INCORPORATION OF SABA (*MUSA PARADISIACA*) BANANA PEEL IN FRESH PASTA

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ABSTRACT

Saba or Cardaba is one of the locally grown species of banana in the Philippines. It is frequently used in making desserts such as cakes, chips, banana cues, and turon. Oftentimes after using, the saba's peel serves no other purpose and is just thrown away. In this light, this study aims to produce flour from saba peel and use it as partial substitute to semolina flour in generating fresh pasta. In addition, the study aims to identify its nutritive quality through proximate and microbial analysis, its acceptability using 9-point hedonic scale, and its production cost. The saba peel was first dried at 60^{O} C for 8 hours using a cabinet dryer. Afterwards, it was ground, and then mixed with semolina flour in varying saba peel flour to semolina flour percentage (0%, 5%, 10%, 15%, and 20% saba peel flour). Using sensory evaluation, it was found out that the fresh pasta with 20% saba peel flour obtained the highest result in terms of aroma, flavor, texture and general acceptability. Consecutively, analysis of the nutritive quality of the freshly cooked pasta showed that the 20% saba peel pasta exhibited higher content of ash (0.88%), moisture (62.4%), total fat (6.4%) and total dietary fiber (0.85% for soluble fiber and 4.9% for insoluble fiber) as compared to the Semolina pasta. Results of the microbial analysis also showed that the pasta was safe to consume.

Keywords: *Proximate and microbial analysis, Saba peel pasta, Semolina flour*

INTRODUCTION

Banana is grown extensively in tropical countries including the Philippines where it is one of the most widely grown fruit-bearing plants. It is frequently consumed globally and locally (Nelson, et al, 2006). According to De Langhe, et al. (2009) banana is a key domesticate of subsistence farmers across the wet tropics and subtropics, including the Americas, Africa, South Asia, mainland and Island Southeast Asia, Melanesia, and the

Pacific where an abundant supply of bananas is available throughout the year. In the year 2009 (Evans and Ballen, 2012), the Philippines was next to India among the top five banana-producing countries with major local producers of saba in the regions of Davao, Soccsksargen, Davao del Sur, North Cotabato, and Lanao del Norte.

Banana is one of the most nutritious fruits, being a good source of potassium, vitamins (such as A, B6, C and D), and minerals. It also helps in losing weight as it is easily digested, and aids in the body's retention of calcium, nitrogen, and phosphorus, all of which work to build healthy and regenerated tissues (Sampath Kumar, et al, 2012).

There are different species of bananas cultivated apart from the hundreds of fully domesticated banana varieties around the world. In the Philippines, *saba* or the *cardaba* is one of the local banana species. It has the highest content of nutrients because it has the deepest roots among other banana plants, allowing it to absorb more nutrients from the soil (Health Tips and Natural Healing Benefits, 2012). It also contains high amounts of resistant starch up to 68.1%, higher than other tropical banana cultivars, and pectin and potassium so it can be used as treatment for diarrhea (Hongpattarakere, et al, 2014). This banana cultivar is the most popular variety for food processing in the domestic and export markets, commonly used in the preparation of snack foods (Dela Cruz, et al, 2008). Additionally, saba is a cooking banana variety with an unusual bluish green, blunt-shaped fruit and bright white pulp. It can either be eaten raw or cooked, or can be processed into ketchup, cakes and pastries (Ayo-Omogie, et al, 2010).

According to the study of Caburnay, et al. (2012), saba is one of the varieties of bananas used by people in making desserts such as banana cake, banana chips, banana cues, and turon. Due to its demand, their production accumulates a bulk of waste including banana peel which can pose an environmental problem. Hence, the researchers decided to utilize the banana peel and turn it into another product where it may present various uses and benefits.

Banana peel as a raw material is said to be a good source of potassium and fiber containing more soluble and insoluble fiber than its flesh. The intake of dietary fiber can reduce and prevent certain diseases, promote digestion and bowel movements, and reduce blood cholesterol levels. It is also known to promote wound healing mainly from burns and to help overcome or prevent substantial number of illnesses, such as depression (Pereira, et al, 2014).

