

Technology Diffusion of Blended Breadnut Coffee Formulation

Charmaine P. Antecristo

Cebu Technological University – Moalboal Campus

Email address: charmaine.antecristo@ctu.edu.ph

Abstract— Coffee became a profitable product in the Philippines; thus, aside from coffee beans, other nuts such as breadnut seeds could be utilized as coffee. However, without caffeine, the product could never be called coffee. In this study, the mixture of breadnut (*Artocarpus Camansi*) powder and commercial coffee powder added nutritional value. It aims to evaluate the sensory attributes and chemical and microbial composition of breadnut coffee to prove that breadnut seeds could be an alternative source of coffee that offers better health benefits at low cost and attainability. These will also be the basis for a technology diffusion of blended breadnut coffee. Thus, this study is essential since breadnuts are abundant in the Philippines. This study employed an experimental method of research that investigates and evaluates the sensory attributes and chemical characteristics of blended breadnut coffee likewise its acceptability. The 160 respondents investigated the sensory properties of the four sample treatments as to their color, aroma/odor, body, taste, aftertaste, and general acceptability. While the chemical properties of the most acceptable blended breadnut coffee formulation will be analyzed through laboratory tests. The data were analyzed using SPSS26. The breadnut coffee powder formulations are nutritious and with acceptable sensory attributes that can be used as a substitute for other commercial coffee products. Moreover, Treatment 3 (75% breadnut coffee powder and 25% pure coffee powder) is said to be more acceptable by the respondents, aside from the control. Based on the chemical and microbial analysis, a coffee's acidity and fat content have been reduced due to the nutrients produced as the breadnut coffee powder is added. Moreover, blended breadnut coffee is proven to be filled with enough nutrients and is safe to consume by the consumers; thus, it is recommended for technology diffusion.

Keywords— Discipline, chemical, coffee, microbial, sensory attributes, design, geography, technology diffusion.

I. INTRODUCTION

Coffee (*coffea*) is a source of livelihood for small farmers worldwide, notably in Asia and the Pacific, who are frequently entirely reliant on the commodity (Chapman, K.R., n.d.; Butt and Sultan 2011). Coffee is not only a therapeutic option, but it is also a beverage with several potential health advantages (Bae et al., 2014). Coffee became a profitable product in the Philippines due to moderate weather, fertile soil, and substantial mountainous terrain (Salazar et al., 2020; Butt and Sultan, 2011).

Some Filipinos use nuts in making coffee since the larger cherries and beans are a staple in the Philippine coffee landscape (Philippine Coffee, n.d.). There are several classifications of nuts based on the following families, and breadnut is one of them (Bahram Tadayyon, 2013). Breadnut (*Artocarpus camansi*) is considered a form of seeded breadfruit. It is indigenous in the Philippines and is commonly known as

kamansi. Many studies mentioned that breadnuts are a good source of nutrients such as protein, carbohydrates, and minerals but are low in fat compared to other nuts like almonds, Brazil, and macadamia nuts (Adeleke & Abiodun, 2010). and (Waghray & Gulla (2011) utilized breadnut seeds as an ingredient for coffee.

In this study, the breadnut seed (*Artocarpus Camansi*) powder will be mixed with brewed coffee powder to add its nutritional value. It aims to evaluate the sensory attributes, physicochemical and microbial composition of blended breadnut coffee to prove that breadnut seeds could be an alternative source of coffee that offers better health benefits at low cost and attainability. These will also be the basis for a technology diffusion of blended breadnut coffee. Thus, this study is essential since breadnuts are abundant in the Philippines.

II. REVIEW OF LITERATURE

Beverages are an essential component of our daily diet, and they are categorized into two broader horizons, namely alcoholics and non-alcoholics (Bae et al., 2014). Some options are available among non-alcoholic beverages, including coffee, tea, fruit juices, carbonated beverages, etc. (Butt et al., 2011; Butt and Sultan, 2009; Butt et al., 2009). With roughly 500 billion cups consumed yearly, coffee is the second most common beverage after water (Prakash et al., 2002; Clarke and Vitzthum, 2001). It is a vital consumer product and economical crop for domestic and international markets (Kongsom & Panyakul, 2016; Ditlevsen et al., 2019). Coffee is a source of livelihood for small farmers worldwide, notably in Asia and the Pacific, who are frequently entirely reliant on the commodity (Chapman, K.R., n.d.; Butt and Sultan 2011). The coffee industry is important worldwide since it is commercialized in high quantities and produces several by-products (Salazar et al., 2020).

