

DEVELOPMENT OF FOOD PRODUCTS FROM MILLET

Margie C. Aller, Alfredo C. Neri and Adeline P. Dela Cruz

CTU – Barili Campus

ABSTRACT

The study generally seeks to develop food products utilizing millet grain and millet flour. This millet grain/flour served as the main ingredient in preparing the food products and as a partial substitute to the all-purpose and/or cake flour. Specifically, it aims to utilize millet in baking pastries, cookies, and cakes, and cooking pastillas; to evaluate these food products in terms of consumer acceptability; and to produce a techno-pack on the developed food products for extension service.

The experimental method was used in this study to develop products like millet tart, millet (chiffon) cake, millet cookies, and millet pastillas from millet grain and flour. The formulation employed was based on the basic procedure in the preparation and processing for standard recipes. The 9-point Hedonic rating scale was used to evaluate the first and second phase of the product acceptability testing.

Millet can be utilized as main or added ingredient in baking pastries, cookies and cakes, and cooking pastillas. Specifically, millet flour can be used as added ingredient in baking cookies and cakes, while millet grain can be utilized as main ingredient in cooking tart fillings and pastillas.

Assessment on consumer acceptability reveals that millet tart, millet cake, millet cookies and millet pastillas can be considered as possible processed products that utilized millet. A techno-pack for each of the developed products can be produced for extension services.

Among the four recipes formulated, millet pastillas has higher consumer acceptability as “like very much” compared to only “like moderately” for the rest of the millet recipes developed.

INTRODUCTION

Product innovation is a highly significant factor in food production. It is the key to profitability in a competitive world market. Through innovation, people should become better at food production and food processing. Food producing nations process their food through optimum utilization of indigenous products. This is to enhance the palatability of food as well as to increase its nutritive value.

In the Philippines, particularly in selected areas of Cebu province, millet is found to be growing well. Its production has been favorable in the locality upon research conducted at CTU - Barili Campus, Barili, Cebu. Research results so far are promising, showing millet to have great aptitude and versatility and more uses of the grain are being discovered every year, including its potential benefits in the American diet. Millet is a superior feed for poultry, swine, fish, and livestock and, as it is being proven, for humans as well (<http://chetday.com/millet>).

There are many potential cooking variations for millet. Its grain can be made into flour by applying the principles in food innovation. However, limited studies have been conducted to prove these potentials of utilizing millet for baking food products. Thus, these products may have a chance to prove in a commercial market and may have great impact to our country's economy.

It is with these contexts that the researchers were challenged to utilize millet as a main ingredient and as additives in making various baked food products. Hence, this study was conducted.

MATERIALS AND METHODS

The experimental method was used in this study on the development of different food products from millet. Products formulated from millet followed the basic principles on the preparation and processing of foods. The identification of these food products was based on some standard recipes wherein its main ingredient was replaced with the millet flour.

Product Formulations

Each of the recipes formulated followed the standard procedure in its preparation. The identified food products produced were millet tart, millet cake, millet cookies, and millet pastillas. The treatments or formulations for each of these products are presented in Tables 1 to 4. Each of these formulated food products was subjected to taste panelists for sensory evaluation.

Treatment	Product Ingredients										
	Cooked Millet Grain	Evaporated Milk	Margarine	Condensed Milk	Refined Sugar	Vanilla	All Purpose Flour	Shortening	Rock Salt	Baking Soda	Water
T1	2 c	½ c	1 T	½ c	¾ c	1½ t	2 c	½ c	1t	1t	2T
T2	2 c	½ c	1 T	¾ c	½ c	1 t	2 c	½ c	1t	1t	2T
T3	2 c	½ c	1 T	½ c	½ c	1 t	2 c	½ c	1t	1t	2T
T4	2 c	½ c	1 T	½ c	¾ c	1 t	2 c	½ c	1t	1t	2T
T5	2 c	1 c	1 T	¾ c	1 c	1½ t	2 c	½ c	1t	1t	2T
T6	2 c	½ c	1 T	¾ c	½ c	1 t	2 c	½ c	1t	1t	2T
T7	2 c	¾ c	1 T	¾ c	1/3 c	1 t	2 c	½ c	1t	1t	2T

