Tropical Technology Journal
Volume 18, Issue 1 (2015)
ISSN: 1656-0264

Sweet Potato *Ipomoea batatas* Flour for Veggie-Fruit Bumper Production: Technology Dissemination and Adoption

Wilma C. Giango
Cebu Technological University Main Campus
Correspond: wilma_giango@yahoo.com

ABSTRACT

Sweet potato *Ipomoea batatas is* a very popular root crop in the tropics which can be made into several delicacies or food item in terms of product development. This study was an experimental design conducted in a factorial experiment with four main treatment or plot represented by the flour used in making the crust and a sub plot represented by the three different kinds of veggie-fruit filling materials. The study was conducted to determine the formulation of veggie- fruit bumper locally known as "*Empanaditas"* using sweet potato (SP) flour with different ratio of all- purpose flour as crust. The crust were filled with varied veggie-fruit fillings such as squash, mango, pineapple, turnip, chayote and carrots. The ratio of the sweet potato flour with all- purpose flour in making the crust were as follows: Treatment 1=100% all-purpose flour (Control); Treatment 2=75% all-purpose flour + 25% (SP) flour; Treatment 3=50% all-purpose flour + 50% (SP) flour; and Treatment 4=25% all-purpose flour + 75 % (SP) flour. These crust were filled with vegetables and fruits as filling such as squash, mango, pineapple (Mixture A); mango, turnip, pineapple (Mixture B); and, chayote, carrot, pineapple (Mixture C). The acceptability of the product was determined through the crust and the veggie-fruit mixture as filling using the quality attributes of color, aroma, texture, and taste. The proximate nutritional analysis of the most preferred recipe was also determined. Based on the findings of the study, 50% sweet potato flour was tested to be a good ingredient in making pastry crust. Veggie-fruit filling from the mixture of squash, mango, and pineapple was found the most acceptable formulation with the use of 50% sweet potato flour as crust.

Keywords: Pastry crust, sweet potato flour, acceptability, formulation, filling materials.

INTRODUCTION

Sweet potato (*Ipomoea batatas*) belongs to the morning glory family, *Colvolvulacea*, locally known as "camote". The crop is rich in food energy, vitamins A and C, and other essential nutrients that our body needs. It is a versatile crop that when properly used can alleviate food shortage in many parts of the country. The plant is also an important vegetable using the tip most part of the vine or camote tops which is a good source of Vitamin A.

There are many ways to prepare or cook sweet potato. This could be boiled, broiled, fried as chips, baked, and many others. In other countries, tubers are canned, frozen or dehydrated. These are also processed into flour and other industrial products. In bakery products like loaf bread, some bakers used 40% sweet potato flour added with 60% wheat flour. This mixture of

 ISSN: 1656-0264

wheat and sweet potato produce larger loaves of bread than pure hard wheat flour.

At present, many farmers are planting sweet potato mainly for human consumption. Sweet potato is a versatile crop and also known as gold mine of processed product. It plays an important dietary role in the country particularly in rural areas. This has an inexpensive source of energy. In combination with legumes, it can form an ideal food combat for Protein Calorie Malnutrition (PCM) which is so widespread in almost all developing countries. Sweet potato is top listed on the seven crops worldwide that produces more than 105 million metric tons of food products yearly (FAO, 2011). It is considered as one of the worlds' most important food crops. In most cases during calamities like typhoons and heavy floods, sweet potato is being categorized as a substitute to rice as "food security" or "famine relief" wherein people utilized to fight against hunger. There are situations that sweet potato has been added to rice, to maximize its availability.

The nutritional compositions of sweet potato include carbohydrates, fibers, carotenes, thiamine, riboflavin, niacin, potassium, zinc, calcium, iron, vitamins A and C. According to United States Department of Agriculture, sweet potato is enriched with dietary fiber which is good for people who are into diet as it provides 359KJ energy and about 0.05 g per 100 g of the total lipid content. It has an unsaturated fats that are helpful in fighting against anti-aging as it contains anti- oxidants that will help looks more younger looking skin. Other nutrients found in the tubers of the sweet potato are the beta carotene (8,509 µg) and vitamin A (14,187 IU). These values enabled the sweet potato in garnering the highest in any root-vegetables category. The function of vitamin A in our body is to maintain the integrity of healthy mucus membranes and skin and it is a primary nutrient for a healthy vision.

An increase in sweet potato production is likely accompanied with the development of new sweet potato products or sort of convenience foods. However, there are a number of reasons why sweet potato flour is not popular to many bakers, home- makers, food processors, entrepreneurs, and other users. Some of these includes the lack of recipe, ignorance on the nutritive value of the crop, and the lack of knowledge in processing and utilizing root crops. It is on this light that a new sweet potato formulation using its flour as crust and with the use of veggie-fruit mixture as filling in producing *"Empanaditas"* was conceptualized and formulated.

