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# Instructional Recipe Innovation: Reinventing Turmeric Use to Teach Food Preservation in Home Economics

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**Abstract.** Home Economics education plays a critical role in promoting sustainable food practices, nutritional awareness, and cultural appreciation through innovative instructional materials. This study aimed to develop a culturally rooted and nutritionally beneficial functional tea as an instructional recipe. Specifically, it focused on enhancing turmeric-based formulations using locally available ingredients such as turmeric, ginger, cinnamon, lemon, black pepper, and sugar—as natural preservatives. The research adopted a Research and Development (R&D) design guided by the Design Thinking framework, following five stages: Empathize, Define, Ideate, Prototype, and Test. Data collection involved qualitative methods in semi-structured interviews from the Maranao community to gain insights into traditional food practices. Quantitative methods included sensory evaluation, general acceptability using a 9-point hedonic scale, and customer satisfaction surveys administered to fifty (50) community participants. Three formulations were created with varying turmeric extract (2L, 3L, and 4L). Among these, the 2L formulation (F1) achieved the highest acceptability rating (7.94). Physico-chemical analysis of F1 revealed a pH of 5.015, moisture content of 4.70 g/100g, ash content of 1.89 g/100g, and an energy value of 374.79 kcal, all within acceptable dietary standards. Turmeric and ginger were key contributors to the tea's favorable sensory attributes, including appearance, taste, odor, and texture. This study highlights the value of integrating design thinking with cultural culinary traditions to produce food innovations that are health-promoting, sustainable, and pedagogically relevant. The resulting turmeric-based tea revealed that it can be a marketable health beverage and an effective instructional recipe for the food preservation course in Home Economics.

**Keywords:** Turmeric Tea, Home Economics education, Food Preservation, Instructional Recipe, Design Thinking

## 1. Introduction

The food and beverage industry has seen substantial expansion in recent years especially in the area of functional foods and drinks. Tea, a globally favored beverage, is well-regarded for its pleasant taste and wide range of health advantages (Valavanidis, 2019). One of the most rapidly developing sectors in food production, the beverage industry, is experiencing a surge in the use of functional ingredients. Turmeric and cinnamon, in particular, have become increasingly popular and are now considered key ingredients in the food industry because of their potential to promote health and well-being (Kumar et al., 2023). Beyond their nutritional value, these ingredients can enhance overall well-being, boost physical performance, and support cognitive function, mainly due to their rich phytochemical composition. These functional foods may also help in preventing or delaying chronic diseases. The inclusion of turmeric and ginger in instructional recipes aligns with several Sustainable Development Goals by promoting wellness, primarily through their anti-inflammatory and immune-boosting properties (Mao et al., 2019).

Turmeric root is commonly used as a food color to the different cuisines of Maranao communities (Tallara, 2023) in Mindanao, Philippines. It is also often infused with other herbs to improve its medicinal properties (de Ramos et al., 2021). While turmeric is a staple in Maranao cuisine, primarily used as a food coloring and valued for its health benefits (Tallara, 2023), research on turmeric-based beverages within this community is uncommon. The Maranao people, mainly residing around Lake Lanao in Lanao del Sur, are among the largest Muslim groups in the Philippines. Known for their rich Islamic and cultural heritage, Maranao communities are strategically located for resources and trade especially when it comes to Maranao cuisine. Turmeric holds a special place in Maranao cuisine. It is valued for its distinct earthy flavor, vibrant color, and health benefits. It is an essential component in many traditional recipes of the Maranao people, such as *kuning* (yellow rice), *piaparan* (a coconut-based curry), and other local delicacies. This reflects the Maranao people's deep appreciation for natural ingredients and their commitment to preserving both the flavor and wellness aspects of their culinary heritage.

Notably, studies exploring the combination of turmeric with other spices in beverage formulations are also scarce; thus, this research employs Design Thinking—a human-centered approach emphasizing empathy, creativity, and iterative testing—to assess the feasibility of introducing a turmeric-based tea infused with complementary spices available locally in the Maranao community. This process is essential in ensuring that the developed tea beverage aligns with the cultural preferences and health considerations of the Maranao people. Applying design thinking in food innovation has been recognized for its effectiveness in creating products that achieve the target end-users' preferences and needs. Design Thinking contributes significantly to innovation in the food industry by fostering empathy, prototyping, and collaboration throughout development (Olsen, 2014).

Integrating the design thinking phases into the research process aims to develop a turmeric-based tea that not only introduces a novel beverage option but also respects and enhances the Maranao community's existing culinary traditions. This approach ensures that the product development process is deeply rooted in understanding and addressing the community's specific needs and preferences. While the exact origin of the turmeric is uncertain, it is now widely cultivated across different regions of Asia such as the Philippines (de Ramos et al., 2021; Plotto, 2004). Turmeric, which is obtained from the rhizomes of Curcuma longa, is part of the Zingiberaceae family and is widely popular for its health benefits and nutritional value (Prasad & Aggarwal, 2011). Curcumin is said to be the main bioactive compound found in turmeric. Its anti-inflammatory, antimicrobial as well as antifungal characteristics make it beneficial in functional beverages (Sharangi et al., 2022). According to research, beverage mixtures based on turmeric (Curcuma longa) juice with pineapple as a ready-to-drink product can be developed, and their physicochemical, nutritional, and sensory properties were also evaluated (Sun et al., 2023).

The remarkable nutritional and medicinal benefits of turmeric have many contributions, such as increasing demand in the market, where it is widely utilized to produce functional drinks such as turmeric tea and golden root juice. The researchers concluded that turmeric could be used as an efficient natural preservative in increasing the shelf life and as a natural colorant in ready-to-serve beverages (Anjan et al., 2017). Turmeric has also been found to alleviate pain, inflammation, and symptoms of digestive disorders (Singletary, 2020).

