Development of Siomai Wrapper Enriched with Amaranth *(Amaranthus viridis)* Leaves Powder

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ABSTRACT

This study aimed to determine the sensory characteristics, physico-chemical content and cost analysis of cooked and uncooked siomai wrapper enriched with fresh and dried Amaranth leaves. Thirty purposely selected evaluators rated the product based on taste, odor and texture. Results show that wrapper with fresh leaves was more acceptable. Uncooked wrapper with fresh leaves was characterized with lightly green color, timoli gold color wrapper, slightly distinct amaranth odor and slightly smooth texture. Cookedwrapper have pure gift color, sapling color wrapper, slightly pleasing odor, moderately smooth, slightly soft, does not break up after cooking and holds filling, slightly distinct aftertaste and moderately starchy. The physico-chemical parameters were within acceptable level and have a cheaper cost. Incorporation of fresh leaves resulted to better sensory qualities as compared to the wrapper with dried leaves. Commercialization and product innovation of the siomai wrapper with fresh leaves is highly encouraged since it is more acceptable.

Introduction

Between the Ming and Qing dynasties, Shaomai is considered to have originated in Huhhot. Shaomai was served in tea houses as a secondary product as described by historical materials (Chefjohnjun, 2018). Additionally, Filipinos considered siomai as one of the most popular delicacies, and a favorite street food. Though this Philippine street food originated in China, Filipinos improved the taste by enhancing the different varieties or recipes of siomai of ground pork, fish, or even crab meat by adding it with peas or carrots then wrapped in wonton wrapper to make it more appealing (Allan, 2011). These are usually steamed or fried before being sold (BMSED, 2012). Since siomai is affordable and has good taste, Filipinos take it as a light snacks and a part of their main course.

According to the study of Blumberg, Frei, Fulgoni, Waever, and Zeisel (2017), the process of adding nutrients or non-nutrient bioactive components to edible products (e.g., food, food constituents, or supplements) is considered to be fortification. For consumers looking for supplement in their diet, fortification can be used to correct, prevent, balance and restore widespread nutrient intake shortfalls associated with nutrients deficiencies. Enhance nutrient intake of the population could be strategized through food fortification to help alleviate public health.

One possible vegetation that contain viable nutrients that could possibly be mixed with siomai is amaranth. In the botanical family, Amaranth locally known as "kulitis" (*Amaranthus viridis)* is a cosmopolitan species. This plant family is widely adaptive to different environmental stresses, such as drought (Sarker & Oba, 2018) and salinity (Sarker & Oba 2019a). Biochemicals such as carotenoids, proteins, essential amino acids, methionine and lysine, dietary fiber and minerals, such as magnesium, calcium, potassium, copper, phosphorus, zinc, iron, and manganese are present in the Amaranth leaves and stems. (Sarker, Islam, Rabbani, & Oba, 2014). Several pigments, such as carotenoids, chlorophylls, amaranthine, anthocyanins, betalains, betaxanthins, and betacyanins is also abundant in Amaranth (Sarker, Islam, Rabbani, & Oba, 2018a) and vitamin C, betacarotene, flavonoids, and phenolic acids that considered as natural antioxidant phytochemicals (Sarker, Islam, Rabbani & Oba, 2018b), Biochemicals, Several pigments and natural antioxidants act as reactive oxygen species (ROS) scavengers in the human body (Sarker & Oba, 2019a).

Ultimately, chronic health conditions such as diabetes, heart disease, cancer, and stroke can be prevented by amaranth. (Mercola, 2016). This was less utilized as food product but was found as a nutritious leaf. Luckily, it is abundant and it can be found in most supermarkets in the locality.

Framework of the Study

This study was anchored on the Food Fortification Act of 2000 of Republic Act No. 8976 which states that in the promotion of optimal health and to compensate for the loss of nutrients due to processing and/or storage of food, food fortification is considered important. It was further mentioned that food fortification be carried out to compensate inadequacies of Filipino diet, based on present-day needs as measured using the most recent Recommended Dietary Allowance (RDA).

According to Theory of Food, the limitations on the amount and availability of high quality, nutrient-dense foods that will marked the seasonality of foods and contributing to greater variety and periods of food shortage in the normal developing environment. Pollan (2008) has argued that people think more in terms of nutrients than food, which has in turn has led to confusion and ambiguity about what should or should not be eaten the modern dietary environment,

The incorporation of amaranth leaves will help solve the problem on micronutrient deficiency. Along this line, the researcher utilized the amaranth leaves to improve the nutritional value of siomai wrapper.

The original recipe of the siomai wrapper is made of flour which is more of carbohydrate-rich food. The added egg ingredient contributes to the protein content of the wrapper. However, it lacks the micronutrients that are essential for the health of the consumers. The micronutrients present in the amaranth will improve the siomai wrapper products available in the market.

