Watermelon Rind-Ponkan Marmalade: A Physico-chemical Analysis

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Abstract. Today’s consumers are becoming health conscious and this has led to the demand of fruits and vegetable which wastes like the rinds, skins or peels from such are also produced. This study aimed to divert wastes into an innovative food product. Specifically it aimed to utilize watermelon rind and ponkan peelings into marmalade. A quantitative research method is used in the analysis of this study. Four treatments of marmalade were prepared and the most acceptable treatment was analyzed for physicochemical properties. Research results showed that the four treatments of marmalade are acceptable and do not have significant differences in terms of its characteristics and general acceptability. Among the four treatments, T 277 and 482 are the most acceptable with a computed value of 7.73 which means liked very much. The physicochemical analysis of T 277 results (pH-5.39, TA-0.360, WA- 26.66%, TSS-66.3%, Vit. C-below DL, Ash-0.53, Fat-0.85%) are more acceptable as compared with T 482 (pH-5.398, TA-0.354, WA-31.32%, TSS-56.4%, Vit. C-below DL, Ash-0.71 Fat-0.36%). Furthermore, for the sample’s microbial load count, treatment 277 has lesser microbial load which is 70 and 60 CFU respectively while treatment 482 has 70 and 100 CFU in the two batches of samples which were analyzed. Thus in terms of physicochemical properties and microbial analysis, T 277 is more ideal. From the results of the study conducted, it is concluded that the acceptable ratio should be 2:1 that is 400 grams watermelon rind to 200 grams ponkan juice. Specifically, the measurement of ingredients is found to be within a good proportion for marmalade making. A techno-guide on Watermelon Rind Marmalade was then developed showcasing its physico-chemical properties, recipe and costs.

1. Introduction
Generally, today’s consumers are becoming more health conscious and are very particular of the food they eat. Individuals regardless of how old they are care most on the issues of nutrition, fitness, work-related stresses and environment [8]. Fruits, as well as vegetables, are one of the most consumed healthy foods which come in different varieties and are recommended to become part of adults’ diet of at least 400g (5 servings) daily in their meals [20]. In the Philippines, one of the most commonly served fruits in the dining table is watermelons and ponkans. Watermelon pulps are eaten raw, mixed with some fruits for tropical salads, added and blended with milk for shakes, processed as jams or jellies and many other culinary uses. However, the extensive uses and consumption of watermelon pulp also pile up wastes since the rind and skin of the fruit is usually thrown away. The rind is the white layer of the fruit which is often discarded after eating the red fleshy parts and which contains more of the amino acids citrulline. These amino acids are converted to the amino acid arginine and are
valuable to a healthy cardiovascular system and improved circulation as it promotes blood flow [18]. The rind of watermelon is higher in percentage in terms of fresh weight, potassium, and dietary fiber; however, compared to the flesh, the rind is lower in total sugar [12]. Ponkans are also commonly served fruits in the dining table. These are varieties of high yield citrus cultivations with large size fruits similar to oranges [14]. The fruit is a natural source of vitamin C [15] and is readily available in the supermarket at a very inexpensive price. Just like watermelons, ponkans are juicy and is consumed raw leaving the peelings as additional bulk for waste.

With considerable consumption of watermelons and ponkans, a great volume of wastes from its rinds and skins is also produced. Although these watermelon rinds and ponkan peelings are biodegradable, these, however, are still edible and could be a potential source of healthy food and a viable source of nutrients. The purpose of this study is to divert fruit wastes into an edible food product which is less caloric and may provide essential nutrients. Diverting fruit waste such as the rind and peelings into edible food product helps lessen the waste products being thrown and therefore helping the environment. This study aims to utilize watermelon rind and ponkan juice and peelings to develop into marmalade. Furthermore, it aims to evaluate the acceptability and physicochemical characteristics of the marmalade to ensure its nutritious content and to determine its microbial load count on yeasts and mold to ensure it is within safety limits for consumption, therefore making it appealing options for consumers who opted for a healthy lifestyle of consuming fruits in their diet. Significantly, food processing and preservation which are vital in home economics education in the K-12 curriculum enable students to learn the various ways of innovating food products. This research process as a multidisciplinary research also involves significant contribution in the field of science and technology as it involves research analysis and process that entails discovery of innovative food product and in the field of sustainable development studies as it involves diverting food wastes into a food product. Therefore, students would be able to derive idea from this innovative recipe and would serve as an avenue of discovering recipes which could be derived from food wastes which will be an ideal food to be served and consumed.