This study focuses on developing a functional drink which is a Turmeric based beverage infused with other spices such as ginger, cinnamon, lemon, black pepper, and sugar as its preservative agent. Additionally, the research investigates the disparity between supply and demand in the local food industry. By integrating locally significant Maranao species, the research contributes to sustainable development goals such as resource management, energy efficiency, and poverty reduction while promoting culturally meaningful and economically sustainable ingredients.

Additionally, this study involves the Maranao community through a design thinking approach to ensure the final product meets their needs as well as preferences. The developed tea formulation was thoroughly assessed through nutritional analysis, physicochemical testing, sensory evaluation, hedonic scale measurements, and customer satisfaction surveys. Ultimately, this study aims to advance Home Economics Education by fostering food innovation, enhancing nutritional value, and creating economic opportunities within the Maranao community. This research also fosters innovative foods utilizing locally available ingredients and therefore aligns sustainable development and home economics education's principles of resource management and sustainable consumption (International Federation for Home Economics [IFHE], 2019).

This study addresses a critical gap in Home Economics education by emphasizing the importance of instructional recipe innovation, particularly the reinvention of turmeric as a practical approach to teaching food preservation. Food preservation is a fundamental skill in the Technology and Livelihood Education (TLE) curriculum that empowers students to handle, process, and store food safely to extend its shelf life and reduce waste. However, traditional recipes and preservation methods may not always engage students or reflect the evolving food landscape shaped by health trends and local cultural practices. Incorporating innovative as well as culturally relevant recipes like turmeric-based beverages makes learning more engaging and effective, especially in the Maranao community. This approach deepens students' knowledge of food preservation while promoting creativity and valuing local ingredients such as turmeric and ginger. It also supports sustainability and economic development in communities like Maranao, helping prepare students for future challenges in food security, nutrition, and entrepreneurship.

In the context of Home Economics curriculum, food preservation is an essential area that offers practical knowledge for reducing food waste and promoting safety. Through applying traditional and modern preservation techniques, students acquire skills that support household sustainability and potential livelihood ventures. By applying traditional and modern preservation techniques. The inclusion of culturally meaningful recipes, such as turmeric-based beverages, enhances learning experiences by making them more relatable and effective.

The study aims to create an instructional recipe to teach food preservation in Home Economics by developing and analyzing three different formulations of Turmeric-Ginger Cinnamon Tea with varying turmeric extract quantities (2L, 3L, and 4L). The research seeks to (1) understand end-users empathy and define opportunities and challenges in using turmeric and ginger as tea; (2) develop the tea prototypes; (3) test the formulations based on sensory qualities, general acceptability, and customer satisfaction; (4) enhance the most acceptable formulation; (5) determine significant differences among the three formulations; (6) evaluate the most acceptable prototype's physicochemical "properties (pH, water activity, ash, moisture content, crude protein, "and total fat); and (7) assess its

nutritional content. The research ultimately aims to contribute an innovative instructional recipe tailored for Home Economics education.

## 2. Materials and Methods

This study utilized research and development design, integrating the design thinking in developing turmeric based beverage, following five significant phases—the process aimed to develop a beverage-based formulation which is within the end-user's needs and preferences. Specific research instruments were used in the process such as a structured validated research interview guide in the empathy phase, researcher made and validated sensory attributes and consumer satisfaction metrics and the standard hedonic scale for assessing the acceptability of the product developed. The design thinking process began with the empathy phase, which involved interviews with target end users, the Maranao respondents in Mindanao, Philippines. Participants were asked about their perceptions of turmeric utilization, focusing on what they think, feel, say, and do. The interview data was analyzed through thematic analysis and was organized using an empathy map, serving as a foundation for product formulation. Insights from the empathy map guided the Define phase, where key problem opportunities and design challenges were defined. These findings informed the Ideation phase, which determined the optimal turmeric-based product for development. The ideation process included consultations with food semi-experts to assess the interactions between ingredients, ensuring a balanced formulation. Faculty members of Home Economics specializing in food related courses also provided feedback to enhance recipe formulation. Following ideation, the Prototype phase commenced, leading to the initial formulation of the turmeric-based tea. This was followed by the Test phase; wherein quantitative evaluations were conducted. Nine semi-experts first assessed the prototype, which was then evaluated by fifty consumers using sensory scorecards, a hedonic scale, and a customer satisfaction survey.

A total of fifty (50) consumer panelists and nine (9) semi-trained experts participated in the study, all of whom were purposefully selected as potential end users of the product. Consumer panelists were chosen based on their willingness to join, being at least 18 years of age, and having no known allergies to the ingredients used. The Semi-trained experts were included in the ideation phase of prototype development since they have a basic background in food-related knowledge. Individuals under 18, those with limited food knowledge, or those with known allergies to any of the ingredients were excluded from participation. These selection criteria of respondents were carefully designed to ensure a diverse yet competent group capable of providing valuable feedback on the evaluation of the Turmeric Tea.

During the Empathy stage of the Design Thinking process, data collection was carried out using a well-designed semi-structured interview guide. For product tasting and evaluation, participants employed a Sensory Scorecard and a Hedonic Scale questionnaire to assess the attributes of the tea. Before the study, ethical approval was obtained from the College of Education Research and Ethics Committee.

With the approved ethical clearance, the researcher formally submitted a request letter to the College Dean, the Assistant Vice Chancellor for Academic Affairs (External Units), and the School Principal of the local Community High School. The letter served as a formal request for permission to conduct the study and underscored the importance of obtaining informed consent from all participants. It also outlined the researcher's intention to involve community members in the tasting and evaluation of the Turmeric Tea.

