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ORIGINAL PAPER

Product Development of Malunggay (Moringga oleifera) and Sweet Potato (Ipomea batatas) for Pastry and Fillings

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Abstract This study used the experimental method that involved 90 taste panelists composed of culinary arts teachers, food technologist, culinary arts students, homemakers, faculty and staff. The sensory attributes studied the specific criteria on color, flavor, texture, and over-all acceptability. Findings of the study revealed that 75mL camote leaves decoction and 24g dried "malunggay" leaf powder formulation on the "malunggay-camote" pastry shell got the highest mean score in all sensory attributes considered due to higher amount of variables added to the formulation. There were significant differences on the 75mL camote leaves decoction added with 24g dried "malunggay" leaves powder, level of acceptability in terms of flavor and over-all acceptability. On the hedonic mean acceptability score of "malunggay-camote" boat tart product, 75mL camote decoction added with 24g dried malunggay leaves powder is the most acceptable formulation. DOST chemical result showed the aerobic plate count <25x102 EAPC*/g, Escherichia coli Count, <1.0x10 cfu/g. Total Coliform Count <1.0 x 10 cfu/g, Mold and Yeast Count 2.0x10 cfu/g. The microbial results in cfu/g for S. aureus (coagulase+) was $<10^2$, MYC $<10^2$, SPC/APC cfu/g $<10^4$, Coliforms, <50. These results are within the acceptable limit, therefore the product is safe for human consumption.

Key words: pastry boat tart shell, pastry fillings, sensory attributes, taste panelists, techno-guide

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INTRODUCTION

Convenient health foods that impart extra value in the form of nutritious and functional foods are now the highest priority for local product development in the modern food industry (Hsieh and Ofori, 2007). In baking, pastry products like boat tart and pies are usually added with "buko" and pineapple available in the Philippine market. Due to the higher demands from increasingly health conscious consumers, this experimental study focused on the nutritional information for consumer needs by developing baked products like pastry dough and fillings that provide not only superior sensory qualities but also nutritional and functional benefits. Moringa leaves (*Moringa oleifera*) and "camote" leaves (*Ipomea batatas*) were added variables to baked product for good nutrition most especially among the diet of Filipinos nowadays. "Malunggay" is very essential for its medicinal value (Yang et.al 2006; Mishra et. al 2012; Manaois et. al. 2013). Enhanced baked product with dried "malunggay" leaves powder, "camote" leaves decoction, and "camote" root could serve as a valuable source of nutrient in all age groups. Both "malunggay" and "camote" leaves are indigenous and inexpensive food ingredients to boost the nutritional quality of various baked products.

Malnutrition in the Philippines causes a great deal of human suffering and is associated with more than half of all deaths of children worldwide. Malnutrition severely affects the socio-economic development of a nation because a work force that is stunted both mentally and physically may reduce work capacity (Dhakar et.al, 2011). The value-added product of pastry dough and fillings was added with "malunggay" powder and "camote" leaves decoction. Both powerful vegetables are home grown and are available in a locality.

"Modern nutritional science and in the context of food technology is providing more information on the functions and mechanisms of specific food components in health promotion and/or disease prevention" (Hsieh and Ofori, 2007). There are programs in the Philippines addressed to food insecurity through product development for alleviating malnutrition (Barba and Feliciano, 2002). Modern food technology thus provides an alternative health pathway for individuals who are unable to prepare their own healthy foods in order to conveniently obtain desired supplements or special nutrients from prepared baked products of their choice (Hsieh and Ofori, 2007).

Thus, dried "malunggay" leaves powder and "camote" leaves decoction for pastry and filling products have a chance to prove in a commercial market that have great impact to our country's economy. It is within these contexts that the researcher is challenged to utilize malunggay and

sweet potato leaves for dough and sweet potato root for fillings as a main ingredient in formulating pastry and fillings. Hence, this experimental study was conducted.

MATERIALS AND METHODS

The experimental method was used in this study on the development of dried "malunggay" leaves powder and "camote" decoction for pastry and fillings. Products formulated followed the basic principles on the preparation and processing of foods. The identification of these food products were based on the standard of pastry formulation.