Dietary fiber is best known for its ability to prevent or relieve constipation. It provides other health benefits such as helping maintain a healthy weight and lowering the risk of diabetes and heart disease (Mayo Clinic, 2014). It also reduces the risk for developing coronary heart disease, stroke, hypertension, obesity, and certain gastrointestinal disorders with recommended dietary fiber intake for adults of 22-25 grams per day. The high amount of dietary fiber in the peel poses a possibility to utilize it as a functional ingredient in starch-rich products such as pasta (Saifullah, et al, 2009). Mudgil and Barak in 2013 stated that dietary fiber can be used in processed food products not only to improve the dietary fiber content itself but also to improve its viscosity, texture, sensory characteristics, and shelf life.

In 2014, sales of pasta noodles in the Philippines continued to grow in volume and value terms. Increasingly penetrating pasta noodles in the Philippines are Asian-inspired specialty flavors, not just from the Philippines but from neighboring Asian countries, too (Noodles in the Philippines, 2015). It is a stable food product produced mainly in mixing durum wheat, semolina flour and water. It can be consumed after cooking as fresh pasta or can also be dried for future use (Padalino, et al, 2011). Banana flour can be used as a substitute usage for wheat flour and used to turn into another by-product such as pasta (Barangas, et al, 2010).

In the study of Agama-Acevedo, et.al (2009), it was stated that consumers are unlikely to eat insufficient amount of vegetables and other fiber-rich foods directly. The supplementation of pasta with unripe banana peel flour can play an important role in addressing this problem and achieving health benefits. In the successful consumption of pasta in the Philippines, the researchers proposed to use saba banana peel flour as a partial substitute with semolina flour to produce fresh pasta.

The aim of the study is to develop fresh pasta incorporated with banana peel flour and to determine its acceptability, nutritive quality and total dietary fiber through proximate and microbial analysis, and its production cost.

Theoretical Background

Nowadays, plenty of new products have been produced, developed and released in the market. The researchers want to introduce a new nutritious product that is a potential source of dietary fiber.

This literature review discusses the following points of the study: background of the raw materials that will be utilized, the nutritional content and health benefits of the raw materials, and the procedural method that will be applied to convert the material into a new product sample, instant pasta noodles. This chapter will also present the research theoretical framework to fully understand the research and definition of terms for better comprehension of the study.

Banana is a general term embracing a number of species or hybrids in the genus *Musa* of the family Musaceae. It is a highly nutritious fruit, popular for its aroma and texture, and is easy to peel and eat, besides rich in potassium and calcium and low in sodium content (Mohapatra, et.al, 2010). Banana is native to Southeast Asia where the climate is warm and humid. In the Philippines, the known varieties among 57 banana plant cultivars include saba, lacatan, latundan and senyorita (Barangas, et al, 2010) of which Saba is the most common. In the study of Caburnay, et al (2012), Saba is one of the varieties of banana used for making banana cue, a popular street food in Manila

Mohapatra, et al. (2010) stated that Musacea plants such as banana can be used to generate energy through decomposition, and used as good composting material. Banana waste materials are rich in nutrients and minerals and one of which is the banana peel. The peel wastes from Saba may contain the same valuable components generally found in the banana flesh (Solidum, 2011) which includes carbohydrates, vitamins A, B, C, potassium, soda, chloride of potassium, alkaline phosphates with little sulfate, lime, and silica among others. Additionally, banana peel contains flavonoids and catecholamine.

Flour made from banana is one of the most known products among the stated ones (Barangas, et al, 2010). It contains high fiber, minerals such as phosphorus and potassium, and as much as 13% of the daily value of potassium. The chemical composition of banana flour shows that total starch (73.36%) and dietary fiber (14.52%) were the highest constituents; it has a higher protein and total starch content than control bread (Juarez-Garcia, et al, 2006).