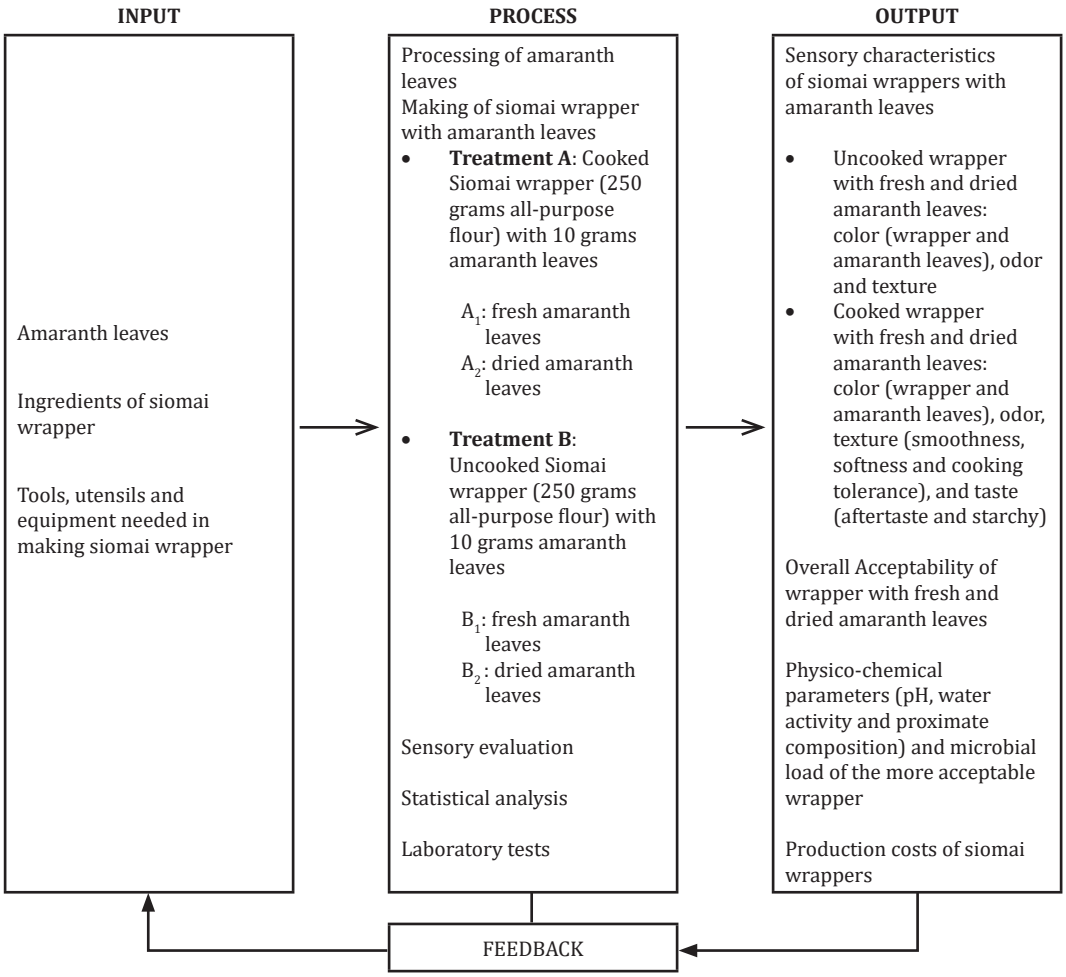

Figure 1. Relationships of the Variables

The relationship of the variables of this study is illustrated in Figure 1.

The researchers were encouraged to conduct an experiment to determine the acceptability of amaranth leaves to be enriched in siomai wrapper.

Specifically, this study sought to answer the following questions:

1. What are the sensory characteristics of the cooked and uncooked siomai wrapper enriched with amaranth leaves (fresh and dried) in terms of color (wrapper and amaranth leaves), odor, texture (smoothness, softness and cooking tolerance), and taste (aftertaste and starchy)?
2. What is the overall acceptability of the siomai wrapper enriched with amaranth leaves (fresh and dried)?
3. Is there a significant difference in the overall acceptability of siomai wrapper enriched with amaranth leaves (fresh and dried)?
4. What are the physico-chemical parameters (pH, water activity and proximate composition) and microbial load (total viable count)

of the most acceptable siomai wrapper?

5. How much is the production costs of the siomai wrapper with fresh and dried amaranth leaves?

Methodology

Research Design

Experimental method of research was employed in conducting the study. This research design was considered appropriate for this study because it aimed to characterize and determine the overall acceptability of the siomai wrapper enriched with amaranth leaves. One siomai wrapper was incorporated with fresh amaranth leaves while the other wrapper was added with dried amaranth leaves.

