 2 (Yellow Dent Corn) placed third with 3.47–3.58 and an overall mean of 3.53. In short, while all spreads were strongly liked, Sweet Corn stood out as the most favored and the most suitable variety for product development. Together, these studies confirm that sensory qualities, particularly sweetness, aroma, and texture, are critical in determining consumer preference for corn-based products.

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Table 4. Difference on the preference level for sensory characteristics of the three treatments

Sensory Attributes	Mean		Friedman X^2	p-value	Decision	Interpretation	Post-hoc Tests				
								TEST STAT	p-value	Decision	Interpretation
Appearance	T1	3.63	8.89	0.012	Reject null hypothesis	Significant	T1vs.T2	1.43	0.154	Fail to Reject null hypothesis	Insignificant
	T2	3.52					T1vs.T3	1.64	0.104	Reject null hypothesis	Significant
	T3	3.77					T2vs.T3	3.07	<0.003	Reject null hypothesis	Significant
Aroma	T1	3.48	10.5	0.005	Reject null hypothesis	Significant	T1vs.T2	0.232	0.817	Fail to Reject null hypothesis	Insignificant
	T2	3.47					T1vs.T3	2.785	0.006	Reject null hypothesis	Significant
	T3	3.68					T2vs.T3	3.017	0.003	Reject null hypothesis	Significant
Taste	T1	3.62	6.59	0.037	Reject null hypothesis	Significant	T1vs.T2	0.857	0.393	Fail to Reject null hypothesis	Insignificant
	T2	3.58					T1vs.T3	1.714	0.089	Reject null hypothesis	Significant
	T3	3.75					T2vs.T3	2.571	0.011	Reject null hypothesis	Significant
Texture	T1	3.50	7.74	0.021	Reject null hypothesis	Significant	T1vs.T2	0.407	0.684	Fail to Reject null hypothesis	Insignificant
	T2	3.53					T1vs.T3	2.648	0.009	Reject null hypothesis	Significant
	T3	3.72					T2vs.T3	2.241	0.027	Reject null hypothesis	Significant
Overall	T1	3.56	16.8	<.001	Reject null hypothesis	Significant	T1vs.T2	0.790	.431	Fail to Reject null hypothesis	Significant
	T2	3.53					T1vs.T3	3.340	.001	Reject null hypothesis	Significant
	T3	3.73					T2vs.T3	4.130	<.001	Reject null hypothesis	Significant

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Table 4 shows the differences in preference levels for the sensory characteristics of the three corn spread treatments. The Friedman test revealed statistically significant differences in appearance ($\chi^2 = 8.89$, $p = 0.012$), aroma ($\chi^2 = 10.5$, $p = 0.005$), taste ($\chi^2 = 6.59$, $p = 0.037$), texture ($\chi^2 = 7.74$, $p = 0.021$), and overall acceptability ($\chi^2 = 16.8$, $p < .001$). Since all p-values were below the 0.05 level of significance, the null hypothesis was rejected in each case. This confirms that respondents did not rate the three corn spreads equally; their preferences varied by corn type. For appearance, post hoc comparisons showed that Treatment 3 was significantly preferred over Treatment 2 ($p = .003$), whereas no significant difference was observed between Treatments 1 and 2 ($p = .154$). This suggests that visual qualities such as brightness and gloss strongly influenced consumer judgments, with Treatment 3 standing out as the most visually appealing. This finding supports Stone & Sidel (2004), who emphasized that appearance is often the first sensory cue shaping consumer expectations. In terms of aroma, Treatment 3 was significantly preferred over both Treatment 1 ($p = .006$) and Treatment 2 ($p = .003$), while Treatments 1 and 2 did not differ significantly ($p = .817$).