Experimental Design

To evaluate the quality and overall acceptability, each product recipe formulated was evaluated by Culinary Arts Teachers, Culinary Arts Students, Food Technologist, Homemakers, Faculty and Staff as taste panelists. Each food recipe consisted of a number of formulations which served as the treatments. A number of small quantities of each formulation of food product recipe were arranged on individual sensory booth with score/code guide sheets for the taste panelists. The food product samples were randomly arranged and number-coded for proper identification. One preparation of the same formulated food recipe served as its replication.

Environment of the Study

This study was conducted at the Food Processing Laboratory of the Hospitality Management Department of CTU – Barili Campus. Particularly, the product preparations/formulations and conduct of sensory evaluation were done in this laboratory. Gatchalian (2009) emphasizes the sensory evaluation laboratory containing booths which area where physical and environmental conditions are controlled to optimize sensory testing efficiency.

The major considerations in the lay-out are accessible to those who used the area, comfort, convenience and relationship with other offices and laboratories. Environmental factors which could affect one's level of concentration while doing the evaluation were considered. The evaluation booths can adjoin offices associated with research or other related activities which do not create noise and unusual types of odors (Gatchalian, 2009).

The construction of individual sensory booth was applied in a research room at Tanguile Bldg., Rm 102 of the DEHM Dept. of the CTU – Barili Campus, Cebu.

Respondents of the Study

There were 90 taste panelists who evaluated the formulated products during the actual sensory evaluation. In actual sensory evaluation, there were 90 or 100% total taste panelists composed of Culinary Arts Teachers, Culinary Arts Students, Food Technologist, Homemakers, and Faculty and Staff. Table 1 shows the distribution of taste panelists who evaluated the trial formulation of the malunggay and camote boat tart product.

Table 1. Taste Panelists for Trial Formulation and Sensory Evaluation.

Respondents	Actual Sensory n	Evaluation %
A. Trained Panelists		
1. Culinary Arts Teachers	2	2%
2. Culinary Arts Students	62	69%
3. Food Technologist	1	1%
B. Consumer Panelists		
1. Home makers	5	6%
2. Faculty and staff	20	22%
Total	**90**	**100%**

Gathering of Data

Data from consumer sensory evaluation of all the formulated food products were gathered through the use of score sheets. The identified taste panelists (trained and consumer) answered the said score sheets in terms of color, flavor, texture, and over-all acceptability of the food products. Their comments, suggestions, and reactions were obtained and recorded during the session.

The Scoring and Scaling Procedure

On the first phase of testing, comments and suggestions from the selected panelists were gathered to determine the amount of dried malunggay leaves powder and camote leaves decoction added to the sensory formulation. The hedonic rating scale was used to evaluate the first and second phases of the acceptability testing.

Hedonic mean scores were calculated on every attribute per treatment. The interpretation of these data facilitated the sensory acceptability results with the use of the established range of the weighted mean based on the nine–point hedonic rating scale. The weighted means were the results of the total raw scores converted from the hedonic sensory evaluation in every treatment per attribute. Data treated further with the average mean to determine the most acceptable formulation. Table 2 presents the numerical range with specific verbal description per level. The computed ranges in Table 2 categorized the level at which the product is established after the 9-point Hedonic scale rating. This also facilitated a clear cut interpretation of the data for sensory acceptability of the food products.

Hedonic Test for Sensory Acceptability Range

There are 9-point hedonic rating scale categories, to establish the range for acceptability characteristics of the product, the lowest value deducted from the highest possible score and the difference was divided by the highest given point. This facilitated ease in the interpretation of data as to the specific category reflected in Table 2.