Table 2. Millet chiffon cake formulations

Treatment	Product Ingredients										
	Cooked Millet Flour	Cake Flour	Refined Sugar	Oil	Egg	Water	Evaporated milk	Vanilla	Baking Powder	Cream of Tartar	Water
T1	¾ c	1 ¾ c	1 c	¼ c	10 pcs	½ c	¼ c	3 t	3 t	1 t	2T
T2	½ c	1 ½ c	1¼ c	¼ c	10 pcs	½ c	¼ c	3 t	3 t	1 t	2T
T3	1¼ c	1 ¼ c	½ c	¼ c	10 pcs	½ c	¼ c	3 t	3 t	1 t	2T
T4	¼ c	1 ¾ c	1 c	¼ c	10 pcs	½ c	¼ c	3 t	3 t	1 t	2T
T5	½ c	1 ½ c	1½ c	¼ c	10 pcs	½ c	¼ c	3 t	3 t	1 t	2T
T6	¾ c	1 ¾ c	1 c	¼ c	10 pcs	½ c	¼ c	3 t	3 t	1 t	2T
T7	¼ c	1 ¼ c	1 c	¼ c	10 pcs	½ c	¼ c	3 t	3 t	1 t	2T

Table 3. Millet cookies formulations

Treatment	Product Ingredients									
	Cooked Millet Grain	All Purpose Flour	Refined Sugar	Margarine	Egg	Baking Soda	Cinnamon Powder	Rock Salt	Chopped Peanuts	Chopped Raisins
T1	1 ¼ c	3 ½	¾ c	1 ¼ c	2 DCS	2 t	1 t	½ t	½ c	½ c
T2	1 ½ c	3 ½	1c	1 ¼ c	2 DCS	2 t	1 ½ t	½ t	½ c	½ c
T3	1 ¼ c	3 ½	1 ¼ c	1 ¾ c	2 DCS	2 t	1 ½ t	½ t	½ c	½ c
T4	¾ c	3 ½	¾ c	1 ¼ c	2 DCS	1 t	1 ¼ t	½ t	½ c	½ c
T5	¾ c	3 ½	1 c	1 ¼ c	2 DCS	2 t	1 ½ t	½ t	½ c	½ c
T6	½ c	3 ½	¾ c	1 ½ c	2 DCS	2 t	2 t	½ t	½ c	½ c
T7	¾ c	3 ½	¾ c	1 ¼ c	2 DCS	2 t	1 ½ t	½ t	½ c	½ c

Table 4. Millet pastillas formulations

Treatment	Product Ingredients								
	Cooked Millet Flour	Evaporated Milk	Margarine	Condensed Milk	Refined Sugar	Vanilla	Corn starch	Water	Coat
T1	1 c	¼ c	2 t	¼ c	½ c	1 t	½ c	2 T	Milk powder
T2	1 c	¼ c	2 t	¼ c	¾ c	1 t	½ c	2 T	Chopped nuts
T3	1 c	¼ c	2 t	¼ c	1 c	1 t	½ c	2 T	Dessicated Coconut

Experimental Design

To evaluate the quality and overall acceptability, each of the product recipes formulated was tasted by HM students, 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 formulated food product recipe were arranged in tables with score/code guide sheets for the tasters to respond or answer. 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 the CTU – Barili Campus. Particularly, the products preparations/formulations and conduct of sensory evaluation were done in this laboratory.

Respondents of the Study

There were two sets of panelists used in this study, namely: a) 5 taste panelists who evaluated the pre-trial formulation; and b) 20 consumer panelists who evaluated during the actual sensory evaluation on each of the four

(4) formulated food products. The purpose of the first set of panelists was to evaluate the amount of millet flour, milk and sugar added to the standard recipe on each formulated food product. The formulations as treatments for millet tart, millet cake, millet cookies, and millet pastillas utilizing millet grain and millet flour were evaluated using the nine-point hedonic rating scale (as shown in Table 7). This was used as the basis for the qualitative interpretation of the numerical scores given by the respondents.

To evaluate the sensory acceptability of the formulated food products, responses are taken from twenty (20) taste panelists as the respondents. They were given score/code guide sheets for recording the scores during the sensory evaluation procedure. The instrument used was explained in dialect by the researchers so that the panelists can fully-understand the quantitative rating and the corresponding qualitative interpretation during the sensory evaluation process. Of the twenty (20) purposive panelists, 7 or 35% were culinary arts students while 13 or 65 % were teachers and staff. Table 5 shows the distribution of respondents who evaluated the trial formulation of the millet food products.

Table 5. Distribution of respondents for the trial formulation of millet food products

Respondent	Frequency	Percent (%)
Teacher and Staff	13	65
Culinary Arts Student	7	35
Total	20	100

The consumer panelists were the ones who evaluated the formulation during the actual tasting of the formulated food products. They composed the AHM and BSHM undergraduate students and the teachers and staff invited to make sensory evaluation on the products (Table 6).