1.1 Statement of the Problem

This study aims to determine the acceptability of watermelon rind and ponkan into marmalade and to assess the physicochemical characteristics of the product. Specifically, it seeks to answer the following questions:

1. What are the attributes of watermelon rind-ponkan marmalade in terms of;
   a. Color
   b. Aroma
   c. Taste
   d. Texture
   e. Spreadability

2. What is the acceptability of the watermelon rind-ponkan marmalade in terms of its sensory attributes:
   a. Color
   b. Aroma
   c. Taste
   d. Texture
   e. Spreadability

3. What is the level of acceptability of each treatment of watermelon rind-ponkan marmalade?

4. Is there any significant difference among the four treatments in terms of the level of its acceptability?

5. Is there any significant difference among the four treatments in its characteristics in terms of color, aroma, spreadability, taste and texture?

6. What are the properties of watermelon rind-ponkan marmalade in terms of?
   6.1 Physico-chemical properties
6.2 Microbial Analysis

7. What Techno-guide can be developed based on the findings of the study?

1.2 Null Hypothesis

Ho: There is no significant difference among the four treatments in terms of color, aroma, spreadability, taste, and texture.

Ho: There is no significant difference among the four treatments in terms of its general acceptability.

Theoretical Background

2. Methodology

2.1 Research Design

A quantitative research method was used in this study. In this study, four treatments were cooked and each had undergone quantitative evaluation of sensory attributes and acceptability of each attribute. The general acceptability of each treatment was evaluated in order to determine the most acceptable treatment. Each treatment was compared to determine if there are any significant differences in each treatment. The most acceptable marmalade was then assessed for physico-chemical and microbial analysis.

2.2 Participants

The research participants were eleven (n=11) sets of panel of tasters who were composed of the faculty members handling food laboratory subjects in the field of Technology and Livelihood Education, Hotel and Restaurant Management and Home Economics and who are purposively chosen since they are considered as experienced and knowledgeable in food sensory evaluation. These panels of tasters have determined the acceptability and sensory attributes of the four treatments of Watermelon rind-ponkan marmalade.

2.3 Research Instruments

A research questionnaire was used as an instrument for the data gathering and analysis. It was used to assess the acceptability and the sensory attributes of the watermelon rind-ponkan marmalade. The research instrument was composed of two parts: the sensory evaluation scorecard and the hedonic scale which were used in the data gathering process.

The first part of the questionnaire was used to determine the characteristics of the Marmalade in terms of color, aroma, texture, taste and spreadability. The acceptability of each characteristic was determined by the respondents by giving a score from one (1) to five (5) were in five (5) is the highest and represents liked extremely while one (1) is disliked extremely. The second part of the research questionnaire is the hedonic scale which was used to determine the over-all acceptability [19] of the Marmalade among the panels of tasters. The research instrument was filled in by the panel of tasters through writing a check mark on the box that correspond the answer of their choice and the number that corresponds the rate of their acceptability of the product’s characteristics.
2.4 Procedures

This study involved three phases of the research procedure which are product development, product testing and product evaluation and analysis.

**Product Development Phase**
- Development of Ideas for New Product

**Product Testing**
- Preliminary Experimental Testing
- Experimental Process
- Preparation of the four Treatments
- Final Recipe of the Four Treatments

**Product Evaluation and Analysis**
- Sensory Attributes Evaluation
- Physico-Chemical Analysis
- Microbial Analysis

Specifically, the study’s product development set up have four treatments of the watermelon rind-ponkan marmalade. Figure 1 shows the process flowchart of the product development of Marmalade. The four treatments have the same preparations of the ingredients as made in the second experimental trial. However the measurement of the main ingredient which is the watermelon rind is different from each treatment while the rest of the ingredients have the same measurements. Each treatment undergoes quantitative analysis on the sensory attributes and the product’s general acceptability. The sensory attributes evaluated includes color, aroma, spreadability, taste and texture [6]. The overall acceptability of the product is also evaluated among the four treatments using the hedonic scale. After determining the most acceptable marmalade among the four treatments, the most acceptable treatment

![Figure 1. The process flowchart of the product development of Marmalade.](image-url)
undergoes physico-chemical analysis. The physico-chemical analysis includes pH, titratable acidity, water content, total sugar, and density, microbial load count of yeasts and molds and nutritional analysis. Specifically Nutritional analysis includes analysis of ash content, fat, and vitamin C.