Moreover, coffee is the most widely consumed chemical (caffeine) in several nations (Matijasevich et al., 2005). Caffeine is a white crystalline powder having a bitter taste. And the coffee's actual potency is controlled by the degree of roast (the darker the roast, the more potent) and the coffee-to-water ratio employed during the brewing process (Küçük et al., 2017; Belay et al., 2008). It serves as a mild psychostimulant-like substance in humans, increasing alertness and tension (psychological representation of physiological arousal), improving sustained attention, encoding of new information, and psychomotor performance for speed and accuracy at low

and moderate dosages (Adan et al., 2008; De Melo Pereira et al., 2020).

However, decaffeinated coffee is an alternative to regular coffee at practically every coffee shop. Contrary to popular belief, decaf coffee does contain caffeine, though far lower than regular coffee (Mazzafera et al., 2009). The health benefits of decaffeinated coffee are often attributed to chlorogenic acid. Likewise, its lignans and some mineral components also possess therapeutic potential (Celik et al., 2009; Suzuki et al., 2008; Farah and Donangelo, 2006; Ky et al., 2001). It protects against cardiovascular diseases, diabetes mellitus, Parkinson's disease, Alzheimer's disease, and DNA damage and improves its antioxidant status (Migliore et al., 2009). It produces alertness through stimulating functions and effective treatment for sleepy people (Boutrel et al., 2004).

Furthermore, coffee became a profitable product in the Philippines due to moderate weather, fertile soil, and substantial mountainous terrain (Tumanan & Lansangan, 2012). Besides, Philippine Liberica, often known as Barako/Baraco in the Philippines, is a robust coffee bean. The larger cherries and beans, primarily grown in the provinces of Batangas and Cavite, are a staple in the Philippine coffee landscape (Philippine Coffee n.d.). Additionally, breadfruit has long been an important staple crop and a primary component of the traditional agroforestry system in the Philippines where numerous varieties are grown. Breadnuts have a large seed covered by a tasty citrus-flavored orange-coloured skin that can be boiled or dried and ground to make porridge or bread. After boiling, it tastes like mashed potato, but after roasting, it tastes like coffee or chocolate (Bahram Tadayyon, 2013).

There are several classifications of nuts based on the following families, and breadnut is one of them (Bahram Tadayyon, 2013). Breadnut (*Artocarpus camansi*) is considered a form of seeded breadfruit. It is indigenous in the Philippines and is commonly known as *kamansi*. Its fruit contains numerous seeds from 12 to as many as 150 and is embedded in its fleshy pulp. The seeds are rounded or flattened by compression and are about 2.5 cm long. Many studies mentioned that breadnuts are a good source of nutrients such as protein, carbohydrates, and minerals but low in fat compared to other nuts like almonds, Brazil, and macadamia nuts (Ragone, 2006).

Additionally, the breadnut product is being developed for widespread usage (Go et al., 2015), Macandora and Sanchez (2010) mentioned that they used breadnut seeds to make coffee and proved that they could be utilized as coffee. They picked matured breadnut seeds for their analysis. According to the result of their study of Nutritional Composition of Breadnut Seeds (*Artocarpus camansi*), the values of the proximate composition of breadnut seeds as protein (4.87%), fat (3.48%), and carbohydrate (26.11%). Ash and crude fibers, respectively, 3.43 percent and 1.20 percent. Phosphorus had the greatest mineral content value of 363 mg/kg, potassium 325 mg/kg and sodium 248 mg/kg, and iron had the lowest value of 0.5 percent mg/kg and copper 0.12 mg/kg. The breadnut seeds might be ground into composite flour, and the oil could be used as a human food source (Adeleke & Abiodun, 2010).

Technology diffusion of blended breadnut coffee shows the dynamic consequences of adoption in the market to give attention to the consumers. It describes technology accumulation across time and adopters resulting from individual adoption decisions (Comin et al., 2014). The customer acceptance of any product is influenced by its packaging design, branding, and price. Individual consumers purchase for themselves or others to suit their own needs and desires. Individual customers can be from various origins, ages, and life stages (Kardes et al., 2011). The first step toward success is understanding how to set your products apart from commodity packaging (Wang et al., 2007). The research focused on three key issues: the appropriateness of look, branding, and pricing, as evidenced by the initial impression of the product's packaging (Harith et al., 2014). Results show that consumers notice the differences each coffee packaging possesses in the market and purchase what they like based on their perception (Creusen et al., 2005).

