



Presented at the DLSU Research Congress 2017
De La Salle University, Manila, Philippines
June 20 to 22, 2017

Utilization of Breadnut (*Artocarpus camansi*) as a Meat Replacement for Meatballs

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Abstract: Meatball is a foodstuff made up of minced meat combined with other ingredients, typically rolled and shaped by hands (Bruno, M., 2015). Breadnut fruit or *camansi*, on the other hand is known to be fiber-rich. A single serving consists of 10.8g of dietary fiber. Dietary fiber provides health advantages and assists in digestion of food and can help in reducing levels of cholesterol. It is also a better source of protein, comparable to sweet potato and banana, and a good source of iron, calcium, potassium, riboflavin and niacin (Stuart, 2014). The general objective of the study was to utilize the breadnut as a meat replacement for meatball. Further, the study aimed to determine the: most preferred formulation of breadnut meatball; sensory acceptability of breadnut meatball; cost of direct materials; and shelf life of breadnut meatball.

The study undergone four phases. Phase 1 focused on production formulation. The formulations of the product were as follows: Formulation 1 contains 25% breadnut and 75% ground beef; Formulation 2 had 50% breadnut and 50% ground beef; and Formulation 3 had 75% breadnut and 25% ground beef. Breadnut was added gradually to achieve the desired formulation. Phase 2 determined the consumer acceptance and preference. Phase 3 determined the possible shelf life of the product. Phase 4 determined the cost of direct materials for each formulation.

The researchers used consumer type panel to determine the acceptability of the product. As a result, Formulation 1 has the same color when compared to the control sample and Formulation 2 and 3 had the lighter color. It was noted that Formulation 1 was the most preferred sample. Based on the sensory acceptability of 60 respondents, there was no significant difference among the formulated products in terms of general acceptability, texture, flavor and after taste. The cost of direct materials for formulated products were also cheaper than the cost of control sample per serving of 43 grams \pm 2 grams. The shelf life of the formulated product was two weeks from the day it was formulated.

Key Words: Breadnut, Meatball, Beef.

1. INTRODUCTION

Meatballs are famous with many vernacular names, such as *bakso* in Indonesia, *bola-bola* in Philippines, and *albondigas* in Portugal and Brazil. The history of meatball recipes is very rare to find as there is no clear evidence regarding its origin. Legends stated that Persia may be the origin of meatball recipes as *kofte* is a Persian word for

minced meatballs. Meatball recipes and cooking techniques have variations throughout the world. However, various ingredients were added to enhance its taste. Varieties of sauces are also prepared with meatballs. Meatball recipes are rich in protein. The nutritional value depends upon the kind of meat used and how it was cooked



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(ifood.tv.com, 2015). It can be prepared either boiled or baked instead of fried to avoid calories. Steamed meatball recipes are also quite popular in various cuisines (Bruno, 2015).

Meatball recipes is one of the versatile food products that everyone could prepare, whatever ingredient he may use. Recipes using meat include lamb, chicken, fish, prawns, venison, and duck. Vegetarian recipes for meatballs include corn and quinoa balls, chickpea and cauliflower balls, and tofu with mushroom (Bruno, 2015). The nutrition of meatballs as stated by USDA (2015), are as follows: calories (136), total fat (6g), saturated fat (0.9g), polyunsaturated fat (1.6g), monounsaturated fat (3.5g), trans fat (0.2g), sodium (456.5mg), potassium (425.9mg), total carbohydrate (9g), dietary fiber (5g), sugar (0.2g), protein (15g), vitamin A (2%), magnesium (1%), iron (13%), and calcium (10%).

Breadnut or *camansi* in *Tagalog* is a large tree and is often confused with breadfruit (*Artocarpus altilis*). It can be distinguished by its large spiny fruits with little pulp and numerous large, light brown seeds. Breadnut distribution were reported to come from Cagayan, Laguna, Leyte, and Cebu; occasional in Quezon province and in Manila. *Artocarpus* species are rich in phenolic components including flavonoids, stilbenoids, arylbenzofurans, and jacalin, which said to be antioxidant, anti-carcinogenic, and anti-inflammatory. Breadnut seed are rich in starch, protein, low fat, and a good source of minerals like calcium, magnesium, phosphorus, and contains niacin as compared with other nuts (Stuart, 2014). Breadnuts were boiled and eaten as a vegetable, particularly the immature fruits. All parts of the mature and ripe fruits are edible (National Tropical Botanical Garden, 2015).

Breadnut fruit is known to be fiber-rich. A single serving consists of 10.8g of dietary fiber. Dietary fiber provides health advantages and assists in digestion of food and can help in reducing levels of cholesterol. *Camansi* is a better source of protein, comparable to sweet potato and banana, and a good source of iron, calcium, potassium, riboflavin and niacin (Stuart, 2014).