Table 2. Hedonic Test for Sensory Acceptability Range

Numerical Range	*Hedonic Score*	*Qualitative Range*
8.04 - 9.00	9	Like extremely category refers to the highest degree of satisfaction in terms of the product quality characteristics studied.
7.51 - 8.03	8	Like very much category refers to a considerable higher degree of satisfaction in product quality in terms of sensory attributes being studied.
6.28 - 7.50	7	Like moderately category refers to a high degree of satisfaction of the products sensory quality studied.
5.40 - 6.27	6	Like slightly category refers to a low degree of satisfaction of the product sensory quality being studied.
4.52 - 5.39	5	Neither like nor dislike category range refers to the neutral grounds of acceptance between satisfaction and dissatisfaction on the product quality in terms of the sensory attributes studied.
3.64 - 4.51	4	Dislike slightly category range refers to least degree of satisfaction of the product quality studied.
2.76 - 3.63	3	Dislike moderately category range refers to the lower degree of dissatisfaction of the product quality studied.
1.88 - 2.75	2	Dislike very much category range refers to a higher degree of dissatisfaction on the product sensory quality studied.
1.00 - 1.87	1	Dislike extremely category refers to the highest degree of dissatisfaction on the product in terms of the sensory attributes studied.

Reference: Gatchalian, (2009).

Statistical Tool

The sensory characteristics of "malunggay" and "camote" tart and pie product as to color, flavor, texture, and over-all acceptability were evaluated by the taste panelist in 3 replications using the 9–point hedonic scale. The score sheets in every replication gathered and scores were tallied by treatments considering the general characteristics of the product. Thus, the results determined the sensory acceptability of the product. The tallied data treated further using the Arithmetic Mean and Duncan's Multiple Range Test (DMRT) to determine the most acceptable formulation.

Product Formulations

The formulated recipe on pastry boat tart product (shell) and pastry filling followed the standard procedure in its preparation. The identified food product utilized the malunggay powder and sweet potato leaves decoction as variables. The treatments of these products are presented in Tables 3 and 4. The pastry boat tart shell product was first conducted for the first sensory evaluation and the highly acceptable pastry shell was added with pastry filling and subjected to taste panelist for the second sensory evaluation.

Table 3. Pastry Boat Tart Shell Product Formulation.

Treatments	*Evaporated Milk*	*Butter*	*Condensed Milk*	*Boiled Camote*	*Cornstarch Powder*	*Refine Sugar*	*Pineapple Flavoring*	*Camote leaves decoction*	*Dried malunggay Leaves powder*
T0	100 mL	100g	100mL	300g	12g	50g	15mL	0mL	0g
T1	100 mL	100g	100mL	300g	12g	50g	15mL	60 mL	12g
T2	100 mL	100g	100mL	300g	12g	50g	15mL	75 mL	18g
T3	100 mL	100g	100mL	300g	12g	50g	15mL	90 mL	24g

Table 4. Pastry Boat Tart Filling Formulation.

Treatments	*All Purpose Flour*	*Lard*	*Iodized salt*	*Camote Decoction*	*Malunggay Powder*
T0	635g	310g	6.3g	0mL	0g
T1	635g	310g	6.3g	25mL	12g
T2	635g	310g	6.3g	50 mL	18g
T3	635g	310g	6.3g	75 mL	24g

Method of Preparation for Camote Leaves Decoction

Put the 50g camote leaves and 1 cup of water in the pan. Bring to boil for 15 minutes at 175^0F. Remove the pan. Drain the camote leaves using strainer. Pour it in a sterilized container. Set aside.

Method of Preparation on Drying the Moringa Leaf Powder

Fresh moringa leaves were processed into dry form for human consumption purpose and dried leaves stored for a long time to be used regularly (Mishra et al., 2012). They further contend that mild-heating and drying process could be achieved using common household facility such as stove.

Method of Preparation for Pastry Boat Tart Shell Product

Add softened shortening, "malunggay" leaf powder, "camote" decoction and rock salt to the 635g all purpose flour in a 2 liter mixing bowl. Blend the mixture with pastry blender to form a paste. This forms barely moistened dough. Gather the dough into a ball by placing on a sheet of wax paper. Place a second piece of wax paper on top of the dough and flatten it with rolling pin. Do not roll over the edges of the dough since this makes the edges very thin. Stop rolling just before reaching the edges. The sheeted dough should be 1/8-inch thick. Except for trimmings to be used after fitting this sheeted dough on the pie pan; practically, all the dough was used up for one pie pan. When rolling the dough, allow for the depth of the pan which is not more than 1-inch deep. To transfer pie crust dough to pie pan, lift off top piece of wax paper and fix the sheeted dough wax paper up onto the pie pan; press to the bottom and sides of the pan so as to fit the dough on the pan. Do not stretch the dough when lifting into the pan to maintain its shape during baking. Place the preferred dough at the center of a pie pan and start flattening and spreading to the edges of the pan bottom and up to the sides and rim. This manner of rolling the bottom crust facilitates the preparation. The top crust, however, has to be sheeted between pieces of wax preparation. The top crust with "malunggay-camote" fillings, however, has to be sheeted between two pieces of wax paper. Bake for 30 minutes at 300^0F.