The quantitative analysis of the sensory attributes of the product is significant to determine whether the developed food product meets the desired characteristics, and to evaluate differences in terms of content and acceptability between prepared treatments. The general acceptability of the product was measured to determine whether the product is acceptable and ideal for consumption. Furthermore the physico-chemical analysis of the developed product was evaluated to determine the content and benefits of the product to the consumers.

2.5 Data Analysis

The data gathered was tabulated and statistically treated using the weighted mean and the Analysis of Variance or ANOVA.

3. Results and Discussions

Characteristics of the Four Treatments of Watermelon Rind-Ponkan Marmalade

Table 1 shows the characteristics of the four treatments of watermelon rind-ponkan marmalade as evaluated by the panel of tasters.

For the color, treatment number 619 and number 277 had Light orange color with a mean result of 4.00 and 3.45 respectively. Treatment number 482 and number 652 obtain a computed value of 2.91 and 3.09 respectively with a description that each treatment has a yellow orange color.

It can be established that treatments which have nearer value or measurement of the watermelon rind in the recipe have similar color.

The aroma of each treatment were evaluated as moderately pleasant with a computed value of 4.00 for treatment number 619, 4.09 for treatment number 277, 3.90 for treatment number 482 and 3.82 for treatment 652. Treatment number 619 received the highest computed value of 4.09. The similar perception of the respondents on the aroma can be linked to the impact of the odor of the watermelon rind to the marmalade mixture since it is the main ingredient which is higher in quantity as compared with ponkans.

The characteristics on Spreadability of the watermelon rind-ponkan marmalade received highest rating among all the characteristics being evaluated. Treatment 277 obtained a computed value of 4.46 with a qualitative description of very spreadable and is also the treatment with the highest computed value for spreadability. Treatment 619 has a computed value of 4.36 which is also very spreadable. Treatment 482 obtained 4.18 with a description of spreadable while treatment 652 has the lowest computed value of evaluation which is 4.09 with a qualitative description of spreadable.

In terms of the taste of the marmalade, treatment number 619 and treatment number 482 obtained the highest computed value of 4.09 both treatments have very sweet and moderately sour taste. Treatment 277 has a computed value of 3.90 and treatment 652 has 3.45 both of which the same descriptions with the first two treatments which is very sweet and moderately sour. All four treatments have the same quantity of sugar and ponkan juice which have contributed to the very sweet and moderately sour taste. It can also be concluded that the quantity of watermelon rind have little impact on the taste of the marmalade since the rind itself has generally bland taste.

The results on the evaluation of the texture as perceived by the panel of tasters are also the same among the four treatments which is smooth and firm jelly. The treatment with the highest computed value is treatment number 652 which is 4.0 followed by the three remaining treatments which are treatment number 619, 277 and 482 all of which have a computed value of 3.91.

The characteristics of each treatment can be linked to the effect of the balance quantity or amount of ingredients. It is important to remember that the balance content of sugar pectin and acid source are all essential in achieving the desirable and acceptable characteristics of marmalade [28] in terms of color, aroma, spreadability, taste and texture.
Acceptability of the Characteristics of the Four Treatments of Watermelon Rind-Ponkan Marmalade

The acceptability of each sensory attributes of each treatment was also evaluated by the panel of tasters. Table 1 shows the computed values and qualitative description of the acceptability of the characteristics on each treatment of watermelon rind-ponkan marmalade.

Table 1. Acceptability of the Characteristic of the Four Treatments of Watermelon Rind Ponkan Marmalade

| Characteristics | Treatment 619 | Treatment 277 | Treatment 482 | Treatment 652 |
|-----------------|---------------|---------------|---------------|---------------|
| Color           | 4.18 Like Moderately | 4.00 Like Moderately | 3.91 Like Moderately | 3.73 Like Moderately |
| Aroma           | 3.82 Like Moderately | 4.10 Like Moderately | 4.00 Like Moderately | 3.82 Like Moderately |
| Spreadability   | 4.55 Like Extremely | 4.27 Like Extremely | 4.18 Like Extremely | 4.27 Like Moderately |
| Taste           | 4.01 Like Moderately | 4.00 Like Moderately | 4.01 Like Moderately | 3.36 Like Moderately |
| Texture         | 4.09 Like Moderately | 4.09 Like Moderately | 3.91 Like Moderately | 4.09 Like Moderately |

In terms of color, treatment number 619 obtained the highest computed value of 4.18 followed by treatment number 277 with 4.00 computed value, then treatment number 482 with 3.91 and the least is treatment number 652 with 3.73 computed values. All computed values have a description of Like moderately. This implies that the research respondents moderately liked the color of the four treatments whether it is light orange or yellow orange.