The experimental lay-out of the study was determined using the fish bowl method. Sheets of paper were written with the Treatment A or B and the replication of each treatment.

Evaluation

There were thirty (30) evaluators composed of Home Economic graduate school students of a university in Iloilo City. They were purposively selected after the triangle test. The aforementioned test was done and supervised by the researchers. They were given three glasses of fresh milk. They were requested to identify the same fresh milk using their different senses. Those who correctly identified the same fresh milk were tagged as expert evaluators. They were purposively selected because of their expertise in the sensory evaluation of food products.

Sources of Data

The sources of data for the sensory characteristics and overall acceptability were the responses of the evaluators while the laboratory results of the physico-chemical and microbial test were based on the analysis conducted by the School of Technology, University of the Philippines Visayas, Miagao, Iloilo.

Cooked Siomai Wrapper

Treatment A_1: Replication 1	Treatment A_1: Replication 3	Treatment A_2: Replication 3
Treatment A_2: Replication 2	Treatment A_2: Replication 1	Treatment A_1: Replication 2

Uncooked Siomai Wrapper

Treatment B_1: Replication 1	Treatment B_1: Replication 3	Treatment B_2: Replication 3
Treatment B_2: Replication 2	Treatment B_2: Replication 1	Treatment B_1: Replication 2

Figure 2. Experimental Lay-out of the Study

Legend:

Treatment A_1 - cooked siomai wrapper (250 grams all-purpose flour): 10 grams fresh amaranth leaves

Treatment A_2 - cooked siomai wrapper (250 grams all-purpose flour): 10 grams dried amaranth leaves

Treatment B_1 - uncooked siomai wrapper (250 grams all-purpose): 10 grams fresh amaranth leaves

Treatment B_2 - uncooked siomai wrapper (250 grams all-purpose): 10 grams dried amaranth leaves