Method of Preparation for "Camote" Root Filling

Put the 350g "camote" root and 1 liter of water in a 2L pan. Cover. Bring to boil for 30 minutes at 200-250^0F. Pare off the skin and grate the "camote" root. Measure 300g for pastry filling. The 300g grated "camote" root was added with 100mL evaporated milk,100g butter,100mL condensed milk, 12g cornstarch, 50g refine sugar, 15 mL pineapple flavoring, 90 mL "camote" decoction and 24g "malunggay" leaves powder into a non-stick pan.

Method of Preparation for "Malunggay-Camote" Boat Tart Recipe

The pre-cooked pastry boat tart shell was added on the top with 62g "camote" root enhanced with "malunggay" leaf powder. Top with crushed unsalted peanuts. Bake for 20 minutes at 300^oF.

RESULTS AND DISCUSSION

Hedonic Mean Acceptability Score of "Malunggay-Camote" Pastry SHELL

Different means of food preparation influence the nutritional and functional qualities of moringa (Yanget.al. 2006). Table 5 reveals the hedonic mean acceptability scores and the corresponding qualitative interpretation of the "malunggay-camote" boat tart product were evaluated by the taste panelists. Due to their excellent nutritional properties, "malunggay" or moringa leaves should be considered as a supplementing ingredient in different food preparations (Manaois, 2013).

The 75 mL Camote Decoction (CD) and 24g Dried Malungay Powder (MP) formulation had the highest mean score ranging from 7.55 to 7.73 that means **Like Very Much (LVM).** Respectively, flavor and texture had a mean score ranging from 7.12 to 7.43 categorized as **Like Moderately (LM)**. The 90mL CD and 24g MP formulation contained the highest variables of added to the standard pastry formulation, the rest of the treatments got the same quantitative interpretation that fell on **LM**. The 50 mL CD and 18g MP formulation have significant differences as to flavor and over-all acceptability. Data reveals that the higher amount of variables added is most preferred as flavor and over-all acceptability of the product as evaluated by the taste panelist among the treatments studied in consistency of the studies of Manaois et.al. (2013) that MP were as crunchy and acceptable control added to food product.

Collectively, the 3 treatments on texture obtained a mean ranged from 6.93 to 6.71 with the same verbal description of **LM** while 50mL CD and 18g MP formulation obtained the highest mean score of 7.02 means **LVM.** Data implied that lowest amount of 25 CD and 12g MP produced a higher preference score of 6.79 means **LVM** this contends that addition of small amounts of MP will have no discernible effect on the taste on a sauce (Mishra

et.al., 2012). Higher amount of MP to the boat tart shell formulation were most preferred by the taste panelist in contrary of the findings of Kar et.al. (2013) that moringa leaf enriched biscuits were acceptable in sensory profiling but the typical leafy flavor and slight bitter taste of the product decreases its consumer acceptance leading to further modifications like addition of strong flavour and taste enhancing agent.

Table 5. Hedonic Mean Acceptability Score of Malunggay-Camote Pastry Shell and Malunggay-Camote boat Tart Product.