The aroma of the four treatments was also moderately liked by the respondents. Treatment number 277 obtained the highest computed value of 4.10 followed by treatment number 482 with 4.00 computed value, treatment number 619 and treatment number 652 with the same computed value of 3.82. This implies that the quantity of watermelon affects the aroma of the marmalade which is liked moderately by the research participants.

The spreadability of the four treatments of marmalade had the highest computed values among the other characteristics. Treatment number 619 obtained the highest computed value of 4.55 with a description of like extremely. Treatment number 277 obtained a computed value of 4.27 which is also extremely liked by the research participants. Both treatment number 652 and 482 obtained a descriptive value of liked moderately with a computed value of 4.2 and 4.18 respectively. The spreadability is one of significant characteristic of marmalade, as a food in the form of spread marmalades should be easily spread on top of sliced bread and biscuits or crackers. The panel of tasters have evaluated the marmalades to be very spreadable (treatment number 619 and 277) and spreadable (treatment 482 and 652), thus the characteristic on spreadability were also liked extremely and moderately.

The tastes of the four treatments were liked moderately. Treatment number 619 and 482 obtained a computed value of 4.01 followed by treatment number 619 with a computed value of 4.00 while treatment number 652 received the lowest computed value of 3.36. Treatment 652 has the highest quantity of watermelon rind marmalade. The likeness of the panel of tasters on the taste of the marmalade can be linked into the proportion of the based fruit ingredients which is not so dominant with the quantity of watermelon rind. This implies that the taste is acceptable and within the ideal
proportion between the weight of fruit and the sugar. This result run parallel to the formulated recipe on the technical brief of jams, jellies and marmalades which states that in order to create a good quality jam, the proportion of fruit and sugar in a recipe should be 50% sugar and 50% fruit weight while the minimum allowable amount should be 40% fruit and 60% sugar, however for fruits with high water content such as watermelon there is an exception [3]. In the recipe provided by the technical brief, a ratio of 2:1 that is 115kg Watermelon and 55kg sugar (for bulk production) was used.

The texture of marmalade was also acceptable to the research participants as liked moderately. The highest computed value of 4.09 was obtained by the three treatments which are treatment number 619, 277 and 652. Treatment number 482 obtained a computed value of 3.91 which is still liked moderately by the respondents. The texture of the marmalade as evaluated by the respondents was smooth and firm jelly; however there are very small sized strips of ponkan peelings which give the marmalade a variation in the texture. The acceptability of liked moderately is linked to the presence of ponkan peelings in the marmalade. Thus, it is suggested that ponkan peelings should be shredded thinly.

**Level of Acceptability of Each Treatment of Watermelon Rind-Ponkan Marmalade**

The acceptability of each treatment of watermelon rind-ponkan marmalade was determined using the standard questionnaire-Hedonic Scale. Table 3 shows the degree of acceptability of the four treatments.

The acceptability of the four treatments of watermelon rind-ponkan marmalade was determined. Treatment number 277 and 482 received the highest computed value of 7.73 with a description like very much. This was followed by treatment number 619 with a computed value of 7.64 still with a description like very much. Treatment number 652 received the lowest computed value of 7.46 among the four treatments however its descriptive value is still liked very much. Treatments which have gained the highest computed value of likeness is the marmalade with a ratio of 2:1 (400 grams watermelon rind with 200 grams ponkan) and 2.5:1 (500 grams watermelon rind with 200 grams ponkan). On the other hand a ratio of 1:3 (200 grams ponkan with 600 grams of watermelon rind) was liked moderately. This implies that treatments with more watermelon rind are the least acceptable.

**Difference among the Four Treatments in Terms of the Level of its Acceptability**

An analysis of variance was used to determine if there are significant differences among the four treatments. Table 2 presents the data showing significant differences among the four treatments in terms of general acceptability.