Table 6. Distribution of consumer taste panelists for the products sensory evaluation.

Respondent	Frequency		Total	Percent (%)
	II	III		
AHM/BSHM Student	5	2	7	35
Teachers and Staff	3	10	13	65
Total	8	12	20	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 20 taste panelists answered the said score sheets in terms of color, flavor, texture, taste and general acceptability of the food products. Their comments, suggestions, and reactions were also 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 millet flour and sugar added to the sensory formulation. The Hedonic rating scale was used to evaluate the first and second phases of the acceptability testing.

The nine-point Hedonic scale is as follows: 1 - Dislike extremely, 2 - Dislike very much, 3 - Dislike moderately, 4 - Dislike slightly, 5 - Neither like nor dislike, 6 - Like slightly, 7 - Like moderately, 8 - Like very much, and 9 - Like extremely.

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 was treated further with the average mean to determine the most acceptable formulation. Table 7 presents the numerical range with specific verbal description per level.

The computed ranges in Table 7 were prepared to categorically pinpoint the level at which the product specifically fall after the 9-point Hedonic scale rating. This also facilitated a clear cut interpretation of the data for sensory acceptability of the food products.

Table 7. Average weighted range based on the 9-point Hedonic scale

Numerical Range	Qualitative Interpretation
8.50 - 9.00	Like extremely (LE)
7.50 - 8.49	Like very much (LVM)
6.50 - 7.49	Like moderately (LM)
5.50 - 6.49	Like slightly (LS)
4.50 - 5.49	Neither like nor dislike (NLND)
3.50 - 4.49	Dislike slightly (DS)
2.50 - 3.49	Dislike moderately (DM)
1.50 - 2.49	Dislike very much (DVM)
1.00 - 1.49	Dislike extremely (DE)

* Dr. Malabago's suggested numerical range

Hedonic Test for Sensory Acceptability Range

There were 9 scale categories. To establish the range for acceptability characteristics of the product, the lowest value was 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 the description will fall as in Table 8.

Table 8. Hedonic test for sensory acceptability range

Numerical Range	Hedonic Score	Qualitative Range
8.50 - 9.00	9	Like extremely category refers to the highest degree of satisfaction in terms of the product quality characteristics studied.
7.50 - 8.49	8	Like very much category refers to a considerable higher degree of satisfaction in product quality in terms of sensory attributes being studied.
6.50 - 7.49	7	Like moderately category refers to a high degree of satisfaction of the products sensory quality studied.
5.50 - 4.49	6	Like slightly category refers to a low degree of satisfaction of the product sensory quality being studied.
4.50 - 5.49	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.
3.50 - 4.49	4	Dislike slightly category range refers to least degree of satisfaction of the product quality studied.

2.50 - 3.49	3	Dislike moderately category range refers to the lower degree of dissatisfaction of the product quality studied.
1.50 - 2.49	2	Dislike very much category range refers to a higher degree of dissatisfaction on the product sensory quality studied.
1.00 - 1.49	1	Dislike extremely category refers to the highest degree of dissatisfaction on the product in terms of the sensory attributes studied.

RESULTS AND DISCUSSION

Table 9 presents the hedonic mean acceptability scores and the corresponding qualitative interpretation of the five (5) product sensory attributes for millet tart by taste panelists. Among the 7 treatments or formulations used, the highest mean score of 7.25 on color acceptability is observed in T2 and T7 with a qualitative interpretation of “like moderately” and the lowest mean score is the T4 formulation. The lowest preference on color in T4 among taste panelists was caused may be by a more dark brown appearance of the millet tart. It was observed that sugar enhanced browning and higher sugar added in T4 affected the color of the baked product. Addition of equally higher proportions of condensed and evaporated milk in T2 and T7 produced a lighter effect on color of the millet tart fillings. Hence, panelists had higher preference on lighter colors of the baked product.

On flavor, T5 formulation obtained the highest mean score of 7.60 (like very much). This formulation (T5) seems to be more preferred while T4 seems to be less preferred (like slightly) by the taste panelists. However, generally the variations in hedonic mean scores of the rest of the product sensory attributes between the 7 treatments did not make any difference on the qualitative interpretation as to product sensory qualities other than the “like moderately”.

Table 9. Hedonic mean acceptability scores for millet tart by taste panelists.