Researchers from University of California (2009) stated that fiber is an important part of a healthy diet as it moves food and waste efficiently through the digestive system (University of California, 2009). Moreover, fiber comes in two varieties: insoluble and soluble fibers. The insoluble fiber does not dissolve in water. It is the bulky fiber that helps to prevent constipation, and is found in whole grains, wheat cereals, and vegetables such as carrots, celery, and tomatoes. On the other hand, soluble fiber dissolves in water and helps control blood sugar levels and reduce cholesterol.

Carbohydrates can be divided into two groups: those that are digested in the small intestine and those that are not. Sugars and most starches fall into the first group. They are rapidly absorbed and used for short term energy. The second group consists of resistant starch and dietary fiber. They pass through the small intestine undigested and, if not digested, can't provide energy (Wheat Food Council, 2007).

Starch is the most important semi-crystalline storage polysaccharide found in plant and a high content can be found in banana flour. Unripe banana fruits have a higher starch concentration than ripe fruit, and this starch degrades to a relatively small monosaccharide (Dela Torre-Gutierrez, et al, 2008). Moreover, resistant starch provides fiber, prebiotic benefits to the gut, overall colon health and bowel related benefits.

Pasta is a stable food product that is produced mainly in mixing durum wheat semolina and water. It can be consumed after cooking as fresh pasta or can also be dried for future use (Padalino, et al, 2011). Barangas, et al. in 2010, demonstrated that banana flour can be used as substitute usage for wheat flour and used it to turn into another by-product such as pasta. Pasta, with its origin in Italy, has gained wide popularity as a

convenient and nutritionally palatable, low glycaemic food. Traditionally, pasta is made from durum wheat semolina which imparts the desired texture and cooking quality to the product (Gopalakrishnan, et al, 2011).

Saifullah, R., Et al. (2009), suggested that another part of banana can be used to make flour which is the peel of banana. The said flour can be used to produce another product which is the pasta. As these studies indicated a high content of dietary fiber in the peel, it would be possible to utilize the peel as functional ingredient in starch-rich products as the fresh pasta. In the study of Agama-Acevedo, et.al (2009) it was stated that consumers are unlikely to eat insufficient amount of vegetables and other fiber-rich foods directly, thus, the supplementation of pasta with unripe banana peel flour can play an important role in achieving health benefits.