Preparation of Amaranth Leaves

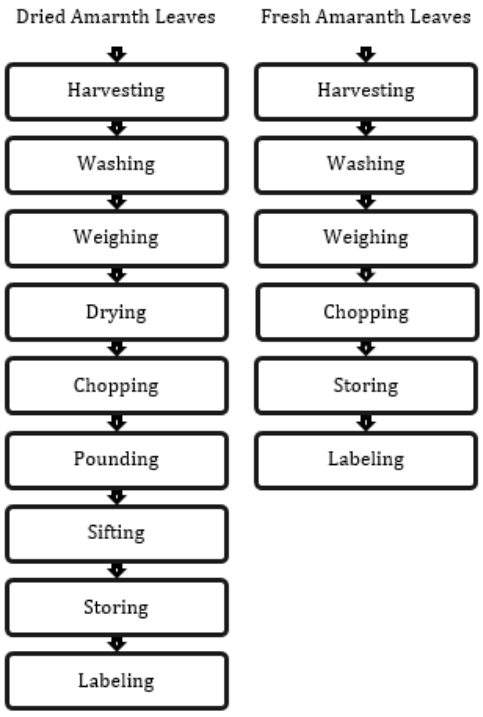

Figure 3. Process in Preparing Fresh and Dried Amaranth Leaves

Standardization of Siomai Wrapper Recipe

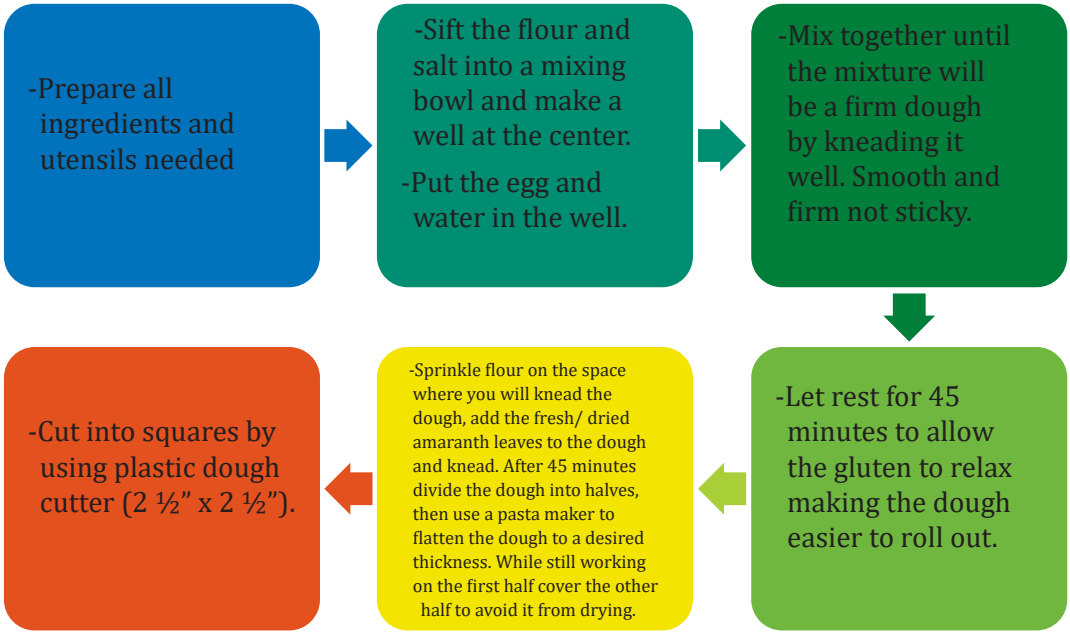

Figure 3. Process in Standardization of Recipe

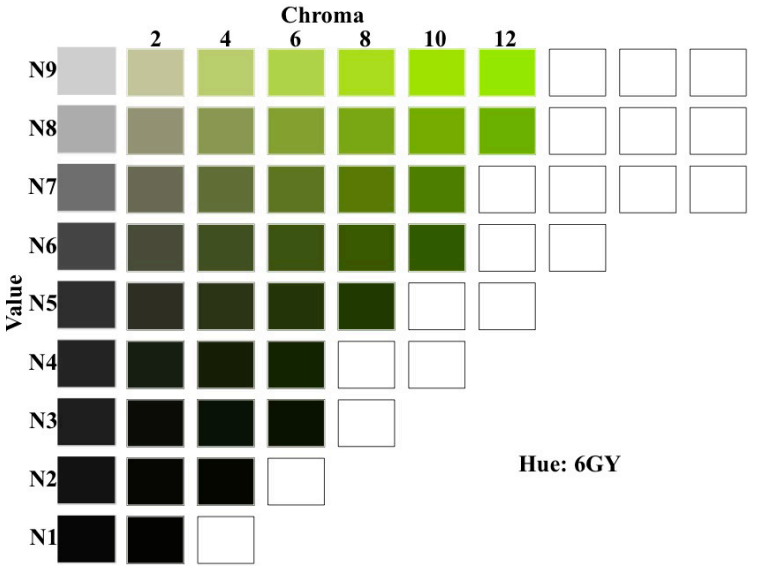

Figure 4. Color of the Wrapper: 6GY Value and Chroma Based on Munsell Chart

Data Processing

After the finished product was evaluated by the panel of evaluators, the researchers gathered the score sheets for analysis of result. Data were tallied, tabulated and analyzed.

The frequency and percentage were used in sensory characterization while mean was used in overall acceptability. The t-test was employed to ascertain the significant difference between the two treatments. All tests were set at .01 level of significance.

The arbitrary scale for the overall acceptability were as follows:

8.50-9.00 Liked extremely
7.50-8.49 Liked very much
6.50-7.49 Liked moderately
5.50-6.49 Liked slightly
4.50-5.49 Neither liked nor disliked
3.50-4.49 Disliked slightly
2.50-3.49 Disliked moderately
1.50-2.49 Disliked very much
1.00-1.49 Disliked extremely

Results

This section presents a summary of the research findings and analysis of the data used in the study.

Comparing the result of this study to the color based on Nippon Paint Philippines, Inc. Colours, the color of the fresh amaranth leaves (6GY 8/4) is closely alike to lightly green while the dried amaranth leaves (6GY 4/4) is blueberry.

Results showed that the color of the fresh amaranth leaves was characterized as 6GY 8/4 (16.67%) while the dried amaranth leaves was identified as 6GY 4/4 (16.67%).These findings showed that the fresh leaves have higher color value (lightness of color) than dried leaves. However, the two have equal chroma (color purity). These findings imply that the hue (green color) of the leaves were affected by drying process because there was a change in the lightness of the leaves. The leaves were darkened by the drying process.