Treatment	Color	QI	Flavor	QI	Texture	QI	Taste	QI	Overall	QI
T1	7.05	LM	6.63	LM	6.50	LM	6.88	LM	7.00	LM
T2	7.25	LM	6.60	LM	6.15	LS	6.35	LS	6.95	LM
T3	6.95	LM	7.10	LM	6.88	LM	7.18	LM	7.10	LM
T4	6.50	LM	6.05	LS	6.45	LS	6.25	LS	6.45	LS
T5	7.10	LM	7.60	LVM	7.25	LM	7.10	LM	7.35	LM
T6	6.90	LM	6.85	LM	6.75	LM	7.05	LM	6.80	LM
T7	7.25	LM	7.20	LM	7.15	LM	7.20	LM	7.25	LM
Total	49.00		48.03		47.13		48.00		48.90	
Mean	7.00	LM	6.86	LM	6.73	LM	6.86	LM	6.99	LM
Grand Mean									6.83	LM

The hedonic mean acceptability scores for millet cake by taste panelists is shown in Table 10. Among the 8 treatments used, T5 obtained the highest mean score (7.55) in terms of color preference (like very much). On overall acceptability, T7 and T4 got the highest mean scores of 7.60 and 7.50, respectively. These formulations were preferred as “like very much” by the taste panelists among others. This result implies that addition of the considerable lower amount of millet flour in the formulation produced a better product (millet chiffon cake) characterized by finer texture, better taste, higher overall acceptability.

Table 10. Hedonic mean acceptability scores for millet cake by taste panelists

Treatment	Color	QI	Flavor	QI	Texture	QI	Taste	QI	Overall	QI
T1	6.28	LS	6.05	LS	6.05	LS	5.98	LS	6.15	LS
T2	5.50	LS	5.25	NLND	5.10	NLND	5.25	NLND	5.55	LS
T3	6.10	LS	5.45	NLND	5.60	LS	5.65	LS	5.45	NLND
T4	6.85	LM	7.25	LM	7.15	LM	7.45	LM	7.50	LVM
T5	7.55	LVM	6.85	LM	6.75	LM	6.65	LM	6.85	LM
T6	7.00	LM	7.00	LM	6.75	LM	7.10	LM	7.10	LM
T7	6.85	LM	7.25	LM	7.45	LM	7.80	LVM	7.60	LVM
T8	6.85	LM	7.00	LM	6.85	LM	6.55	LM	6.95	LM
Total	52.98		52.10		51.70		52.43		53.15	
Mean	6.62	LM	6.51	LM	6.46	LS	6.55	LM	6.64	LM
Grand Mean									6.56	LM

Table 11 depicts the nine (9) treatments as formulations of millet cookies utilizing millet grain. On color, both T3 and T9 have a “like very much” (7.50) preference by the taste panelists. On texture, T5 and T9 have higher mean scores of 7.30 and 7.20 and on taste 7.25 and 7.85, respectively. However, on the overall acceptability, T2 with a mean score of 7.50 go with T9 (7.65) as the formulations that obtained the highest preference as “like very much. This goes to show that higher amount of cooked millet grain added to the formulation makes millet cookies highly acceptable by the taste panelists. Furthermore, higher amount of cinnamon powder added to the formulation contributed to a better millet cookies product. A much higher preference however, is noticed when added proportion of cooked millet to cinnamon powder was lower.

Table 11. Hedonic mean acceptability scores for millet cookies by taste panelists

Treatment	Color	QI	Flavor	QI	Texture	QI	Taste	QI	Overall	QI
T1	6.65	LM	6.80	LM	6.85	LM	6.35	LS	6.75	LM
T2	7.35	LM	7.25	LM	6.90	LM	7.25	LM	7.50	LVM
T3	7.50	LVM	7.00	LM	6.90	LM	7.10	LM	7.25	LM
T4	6.45	LS	5.95	LS	6.15	LS	6.30	LS	6.30	LS
T5	7.45	LM	7.20	LM	7.30	LM	7.25	LM	7.40	LM
T6	5.55	LS	5.15	NLND	5.25	NLND	4.75	NLND	5.20	NLND
T7	7.15	LM	6.90	LM	7.40	LM	7.00	LM	7.35	LM
T8	6.90	LM	6.90	LM	6.70	LM	6.85	LM	6.80	LM
T9	7.50	LVM	7.95	LVM	7.20	LM	7.85	LVM	7.65	LVM
Total	62.50		61.10		60.65		60.70		62.20	
Mean								LM	6.91	LM
Grand Mean									6.83	LM

Considering only the three (3) treatment formulations made for millet pastillas, Table 12 reveals a much higher preference of the product. Consistently in terms of all the sensory attributes, T1, T2, and T3 have a “like very much” acceptability with mean scores from highest to lowest, arranged in that treatment order. The formulations considered equal amount of cooked millet flour added to the 3 treatments. And the little variations in mean scores was merely caused by the varied amounts of refined sugar added and the different coating ingredients used. The result suggests that lower amount of sugar added to the formulation tend to increase the sensory acceptability of millet pastillas. Milk powder as coat was preferred over chopped nut and desiccated coconut.