Production of new products from sweet potato can help contribute to the country's economic revenue and give solution to the problem of malnutrition and poverty. If this technology from sweet potato can be properly developed and disseminated, it may be a good livelihood program to people in the village to augment their family income and at the same time for home consumption. Thus, this study was conducted along this purpose.

MATERIALS AND METHODS

Research Design

This study utilized an experimental design conducted in a factorial experiment with four

main plots represented by the amounts of flour used in making the crust, and a sub plot represented by the three different kinds of vegetables and fruits as filling materials. These formulated recipes were done in triplicates. The four treatments (Ts) were: 100% all- purpose flour as control ($T_{1)}$; 75% all- purpose flour + 25% sweet potato flour as T_2; 50% all- purpose flour + 50% sweet potato flour as T_3; and 25% all- purpose flour and 75% sweet potato flour as T_4. These treatments were filled with three kinds of vegetable - fruit fillings, such as: Filling A composed of squash, mango, and pineapple; Filling B composed of mango, turnip, and pineapple; and Filling C composed of chayote, carrots and pineapple.

Procedure

This study involved the basic procedure in preparing the crust wherein the first formulation was purely using 100% all- purpose flour. The different amount of sweet potato flour were added to the other three (3) formulated treatment of the study. One treatment- recipe was added with 25% sweet potato flour, another recipe was added with 50% sweet potato flour and other recipe was added with 75% sweet potato flour. Except the use of varying quantities of flour, the measurements of all other ingredients were held constant in all treatment formulations. These treatments for crust were all filled with three kinds of vegetable - fruit fillings, in which Filling A include squash, mango, and pineapple; Filling B with mango, turnip and pineapple, and Filling C with chayote, carrots and pineapple. These recipe formulations were prepared in three trials with three replications per formulation.

Sensory Evaluation

The different recipe treatments were prepared and subjected to sensory evaluation for three trials by 62 panellists. The panellists were randomly selected using the purposive quota sampling from the identified food panellists who had exposure to sensory evaluation from the group of experts in bakers and from the untrained group, mostly students and housewives. The sensory evaluation instruments used to determine the color, aroma, texture, taste and general acceptability of the product were the descriptive and preference test in hedonic scale. Food testing was done on three separate occasions.

Statistical Treatment

The data gathered on sensory evaluation were collated, tabulated and analysed statistically using Analysis of Variance (ANOVA) at 5% level of significance. This was used to determine if there is significant difference among the varying levels of the recipe formulations. The average weighted mean was also used to determine the mean scores of the various formulations.

RESULTS AND DISCUSSION

Characterization of the quality attributes i.e. color, aroma, texture, taste and general acceptability of the formulated Empanaditas were based on the perceptions of the respondents

 ISSN: 1656-0264

on sensory evaluation using Preference and Descriptive Tests.

Color

In terms of colour attribute, result shows that the products were found to have significant difference using ANOVA at 5% level of significance (F= 59.27; α = 3.05). Similarly, there is significant difference on the colour characteristic of the veggie-fruit filling comprising of different vegetables and fruits using ANOVA at 5% level of significance (Fc= 17.61; Ft =3.44). Based on the result, it was noted that the there was no interaction between the sweet potato flour which was used as crust, and veggie-fruit as filling materials on the acceptability of the product in terms of colour (Table 1).

Table 1. ANOVA result on Color Evaluation of the *Empanaditas* Formulations

Sources of Variation	Df	SUM OF SQUARE	MEAN SQUARE	F-COMPT	F- TAB	
					5%	1%
Replications	2	0.0709	0.03545	1.32 ^{ns}	3.44	5.74
Between Recipe	3	4.7655	1.5885	59.27**	3.05	4.81
Between Fillings	2	0.9439	0.4719	17.61**	3.44	5.74
Interaction	6	0.1896	0.0316	1.18 ^{ns}	2.55	3.75
Error	22	0.5901	0.0268			
Total	**35**	**6.556**				

Aroma

In characterizing aroma, analysis of variance (ANOVA) at 5% level of significance was also used to determine if there is significant difference on the preference test scores on aroma. Result shows that there was a high significant difference between treatment recipes with Fc= 212.9; Ft = 3.05 for recipe, and Fc=16.35; Ft =3.44 for fillings, respectively. However, there was no interaction effect noted between the recipe and fillings, but rather a distinct difference in aroma were observed by the panellist between treatments (Table 2).