TECHNOGUIDE IN THE PREPARATION OF CORN (Zea mays) SPREAD ENRICHED WITH CARABAO'S MILK

Rationale

Because of innovation, there are now different kinds of food produced almost everywhere. New products are introduced from time to time, making it easier for consumers to access foods that suit their needs. However, in many localities, while resources are abundant, only a few are being fully utilized and transformed into value-added products. This underutilization of indigenous crops and dairy products highlights the need for research exploring their potential to develop nutritious, affordable, and culturally relevant food products. Corn (Zea mays), a staple crop in the Philippines, is widely available and versatile, yet its application in processed food innovation remains limited. Carabao's milk, on the other hand, is nutritionally superior, rich in protein, calcium, and micronutrients, but is often consumed in traditional forms without further diversification. By combining these two locally available resources, the preparation of corn spreads enriched with carabao's milk aims to create a product that balances sensory appeal with nutritional value while promoting the use of indigenous materials.

In this connection, the researcher pursued an experiment on the preparation of corn (Zea mays) spreads enriched with carabao's milk. The intention was not merely to introduce a new product for profit but to develop a healthy, locally sourced spread that balances sensory satisfaction with nutritional value. Corn, being abundant and underutilized in many communities, and carabao's milk, recognized for its superior nutrient profile, together provide a promising foundation for food innovation.

Objectives

The main thrusts of this proposed technology guide are the following to:

1. acquaint and introduce the school administrators, teachers, parents, students, consumers and spread producers about Corn (Zea mays) Spread Enriched with Carabao's milk.
2. stimulate the utilization of local agricultural crops and dairy goods by demonstrating their potential in food innovation and product development.
3. encourage the interest of students, spread producers, and especially cookery majors in utilizing locally available resources by developing innovative food products such as corn (Zea mays) spreads enriched with carabao's milk.
4. improve and lift up the acceptance level of Corn and Carabao's Milk flavoured spread by enhancing its sensory attributes namely appearance, aroma, taste and texture.
5. Serve a new healthy food product in the school canteen, bakeshops and in the market.

VI. CONCLUSION AND RECOMMENDATIONS

Conclusions

Based on the study's findings, the researcher concluded that the Sweet Corn (Zea mays saccharata) Spread enriched with Carabao's milk has strong potential as a promising food product, offering both nutritional and sensory benefits. The sensory evaluation showed that all three treatments—White Corn, Yellow Dent Corn, and Sweet Corn—were generally rated as "Most Preferred," with Treatment 3 (Sweet Corn) consistently receiving the highest weighted mean scores across appearance, aroma, taste, texture, and overall acceptability. The Friedman and pairwise tests revealed significant differences between Sweet Corn and the other two treatments, confirming its superior sensory qualities. In terms of nutrition, the spread was found to be moderately rich in carbohydrates and sugars, low in fat, and free from harmful trans fats, making it a healthier alternative to traditional spreads. Taken together, these results highlight that while all corn varieties produced acceptable spreads, Sweet Corn emerged as the most suitable choice for product development, combining appealing sensory attributes with a wholesome nutritional profile.

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Recommendations

Based on the conclusion drawn from the study, the proponent comes up with the following recommendations:

1. Conduct broader sensory evaluations and consumer preference studies across different age groups and communities to validate the product's appeal and ensure consistent quality standards.
2. Collaborate with food safety and regulatory agencies to secure certifications and comply with national food safety requirements, ensuring the product is safe and market-ready.
3. Cook the corn before grating to improve the texture of the spreads. Pre-cooking softens the kernels, enhances smoothness, and reduces graininess, ensuring a more desirable mouthfeel and higher consumer acceptability.
4. Adopt refrigeration as the standard storage method for corn spreads enriched with carabao's milk to ensure product quality and consumer safety. Cold storage nearly doubles shelf life compared to room temperature, maintaining acceptable sensory qualities for up to six weeks. For community and commercial distribution, implement refrigeration practices and clear storage guidelines to preserve flavor, texture, and overall acceptability while minimizing spoilage risks.
5. Future research may explore product fortification (e.g., adding vitamins or minerals), testing in larger consumer markets, and developing variations of the spread to expand its potential applications and improve nutritional value.
6. Sweet Corn (Zea mays saccharata) is highly recommended for massive production, as it consistently demonstrates superior sensory qualities and consumer preference, making it the most suitable variety for large-scale commercialization.

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