Despite its being nutritious and potential uses and food, breadnut remains underutilized. They further pointed out that the seeds need to be processed to avoid spoilage and wastage during its season. One of the ways to preserve them is to dry them. The seeds are a valued food and are widely collected. Gathered seeds are sold in village markets, providing an important source of income for women in the Caribbean and parts of Central and

South America. Breadnut seeds can be roasted and are similar to chestnuts in texture and flavor; can be canned in brine, or processed into nut butter or nut paste, flour, or oil (Ragone, 2006). The seeds can be used to produce flour, resulting in a product rich in protein, similar or higher than that found in wheat. The use of breadnut seed flour and all purpose flour mixtures in food products like cookies will encourage a widespread use of underutilized breadnut. The cookies with breadnut seed flour in any level of substitution were highly acceptable to the panelists, since there were no cookie sample rejected based on the 9-point hedonic scale. But the most acceptable formulation based on general acceptability score was the cookie with 50% all purpose flour and 50% breadnut seed flour (Go, Velos, Minyamin, Bagsit, and Pableo, 2003).

The researchers utilized breadnut as a meat replacement in meatball because of its unique characteristics and nutritional value. The common types of meat used in meatballs are beef and pork. The researchers come up with an idea to use breadnut to lessen the meat content and achieve a healthy meatball. This study will be helpful to the following individuals: *farmers*, they will be encouraged to plant more breadnut since this will give them additional profit; *health-conscious* consumer, it will help them enjoy their meal in a healthy way; and *young generations*, they will be more aware about the breadnut and its health benefits. Also, this study will help them to know the fruit deeper.

The general objective of the study was to utilize the breadnut as a meat replacement for meatball. The study aimed to determine the: most preferred formulation of breadnut meatball; sensory acceptability of breadnut meatball; cost of direct materials; and shelf life of breadnut meatball.

The study only focused on the product formulation of breadnut-enriched meatball. This includes the determination of product acceptability and consumer preference. Determination of its possible shelf-life and its cost of direct materials were also included in this study. The formulated product does not undergo marketing feasibility and nutritional analysis.

2. METHODOLOGY

The study underwent four phases. Phase 1 focused on production formulation. The formulations of the product were as follows: Formulation 1

contains 25% breadnut and 75% ground beef; Formulation 2 had 50% breadnut and 50% ground beef; and Formulation 3 had 75% breadnut and 25% ground beef. The study adopted the recipe from Emma Christensen (thekitchn.com, Apartment Therapy, 2015) and modified in accordance of the study. Breadnut was added gradually to achieve the desired formulation.

Phase 2 determined the consumer acceptance and consumer preference. Sixty respondents were asked to evaluate the formulated products based on general acceptability, appearance, flavor, texture, and after taste using the 9-point Hedonic scale for consumer acceptance. The respondents were healthy and free from any form of allergies or diseases. They were also asked to ranked the formulated products based on their preference with 1 as the most preferred and 4 as the least preferred. To test if differences exists between and among the formulated products, One-way Analysis of Variance was used in consumer acceptance and Tukey test was used as ad hoc; and Baskers Table was used in consumer preference test. Products were presented using a three-digit code to avoid bias among the respondents.

Phase 3 determined the possible shelf life of the product. The formulated products were placed in an air-tight container and stored in a freezer. It was observed in the daily basis based on its sensory attributes. Phase 4 determined the cost of direct materials for each formulation. The cost of direct material was based on the current price of ingredients in time of the study. Figure 1 is the process chart for breadnut meatball.

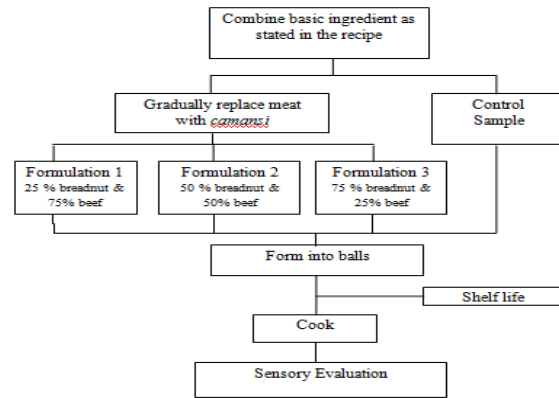


Figure 1. Process chart for breadnut meatball

3. RESULTS AND DISCUSSIONS

3.1 Product Formulation

The researchers formulated meatballs using breadnut as a meat replacement (Fig. 2). As per observation, Formulation 1 seems to be have no difference from the control because it only contains 25% breadnut. Formulation 2 had a light color because of the equal amount of breadnut and beef. Formulation 3 had the lightest color because it only contains 25% beef. The formulated product becomes lighter in color as more breadnut was added.



Figure 2. The control and formulated products. Clockwise from upper left: Control sample, Formulation 1, Formulation 2, and Formulation 3.



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3.2 Sensory Evaluation

The summary of consumer acceptance and consumer preference of the formulated products were shown in Tables 1 and 2.