Treatments	*Sensory Attributes*							
	Color		*Flavor*		*Texture*		*Over-all Acceptability*	
	Rating	*Verbal Description*	*Rating*	*Verbal Description*	*Rating*	*Verbal Description*	*Rating*	*Verbal Description*
0mL CD + 0g DM	**7.04**	LM	**6.60** [ab]	LM	**6.93**	LM	**7.20** [b]	LM
5mL CD + 12g DM	**6.98**	LM	**6.57** [ab]	LM	**6.79**	LVM	**7.02** [b]	LM
mL CD +18g DM	**6.85**	LM	**6.38** [b]	LM	**6.71**	LM	**6.74** [b]	LVM
75mL CD + 24g DM	**7.55**	LVM	**7.12** [a]	LM	**7.43**	LM	**7.73** [a]	LVM

Mean within a column followed by a column letter is not significantly different from each other DRMT at 5% level of significance; 1.00-1.87; Dislike Extremely; 1.88-2.75 Dislike Very Much; 2.76-3.63 Dislike Moderately; 3.64-4.51 Dislike Slightly; 4.52-5.39 Neither Like or Dislike; 5.40-6.27 Like Slightly; 6.28-7.15 Like Moderately; 7.16-8.03 Like Very Much; 8.04-9.0 Like Extremely; Legend: Camote Decoction (CD) and Malunggay Powder (MP)

Collectively, 90 mL CD and 24g DMLP formulation had the highest mean score to all sensory attributes (color, flavor, texture and over-all acceptability as evaluated by the taste panelists. Moreover, there are significant differences on over-all acceptability due to higher amount of variables 75mL CD and 24g DMLP. This supports the findings of Abilgos (1996) as cited by Manaois, (2013) that addition of nutrient-rich indigenous vegetables, such as moringga, foods have been shown to effectively enhance the nutrient profile of the foods without compromising quality and consumer acceptability. As to color acceptability of the "malunggay-camote" boat tart product with a mean range from 7.12 to 7.55 the formulation with highest amount of 90mL CD and 24g DMLP obtained a highest acceptability the results corroborates the findings of flat noodle added with DMLP, the test revealed that the 5 percent level of supplementation of malunggay leaves was preferred to be light green in color got the highest acceptability score of all substituted products (Abilgos, 1996).

Table 6. Hedonic Mean Acceptability Score of Malunggay-Camote Boat Tart Product.

Treatments	**Sensory Attributes**							
	Color		**Flavor**		**Texture**		**Over-all Acceptability**	
	Rating	*Verbal Description*	*Rating*	*Verbal Description*	*Rating*	*Verbal Description*	*Rating*	*Verbal Description*
0mL CDC + 0g DMLP	7.04	LM	6.60 [ab]	LM	6.93	LM	7.20 [b]	LM
60mL CD +12g DMLP	6.98	LM	6.57 [ab]	LM	6.79	LVM	7.02 [b]	LM
75mL CD+18g DMLP	6.85	LM	6.38 [b]	LM	6.71	LM	6.74 [b]	LVM
90mL CD+24g DMLP	7.55	LVM	7.12 [a]	LM	7.43	LM	7.73 [a]	LVM

Mean within a column followed by a column letter is not significantly different from each other DRMT at 5% level of significance; 1.00-1.87; Dislike Extremely;1.88-2.75 Dislike Very Much;2.76-3.63 Dislike Moderately; 3.64-4.51 Dislike Slightly;4.52-5.39 Neither Like or Dislike;5.40-6.27 Like Slightly; 6.28-7.15 Like Moderately;7.16-8.03 Like Very Much;8.04-9.0 Like Extremely; Legend: Camote Decoction (CD) and Malunggay Powder (MP)

Nutritive Value Analysis

Data revealed that crushed malunggay leaves can be used as ingredient to bio-fortify food preparations resulted to higher acceptability on pastry filling product (DA Bureau of Plant Industry Crop Research Division, www.biotechforlife.com.ph). In the study, Malungay-Camote product contains nutritional value as shown in Table 7. Moringa should be promoted for greater consumption for human use to improve nutrition and strengthen immune functions.

Table 7. Nutritive Value Analysis on Malunggay and Camote Boat Tart Product

Nutrition Information Serving Size Per Container 10	*Amount Per Serving*	*Per 100g 320 kcal*
Energy	83 kcal	320kcal
Total Fat	3g	12g
Total Carbohydrates	13g	50g
Sugar	13g	24g
Protein	1g	4g
Sodium	26mg	100mg

Fig.2. Malunggay-Camote Boat Tart Product

CONCLUSIONS

Based on the findings of the study, it can be concluded that "malunggay" powder and camote decoction can be utilized as added ingredient in pastry products both pastry shell and pastry fillings.

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