To analyze the data collected during the product evaluation, the researcher utilized a range of statistical tools and techniques. During the Empathize stage of the Design Thinking process, Thematic Analysis was employed to interpret qualitative responses and gain insights into what end-users say, think, feel, and do, which was presented through an

Empathy map. The researchers also used weighted mean and standard deviation to assess the product's sensory attributes—specifically color, aroma, texture, mouthfeel, and taste, and the overall acceptability through the standard 9-point hedonic scale and consumer satisfaction. These statistical tools enabled the quantification of responses, offering a clear view of participants' overall perception of each characteristic. Consumer satisfaction ranges from "very satisfied" to "very dissatisfied," providing a comprehensive measure of overall satisfaction with the product and capturing levels of consumer approval.

To ensure the validity of the researcher made questionnaires, food experts conducted a content validation process, resulting in a Content Validity Index (CVI) of 1.0, indicating high relevance and representativeness. The test phase involved evaluating three prototypes through sensory acceptability tests by semi-experts and consumer panels, including faculty, staff, and students. The most acceptable formulations underwent further food quality analysis, including nutritional and physico-chemical assessments. Since the researchers used design thinking's iterative nature, reformulations based on consumer feedback led to three final formulations (F1, F2, and F3) with varying turmeric extract levels (2L, 3L, and 4L, respectively). A second evaluation was conducted with fifty (50) community members to assess sensory attributes, acceptability, and satisfaction, ensuring the most optimized formulation was selected for final analysis.

## 3. Results and Discussion

The research result was based on the objectives in developing the Turmeric based beverage following the research process.

### 3.1 Empathy Map

The first phase of the design thinking process is empathy wherein the researchers conducted an interview among end-users through a structured guide to gather their perspectives on Turmeric and its use as a beverage. In this phase, the researchers use an empathy map as a guide in determining problem opportunities and design challenges based on the answers of the interviewed respondents.

Figure 1 presents the Empathy Map, which shows what the end users say, think, feel, and do. The empathy map shows the thematic analysis of the end users' responses regarding Turmeric use. These themes were identified by analyzing the insights the participants shared. At this stage, ten (10) end users were interviewed to gather their perspectives and experiences.

The empathy map highlights what the end-users say, think, feel, and do regarding using turmeric as a beverage. Considering their potential for beverage applications, users recognize turmeric as an essential culinary ingredients, natural enhancers, and medicinal components. They positively perceive turmeric tea, associating it with health benefits and an enjoyable flavor, especially when combined with ginger and cinnamon. Maranao community think about the feasibility of using these ingredients for food coloring, medicine, and flavoring in Maranao cuisine. Moreover, Maranao people are utilizing turmeric and ginger as essential condiments and natural preservatives as well as acknowledging their role in neutralizing odors in cooking. Overall, the map reflects strong cultural and functional relevance, indicating a high potential for turmeric as both a traditional and innovative beverage.

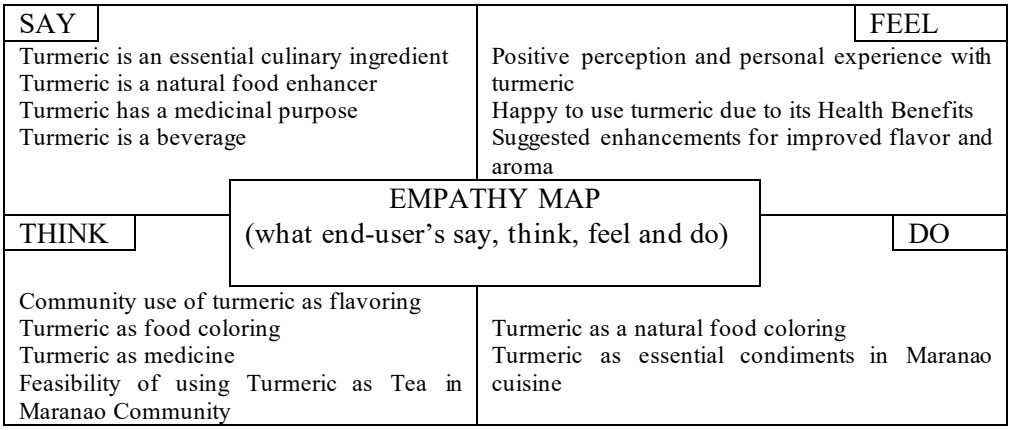

Figure. 1 The Empathy Map

Based on the empathy map results, end users revealed that turmeric and ginger are common ingredients in Maranao cuisine, often used in main dishes and valued for their food-enhancing and medicinal properties as well. They think that turning these into a tea or juice—especially when combined with cinnamon—feels natural and aligns with long-standing cultural practices, noting its health benefits, aroma, and taste. Users feel excited and amazed by the idea, believing elders in the community would especially appreciate it. As a result, many expressed a strong interest in trying turmeric-ginger tea with added ingredients like cinnamon.

3.2 Define

In this stage, the researchers determined design challenges drawn based on the interviews gathered in the Empathy stage. The researchers accumulated the information collected during the empathy stage to define the problem accurately. Moreover, in this stage, the researcher identifies all the target users' design challenges and problem opportunities and chooses the main core problem which is the main objective of this research. It was also identified in this stage the problems encountered by the target users such as how to prepare the beverage ready-to-mix and its availability. Table 1 presents the problem opportunities and design challenges.