Table 1. Summary of Consumer Acceptance*

Attribute	Control	F1	F2	F3
General	7.83 ^a	7.82 ^a	7.68 ^a	7.47 ^a
Acceptability	7.82 ^a	7.95 ^{ab}	7.63 ^a	7.60 ^{ac}
Appearance	7.75 ^a	7.70 ^a	7.57 ^a	7.42 ^a
Texture	7.88 ^a	7.98 ^a	7.85 ^a	7.65 ^a
After Taste	8.30 ^a	8.20 ^a	8.20 ^a	8.07 ^a

*@ 95% level of confidence. Critical value=2.64. Means not sharing the same letter are significantly different. F1(Formulation 1), F2 (Formulation 2), and F3 (Formulation 3).

Table 2. Summary of Consumer Preference*

Formulation	Total	Rank
Control sample	134 ^a	2
F1	132 ^a	1
F2	148 ^a	3
F3	186 ^b	4

*@ 95% level of confidence. Critical value=36.3. Rank sums not sharing the same letter are significantly different. A lower rank sum indicates higher preference. F1 (Formulation 1), F2 (Formulation 2), and F3 (Formulation 3).

General acceptability. General acceptability is something to be considered to be socially accepted or within the realm of what is appropriate, or something that is tolerable but not necessarily desired (Your dictionary, 2015). Based on the analysis of variance, there was no significant difference among the formulations on their general acceptability. Formulation 1 ranked as the most preferred product by the respondents and Formulation 3 is significantly different from other formulations. The appearance of Formulation 3 had the lightest color.

Appearance liking. Appearance is the physical characteristics of food. This includes color, size, shape, consistency or viscosity, and defects (Gatchalian and Brannan, 2011). Based on the analysis of variance of the appearance liking, there was significant difference between Formulation 1

and Formulation 3. Formulation 1 had almost the same color as control sample because it has the highest meat content among the formulations. It was noted that the addition of breadnut would produce lighter color in meatballs.

Texture liking. Texture refers to those qualities of a food that can be felt with fingers, tongue, palate, or teeth (Foodscienceavenue, 2008). Based on the analysis of variance there was no significant difference among the formulations. Formulation 1 had the highest mean of liking because it contains more meat as compared to the other formulations.

Flavor liking. Flavor is perceived through the combination of odor and taste. This are very important attributes of food products which greatly determine their acceptance or rejection (Gatchalian and Brannan, 2011). Based on the analysis of variance, there was no significant difference among the formulation. Formulation 1 was the most preferred because the formulation still provides the “beefy” flavor in which the respondents failed to notice.

After taste. After taste is the flavor that a food or drink leaves in the mouth when someone have swallowed it (Cambridge University Press, 2015). Based on the analysis of variance, there was no significant difference among the formulations. The control sample is the most preferred on after taste liking because of the pureness of the meat content.

3.3 Shelf life Study

The formulated products were checked on a daily basis and evaluated by the researchers based on its appearance, texture, flavor, odor, and after taste. It was stored in an air-tight container and placed in a freezer for 14 days. On Day 8 to Day 10, the researchers observed that Formulation 3 had changes in its color and texture but the flavor remained the same. On Day 15, the formulated products produced too much moisture and the texture became soggy.

3.4 Cost of Direct Materials

The direct materials used in the study was modified based on each formulation. Each formulation became cheaper as breadnut was added. The highest cost of direct material was the control



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sample. It used 100% ground beef to make meatballs. Formulation 3 was the most inexpensive meatball because it contains highest amount of breadnut to replace beef meat. All formulations have the same yield of 20 pieces at 43 grams each. Table 3 summarizes the cost of direct materials in each formulation.

Table 3. Summary of Cost of Direct Materials*

Formulation	Total Cost (Php)	Yield
Control sample	197.48	20 pieces
Formulation 1	182.48	20 pieces
Formulation 2	167.48	20 pieces
Formulation 3	152.48	20 pieces

*based on the market price of the ingredients in time of the study.

4. CONCLUSIONS

The researchers concluded the following based on the results of the study. The most preferred and most accepted formulation was Formulation 1 based on the answers of the respondents. Based on consumer acceptance, there is no significant difference in terms of its general acceptability, texture, flavor and after taste, while significant difference exists between Formulation 1 and Formulation 3 in terms of appearance. The cost of direct materials of Formulation 1 was Php182.48, which is the highest among the formulations while Formulation 3 had the least amount of direct materials because it contains the highest percentage of breadnut. The shelf life of the developed product lasted for two weeks without the addition of any preservative.

5. ACKNOWLEDGMENT

The researchers wishes to acknowledge these special people whose influence made it possible to finish their study: first and above all, to God Almighty, for the strength, blessing, guidance, and spiritual support to finish their study; Mr. Alberto M. Aguilar and Mr. Michael G. Consignado, former department chairs of Management and Ma. Andrea C. Francia, current department chair of Management; Ms. Lea Marissa S. Domingo, research

and development coordinator; Ms. Yolanda A. Ilagan, Ph.D, former campus dean; Prof. Cristina M. Signo, current dean, for being a good counselor and adviser, for the support and guidance; deepest gratitude and appreciation goes to their parents and siblings, for being with them all through the way and for showing their unconditional love and unending support financially, emotionally, and spiritually; and Roselle Tuzon, Marieden Flores, and Kenneth Gubagaras for the support and shared knowledge for the good friendship and belongingness until the end of their study.

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