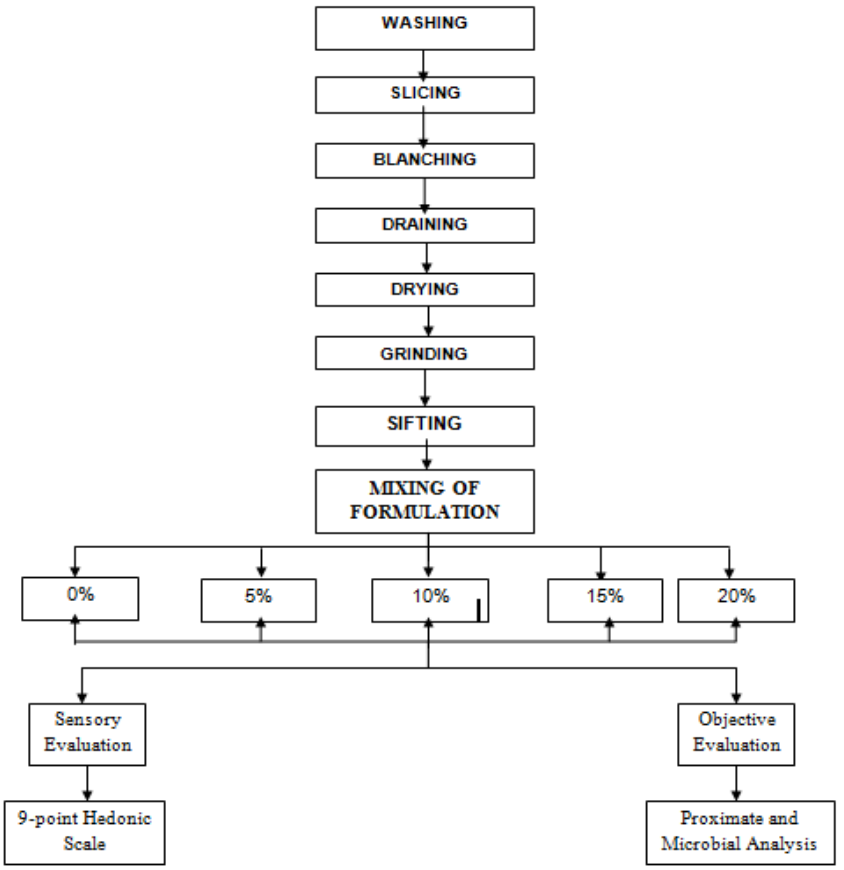

Figure 1. Conceptual Framework

METHOD

Preparation of the sample

Saba banana peels were collected and gathered from a local market (banana cue vendor). Then, the sample was dried using a cabinet drier (Memmert Brand) at 60^0C for 8 hours. This drying schedule was adopted from DOST. The dried sample was turned into flour by using a blender and a 22 mm mesh screen. Other materials like semolina flour, water, eggs, salt, and oil required for pasta making were purchased from the market. The food grade chemical used was calcium propionate and was purchased from Neco Philippines, Inc. at Sta. Cruz, Manila. Digital balance (Metaltex), blender (SJB- 1.5LA), rolling pin, pasta maker, sauce pan, mixing bowl, spatula, large pot, colander, measuring spoons, and cups were requested and borrowed from Food Laboratory of the Colegio.

Banana peels were prepared and washed thoroughly with distilled water, after which were sliced thinly. They were then blanched in 100^0C distilled water for 5 minutes and drained. Then, the peel was dried using cabinet dryer at 60^0C for 8 hours, ground using the blender (SJB-1.5LA) and sieved in a 22 mm mesh screen with a mean particle size of 0.15 mm.

Pasta Formulation

The basic formulations used for preparation of fresh pasta were outlined in Table 1. The fresh pasta was prepared with the incorporation of cabinet dried banana peel flour in 0%, 5%, 10%, 15% and 20% with semolina flour. The formulation used in this study was adopted from Asif-Ul-Alam, et al, (2014) and the standard formulation was based from the basic pasta recipe of Bob's Red Mill.

Table 1. Standard Formulation of Pasta

Ingredients	Quantity
Semolina Flour	187.5 g
Salt	1.42 g
Oil	30 mL
Water	30 mL
Egg	1 pc

Preparation of Saba Peel Pasta

The pre-weighed ingredients including calcium propionate were mixed properly. A mixture of raw materials (saba peel flour) was added to obtain a uniform dough. The eggs, water and olive oil were beat together, then mixed until it form a dough and the dough was allowed to relax for 30 minutes before rolling out. The dough was then kneaded and rolled. The rolled out dough was then cut out in pasta cutter with 1.3 mm dimension. (After), the cut out fresh pasta can be stored in the refrigerator or can be cooked/boiled immediately with a dish.

Utilization of Pasta in Dish (Chicken Broth)

The ingredients (chicken, carrots, onion and celery) were first washed and sliced. They were then combined with water in a large pot, and boiled it in 100^0C for 1 hour. Upon boiling, chicken cubes were added and heated into simmer for 3 hours. Chicken broth was then strained and served hot with saba peel pasta.

Sensory Evaluation

The five pasta samples were analyzed for its sensory attributes. Sensory quality attributes were evaluated by a panel of 50 untrained members using 9-point Hedonic scale as shown in Table 1. The cooked pasta was evaluated according to their appearance, texture, aroma, flavor and general acceptability.

The utilization of pasta dish with chicken broth was also evaluated using 9-point hedonic scale and according to their appearance, texture, aroma, flavor and general acceptability. This utilization should be done to determine the applicability of the raw materials.

Table 2: 9-point Hedonic Scale

Scale	Qualitative Description
9	Like extremely
8	Like very much
7	Like moderately
6	Like slightly
5	Neither like nor dislike
4	Dislike slightly
3	Dislike moderately
2	Dislike very much
1	Dislike extremely

Statistical Analysis

Experimental data were analyzed and computed using the Analysis of the Variance (ANOVA). Significant differences at 5% level of significance were computed using the Duncan Multiple Range Test (DMRT).