The problem opportunities and design challenges in the utilization of the Turmeric based beverage were defined as follows:

Table 1: Problem opportunities and design challenges

| Problem Opportunities | Design Challenges |
|---|---|
| *"Turmeric is generally utilized as a spice and specifically as a food color in the Maranao community."* | *"How might the researchers develop a new way to utilized Turmeric in the Maranao culture"* |
| *"Turmeric is manually prepared and utilized as spices in the Maranao community."* | *"How might the researchers prepare and utilize making turmeric, ready –to mix and readily available?"* |

In the define phase, researchers defined the problem opportunities, such as turmeric being integral to the Maranao community's culinary and medicinal practices. Turmeric is primarily used as a spice and herbal medicine and plays a key role as a natural food colorant. However, both the food handlers and home cooks often face a more extended preparation period due to the labor-intensive process of handling turmeric, which includes peeling, slicing, drying, and grinding it before it can be used in beverages, which results in reduced accessibility and convenience. Therefore, during the define phase, a clear opportunity emerged to explore solutions that could make turmeric more convenient for

contemporary use while preserving its cultural significance. The design challenge determines innovative methods to continuously incorporate turmeric into the daily lives of the Maranao community in ways that are both convenient and aligned with modern utilization. Turmeric can be created as a ready-to-mix product or other innovations that preserve the integrity of these traditional ingredients. The design challenge was defined as a different way to utilize turmeric that integrates convenience and efficiency while ensuring the new methods respect and enhance the cultural importance of turmeric in the Maranao cuisine, making them more accessible and efficient for other purposes.

3.3 Ideate, Prototype and Testing Stage

In the Ideation phase, the researchers identified key problem opportunities and design challenges, leading to the development of a ready-to-mix, turmeric-based beverage. This stage involved consultations with food semi-experts who are Home Economics faculty members, resulting in the formulation of a turmeric-based tea in powdered form. The product was designed as a pre-packaged, ready-to-use beverage, incorporating spices such as ginger, cinnamon, lemon, and sugar to enhance flavor, ensure preservation, and improve availability.

The first prototype formulation undergoes the test phase as it was evaluated by the fifty (50) end users from the Maranao community. Through a structured food-tasting assessment tools, end users evaluated turmeric-based tea's sensory attributes and acceptability. Table 2 presents the sensory attributes of the first prototype of turmeric- tea in powdered form.

Table 2: Sensory Attributes of the first formulation of Turmeric Tea (Powdered Form)

| Sensory Attributes Indicator | Value | Description |
|---|---|---|
| Color | 2.89± 0.33 | Dark Yellowish Brown |
| Aroma | 2.89± 0.33 | Very Pleasant |
| Texture | 2.56± 0.53 | Powdery |

Values represent mean ± standard deviation (n = 50)

Table 2 presents the sensory evaluation results for the first prototype of turmeric tea powder. The color of the tea powder showed a mean score of 2.89 and a standard deviation of 0.33, indicating that most respondents perceived it as dark yellowish brown. This coloration is primarily attributed to the natural pigments in its ingredients, including curcuminoids in turmeric, gingerols in ginger, and cinnamaldehyde in cinnamon—compounds known for imparting rich, vibrant hues to food products. Research highlights that curcuminoids significantly contribute to the yellow-orange coloration of turmeric-based formulations (Koop et al., 2022). Since color plays a crucial role in consumer perception and product appeal, it is key to ensuring market acceptance. Regarding aroma, the tea powder achieved a mean score of 2.89 with a standard deviation of 0.33, indicating that respondents generally found its scent very pleasant. This distinctive fragrance is attributed to the volatile compounds present in turmeric, ginger, and cinnamon. Ginger contains gingerols, which produce a warm and slightly spicy aroma, while turmeric's turmerone imparts an earthy, woody scent. Cinnamon's characteristic sweet and spicy fragrance comes from its dominant compound, cinnamaldehyde. Aroma is a key factor in consumer preference for herbal teas, significantly influencing sensory perception and overall acceptability (Yang and Lee, 2019). The texture of the tea powder received a mean score of 2.56 with a standard deviation of 0.53, with most respondents describing it as powdery. This texture is typical for herbal tea powders, which are designed to dissolve in hot water. However, incomplete dissolution may result in sedimentation, negatively affecting the mouthfeel and overall sensory experience. A gritty or chalky sensation could reduce consumer satisfaction. The formulation and sensory evaluation of herbal teas made

from Moringa oleifera, Hibiscus sabdariffa, and Cymbopogon citratus emphasized the importance of optimizing texture to enhance consumer acceptance and marketability (Oduro et al.,2013).

Table 3: Sensory Attributes of the first formulation of Turmeric Tea (Beverage Form)

| Sensory Attributes Indicator | Value | Description |
|---|---|---|
| Color | 2.78+ 0.44 | Dark Yellowish Brown |
| Aroma | 2.78 + 0.44 | Very Pleasant |
| Taste | 2.56 + 0.53 | Very Sweet and a Little Spicy |
| Mouthfeel | 2.00 + 0.71 | Creamy |

Values represent mean ± standard deviation (n = 50)

