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Formulation, organoleptic properties, proximate composition and nutritional adequacy of Banana Blossom (*Musa sapientum* L) cookies

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Key words: Banana blossom cookies, Formulation, Nutritional adequacy

Abstract

One of the products of the banana tree is the banana blossom, also known as the banana heart or banana flower. With the abundance of the banana trees here in the Philippines, the banana hearts are easy to find, however, its optimum utilization in the area of bakery products has not yet been established. The study was conducted to determine the feasibility of using banana blossom powder in baking cookies. The banana blossom was incorporated at the levels of 6%, 11.5% and 16 to the formula. The three formulas were subjected to organoleptic evaluation. All the cookies were found acceptable on the 9-point hedonic scale in terms of taste, aroma, texture and general acceptability. Formula 2 was most preferred by the sensory panel with overall acceptability score of 7.8. Only the most preferred cookie was assessed for its proximate composition and nutritional adequacy. The ash, crude fat, crude protein, total carbohydrates, moisture, sodium and total calories of cookies prepared with 11.5% incorporation was found to contain 1.93%, 28.32%, 9.84%, 45.59%, 14.34%, 313.18mg/100 g, 476.61kcal/100g, respectively. A serving of the cookie was found “less than adequate” in all the nutrients of interest for age groups 30-49 and 10-12 years old. The cookie is recommended for people who are overweight and or obese. Studies on its mineral and vitamin profile and shelf life are highly recommended.

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Introduction

Banana is an abundant native resource in the Philippines. It survives very well in this country because it provides the heat and humidity the banana needs for growth. One of the products of the banana tree is the banana blossom, also known as the banana heart or banana flower. With the abundance of the banana trees here in the Philippines, the banana hearts are easy to find, however, its optimum utilization in the area of bakery products has not yet been established.

In the Philippines, the prevalence of overweight and obesity among adults showed a gradually increasing trend. While some are not worried about their condition, there are those who want to make a a change and become conscious of what they take in. This drove the researcher to find other ways of using banana heart in a recipe where everybody can savor while at the same time enjoy its health benefits.

Being one of the top banana producing countries in the world, banana farmers in the Philippines can capitalize on this by marketing banana blossoms properly. Filipino restaurants and bakeries can revolutionize the use of the banana blossom in baked goods.

The study aimed to determine the feasibility of utilizing banana blossoms in making cookies. Specifically, it aimed to determine the best formulation in the preparation of Banana Blossom Cookies as reflected in its sensorial qualities. The study also focused on the evaluation of the proximate composition of the baked product. In addition, nutritional adequacy of the cookies for man and woman ages 30-49 and boy and girl ages 10-12 years old shall also be evaluated.

Banana blossoms are generally used as a vegetable delicacy like Sisig na Puso ng Saging, a base for soups, a hamburger patty, an ingredient in Kare-kare, etc. None of the literatures investigated uses banana blossom as an ingredient in cookies (Mishra, Tewari & Tiwari, 2017). Aside from their unique tart taste, banana blossoms come with an incredible array of health benefits (Liyanage *et al*., 2016). They are abundant in fiber, protein, potassium, vitamins A, C, E, and K, and iron making them a great addition to the kitchen. (Sartika & Rahmi, 2019; Florent, Loh & Thomas, 2015).

A cookie is a handy, baked, flat and sweet snack item usually paired with coffee or drinks. Its major ingredients include flour, sugar and some type of oil or fat. It may include other ingredients such as raisins, oats, chocolate chips, nuts, etc. Fresh-baked cookies are sold at bakeries and coffee houses. (Komal & Kaur, 2019). The food market is constantly changing, leading to a growing diversity of available foods (Sichert-Hellert *et al*., 2007). Among them, bakery products, such as sweet or salty biscuits (commonly known as cookies or crackers, respectively) are food items regularly consumed by people of all social classes and age groups (Fernando *et al*., 2017; Chopra, Rani & Singh, 2018).