**Table 2. Level of Acceptability of Each Treatment of Watermelon Rind Ponkan Marmalade**

| Treatment Number | \( \bar{X} \) | Description         |
|------------------|--------------|---------------------|
| 619              | 7.64         | Like Very Much      |
| 277              | 7.73         | Like Very Much      |
| 482              | 7.73         | Like Very Much      |
| 652              | 7.46         | Like Very Much      |
It can be gleaned in table 4 that the computed P-value of 0.648 is greater than the alpha value of 0.05. It means that there is no significant difference among the four treatments of Watermelon Rind-Ponkan Marmalade in terms of their acceptability. Therefore the null hypothesis is accepted. This implies that the four treatments of the marmalade have comparable level of acceptability as evaluated by the research participants.

**Difference among the Four Treatments in its Characteristics in Terms of Color, Aroma, Spreadability, Taste and Texture**

It can be gleaned in table 4 the computed values that determines if there are significant differences in the characteristics of the four treatments of marmalade.

**Table 3. Difference in General Acceptability of the Four Treatments of Watermelon Rind Ponkan Marmalade**

| Treatment | f value | P value | Remarks             |
|-----------|---------|---------|---------------------|
| 619       | 7.64    | 0.44    | Not Significant     |
| 277       | 7.73    | 0.648   | Not Significant     |
| 482       | 7.73    |         |                     |
| 652       | 7.46    |         |                     |

**Table 4. Difference in the Characteristics of the Four Treatments of Watermelon Rind-Ponkan Marmalade**

| Characteristics | Treatment 619 | Treatment 277 | Treatment 482 | Treatment 652 | P-value | Remarks         |
|-----------------|---------------|---------------|---------------|---------------|---------|-----------------|
| Color           | 4.00          | 3.46          | 2.91          | 3.09          | 0.30    | Not Significant |
| Aroma           | 4.00          | 4.10          | 3.91          | 3.82          | 0.84    | Not Significant |
| Spreadability   | 4.36          | 4.46          | 4.18          | 4.09          | 0.52    | Not Significant |
| Taste           | 4.09          | 3.91          | 4.09          | 3.46          | 0.33    | Not Significant |
| Texture         | 3.91          | 3.91          | 3.91          | 4.00          | 0.99    | Not Significant |

It can be seen in the table that all the computed P-value is greater than 0.05 level of significance and therefore the null hypothesis which states that "there is no significant difference among the four treatments in terms of color, aroma, spreadability, taste, and texture" is accepted. This implies that the variation on the quantity of the watermelon rind in the four treatments of marmalade mixture do not give significant differences between the characteristics of the four treatments.

**Physico-Chemical Properties and Microbial Analysis of Watermelon Rind-Ponkan Marmalade**
There were two (2) treatments which obtained the highest computed value of acceptability which are treatment numbers 277 and 482. The two samples having the highest computed value undergo physicochemical and microbial analysis. There are different analyses done on marmalade. Table 6.1 presents the result of some of the physicochemical analysis made.

### Table 5 Physicochemical Properties of Watermelon Rind-Ponkan Marmalade.

| Physico-chemical Parameters | RESULTS |
|-----------------------------|---------|
|                             | Treatment 277 | Treatment 482 |
| pH                          | 5.39     | 5.38     |
| Titratable Acidity (in citric acid) | 0.360     | 0.354     |
| Moisture/Water Activity     | 26.66    | 31.32    |
| Density                     | 1.175 g/ml | 1.217 g/ml |
| Total Soluble Solids        | 66.3%    | 56.4%    |
| (represented mainly by sugar) |         |         |
| Nutritional Analysis: Vitamin C | ≤ DL     | ≤DL     |
| Nutritional Analysis: Total Ash | 0.53     | 0.71     |
| Nutritional Analysis: Fat   | 0.85%    | 0.36%    |

The proximate physicochemical composition of Watermelon Rind-Ponkan Marmalade is shown in table 5.

**pH**

The pH of Watermelon Rind-Ponkan Marmalade of treatment 277 is 5.39 and 5.38 which shows that the two treatments have similar pH. This implies that the marmalade mixture is low-acidic. This acidity is similar to the acidity of black coffee. The ideal acidity of an orange as compared to most citrus fruits such as tangerine, grapefruit, limes and lemons this have contributed to the low acid pH level of the marmalade. Furthermore watermelon is also low-acid fruit with a pH level of 5.18-5.60 [13] thus the marmalade which has a higher quantity of watermelon rind as compared to ponkans among the treatments are low-acid. However, the pH of a particular fruit preserve should not be too low ≥ 3.5 as this induces the sensory quality’s deterioration such as the crystallization of glucose, granulated texture of preserves; excessive acidic flavor and exudation phenomenon [4].