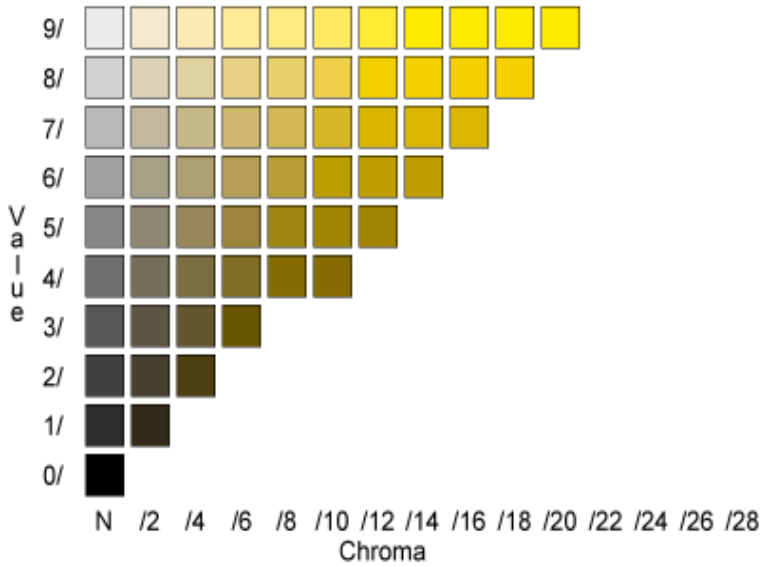

Figure 5. Color of the Wrapper: 5Y Value and Chroma Based on Munsell Chart

Such can be explained by the behavior of major color pigment present in amaranth leaves which is chlorophyll. According to Śledź, Nowak and Witrowa-Rajchert, (2014) (as cited by Rubinskienė, Viškelis, Dambrauskienė, Jonas Viškelis, & Karklelienė, 2015) degradation can also influence the deterioration of color. The results also show that drying has a significant impact on chlorophyll degradation.

About 16.67% of the respondents characterized the siomai wrapper with fresh amaranth leaves as 5Y 5/8 as to color. The same percentage, 16.67% of the respondents rated the siomai wrapper with dried amaranth leaves to be 5Y 4/4 .

This results means that in terms of value, the uncooked siomai wrapper with dried amaranth leaves was lighter. As to chroma, the same wrapper had lower purity in color. This implies that the kind of leaves incorporated in the siomai wrapper had an effect on the hue (yellow color) of the wrapper.It can also be deduced that incorporation of dried leaves can reduce both the value and chroma of the siomai wrapper.

The findings are closely similar with the findings of Sant'Anna, PortaChristiano, Ferreira Marczak, Tessaro and Cruz SilveiraThys (2014). Their results showed that incorporation of dried grape marc powder had contributed to the changes in color of the fettuccini pasta. The same result was obtained in this study that the kind (fresh and dried) of amaranth leaves added to the siomai wrapper led to a difference in color of the two treatments.

Comparing the result of this study to the color based on Nippon Paint Philippines, Inc. Colours., the color of the fresh amaranth leaves (6GY 8/2) is closely alike to pure gift while the dried amaranth leaves (6GY 6/4) is bronze olive. Such findings show that the color of the cooked siomai wrapper with fresh amaranth leaves was evaluated by 16.67% of the panelist as 5Y 6/4 . As compared to its color before cooking which was 5Y 5/8, there was a decrease in its value but increased in its chroma. The color of the cooked siomai wrapper with dried amaranth

leaves on the other hand was characterized as 5Y 4/4  . The same color specification was observed when the wrapper was not cooked. This means that there is no change in color. Egg yolk which has carotenoid (Schieber & Weber, 2006) contained in the added egg to the siomai contributed to the small tint of yellow in the color of the wrapper. Based on the findings of Hwang, Stacewicz-Sapuntzakis, and Bowen (2012), the average concentration of carotenoids increased when the fresh tomato was heated. This explains the increase in the chroma of the cooked siomai wrapper with fresh amaranth leaves as the chlorophyll degraded. However, this was not apparent in the siomai wrapper with dried amaranth leaves. The concentration of chlorophyll in the wrapper did not resulted to obvious change in the color.

Table 1

Over-all Results of Sensory of Characterization of Siomai Wrapper Enriched with Amaranth (Amaranthus viridis) Leaves

Parameters				Treatment A (Fresh)	Treatment B (Dried)
Uncooked		Odor	f	11	13
			%	36.67	43.33
			Description	Slightly distinct amaranth odor	Slightly distinct amaranth odor
		Texture	f	11	9
			%	36.67	30.00
			Description	Slightly Smooth	Slightly Smooth
Cooked		Odor	f	12	11
			%	40.00	36.67
			Description	Slightly pleasing odor	Moderately pleasing odor
	Texture	Smoothness	f	11	11
			%	36.67	36.67
			Description	Moderately smooth	Slightly smooth
		Softness	f	17	12
			%	56.67	40.00
			Description	Slightly soft	Slightly firm
		Cooking tolerance	f	18	18
			%	60.00	60.00
			Description	Does not break up after cooking and holds filling	Does not break up after cooking and holds filling
	Taste	Aftertaste	f	15	13
			%	50.00	43.33
			Description	Slightly distinct aftertaste	Moderately distinct aftertaste
		Starchy	f	10	9
			%	33.33	30.00
			Description	Not starchy and moderately starchy	Moderately starchy
General Acceptability			Mean	7.48	6.41
			Sd	0.84	0.77
			Description	Like moderately	Like slightly

Winger, Khouryieh, Aramouni, and Herald (2014) also mentioned that flour color is also correlated to ash content which is used as an indicator of bran and germ contamination in milling. However, this was not so significant once the noodles were cooked. In relation to the present study, the effect of heat on the whiteness of the wrapper, contributed to color change.