The need for nutritionally-rich products is increasing among consumers of any age groups with different socio-economic status. Food industries respond by striving to formulate food products which are less expensive, readily available, and with good sensory qualities. Cookies are convenient, ready-to-eat snack which is consumed world-wide. Nutritional qualities of cookies may be improved incorporating composite flour, vegetables and other common backyard produce. (Okpala & Ofoedu, 2018; Sharma, Singh & Katyal, 2016)

Healthy cookies contain whole grain flour, which provide vitamins, minerals, and fiber, all of which are nutritious (Abdel-Moemin, 2015; Tahilramani & Sengupta). Addition of banana blossom to cookies increases its fiber content (Khoozani, Birch & Bekhit, 2019). Dietary fiber has many health benefits including preventing constipation, helping in weight loss, and lowering blood cholesterol (Dahl & Stewart, 2015; Fuller *et al*., 2016; McRorie Jr, 2015). Cookies or biscuits may be mass-produced in factories, made in small bakeries or homemade. Factory-made cookies are sold in grocery stores, convenience stores and vending machines. Fresh-baked cookies are sold at bakeries and coffeehouses.

There are a lot of cookies available in the market. None of these uses our locally produced and cheap but nutritious banana blossom. Maximizing the utilization of banana blossoms in the form of cookies does not only benefit the consumers of the new product but may contribute to the income of banana growers in the locality. (Tolno *et al*., 2016). This alternative cookie, whose one main ingredient is banana blossom or banana flower, could provide additional rich choices for cookies among the sweet tooth. The cookies are also a formulation that incorporates vegetables in blind manner making them unidentifiable by children who dislike vegetables. With its component ingredients being banana blossom, composite flour and crisped rice, this can fall under the Department of Education, Philippines, Classification of GREEN FOOD described as "the best choices for a healthy school canteen", and that, it should be made available every day. The initial findings of the study is hoped to be useful for culinary experts and bakers as they further explore other possibilities of incorporating banana blossoms in its different forms in varied recipes.

Methods and procedures

Procurement and Preparation of the Banana Blossom

The banana blossom was bought from Don Domingo Market, Tuguegarao City Philippines. It was cleaned, chopped and dried under the sun and crushed to reduce further particle size.

Cookie Formulations and Development

Three trials with varying amount of banana blossom powder (BBP) were prepared for the formulation study to determine the right proportion in the preparation of banana blossom cookies. The banana blossom was incorporated at the levels of 6%, 11.5% and 16% to the formula. The cookie was prepared using the creaming method.

Organoleptic Properties of Banana Blossom Cookies (BBC)

Respondents

The organoleptic evaluation of the BBC included its taste, aroma, color, texture and general acceptability. The test was carried out using the 9-point hedonic scale with the participation of five semi- trained and 50 untrained participants. All the panelists were instructed on how to complete the form and the manner in which the test would be carried out.

Test Conditions and Selection Criteria

1. The panel of tasters were:

a. healthy-not suffering from colds or any other diseases that may affect their sense of taste

b. Not very hungry nor full.

c. Not smoking or chewing gum.

2. The "tasting laboratory" with improvised cubicle was well lighted and ventilated.

3. The room has no scents or awful odor.

Sample Presentation

The Banana Blossom Cookies were individually packed in wax paper weighing 5g each. Each lot was coded with three-digit numbers and presented to the panelists along 9-point Hedonic Scale. Panel of tasters were assembled in a "tasting laboratory" with improvised cubicle for each panelist to avoid comparison of their evaluation on the product. A glass of water and a cracker to cleanse their palate were also provided.

Statistical analysis

Responses from the score sheets of the panelists in the organoleptic evaluation were statistically analyzed by taking the weighted mean.

Arbitrary Scale	Adjectival Description
1-1.88	Dislike Extremely
1.89-2.77	Dislike Very Much
2.78-3.66	Dislike Moderately
3.67-4.55	Dislike Extremely
4.56-5.44	Neither Like Nor Dislike
5.45-6.33	Like Slightly
6.34-7.22	Like Moderately
7.23-8.11	Like Very Much
8.12-9.00	Like Extremely

Proximate Analysis

The Banana Blossom Cookies were subjected to proximate analysis at the Department of Science and Technology(DOST). Table 1 summarizes the results and the methods applied in the determination of the proximate composition of the product.