**Titratable Acidity**

In the food analysis, the Titratable acidity and pH are interrelated concepts that deal with acidity. The titratable acidity (TA) is one of the factors which affect product quality [10]. Together with sugar content, the TA of fruits serves as an indicator of maturity. In general the higher the maturity of the fruit results to a lower acid content. This is explained in the ripening process, such as tomatoes from green to mature stage. The higher the maturity of the fruit also leads to an increase in sugar content. The titratable acidity of treatment number 277 is 0.360 while treatment number 482 is 0.354. The little value of titratable acidity is parallel to the low acid level of marmalade’s pH.

**Density**

The density of the two treatments was also determined. It is relevant to determine food weight from data on food volume requires that density of the food be known. Determining the food density is essential to estimate nutrient density portion. In the analysis, the density of the two treatments are 1.175 g/ml for treatment 277 and 1.217 for treatment 482 and it can be observed that both have similar densities. In the Density Database version 1 of July 2011 by FAO it is recorded that similar product like jelly and jam have a density of 1.245 and 1.333 respectively. This can be associated with the information that fruit preserves like marmalades are low caloric type of food.
Moisture Content

One of the essential physico-chemical parameters of food is the determination of moisture content and deviation from the standard percentage of the moisture content depending on the type of product can adversely impact the physical properties of food. The moisture content of a food directly impacts its taste, weight, texture, appearance and shelf life. The rate of microbial growth increases with total water content, thus the food analyst engage in the balance of moisture and total solids to ensure product quality and safety [2]. In the present study conducted the moisture content of treatment 277 is 26.66 and treatment 482 is 31.32. These results are within the acceptable approximate moisture contents on jams and preserves which is 30% [5].

Total Soluble Solids

Fruit preserves such as jams, jellies and marmalade are high in acids and solids represented chiefly by sugar making these products shelf-stable [17]. These fruit preserves are basically a mixtures of fruits and sweetening agents which have been suitably gelled with a minimum soluble solids (SS) content of 60% (by refractometer) [11]. In the study conducted, chemical analysis on Total soluble solids which is mainly represented by sugar and other ionic minerals is 66.3% for treatment 277 while treatment 482 is 56.4% total soluble solids. This implies that treatment 277 has higher solid content and is close to the ideal range of total solids among fruit preserves. Results of total solids can be attributed to the differences in the quantity of Watermelon rind, since treatment 482 has less soluble solids because it has higher watermelon rind content which also has higher moisture content of 31.32 as compared with treatment number 277.

Vitamin C

Vitamin C or ascorbic acid is a naturally occurring antioxidant generally found in citrus fruits; however this antioxidant significantly decreased during heating. In the study conducted by Benmeziane, F. et.al. in 2018 on the “Physicochemical Characteristics and Phytochemical Content of Jam Made from Melon”, the vitamin C content of melon jam showed a significant decrease from the reported content of a freshly harvested watermelon [4]. This result is similar with the present study conducted in which both treatments have damaged or deteriorated vitamin C after heating or boiling of the marmalade reaching 104°C. Both treatments have less than detected levels of vitamin C (≤DL).

Ash Content

Determination of the Ash content is also conducted on the two most acceptable treatments. Ash refers to the inorganic residue after either the ignition or complete oxidation of organic matter in the food sample. An integral part of proximate analysis for nutritional evaluation is the determination of the ash content. Furthermore, as content is also an important quality attribute for some food ingredients [9]. Ash content represents the quantity of minerals or the measure of the total amount of minerals like calcium, phosphorous and iron present within the food and the value of ash indicates the stability of products. In the study entitled “Utilization of Watermelon Rinds and Sharlyn Melon Peels as a Natural Source of Dietary Fiber and Antioxidant in Cake” result in the study showed that watermelon rind has 13.09% ash content [1]. This implies that watermelon rind has high ash content. The total ash content in the present study conducted was 0.53% for treatment 277 and 0.71% for treatment 482. It can be seen in table 6 that treatment 482 has higher ash content since it also has higher quantity of watermelon rind.

Fat Content

The product’s fat content was also determined to obtain data whether marmalade could add fat in your diet. In the study conducted both samples do not have considerable amount of fat. Treatment 277 has a 0.85% fat while treatment 482 has 0.36 % fat content. These fat contents can be associated to nutrition profile of tangerines, a similar citrus fruit family which has around 0.31 grams fat which only accounts into 1% of percentage RDA [16]. These results do not give significant fat value in the calories of marmalade.