The result of the present study was similar with the result to the study of Zhang, Ye, Liu, Xiao, Sun and He (2011). Evidently, the result shows that variation in color of the boiled dumpling sheet was less broader than that of the raw dumpling sheet in terms of sensory evaluation parameters of among tested wheat cultivars. This is an indication that the filling influence on dumpling color. In the present study, the result shows that cooking the siomai wrapper enhanced the color of the product particularly with fresh amaranth leaves.

Table 1 shows that 36.67% of the evaluators rated the odor of the uncooked siomai wrapper as *slightly distinct amaranth odor*. The same description of *slightly distinct amaranth odor* was given to the wrapper with dried amaranth leaves by 36.67% of the evaluators. These results means that regardless of the kind of amaranth leaves either fresh or dried added to the siomai wrapper, the amaranth odor was only *slightly distinct*.

The findings are supported by the result of Mathur, Khatri, Samanta, Sharma, and Mandal (2010) who characterized the amaranth leaves particularly the species *Amaranthus spinosus Linn*. The results of the morphological properties of the leaves show that amaranth has a characteristic odor. In this study, the characteristic amaranth odor was perceived as slightly distinct incorporated in the siomai wrapper. This finding implies that 10 grams of fresh or dried amaranth leaves added to 250 grams of flour, 115 grams water, 6 grams salt and 53 grams egg can yield a siomai wrapper with slightly distinct amaranth odor. The amount of amaranth leaves in proportion to the other ingredients is just enough that the amaranth will not have a strong characteristic odor when sniffed.

Furthermore, the Table 1 shows that the uncooked siomai wrappers enriched with both fresh (36.67%) and dried (30.00%) amaranth leaves were characterized as *slightly smooth in texture*. This finding means that wheteher the amaranth added was fresh or dried, the same smoothness will be achieved.

The smoothness of the wrapper was influenced by the process of making the product. Gray (2015) cited that the three major factors that affect texture of the pasta were kneading, resting and rolling. In the later step, the laminating process has to do with the final texture of the dough. Laminating is the basic process of folding the dough into smaller package and feeding it back into the pasta-maker. Relatedly, the later study imply that kneading the dough properly, allowing it to rest for 45 minutes, and running it through the pasta maker will yield a smooth siomai wrapper. The addition of amaranth leaves either fresh or dried, and both were powdered form, the rolling in pasta maker process employed yielded to the same smoothness of the two treatments.

As to the odor, 40.00% of the evaluators rated the cooked siomai wrapper with fresh amaranth leaves was described as *slightly pleasing odor* while the cooked siomai wrapper with dried amaranth leaves was described as *moderately pleasing odor* by 36.67% of the evaluators. This result means that the siomai wrapper with dried amaranth leaves have a more pleasing odor among the two treatments.

On the other hand, 36.67% of the evaluators rated the texture (smoothness) of the siomai wrapper, cooked siomai

wrapper *moderately smooth*. This treatment obtained a better texture as to smoothness as compared to the cooked siomai wrapper with dried amaranth leaves. The latter was described by 36.67% of the evaluators as *"slightly smooth"*.

Kenghe, Nimkar, and Shirkole (2011) further explained in their findings that drying the curry leaves using tray drying yielded to a product that are more porous and uniform in structure than those obtained from sun and shade drying. This literature conforms to the present study that the wrapper with dried amaranth leaves has inferior texture as to smoothness. Aside from moisture loss in the drying process, the amaranth leaves have coarser texture since it was air dried. Thus, it affecting the smoothness of the wrapper.

The results show that as to the texture (softness), 56.67% of the panelists rated cooked siomai wrapper with fresh amaranth leaves *slightly smooth* while cooked siomai wrapper with dried amaranth leaves was described as *slightly firm* by 40.00% of the evaluators. This result means that the siomai wrapper with fresh amaranth leaves yielded to a softer cooked siomai wrapper.

This finding is closely similar with the result of Gray (2015), who observed that the wrapper that was not allowed to rest for a period of time was firmer and tougher. In the current study, although the dough of the two treatments were allowed to rest, the wrapper with dried amaranth leaves was firmer. Resting allowed the further distribution of moisture in the dough, but the dried leaves has less moisture than the fresh leaves and usually dried leaves have lesser pores where moisture could easily penetrate.

Moreover, 60.00% of the evaluators rated the texture (cooking tolerance) for the both cooked siomai wrapper with fresh and that with dried amaranth leaves as *does not break up after cooking and holds filling*. This result means that regardless of the method of preparation of amaranth leaves, the texture (cooking tolerance) of the siomai wrapper was the same.