Complete Proximate Analysis

The cooked pasta was analyzed at the Sentrotek by its carbohydrate content was calculated using the subtraction method from ash, moisture, fat and protein. Protein content using the (Kjeldhal) with AOAC number 920.87, Total Dietary Fiber, Soluble and Insoluble Fiber content using (Enzymatic-Gravimtery) with AOAC number 991.43 method, Fat content using (Acid Hydrolysis) with AOAC number 922.06, Moisture using (Gravimetry) with AOAC number 934.01 and Ash using the (Gravimetry) with AOAC number 923.03.

Microbial Analysis

Aerobic Plate Count (APC), E.Coli was determined using (MPN Method), Salmonella was determined using (Conventional Method) and Yeast and Mold Count was determined using (Pour Plate Method), and the analyses were from Food Microbiology Manual.

RESULTS

Table 3. Mean Score of pasta with variance incorporation levels of saba peel flour

	0%	5%	10%	15%	20%
[1]**Appearance**	8.02^{b}	7.72^{a}	7.72^{a}	7.68^{a}	7.66^{a}
[2]**Aroma**	7.96^{a}	7.66^{a}	7.96^{a}	7.94^{a}	8.16^{b}
[3]**Flavor**	8.06^{ac}	7.54^{b}	7.82^{bc}	7.82^{bc}	8.32^{a}
[4]**Texture**	8.08^{a}	7.46^{b}	7.38^{bc}	8.14^{ac}	8.18^{a}

Table 3.1 Appearance Sensory Scores with its Qualitative Description

APPEARANCE	
0%	Like very much
5%	Like very much
10%	Like very much
15%	Like very much
20%	Like very much

Table 3.2 Aroma Sensory Scores with its Qualitative Description

AROMA	
0%	Like very much
5%	Like very much
10%	Like very much
15%	Like very much
20%	Like very much

[1]For Appearance, at 5% level of significance, sample 5%, 10%, 15% and 20% are not significantly different from one another but significantly different from 0%. The appearance of sample A with a yellowish color is not the same with the sample of 5%, 10%, 15% and 20% with the brownish color.

[2]For Aroma, sample 0%, 5%, 10%, and 15% are not significantly different from one another but significantly different from 20% which means that the sample 20% contain the most prominent aroma of banana compared to the other samples.

[3]For Flavor, sample 0% is not significantly different from 20% but significantly different from 5%, 10% and 15%. Sample 5% is significantly different from 10% and 15% but not significantly different from 20%. On the other hand, sample 5% to 10%; 5% to 15%; to15% to 20%; 10% to 20% and 15% to 20% are not significant from one another.

[4]For Texture, 0% is not significantly different from 20% but significantly different from 15%, which means 0% and 20% are the same while 15% is different from the two sample. 5% is significantly different from 10% and 20%, which the three have a difference.

[5]For General Acceptability, 0% is not significantly different from 20%, the two are similar from one another while sample 15% is significantly different from 5% and 10%, there are different among the three.

Table 3.3 Flavor Sensory Scores with its Qualitative Description

FLAVOR	
0%	Like very much
5%	Like very much
10%	Like very much
15%	Like very much
20%	Like very much

Table 3. 4 Texture Sensory Scores with its Qualitative Description

TEXTURE	
0%	Like very much
5%	Like moderately
10%	Like moderately
15%	Like very much
20%	Like very much

Table 3. 5 General Acceptability Sensory Scores with its Qualitative Description

GENERAL ACCEPTABILITY	
0%	Like very much
5%	Like very much
10%	Like very much
15%	Like very much
20%	Like extremely

Table 4. Proximate Analysis of Cooked Saba Peel Pasta and Semolina Pasta

PARAMETERS	COOKED SABA PEEL PASTA (20%)	COOKED SEMOLINA PASTA (0%)
Total carbohydrates, % w/w	25.3	29.8
Ash, % w/w	0.88	0.48
Moisture, % w/w	62.4	58.7
Protein (N x 6.25), % w/w	5.0	6.2
Total Fat, % w/w	6.4	4.8
Total Sugar as Invert, % w/w	1.3	2.0
Total Dietary Fiber, % w/w		
Soluble	0.85	0.80
Insoluble	4.9	0.35