Microbial Analysis on Yeasts and Molds of Watermelon Rind-Ponkan Marmalade
To evaluate the product’s microbial load count on yeasts and molds, pour plate method was used. This test was made by the Department of Science and Technology Region X. Table 6 reports the microbial analysis of the product.

Table 6 Report of Microbial Analysis of Watermelon Rind-Ponkan Marmalade.

| MICROBIAL YEAST AND MOLDS COUNT RESULTS | MICROBIAL YEAST AND MOLDS COUNT RESULTS |
|----------------------------------------|----------------------------------------|
| Date of Sampling: September 19, 2018   | Date of Sampling: October 2, 2018       |
| Date of Analysis: October 3-8, 2018    | Date of Analysis: October 3-8, 2018     |
| Method Used: Pour Plate                | Method Used: Pour Plate                 |
|                                        | (Potato Dextrose Agar 25°C/120h)        |
| Treatment 277                          | Treatment 482                           |
| 70 CFU*/g                              | 70 CFU*/g                               |
|                                        | 60 CFU*/g                               |
|                                        | 100 CFU*/g                              |

*Bacteriological Analytical Manual, Online Edition 8, USFDA. Association of Official Analytical Chemists.

*Estimated count outside 10-150 colonies per plate range.

It can be gleaned in table 7 that the first set of samples were analyzed twenty three (23) days after the product was processed. Result showed that both samples have 70 CFU (Colony forming unit per gram). On the other hand, the second batch of treatments which were analyzed eight (8) days after the processing of marmalade obtained different results. Treatment 277 had 60 CFU/g and Treatment 482 had 100 CFU/g. These results may be associated with handling of raw materials, processing of the product and packaging. However, all the samples are within the safety limits as specified in the GCC Standardization Organization (GSO) Final draft on microbiological criteria for foodstuffs on Jam, Jelly, and Marmalade which states that a minimum allowable number of CFUs should be 10³ CFU [7].

Techno-guide of Watermelon Rind-Ponkan Marmalade

Marmalades are fruit preserves commonly prepared in the food laboratory of an academic institution together with Jams, Jellies, Conserves and Purees. In this study the researcher developed marmalades made of commonly available ingredients like Ponkans which are cheaper than oranges in the Philippines and Watermelon Rinds which are commonly thrown after utilizing the red fleshy part. The researcher prepared a techno-guide for watermelon rind-ponkan marmalade.

The techno guide that the researcher have prepared gives an overview and background of what is a marmalade, what were the main ingredients used for the marmalade and its nutritional benefits and some of the nutritional information and as well as the expenses and suggested price of the marmalade.

4. Conclusions

Results of the study showed that the difference of each treatment on the quantity of watermelon rind does not significantly affect the product’s taste, aroma, texture, spreadability, taste and its general acceptability. Based on the result of the physico-chemical analysis treatment number 277 showed ideal results as compared to treatment 482. It is therefore acceptable that the ratio of the main ingredient to obtain ideal result should be 2:1 that is 400 grams watermelon rind to 200 grams ponkan juice. Moreover, w ith the results of the study conducted, it can be concluded that the recipe, specifically on the measurement of ingredients is found to be within a good proportion for marmalade making specially for fruit preserves with base ingredients that is high in water contents like watermelons. Furthermore, results of the microbial load count for both treatments are found to have microorganisms.
although it is within acceptable safety limits. Consequently, it is concluded that there is a need to improve or revised the procedure made in the marmalade recipe.

5. Recommendations

From the results of the study conducted it is recommended that research studies on innovative food research using ponkan and ponkan peelings as the main ingredient should be conducted since there are very few researches on ponkans to include on how this fruit will be preserved making it available for the whole year. It was also recommended that the watermelon rind-ponkan marmalade should be evaluated by a number of none experts and who can be considered as the target market of the product and that the product should undergo a commercial sterility test. Then, it was suggested that Watermelon Rind-Ponkan Marmalade should be fortified with ascorbic acid/vitamin C as the natural vitamin C of the Ponkans and Watermelon is deteriorated in the heating process. Furthermore, a Phytochemical analysis of the marmalade should be conducted to assess other nutritional and antioxidant benefits of the marmalade.

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