Table 3 reveals the sensory attributes of the prototype of turmeric-ginger cinnamon tea in beverage form, based on fifty (50) respondents, showed positive feedback on color and aroma, scoring an average of 2.78 ± 0.44, described as dark yellowish brown and very pleasant. The taste, with a mean score of 2.56 ± 0.53, was very sweet and with a slight spiciness. Meanwhile, the mouthfeel received the lowest rating of 2.00 ± 0.71, described as creamy, indicating potential areas for improvement to enhance the overall sensory experience of the beverage. Respondents primarily described its color as dark yellowish brown, which can be attributed to the natural pigments found in its key ingredients. Curcumin presents in turmeric provide a rich yellow hue, gingerols in ginger contribute to a light brown tint, and cinnamaldehyde in cinnamon imparts a reddish-brown color. These compounds work together to create the tea's distinct dark yellowish-brown appearance. Given the importance of color in shaping consumer perception and product acceptance, studies such as Pathare et al. (2013) emphasize its influence on consumer preferences and expectations regarding flavor and quality. The tea's aroma received a mean score of 2.78 (SD = 0.44), indicating that respondents found its fragrance highly pleasant. This appealing scent results from the synergistic combination of volatile compounds in turmeric, ginger, and cinnamon. These spices contain essential oils and aromatic compounds, contributing to a complex and inviting fragrance. Research by Delwiche (2004) suggests that aroma and taste perception are closely interconnected, with a pleasant aroma positively enhancing flavor and overall acceptability. Regarding taste, respondents perceived the tea as moderately sweet with mild spiciness, reflected in a mean taste score of 2.56 (SD = 0.53). The natural sweetness of cinnamon and the gentle pungency of ginger contributed to a well-balanced flavor profile, aligning with previous research on spice-infused beverages (Sharma, 2021). The tea received a mean score of 2.00 (SD = 0.71) for mouthfeel, with respondents predominantly describing it as creamy. This creamy sensation may be due to the solubility of bioactive compounds such as curcumin in turmeric, which can influence texture perception (Sharifi-Rad et al., 2020). Overall, the sensory attributes of turmeric tea, including its color, aroma, taste, and mouthfeel, contribute to its appeal and potential market acceptance. These findings highlight the importance of natural pigments, volatile compounds, and bioactive ingredients in shaping consumer perception of the beverage.

Researchers also thematically analyzed the semi-experts and end-users' recommendations to improve the first prototype as presented in table 4 and 4.1 for powdered form and beverage form respectively.

Table 4: Respondents Comments to Improve the First Formulation of Turmeric tea (Powdered Form)

| Themes | Coded Responses |
|---|---|
| Improve the texture of the tea powder | "The seasoning's spiciness and heat linger in the mouth,<br>"Adjust the texture. It's a mixture of fine and coarse." R2<br>"You should subject your product to more grinding to achieve the powdery texture, since you will not use a teabag." R3<br>"The powder should be refined for it to be easily mixed." R5<br>"Improve the texture of the tea powder." R4<br>"The texture should be fine or powdery if meant to be dissolved directly." R6 |
| Ratio of Cinnamon powder. | "The sweetness is overwhelming. Perhaps change the ratio of the cinnamon."<br>"Adjust the quantity of the cinnamon." R1<br>"I like the tea mixture but lessen the cinnamon to even the sweetness." R7 |

Table 4 reveals that the respondents first recommended improving the texture of the powder by making it more finely and uniformly ground, as the current mix of fine and coarse particles affects solubility and the overall drinking experience of the consumer. They also suggested adjusting the ratio of the cinnamon, which was found to be too intense and sweet, which overpowers other flavors. Overall, the feedback emphasizes the need to enhance both texture and flavor for a better-quality product.

Table 4.1: Respondents Comments to Improve the First Formulation of Turmeric tea (Beverage Form)

| Themes | Coded Responses |
|---|---|
| Improve the taste of the tea. | "I would love to taste the lemon more." R2 |
| Improve the texture of the tea powder | "It is better if it will be improved to a finely powdered form, so it dissolves easily and no residue" R5 |

Table 4.1 summarizes respondents' feedback on improving the first turmeric tea prototype as a beverage. Key concerns include that the tea must be refined to improve the tea powder's texture through additional grinding for better mixability and adjusting the cinnamon ratio to balance its sweetness. These insights emphasize the need for texture and ingredient proportion modifications to enhance overall product quality. Since design thinking process is non-linear, a reformulation of the first prototype was made which again undergoes tests through evaluation of its sensory attributes, overall acceptability, and consumer satisfaction. The most acceptable formulation was tested for physicochemical attributes and nutritional analysis.

Three formulations were made after reformulation of the first prototype. Each formulation has varying amounts of turmeric being the main ingredient of tea.

Table 5.1 presents the sensory attributes of powdered form of tea as evaluated by the end users. It reveals a comprehensive overview of the sensory attributes of the turmeric tea in its powdered form. Among the three formulations, Formulation 3 (F3) exhibited the highest mean score for color at 2.88, indicating that panelists found it the most visually appealing. This dark yellowish hue is due to the higher curcumin content in turmeric, which has been widely recognized for enhancing herbal beverages' color intensity (Gupta et al., 2019).

Table 5.1: Sensory Attributes of the Three Formulations of Turmeric Tea (Powdered Form)

| Sensory Attributes | Mean | F1 Description | Mean | F2 Description | Mean | F3 Description |
|---|---|---|---|---|---|---|
| Color | 1.27 | Light Yellow | 2.10 | Medium Yellow | 2.88 | Dark Yellowish |
| Aroma | 2.13 | Pleasant | 2.25 | Pleasant | 2.48 | Very Pleasant |
| Texture | 2.58 | Powdery | 2.04 | Fine | 1.42 | Coarse |

Values represent the mean (n = 50)
[1]F1 – turmeric-ginger cinnamon tea with 2 liters of turmeric extract
[2]F2 – turmeric-ginger cinnamon tea with 3 liters of turmeric extract
[3]F3 – turmeric-ginger cinnamon tea with 4 liters of turmeric extract

Research suggests that deeper yellow hues in tea products are often associated with higher bioactive compound content, positively influencing consumer perception and preference (Sharma, 2021). Similarly, F3 received the highest aroma rating, with a mean score of 2.48, and was described as very pleasant. It suggests that the volatile compounds in turmeric, ginger, and cinnamons such as curcuminoids, gingerols, and cinnamaldehyde—played a crucial role in the tea's fragrance profile. Studies indicate that aroma is a key determinant in beverage acceptability, as it is closely linked to flavor perception and overall sensory satisfaction (Delwiche, 2004). The synergistic effect of these aromatic compounds contributes to a distinct and appealing sensory experience, which enhances consumer preference (Yang & Lee, 2020). Regarding texture, Formulation 1 (F1) achieved the highest score of 2.58, indicating that it was perceived as the smoothest and most refined among the three formulations. A finer texture is generally preferred in powdered beverages, as it facilitates better solubility and mouthfeel, leading to a more enjoyable drinking experience (Singh & Maharaj, 2014). Conversely, coarser textures may result in sedimentation issues, negatively impacting consumer satisfaction.