Table 12. Hedonic mean acceptability scores for millet pastillas by taste panelists

Treatment	Color	QI	Flavor	QI	Texture	QI	Taste	QI	Overall	QI
T1	7.80	LVM	7.83	LVM	7.53	LVM	7.93	LVM	7.75	LVM
T2	7.78	LVM	7.65	LVM	7.60	LVM	7.68	LVM	7.65	LVM
T3	7.30	LM	7.60	LVM	7.23	LM	7.45	LM	7.50	LVM
Total	22.88		23.08		22.35		23.05		22.90	
Mean	7.63	LVM	7.69	LVM	7.45	LM	7.68	LVM	7.63	LVM
Grand Mean									7.62	LVM

Figure 1 illustrates the hedonic mean scores on color, flavor, texture, taste, and overall acceptability of the four (4) formulated food products. The bar graph shows that millet pastillas is more preferred by most of the panelists with a grand mean of 7.62 that has a qualitative interpretation of “like very much” compared to the rest of the millet food products formulated. As observed, the millet boat tart and the millet cookies seem to have the same preference as “like moderately” by the taste panelists. The millet chiffon cake got the lowest mean rating of 6.56, however, still the preference does not go below the “like moderately” level of product acceptability.

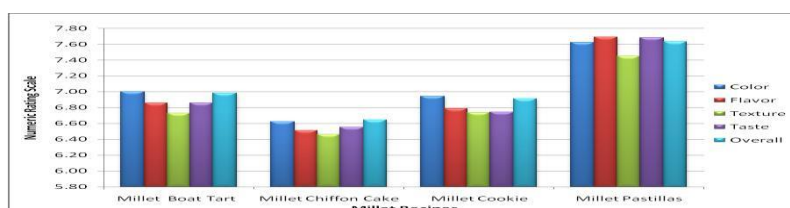


Figure 1. Hedonic mean acceptability scores of the four (4) formulated millet product recipes.

CONCLUSIONS

Based on the above findings of the study, it can be concluded that millet can be utilized as main or added ingredient in baking pastries, cookies and cakes, and cooking pastillas. Millet flour can be used as added ingredient in baking cookies and cakes, while millet grain can be utilized as main ingredient in cooking tart fillings and pastillas.

Based on the sensory evaluation to assess consumer acceptability of the four (4) millet products formulated, it is concluded that millet tart, millet cake, millet cookies and millet pastillas can be considered as possible processed products that utilized millet. It is further concluded that a techno-pack for each of the developed products can be produced for extension services.

RECOMMENDATIONS

With the above findings and conclusions, the following proposals are highly recommended for consideration and action:

Make use of the developed products for extension services and marketing.

Preferably utilize millet in making pastillas as this has higher sensory acceptability than the other formulated recipes.

Conduct similar or related research studies on pastry like pies and pizzas utilizing millet flour as fillings.

Utilize millet as main ingredient in making soup, dish, and bread since the grain contains substantial amount of the necessary nutrients for optimal health.

REFERENCES

Books

Carpenter, R. P. et. al. 2004. **Guidelines For Sensory Analysis In Food Product Development And Quality Control.**

Lawless Harry T And Hildegard Heymann. 2004. **Sensory Evaluation of Food. Principles and Practices.**

Meilgard, D., Civille, G.V.; Carr, B.T. 1991. **Sensory Evaluation Techniques.** Boca Raton Crc Press.

France, Christine, 1995, **50 Calorie Dessert** ©Publishing Limited.

Leocadio, Corazon, G., Revised Edition, 1998, **Essentials in Meal Management.**

Willians, Anne, 1993, **Look and Cook**, © Doorling Kindetsely Limited, London.

White, Benett Ruth, 1979, **Food and Your Future**, © Prentice Hall Inc

Unpublished Thesis and Dissertations

Malabar, E. E., 2003, Recipe Formulations for Crunchy Peanut Cookies: Techo Pack Management, CSCST - Main Campus, Cebu City.

Sarsonas, J.A. 2004. Gabi Flour (Colocasia esculenda Sp.) as an Ingredient In Baking Dough for Pastry: An Extender, CSCST- Main Campus, Cebu City.

Web Sources

www.bobsredmill//millet.com

<http://chetday.com/millet>

www.fodomain@msue.msu.edu

<http://store.honeyvillegrain.com>

www.kidecker.net