Huang, Xiong, Kong, Huang, and Li (2013) claimed that traditional wonton wrappers were added with egg to have good quality characteristics. The integration of egg to wonton wrapper resulted to smooth wrappers that can withstand the heating process and cooking tolerance. This additive does not break up during heating. In the current study, egg was also added in the siomai wrapper to help in the gluten formation of the mixture during processing.

About 43.33% of the evaluators rated the aftertaste of siomai wrapper with dried amaranth leaves with *moderately distinct aftertaste* as compared to the wrapper with fresh amaranth leaves which was described as *slightly distinct aftertaste* by 50.00% of the evaluators. This means that 10 grams of dried amaranth leaves produced more distinct aftertaste than 10 grams of fresh amaranth leaves. Connectedly, the result of Mathur, Khatri, Samanta, Sharma, and Mandal (2010) in the morphological properties of amaranth revealed that the leaves were bitter in taste. Amaranth contains phenolic compounds and in this current study, the compounds were more concentrated in the dried leaves due to weight loss that went along with the moisture loss during the drying process.

In terms of a feeling of starchiness, 33.33% of the respondents evaluated the cooked siomai wrapper with fresh amaranth leaves as *not starchy* and *moderately starchy* while the wrapper with dried amaranth leaves was described as *moderately starchy* by 30.00% of the respondents. This finding means that the two treatments were almost the same in terms of starch taste of the wrappers.

As to overall acceptability, Table 1 shows that, siomai wrapper enriched with

fresh amaranth leaves had a mean rating of 7.48 described as liked moderately while siomai wrapper enriched with dried amaranth leaves had a mean rating of 6.41 described as liked moderately.

Based on the data, the siomai wrapper enriched with fresh amaranth leaves seems to be more acceptable. This finding implies that the over-all characteristics of the siomai wrapper with fresh amaranth leaves were more preferred by the respondents. These characteristics include: for uncooked wrapper, it has *slightly distinct amaranth odor* and *slightly smooth as to texture*; while for the cooked wrapper, the characteristics were has *slightly pleasing odor, moderately smooth, slightly soft, slightly distinct aftertaste, not/moderately starchy* and *does not break up after cooking and holds filling*.

To find out if there are significant differences in the level of acceptability between the two products of siomai wrapper enriched with amaranth leaves as to general acceptability, Analysis of Variance was computed at 0.01 level of significance. There is a significant difference in the general acceptability of the two products ($t = 5.127$, $df = 58$, $p = .000$). Since the probability is less than the .01 level of significance, the hypothesis of no difference is rejected.

Table 2

Result of Physico-Chemical and Microbial Parameters of the More Preferred Wrapper

Parameter	Result
Ph	5.05
Water activity	.967
Moisture content	66.68%
Total plate count	3.36×10^3cfu/g
Crude fat	1.34%
Protein	13.27%
Crude fiber	16.39%

Table 2 shows that the pH level of the siomai wrapper with fresh amaranth leaves is less than that of the neutral value, which means that the wrapper is acidic. According to the National Center for Home Food Preservation (2009) low-acid foods have pH values higher than 4.6 which implies that the siomai wrapper in this study is a low-acid food.

Laboratory findings also revealed that the water activity (a_w) of the siomai wrapper incorporated with fresh amaranth leaves was .967. Based on the concept cited by Sonido, Chavez, and De Leon (2012), microorganisms that can grow at a_w of .95 include *Pseudomonas, Escherichia, Proteus, Shigella, Klebsiella, Bacillus, Clostridium perfringens* and some yeasts. The common examples of foods with this water activity level are highly perishable foods. Hence, such implies that the siomai wrapper with fresh amaranth leaves is highly perishable towards spoilage. This water content of the fresh also contributed to the total water content of the wrapper. Furthermore, the result of water activity is parallel with moisture content which was 66.68%. This finding contradicts with the result of Self-Nutrition Data (2014) that the wonton wrapper had a moisture content of 28.75. However, in this current study, the wrapper was incorporated with fresh amaranth leaves. Results of the study of Funke (2011) revealed that chopped fresh amaranth leaves had a moisture content of 90.35. This level of water content of fresh amaranth leaves contributed to the higher moisture content of the formulated siomai wrapper in this study.

The water content in the food influences the population of microorganisms in the food. As shown in Table 2, the total plate count of the siomai wrapper with fresh amaranth leaves was 3.36×10^3 colony forming units per gram (cfu/g).