Table 2. ANOVA Result on the Aroma of the *Empanaditas* Formulations

Sources of Variation	Df	SUM OF SQUARE	MEAN SQUARE	F-COMPT	F- TAB	
					5%	1%
Replications	2	0.0176	0.0088	0.56 ^{ns}	3.44	5.74
Between Recipe	3	10.0321	3.3440	212.9**	3.05	4.81
Between Fillings	2	0.5134	0.2567	16.35**	3.44	5.74
Interaction	6	0.1722	0.0287	1.18 ^{ns}	2.55	3.75
Error	22	0.346	0.0157			
Total	**35**	**11.0813**				

 ISSN: 1656-0264

Texture

Texture was also characterized and statistically analysed using analysis of variance (ANOVA) at 5% level of significance. Result shows that there was a significant mean difference between treatment formulations, with Fc=11.07; Ft =3.05.Likewise, there was a significant mean difference between fillings, with Fc =17.71; Ft= 3.44.However, there was no interaction effect noted on the texture of both the crust and the fillings (Table 3).

Table 3. ANOVA Result on Texture of *Empanaditas* Formulations

Sources of Variation	Df	SUM OF SQUARE	MEAN SQUARE	F-COMPT	F- TAB 5%	F- TAB 1%
Replications	2	0.0004	0.0002	0.02 ^{ns}	3.44	5.74
Between Recipe	3	3.3210	1.1070	110.7**	3.05	4.81
Between Fillings	2	0.3541	0.1771	17.71**	3.44	5.74
Interaction	6	0.0767	0.0127	1.27 ^{ns}	2.55	3.75
Error	22	0.2180	0.010			
Total	**35**	**3.9702**				

Taste

Taste is a very important characteristic that is required of a food product. Using the analysis of variance (ANOVA) at 5% level, the significant mean difference of the perceptions of respondents on taste of the different veggie- fruit bumper recipes was determined.

It was observed that the taste of the baked product was affected by the kind of materials used in making the crust. There was a significant mean difference in the taste of veggie- fruit bumper between treatment- recipes with the computed Fc=75.77; Fα= 3.44. Likewise, there was significant difference on the kind of fillings used in the recipe formulation with Fc= 5.91; and Fα =3.44 (Table 4).

Table 4. ANOVA Result on Taste of *Empanaditas* Formulations

Sources of Variation	Df	SUM OF SQUARE	MEAN SQUARE	F-COMPT	F- TAB 5%	F- TAB 1%
Replications	2	0.0524	0.0262	1.38 ^{ns}	3.44	5.74
Between Recipe	3	4.2961	1.4320	75.77**	3.05	4.81
Between Fillings	2	0.2234	0.1117	5.91**	3.44	5.74
Interaction	6	0.1009	0.0168	0.88 ^{ns}	2.55	3.75
Error	22	0.4174	0.0189			
Total	**35**	**5.0902**				

 ISSN: 1656-0264

General Acceptability

The difference on the general acceptability of the formulated veggie-fruit bumper products was also determined using ANOVA at 5% level of significance. It was found out that there was significant difference on the general acceptability of veggie- fruit bumper product formulations with Fc =70.39; Ft =2.89; and, there was also significant difference between fillings with Fc = 9.476; Ft =3.32, respectively. There was no interaction effect noted by the panellist between the crust and the fillings when baked as one product (Table 5).

Table 5. ANOVA Result on General Acceptability of *Empanaditas* Formulations

Sources of Variation	Df	SUM OF SQUARE	MEAN SQUARE	F-COMPT	F- TAB 5%	F- TAB 1%
Between sensory attributes	3	2.5950	0.8650	2.29 ^{ns}	2.89	4.45
Between Recipe	3	6.6945	2.2315	70.39**	2.89	4.45
Between Fillings	2	0.6008	0.3004	9.476**	3.32	5.32
Interaction	6	0.0058	0.0009	0.028^{ns}	2.39	3.41
Error	33	1.0452	0.0317			
Total	**47**	**10.9413**				

3.5. Proximate Analysis of the Most Preferred *Empanaditas/* Veggie- Fruit Bumper

The most preferred recipe was the treatment with 50% all- purpose flour and 50% sweet potato flour with squash, mango and pineapple fillings. Samples of this treatment were analysed at the Regional Laboratory Center of the Department of Agriculture, Region VII for proximate analyses. The nutritional contents determined were the crude protein, crude fat, ash content and the moisture content of the product.

The proximate analysis revealed that the most preferred recipe had a high nutritional value. The crude protein was 3.67%, crude fat 1.34%, ash of 0.82% and moisture of 23.2%. The carbohydrate content was 49.9%, sodium was 1974mg/kg, potassium was 4859 mg/kg and calcium was 422 mg/kg.