Table 5.2 presents sensory attributes of the third prototype with three formulations of turmeric tea in its beverage form.

Table 5.2: Sensory Attributes of the Three Formulations of Turmeric Tea (Powdered Form)

| Sensory Attributes | Mean | F1 Description | Mean | F2 Description | Mean | F3 Description |
|---|---|---|---|---|---|---|
| Color | 1.83 | Medium Yellow | 2.00 | Medium Yellow | 2.52 | Dark Yellowish |
| Aroma | 2.08 | Moderately Pleasant | 2.06 | Moderately Pleasant | 2.25 | Moderately Pleasant |
| Taste | 2.04 | Moderately Sweet and a Little Spicy | 2.00 | Moderately Sweet and a Little Spicy | 1.94 | Moderately Sweet and a Little Spicy |
| Mouthfeel | 2.00 | Astringent /Drying | 2.19 | Astringent/Drying | 2.23 | Astringent /Drying |

Values represent the mean (n = 50)
[1]F1 – turmeric-ginger cinnamon tea with 2 liters of turmeric extract
[2]F2 – turmeric-ginger cinnamon tea with 3 liters of turmeric extract
[3]F3 – turmeric-ginger cinnamon tea with 4 liters of turmeric extract

Table 5.2 presents the sensory characteristics of three formulations (F1, F2, and F3) of turmeric tea in its beverage form as evaluated by a panel of 50 tasters. The assessment covered four key attributes: color, aroma, taste, and mouthfeel. Among the formulations, Formulation 3 (F3) exhibited the most intense color, with a mean score of 2.52, described as "dark yellowish." This result aligns with previous studies suggesting that the concentration of curcuminoids in turmeric significantly affects the color intensity of turmeric-based beverages (Sharifi-Rad et al., 2020). For aroma, Formulation 3 (F3) also

received the highest mean score of 2.25, categorized as "moderately pleasant." The presence of ginger and cinnamon likely contributed to this rating, as these spices are known to enhance the aromatic profile of herbal infusions (Singletary, 2020). In terms of taste, Formulation 1 (F1) received the highest mean score of 2.04, described as "moderately sweet with a slight spiciness." The lower concentration of turmeric in F1 (2 liters of turmeric root extract) may have contributed to a milder taste, as higher turmeric content is often associated with increased bitterness (Sharifi-Rad et al., 2020). Lastly, for mouthfeel, Formulation 3 (F3) recorded the highest mean score of 2.23, described as "astringent or drying." The astringency is likely attributed to the increased turmeric concentration (4 liters of turmeric root extract), which contains polyphenolic compounds known for their drying sensation on the mouth (Osakabe et al., 2024). These findings suggest that increasing turmeric extract concentration intensifies color and astringency while also enhancing aroma. However, a higher concentration may reduce perceived sweetness, affecting overall palatability. Sensory evaluations like this are essential in optimizing formulations to balance health benefits and consumer acceptability. Prior research supports the potential health benefits of turmeric, ginger, and cinnamon, including their anti-inflammatory and antioxidant properties (Hewlings & Kalman, 2017). Future studies could explore consumer preferences in different demographic groups to refine the formulation further.

Table 5.3 also presented the acceptability of the third prototype in three formulations of Turmeric Tea in its powdered form and Table 5.4 in its beverage form and this was done using a 9-point Hedonic Scale.

Table 5.3: General Acceptability of the Third Prototype with Three Formulations of Turmeric Tea (Powdered Form)

| Sensory Attributes | F1 Mean | F1 Description | F2 Mean | F2 Description | F3 Mean | F3 Description |
|---|---|---|---|---|---|---|
| Acceptability | 7.73 | Liked Very Much | 7.58 | Liked Very Much | 7.40 | Liked Very Much |

Values represent the mean (n = 50)
[1]F1 – turmeric-ginger cinnamon tea with 2 liters of turmeric extract
[2]F2 – turmeric-ginger cinnamon tea with 3 liters of turmeric extract
[3]F3 – turmeric-ginger cinnamon tea with 4 liters of turmeric extract

Table 5.3 shows the acceptability of the three turmeric tea formulations in powdered form. It was evaluated to determine consumer preference. Among the formulations, F1 which contains 2 liters of turmeric extract, received the highest acceptability rating with a computed mean score of 7.73, categorized as "Liked Very Much." This suggests that turmeric, ginger, and cinnamon balance in F1 contributed to a well-rounded flavor profile, making it the most preferred formulation. The results indicate that F1's turmeric concentration was optimal for enhancing sensory appeal without overpowering the beverage's flavor. Studies have shown that while turmeric is rich in curcumin, a bioactive compound with antioxidant and antimicrobial properties (Anas et al., 2024), excessive amounts may introduce bitterness and astringency, lowering consumer preference (Sharma, 2021). The preference for F1 suggests that moderate turmeric levels (2 liters of extract) are ideal for maintaining a balance between health benefits and taste acceptability. Furthermore, sensory perception is critical in consumer purchasing decisions (Pathare et al., 2013). The findings emphasize the need for careful formulation adjustments in herbal tea production to optimize flavor, aroma, and mouthfeel while ensuring the beverage remains palatable and marketable specifically in the Maranao community. Future research could explore the impact of alternative extraction methods or ingredient modifications to

further improve sensory appeal and consumer acceptance across different demographic groups (Singh & Maharaj, 2014).