Based on the microbiological standards set by Food Standards Australia,

Table 3

The Cost Analysis of the Raw Ingredients

Ingredients	Fresh		Ingredients	Dried	
	Qty.	Cost (Php)		Qty.	Cost (Php)
all-purpose flour	2 cups	15.00	all-purpose flour	2 cups	15.00
Water	½ cup	-	Water	½ cup	-
Salt	¾ tsp	0.50	Salt	¾ tsp	0.50
Egg	1 pc	6.00	Egg	1 pc	6.00
Fresh Amaranth Leaves	10 g	13.00	Dried Amaranth Leaves	10 g	26.00
	TOTAL	34.50		TOTAL	47.50
	No. of wrapper	130 pcs		No. of wrapper	80 pcs
	Cost per piece	0.30		Cost per piece	1.75

the standard plate count of ready to eat foods is 10^4. The microbial load of the wrapper in this study is acceptable based on such standards. Though the product was prepared without heat treatment, the microbial load is still below the standard for ready to eat foods. This microbial population is expected to decrease when the wrapper is cooked. According to Sonido, Chavez, and De Leon, (2012), the application of heat can destroy microorganisms.

Considering the nutritional content of the siomai wrapper with fresh amaranth leaves, it contained 1.34% fat, 13.27% protein and 16.39% crude fiber.

These findings mean that the wrapper contains small amount of fat. Moreover, it also contains a considerable amount of protein because aside from the fact that all-purpose flour contains protein, there was an addition of egg which is rich in protein. Amaranth also contains 2.5% protein (Nutrition Value Organization, 2016).

Whereas considering the crude fiber, the siomai wrapper in this study had higher crude fiber (16.39%) than that of the wonton wrapper of Self-Nutrition Data (2014) which was only 3.13%. This finding implies that the addition of fresh amaranth leaves improved the fiber content of the wrapper.

Table 3 shows that siomai wrapper with fresh amaranth leaves entails the lower costs of PhP 34.50 and the cost per piece of the wrapper is PhP 0.30 while the siomai wrapper with dried amaranth leaves costs PhP 47.50 and the cost per piece of the wrapper is PhP1.75.

This computed cost implies that siomai wrapper with fresh amaranth leaves was cheaper due to the large number of wrapper produced.

Conclusion and Recommendations

This experimental study aimed to characterize and determine the overall acceptability of the siomai wrapper enriched with amaranth leaves. One siomai wrapper was incorporated with fresh amaranth leaves while the other wrapper was added with dried amaranth leaves.

Wrapper with fresh amaranth leaves yielded a better product because of the presence of chlorophyll. Drying process can degrade the chlorophyll content of leaves. It further shows that incorporating the fresh leaves resulted to better sensory qualities particularly in terms of odor, texture and lesser aftertaste of the cooked siomai wrapper as compared to the wrapper with

dried amaranth leaves. This was the effect of the lesser compound concentration and higher water content of the fresh leaves. In drying, there was moisture loss and resulted to higher concentration of flavor compounds that led to more distinct aftertaste. Moreover, evaluators preferred most is the wrapper with fresh amaranth leaves due to its slightly pleasing odor, moderately smooth texture, slightly soft texture when cooked and slightly distinct aftertaste. During the drying process of the amaranth leaves it exhibited a significant decreased in the over-all acceptability of the siomai wrapper. The siomai wrapper with fresh amaranth leaves is a low-acid food, highly perishable food, nutritious and with acceptable microbial load. Furthermore, siomai wrapper with fresh amaranth leaves was more acceptable in terms of production cost because it entailed lesser cost of ingredients and yielded more pieces of siomai wrapper. Enriching the wrapper with fresh amaranth leaves is considered to be economically advantage since it is easily grown anywhere.

The sensory characterization, physico-chemical determination and cost analysis of siomai wrapper enriched with amaranth (*amarathus viridis)* leaves was another very good venue in enriching common foods. Amaranth is a local plant in the community that was considered as a rich source of vitamins and minerals.

It is recommended that dissemination of product innovation using amaranth leaves through lectures, trainings and extension activities. Commercialization of the siomai wrapper with fresh amaranth leaves is highly encouraged since it is more acceptable. Homemakers were encouraged to make their own siomai wrapper enriched with amaranth leaves mixed with other nutritious leaves. Further studies will be conducted on: a) shelf-life tests, detailed nutritional analysis, and resting time analysis of the product; b) the effect of storage on the nutritional value and microbial load of the siomai wrapper with fresh amaranth leaves; c) reduction of amount of dried amaranth leaves on siomai wrapper d) utilization of amaranth leaves as juice and its blended form to be processed as food products and e) policy towards economic impact of amaranth leaves and to its maximum utilization in different sectors of the society.

Further studies of amaranth leaves and as well as utilization of other parts of the plant as food enhancer, additive, infusion and enrichment is suggested. Level of the biochemicals and other nutrients may differ in terms of age, location and season may greatly affect the amaranth plant. Parameters such as previously mentioned may be addressed for future studies. Maximizing further the capacity of the plant for research purposes in the field of food science will be very useful especially during this time of pandemic.

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