Nutritional Adequacy

To determine their contribution to the Recommended Energy and Nutrient Intakes (RENI), the calorie and

nutrient contents of BBC were compared with the RENI for Filipinos, male and female, ages 30-49 and children ages 10-12 years old

As a frame of reference, the term "ADEQUATE" means that 20 per cent or more of the RENI from the BBC was met and "LESS THAN ADEQUATE" denotes any levels lower than 20 per cent. The adequacy level considered as " adequate" was set to at least 20% on the assumption that the subjects take five meals a day.

Figure 1 presents the schematic diagram of the processes in the conduct of the study.

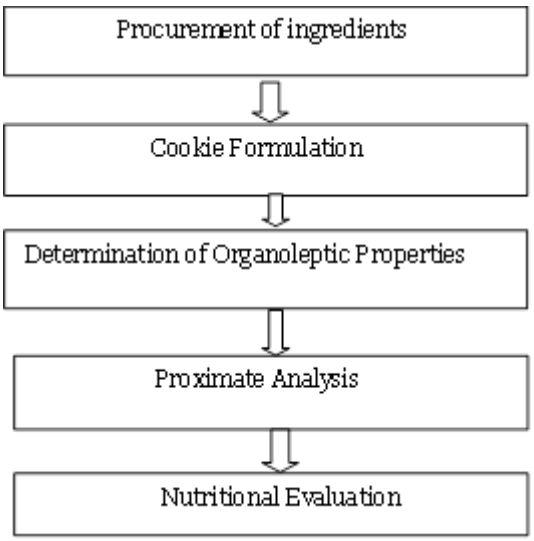

Fig. 1. Schematic Diagram.

Results and discussion

Formulation of Banana Blossom Cookies

Three trials varying the amount of powdered banana blossom were tried. Results showed that the PBB could be incorporated at an optimum rate of 16%.

Organoleptic Properties

Table 1 shows the mean scores for the sensory characteristics of the Banana Blossom Cookies.

As shown in Table 1, Formula 2 garnered the highest weighted mean with 8.01 rated as Like Very Much. Formula 1 was also rated Like Very Much, with a weighted mean of 7.94. Formula 3 got the lowest weighted mean which is 7.18 with adjectival description of Like Moderately.

Table 1. Mean score for the Organoleptic Properties of Banana Blossom Cookies.

Attributes	Formula 1	Formula 2	Formula 3
a. taste	8.0	8.12	6.46
b. aroma	7.7	7.96	6.88
c. Color	8.0	7.96	7.86
d. texture	7.78	8.16	7.72
e. general acceptability	7.18	8.04	6.96
Numerical Value	7.73	8.01	7.18
Adjectival Description	Like Very Much	Like Very Much	Like Moderately

In terms of taste, Formula 2 had the highest mean with 8.12 followed by Formula 1 with 8.0. Of all the attributes evaluated, Formula 2 got the highest mean with the exception of Formula 1 which got the highest rating in color.

Table 2. Proximate Composition (AOAC 20th 3dition 2016).

Analysis Name	Mean	Methodology
Ash	1.91%	Based on AOAC Official Method,,20th edition, 2016
Crude Fat	28.32%	Based on AOAC Official Method,,20th edition, 2016
Crude Protein (Nx6.25)	9.84%	Based on AOAC Official Method,,20th edition, 2016
Moisture	14.34%	Based on AOAC Official Method,,20th edition, 2016
Sodium (Na)	313.18mg/100 g	Dry ashing, Acid digestion, and quantification by inductively coupled plasma optical emission spectrophotometry (ICP-OES)
Calories from Carbohydrates	182.36kcal/100g	By computation
Calories from Fat	254.88kcal/100g	By computation
Calories from Protein	39.37kcal/100g	By computation
Total Calories	476.61kcal/100g	By computation
Total Carbohydrates	45.59%	By computation

All proximate compositions were analyzed in three replicates and presented here as the mean, reported to the same number of significant figures as per original analytical results.