However, the analysis done by USDA National Nutrient Database for Standard Reference has reported that, sweet potato had 28 grams of carbohydrates, 117 kcal calories, 2 grams protein, 0.1 gram fat, 3 grams of dietary fiber, 32 grams of calcium, 0.05 gram iron, 23 mg of magnesium, 397 mg of potassium, 28 mg of Vitamin C, 24877 IU of Vitamin A and 0.3 mg-ATE of Vitamin E. Sweet potato provides many other essential nutrients including Vitamin B6, potassium and iron. It is a good source of dietary fiber, which helps to promote a healthy digestive tract. It is virtually fat free, cholesterol free and very low in sodium.

 ISSN: 1656-0264

CONCLUSION

Based on the findings of the study, sweet potato flour was tested to be a good ingredient in making pastry crust. Veggie-fruit filling from the mixture of squash, mango, and pineapple was derived as the most acceptable recipe with the use of 50% sweet potato flour.

RECOMMENDATION

It is recommended that veggie-fruit bumper must be formulated using 50% sweet potato flour and 50% all-purpose flour for the pastry crust and to be filled with the mixture of squash, mango and pineapple. It is also highly recommended that a techno-guide in this study be used to those who would like to engage in extension activities in preparing veggie-fruit bumper product or the local term ***Empanaditas.***

LITERATURE CITED

Alkuino, J.M. 1986. Comparative Cost and Return Analysis of Indigenous Technologies in Rural Processing of Sweet Potato and Cassava. IDRC, VISCA, Baybay, Leyte.

Cabanilla, L.S. 1996. SweetPotato in the Philippines: Production, Processing and Future Prospects. Department of Economics, College of Economics and Management. UP Los Banos, Laguna.

Edmond. J.B. and C.R. Ammerman. 1981. Sweet Potatoes: Production. Processing and Marketing. AVI Westport, Connecticut.

Escalada, M.M. and E.L. Lopez. 1989. Farmers' Response to VISCA Sweet Potato Varities. VISCA, Baybay, Leyte

Gatchalian, M. 1989. Sensory Evaluation Methods for Quality Assessment and Development. College of Home Economics. UP, Diliman, Quezon City, Philippines. 175pp.

Laurente, C. (2013). *Technology guide for sweet potato (Ipomoea batatas) roll* (Unpublished master's thesis), Cebu Technological University, Cebu City, Philippines

Quilantang, V. (2014).*Techno-pack for sweet potato (ipomoea batatas) cookies* (Unpublished master's thesis), Cebu Technological University, Cebu City, Philippines

Galupo, D. (2013).*Technology adoption of guyabano (Annona muricata) pan de sal* (Unpublished master's thesis), Cebu Technological University, Cebu City, Philippines

Grant, V. & Gardner, B. (2003).*Select markets for taro, sweet potato and yam*, A Report for the Rural Industries Research and Development Corporation (RIRDC). Publication No. 03/052 RIRDC project no. UCQ-13A.

 ISSN: 1656-0264

Sosinski B, He J, Cervantes-Flores R, Pokrzywa M. Bruckner A, Yencho GC (2001). *Sweet potato genomics*. Proceedings of the First International Conference on Sweet Potato. Food and Health for Future, Acta Horticulture, 583:69-76.

FAO (2011). *A Statistical Database).*http://www.faostat.org/site/567/DesktopDefault.aspx?

Page ID=567#anchor (accessed October 7, 2012).

USADA (U.S. Department of Agriculture) (2009).*Agricultural research service*. USDA National Nutrient Database for Standard Reference, Release 22. Nutrient Data Laboratory Home Page.

Szalay, J. (2014). *Sweet potatoes: health benefits, risks and nutrition facts*. Retrieved Date (February 4, 2015) from http://www.livescience.com/46016-Sweet-potato-nutrition-html.

US Department of Agriculture: Dietary Guidelines for Americans (2010).Linus Pauling InstituteMicronutrientInformationCenterRetrievedin2011,http://www/livestrong.com/article/464450-durum-wheat-vs-whole-wheat.

J. Kamolwan, P., Yuthana and H. Vichai. (2003) *physicochemical properties of sweet potato flour and starch as affected by blanching and processing*. Starke, 55, 258.

USDA SR23. Nutritional Data on SkipThePie.org"Sweet potato, raw, unprepared" from (2010) http://www.skipthepie.org/vegetable-products-sweet-potato-raw-unprepared

Whole Grain Council 2004. Retrieved from http://www.wholegrainscouncil.org/Whole-grains-101/definition-of-whole-grains-(2013-03-29).