Table 5. 4: General Acceptability of the Third Prototype with Three Formulations of Turmeric Tea (Beverage Form)

| Sensory Attributes | Mean | F1 Description | Mean | F2 Description | Mean | F3 Description |
|---|---|---|---|---|---|---|
| Acceptability | 7.94 | Liked Very Much | 7.38 | Liked Very Much | 6.96 | Liked Very Much |

Values represent the mean (n = 50)
[1]F1 – turmeric-ginger cinnamon tea with 2 liters of turmeric extract
[2]F2 – turmeric-ginger cinnamon tea with 3 liters of turmeric extract
[3]F3 – turmeric-ginger cinnamon tea with 4 liters of turmeric extract

Table 5.4 reveals the sensory acceptability of the three formulations of turmeric tea in its beverage form with F1 receiving the highest mean score of 7.94, categorized as "Liked Very Much." Among the three formulations, F1, which contained 2 liters of turmeric root extract, emerged as the most preferred. This finding suggests that a moderate concentration of turmeric root extract enhances overall palatability, balancing flavor intensity while minimizing bitterness and astringency. Previous studies indicate that excessive turmeric concentrations can contribute to increased bitterness and astringency due to curcuminoids and polyphenolic compounds (Gupta et al., 2013). Furthermore, turmeric's bioactive components, including curcumin, have been linked to numerous health benefits, such as anti-inflammatory and antioxidant properties, making its incorporation into beverages highly desirable (Hewlings & Kalman, 2017). However, consumer preference studies suggest that an optimal concentration is necessary to maintain a balance between health benefits and taste acceptability (Maulida et al., 2024). The results of this study have practical implications for the formulation of functional beverages. A moderate concentration of turmeric (2 liters per batch) appears to be the most acceptable to consumers, suggesting that beverage manufacturers should carefully consider the turmeric content to optimize both sensory appeal and health benefits. Future research may explore how variations in sweeteners or additional flavoring agents influence acceptability, ensuring broader consumer satisfaction

A customer satisfaction metric was also conducted to determine end-users' satisfaction of the product in terms of its individual sensory attributes. Table 6.1 presented the results of the customer satisfaction of the third prototype in three formulations of turmeric tea in powdered and table 6.2 in its beverage form.

Table 6.1: Customer Satisfaction of the Three Formulations of Turmeric Tea (Powdered Form)

| Sensory Attributes | F1 | F2 | F3 |
|---|---|---|---|
| Color | 4.17 | 4.15 | 3.98 |
| Aroma | 3.92 | 3.85 | 3.98 |
| Texture | 4.42 | 4.04 | 3.85 |

Score values, represented by the mean (n = 50), indicated that all =parameters for the samples were described as "satisfied" and others as "very satisfied."
[1]F1 – turmeric-ginger cinnamon tea with 2 liters of turmeric extract
[2]F2 – turmeric-ginger cinnamon tea with 3 liters of turmeric extract
[3]F3 – turmeric-ginger cinnamon tea with 4 liters of turmeric extract

Table 6.1 presents the customer satisfaction ratings of the three formulations (F1, F2, and F3) of the reformulated turmeric tea in powdered form, as evaluated by fifty (50) respondents. Among the three formulations, Formulation 1 (F1) showed the highest mean score of 4.17 for color, indicating that consumers preferred its visual appeal. The

formulation which is mostly chosen by the respondents contained 2 liters of turmeric extract, suggesting that a moderate concentration of turmeric contributes to a more acceptable and aesthetically pleasing color. Regarding texture, Formulation 1 (F1) also obtained the highest mean score of 4.42, indicating that its consistency was the most favorable among the three formulations. This implies that the quantity of turmeric extract affects not only the color but also the beverage's texture and overall sensory experience. This result is also aligned with the result on the overall acceptability of the product with F1 obtaining the highest acceptability rating. Research has shown that turmeric's bioactive compounds which is the curcuminoids, play a role in both its visual attractiveness and textural properties, with higher concentrations potentially resulting in a more astringent and grainier mouthfeel (Osakabe et al., 2024). The results suggest that a balanced concentration of turmeric extract (2 liters per batch) provides optimal sensory characteristics regarding color and texture. Excessive turmeric content, while beneficial for health due to its anti-inflammatory and antioxidant properties (Hewlings & Kalman, 2017), may negatively affect consumer acceptance due to its potential impact on bitterness, astringency, and textural consistency (Osakabe et al., 2024)

Table 6.2: Customer Satisfaction of the Three Formulations of Turmeric Tea (Beverage Form)

| Sensory Attributes | F1 | F2 | F3 |
|---|---|---|---|
| Color | 4.25 | 4.02 | 3.75 |
| Aroma | 4.25 | 4.15 | 3.98 |
| Taste | 4.21 | 3.85 | 3.54 |
| Mouthfeel | 4.19 | 3.96 | 3.44 |

Score values, represented by the mean (n = 50), indicated that all parameters for the samples were described as “satisfied” and others as “very satisfied.”
[1]F1 – turmeric-ginger cinnamon tea with 2 liters of turmeric extract
[2]F2 – turmeric-ginger cinnamon tea with 3 liters of turmeric extract
[3]F3 – turmeric-ginger cinnamon tea with 4 liters of turmeric extract