Results showed that the ash content of Banana Blossom Cookies (BBC) is 1.91%, Crude fat is 28.32%, Crude Protein (Nx6.25) is 9.84%, Total Carbohydrates is 45.59%, Moisture is 14.34%, Sodium (Na) is 313.18mg/100 g, Calories from Carbohydrates is 182.36kcal/100g, Calories from Fat is 254.88kcal /100g, Calories from Protein is 39.37kcal /100g, and its Total Calories is 476.61kcal/100g

Nutritional Evaluation of the Cookies

The best formulation, (lot 2) was analyzed for its carbohydrate, protein, fat and calorie contents.

The contribution of a serving (30 grams) of BBC to RENIs of the two selected age groups (30-49 years old, and 10-12 years old) were calculated and were shown in Tables 2 and 3 respectively. The nutrients of interest considered here are carbohydrates, proteins, fats and calories.

Table 3. Nutritional adequacy of BBC per serving (30 grams) for 30-49 Y/O.

Calories and Nutrients	Basis RDA[1]		Calorie/ Nutrients	Adequacy (Per cent)		Deficient (-)/ Excess (+)	
	Male	Female	BBC	Male	Female	Male	Female
Calories	2420	1810	142.98	5.91	7.90	-14.09	-12.1
Carbohydrates[2] (Grams)	363	272	13.68	3.77	5.03	-16.23	-14.97
Protein (Grams)	67	58	2.95	4.40	5.09	-15.60	-14.91
Fat[3] (Grams)	81	60	8.5	10.49	14.17	-9.55	-5.83

[1] Based on reference, man and woman ages 30-49 years 59 and 51 kg respectively

[2] Computed at 60 per cent of the kilocalorie RENI

[3] Computed at 30 per cent of the kilocalorie RENI

Table 2 shows that a serving of BBC contributes 5.91% and 7.90% to the energy need of a 30-49 years old, male and female, respectively. The calories or energy in food is provided by its carbohydrates, fat and protein components. The remaining portions of food consist of water, cellulose, minerals and vitamin, none of which yields energy.

While it is true that energy, other than water, may be singled out as the number one need of the body, in this case, Banana Blossom Cookie is a healthy option to those who are wanting to reduce their weight. However, eating about three to five pieces of the cookie is enough to meet at least one-fifth of the RENI for the subjects 30-49 years old for calories.

Carbohydrate contribution to RENI of BBC is 3.77% for male and 5.03% for female. Carbohydrates spare proteins for their unique role of tissue building and repair. Of the nutrients under consideration, carbohydrates have the lowest contribution to the nutrient intake (NI) of the group. This cookie is a healthy option to those who need Low-carb diets such as metabolic syndrome, diabetes, high blood pressure and cardiovascular disease. In fact, almost any diet that helps you shed excess weight can reduce or even reverse risk factors for cardiovascular disease and diabetes.

In terms of its protein contribution, the rate is 4.40% for female and 5.09% for male. This is a low protein food which may be included in the meal plan of persons who are prescribed a low-protein diet. People in need of low protein diet include those with mpaired liver function, disorders that interfere with protein metabolism and kidney disorders. Eating a low-protein diet will reduce the workload on the kidneys so that the remaining healthy part of the kidney does not have to work so hard.

Fat has the highest contribution to the RENI of this age group with 10.49% and 14.17% adequate for male and female respectively. Low-fat diets such as that recommended by the National Cholesterol Education Program (NCEP) were proven to be effective in reducing serum lipid levels and the risk for Cardiovascular Diseases (CVDs). The NCEP recommends a diet pattern with restriction of saturated fat (<7%), minimum intakes of PUFAs and monounsaturated fats of 10% and 20%, respectively, and total fat intake of 25–35%. In addition, low fat per se will reduce calorie supply in the body because of protein catabolism. Depot fat will be withdrawn and body weight reduced.

As a general observation, one does not consume only a piece of a cookie as a snack item. One can consume as many as 4 pieces paired with a cup of coffee. Consuming this amount assures the individual of meeting at least one-fourth of the day's need for the calorie and nutrient requirements of the age group under consideration.

Table 4. Nutritional Adequacy of A Serving of BBC for 10-12 Y/O.