Legend: *1 % Carbohydrates= 100 – (% Moisture + % Ash + % Protein + % Fat)*

Table 5. Microbial Analysis of Cooked Saba Peel Pasta and Semolina Pasta

PARAMETERS	COOKED SABA PEEL PASTA (20%)	COOKED SEMOLINA PASTA (0%)
Aerobic Plate Count, CFU/g	<10 est.	<250 est.
Yeast and Molds, CFU/g	<10 est.	<10 est.
E. Coli, MPN/g	<1.8	<1.8
Salmonella, in 25g	Absent	Absent

Legend:

<1.8 means above sample is negative for E.coli

<10 means zero count in 10---$^{-1}$ sample dilution

<250 means count between 1 and 25 in 10---$^{-1}$ sample dilution

est. = estimated.

Table 6. Cost Analysis of Saba Peel Pasta

Raw Material	Original weight	Original Price	Total amount used (g or ml)	Price of total amount used
Semolina Flour	680 g	Php 185.00	150 g	Php 40.81
Saba Banana	1000 g	Php 60.00	37.5 g	Php 2.25
Water	2000 ml	Php 36.20	30 ml	Php 0.54
Oil	100 ml	Php 13.00	30 ml	Php 3.90
Salt	250 g	Php 5.90	1.42 g	Php 0.03
Egg	1 pc (medium)	Php 5.00	1 pc (medium)	Php 5.00
Calcium Propionate	1000 g	Php 115.00	0.33 g	Php 0.04
TOTAL				Php 52.57 per 400 gms

Market Cost	Php 52.57 per 400 grams
Labor Cost	Php 5.26
Mark-up Price	Php 13.14
Selling Price	Php 70.97/400 gms and 88.71/500 gms

Table 7. Cost Analysis of Semolina Pasta

Raw Material	Original weight	Original Price	Total amount used (g or ml)	Price of total amount used
Semolina Flour	680 g	Php 185.00	187.5 g	Php 51.01
Water	2000 ml	Php 36.20	30 ml	Php 0.54
Oil	100 ml	Php 13.00	30 ml	Php 3.90
Salt	250 g	Php 5.90	1.42 g	Php 0.03
Egg	1 pc (medium)	Php 5.00	1 pc (medium)	Php 5.00
Calcium Propionate	1000 g	Php 115.00	0.33 g	Php 0.04
TOTAL				Php 60.52 per 400 gms

Market Cost	Php 60.52 per 400 grams
Labor Cost	Php 6.05
Mark-up Price	Php 15.13
Selling Price	Php 81.70/400 gms and 102.13/500 gms

DISCUSSION

In the statistical analysis for the sensory evaluation, there was no significant difference between the 20% formulation of *saba* peel pasta and 0% formulation (control) of semolina pasta. It was found that 20% was comparable with the control product which is the 0% formulation.

In the result of the proximate analysis for the *saba* peel pasta, it contained 83.0% higher value of ash, indicative of its high mineral content, particularly the macro-minerals, than the Semolina pasta. The ash content can provide approximate information of the quality of a product (Adeolu and Enesi, 2013). Ash is the inorganic residue remaining after the water and organic matter have been removed by heating in the presence of oxidizing agents, which provides a measure of the total amount of minerals within a food. Analytical techniques for providing information about the total mineral content are based on the fact that the minerals can be distinguished from all the other components within a food in some measurable way. Thus, higher ash content means that the product contains more minerals. On the other hand, the *saba* peel pasta exhibited a lower total carbohydrates content (-15.1%) as compared to that of Semolina pasta. This lower carbohydrate content, together with higher dietary fiber content, makes the saba peel pasta ideal for weight control. This is because dietary fiber is a type of indigestible carbohydrate, thus it does not add any more calorie to the amount of calorie that the carbohydrates provide. Additionally, the dietary fiber slows the absorption of digestible carbohydrate into the blood, helping in weight control. The protein content of the *saba* peel pasta was also lower by 19.4% than that of semolina pasta. According to Adeolu and Enesi (2013), protein is an essential component of diet needed for survival of animals and human beings. Their basic function in nutrition is to supply adequate amount of required amino acids. Nevertheless, the percentage does not deviate significantly from the semolina pasta, making it still a good source of protein.