Table 6.2 reveals that Formulation 1 (F1) in beverage form also received the highest taste rating of all the formulations, with a mean score of 4.21, which can be attributed to its well-balanced blend of cinnamon's natural sweetness, ginger's mild pungency and turmeric's earthy undertones (Sharma, 2021). Same also goes to Formulation 1(F1), which got the highest rating for the indicator mouthfeel (4.19), likely due to its smooth texture and optimal solubility, making it the most preferred formulation in consistency by the respondents. These results showed that a moderate concentration of turmeric extract enhances the overall sensory experience, leading to greater consumer acceptance. It was also revealed that the excessive use of turmeric root may result in bitterness as well as astringency which can negatively affect taste perception (Osakabe et al., 2024). Furthermore, sensory attributes such as color and aroma are important in shaping consumer preferences and influencing purchasing decisions (Pathare et al., 2013; Singh et al., 2021). Therefore, enhancing the ingredient composition is essential for enhancing turmeric-based beverages' sensory appeal and marketability.

The most acceptable formulation which also received highest satisfaction rating in terms of its sensory attributes as evaluated by the end-users, which is Formula 1 with two (2) liters of turmeric extract undergoes physicochemical properties test (Table 7) and nutritional analysis (Table 8).

Table 7: Physicochemical Properties of Turmeric Tea

| Physicochemical Properties | Formulation 1 Result (with 2 liters of Turmeric-Extract) |
|---|---|
| pH | 5.015*@23.9 °c |
| Moisture Content | 4.70 g/100g |
| Ash Content | 1.89 g/100g |
| Water Activity | 0.634@23.9 °c |
| Crude Protein | 0.81 g/100 g |
| Fat, Total | 0.23 g/100g |

Table 7 shows the physicochemical analysis of Turmeric-Ginger-Cinnamon Tea (F1) with 2 liters of turmeric extract highlights its stability and quality. It has a slightly acidic pH (5.015 at 23.9°C) for enhanced flavor and freshness, low moisture (4.70 g/100g) and water activity (0.634) to prevent microbial growth, and an ash content (1.89 g/100g), indicating essential minerals. With minimal crude protein (0.81 g/100g) and fat (0.23 g/100g), it remains a light yet nutritious beverage. These properties ensure a well-balanced, stable, and high-quality herbal tea.

The result shows that the slightly acidic pH (5.015) enhances flavor stability and may inhibits microbial growth (Lund et al., 2020), while the low moisture content (4.70%) and water activity (0.634) contribute to extended shelf life and product stability (Pathare et al., 2013). The ash content (1.89%) reflects the presence of essential minerals beneficial to health. Although the crude protein (0.81 g/100g) and total fat (0.23 g/100g) are relatively low, it includes bioactive compounds such as curcuminoids and gingerols, known for their antioxidant and anti-inflammatory properties (Sharma, 2021). These findings reveal that Formulation 1(F1) is a viable, functional beverage with commercial potential, and future research could improve its bioactive compound extraction and sensory appeal to enhance consumer acceptability.

Table 8: Nutritional Content of Turmeric Tea with 2 liters of Turmeric Extract

| Food Nutrient | Result of Chemical Analysis (per 100g) | Amount of Food Nutrient per Serving Size (Rounded Value) |
|---|---|---|
| Calories, kcal | 374.79 kcal | 30 |
| Calories from fat, kcal | 2.07 kcal | 0 |
| Total Fat, g | 0.23 g | 0 |
| Total Carbohydrates, g | 92.37 g | 8 |
| Protein, g | 0.81 g | 0 |

Table 8 reveals that the nutritional content of Formulation 1 (F1) of turmeric tea containing 2 liters of turmeric extract. This low-calorie, low-fat tea provides 374.79 kcal per 100g, with approximately 30 kcal per serving. It has minimal fat (0.23 g per 100g) and protein (0.81 g per 100g) but is rich in carbohydrates (92.37 g per 100g), offering 8 g per serving as a quick energy source. Its bioactive compounds, including curcumin, gingerol, and cinnamaldehyde, contribute antioxidant and anti-inflammatory benefits (Mao et al., 2019). Moreover, its composition may support digestion, metabolism, and weight management since it is low on fat and calories specifically per serving size. Optimizing ingredient balance can further enhance its nutritional value and marketability (Singh et al., 2021).

## 4. Conclusion

This study demonstrated the feasibility and acceptability of turmeric tea as a functional beverage That can be used as instructional material for teaching learning food preservation in HE classes. The researchers explored consumer preferences and adjusted the formulation to improve its sensory qualities, overall appeal, user satisfaction, and nutritional value using a design-thinking strategy. The initial findings suggest the combination of turmeric, ginger, and cinnamon and other suggested ingredients such as lemon, black pepper, and sugar as its preservative agent improves the tea's color, aroma, taste, and mouthfeel, making it an attractive choice for health-conscious consumers and satisfaction among Maranao end-users. Integrating innovative food concepts and methods in HE classes may increase the likelihood of keeping lessons meaningful and culturally relevant among students belonging to Maranao groups.

Among the three formulations, Formulation 1 (F1) with 2 liters of turmeric extract was the most preferred among end-users, receiving the highest acceptability ratings. It exhibited a well-balanced flavor with ideal sweetness, mild spiciness, and a smooth texture. Moderate turmeric concentrations enhanced sensory characteristics while reducing bitterness and astringency. The physicochemical and nutritional analysis confirmed that Formulation 1 could be a potential source of turmeric-based tea, recognizing the feasibility of using turmeric in a beverage form aside from food coloring among the Maranao community in Mindanao, Philippines. Integrating innovative food concepts and methods in HE classes may increase the likelihood of keeping lessons meaningful and culturally relevant among students belonging to Maranao groups.

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