Calories and Nutrients	Basis RENI[1]		Calorie/Nutrients	Adequacy (Per cent)		Deficient (-)/ Excess (+)	
	Male	Female	Blossom Bar	Male	Female	Male	Female
Calories	2140	1920	142.98	6.68	7.45	-18.32	17.55
Carbohydrates[2] (Grams)	321	288	13.68	4.26	4.75	-20.74	-20.25
Protein (Grams)	54	49	2.95	5.46	6.02	-19.54	-18.98
Fat[3] (Grams)	71	64	8.5	11.97	13.28	-13.30	--11.72

[1] Based on reference, man and woman ages 10-12 years, 34 and 35 kg, respectively

[2] Computed at 60 per cent of the kilocalorie RENI

[3] Computed at 30 per cent of the kilocalorie RENI

Table 3 shows that a serving of BBC contributes 6.68% and 7.45% to the energy need of a 10-12 years old, male and female, respectively.

Carbohydrate contribution to RENI of BBC is 4.26% for male and 4.75% for female. In terms of its protein contribution, the rate is 45.46% for female and 6.02% for male. Fat has the highest contribution to the RENI of this age group with 11.97% and 13.28% adequate for male and female respectively. Of the nutrients under consideration, carbohydrates have the lowest contribution to the nutrient intake (NI) of the group.

It must be noted that all of the nutrients is found LESS THAN ADEQUATE for both age groups under consideration for it did not meet at least 20% of the RENI of both age groups Consuming about two to four pieces of the BBC will assure the consumers of meeting at least one-fifth of their carbohydrate, protein, fat and calorie needs a day.

The Bright Side of the Inadequacy

Many consumers are now health conscious. They want to enjoy almost all kinds of food. Cookies, a common handy food, must contain ingredients rich in vitamins, minerals and even fiber. In the case of the obese and overweight, a calorie-controlled diet is recommended. The product, which is only 6.68 to 7.45.% adequate for calories for children ages 10-12, and 5.91 to 7.90% adequate for age group 30-49 years old would make a healthy option to these people. The addition of the BBP contributed to the bulk of the cookies making them less concentrated in calories; hence, they are a healthy option to dieters and weight-reducers. In addition, diseases that would require low carb, low protein and low fat foods can include the BBC in their diet without having to worry with calorie, protein, fat and carbohydrate overload.

Conclusions

Banana is an abundant native resource in the Philippines. It survives very well in this country because it provides the heat and humidity the banana needs for growth. One of the products of the banana tree is the banana blossom, also known as the banana heart or banana flower. With the abundance of the banana trees here in the Philippines, the banana hearts are easy to find, however, its optimum utilization in the area of bakery products has not yet been established. The study aimed to determine the feasibility of utilizing banana blossoms in making cookies. Specifically, it aimed to determine the best formulation in the preparation of Banana Blossom Cookies as reflected in its sensorial qualities. The study also focused on the evaluation of the proximate composition of the baked product. In addition, nutritional adequacy of the cookies for man and woman ages 30-49 and boy and girl ages 10-12 years old shall also be evaluated.

Results showed that Banana Blossom Powder can be added as one of the main ingredients in cookie preparation to as much as 11.5% of the formula. Proximate analysis showed that the ash content of Banana Blossom Cookies is 1.91%, Crude fat is 28.32%, Crude Protein is 9.84%, Total Carbohydrates is 45.59%, Moisture is 14.34%, Sodium (Na) is 313.18mg/100g and its Total Calories is 476.61kcal/100g. In terms of its adequacy level, Carbohydrate, protein, fat and calorie contents of a serving of the Banana Blossom Cookies

do not meet at least one-fourth or 20% of the RENI of the age groups 30-49 and 10 to 12 years old for calories and nutrients under investigation. Hence, the cookie is recommended for people who are overweight or obese.

Recommendations

For upscaling of the product, the researcher recommends for the standardization of the preparation of BBP and the inclusion of leafy vegetable powder to further enrich the product. Acceptability test involving a large group of respondents of different age groups, market potential analysis, vitamin and mineral profiling, determination of the fiber content as well as packaging and shelf-life determination may be worked out.

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Declaration of conflicting interests

The author declares no conflicts of interest with respect to the research, authorship, and/or publication of this article.

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