Conversely, the moisture level of the *saba* peel pasta was higher than that of Semolina pasta with a difference of 6.30%, suggesting a disadvantage in terms of freshness and shelf life. This is because high moisture content subjects the food item to increased

microbial spoilage, deterioration and short shelf life (Adepoju and Onasanya, 2008). The total fat of *saba* peel pasta was also significantly higher than semolina pasta with 33.3% difference which indicates a shorter shelf life compared to the commercially dry pasta in the market. One of its components, crude fat, determines the free fatty lipids of a product. This parameter can be used as the basis to determine the processing and storage temperatures to prevent auto-oxidation which can lead to rancidity and affect the flavor of the food (Adeolu and Enesi, 2013). However, the high total fat content of *saba* peel pasta helps the body in absorbing fat-soluble vitamins in food.

Dietary fiber is a kind of carbohydrate that provides important health benefits, such as aiding weight control; and lowering risk of diabetes, blood cholesterol levels, and heart diseases (Mayo Clinic, 2015). Based on Table 5, the *saba* peel pasta had an increase of 6.25% soluble dietary fiber content, and an extensively higher insoluble dietary fiber content as compared to Semolina pasta. This can be attributed to the addition of *saba* peel flour, because bananas are naturally rich in dietary fiber (MohdKamil, 2013). Since *saba* peel pasta contain more soluble and insoluble fiber than Semolina pasta, it promotes good digestion, bowel movement, and blood cholesterol level reduction.

In the result of microbial analysis, its being applied to the two samples resulted to negligible presence of bacteria in terms of Aerobic Plate Count (APC), Yeast and Molds, *E. coli* and *Salmonella*. For the APC of *saba* peel and semolina pasta, both samples were free from intolerable amount of plate count. High APC indicates the microbiological quality of a food product, the potential spoilage of the products, and the sanitary conditions under which the food was processed (Ministry of Agriculture, 2012). The Yeast and Molds, *E. coli,* and *Salmonella* for both samples resulted to zero and negative count of intolerable amount of pathogens. According to Ministry of Agriculture (2012), presence of Salmonella can lead to food poisoning. Thus, the *saba* peel pasta are as safe as the semolina pasta. Moreover, the results mean that the *saba* peel pasta, similar to the semolina pasta, are processed cleanly and are safe to consume.

CONCLUSION

Based on the gathered results of the study, the researchers concluded that it is possible to use Saba peel flour as a substitute to semolina flour used in making fresh pasta. Hedonic Rating Scale was used to determine which of the formulations will be acceptable in terms of the appearance, aroma, flavor, texture and general acceptability. With this, the researchers found out that among the formulation taken, the pasta formulation with 20% saba peel obtained the highest mean in terms of aroma, flavor, texture and general acceptability. However, the highest mean for appearance is the 0% (controlled) formulation. Moreover, proximate and microbial analyses showed that the addition of saba peel flour in making fresh pasta helped improved its nutritional value and that the product is safe to consume.

The researchers recommend that all materials and equipment to use in the study must be prepared and of hygienic condition to ensure safer processing of the product. Also, the researchers recommend that the research be further explored by increasing the amount of *saba* peel flour. Aside from fresh pasta, the researchers recommend that its utilization can be maximized by making breads such as *pan de sal*, loaf bread, and biscuits, and in making dishes such as red sauce and white sauce. Moreover, it is recommended to use modified atmosphere vacuum packaging during the experiment for longer shelf life, as it slows the growth of a large number of micro-organism through air removal from the bag. It can also prevent the product from being crushed and will increase its shelf life without compromising organoleptic properties such as quality, color, aroma and flavor.

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