Additionally, aromatic components are essential in coffee beverages as they are the main constituents of the sensory experience of coffee drinkers (Bhumiratana et al., 2011). Furthermore, six factors affect the sensory properties of coffee: plant varieties, growing region/conditions, processing methods (from coffee cherries to green coffee beans), roasting levels, grinding size, and brewing methods (Illy et al., 2005). Because coffee scent is an essential aspect in purchasing decisions, the industry must understand the aroma qualities present at each step and how the attributes grow during manufacturing the coffee drink (Bhumiratana et al., 2011).

As breadfruit agriculture expands, agronomic knowledge of cropping systems and production management is more critical for efficient crop production and loss avoidance (Lincoln et al., 2018). Breadnut is widespread in Amazonia, although it is a clone of breadfruit with far greater commercial potential. A simple type of vegetative propagation was created to help promote breadfruit, and nursery plants were supplied to help spread the word (Van leeuwea et al., 2021).

However, some areas are yet to improve in producing breadnuts to make blended breadnut coffee. Difficulties with transportation and the freshness of some commodities, such as the fresh breadnut seeds available at every market in Puerto Rico, might have also been an issue (Williams et al., 2014). The absence of this product in Hartford markets is most likely owing to the seeds' high oil and low organic acid content, which makes them prohibitively challenging to export in raw, fresh form (Adeleke & Abiodun, 2010). Finding areas with high breadnut cultivation potential is critical to overcoming this possible problem. Establishing nurseries in both private and public sectors is encouraged to increase the supply of high-quality planting material. Selected high-quality cultivars could be replicated and distributed to farmers (Medagoda, 2007). A survey of 83 breadfruits (*Artocarpus altilis*) and chataigne (*Artocarpus camansi*) farmers was conducted in 2009 in five regions of Trinidad and Tobago. Breadfruit consumption has traditionally been stigmatized to determine local consumers' current attitudes toward crops and their response to this market (Abrajano et al., 2021).

Objective

This study aimed to evaluate the sensory attributes, physicochemical and microbial composition of blended breadnut (*Artocarpus camansi*) coffee in the municipality of Moalboal during academic year 2020-2021 as basis for crafting technology diffusion of blended breadnut coffee formulation.

Specifically, it seeks to:

1. Determine the different formulations of the different blended breadnut coffee
2. Evaluate the sensory attributes as to color, aroma, taste, body, aftertaste of the different blended breadnut coffee formulations and its acceptability.
3. Assess the chemical properties as to physicochemical and microbial composition of the most acceptable blended breadnut coffee formulation.

III. METHODOLOGY

Method

This study utilized a parallel-group design. It is an experimental study design in which each subject is randomized to one of two or more distinct treatment/intervention groups (Turner J.R., 2013). The formulations containing breadnut coffee powder are experimental and the formulation with commercial brewed coffee serves as the control.

Respondents

The respondents were composed of 160 coffee drinkers classified according to age groups and gender purposely selected within the locality of Moalboal. The determination of coffee consumption by age group, was adapted from Kerbykate (2013) *Coffee Consumption*. These were the evaluators of the four sample treatments of the blended breadnut coffee to determine the target consumers of the formulated product.

Instrument

The rating sheet for sensory evaluation was the main instrument adapted from Kerbykate, 2013. It is used to determine the descriptive characteristics as to color, aroma/odor, taste, body, aftertaste, and the general acceptability of four formulations of blended breadnut coffee. Acceptability was based on the 5 Likert Scale, described as very acceptable, acceptable, moderately acceptable, less acceptable, and not acceptable. The respondents rated how acceptable the different formulations of the blended breadnut coffee.

Flow of the Study

The research flow of the study considered the Input-Output-Process (IPO) model to obtain answers to the problems raised in this study. The input was deal on the formulation of blended breadnut coffee in four treatments. It also looked into the evaluation of sensory attributes using descriptive and acceptability and the chemical properties, as to proximate composition and microbial analysis, of the most acceptable blended breadnut coffee formulation. On the processing, the for the sensory attributes, the data gathered processed and statistically treated employed weighted mean, One-way and Two-Way Analysis of Variance (ANOVA). Chemical composition data were done through series of laboratory tests.

As the output of the study, the results of the finding was used in crafting technology diffusion of the blended breadnut coffee formulation.

Data Gathering Procedure

The different formulated blended breadnut coffee (BBC) samples were subjected to sensory evaluation by identified respondents. Each of the respondents were randomly assigned a specific treatment and rated each one after scrutinizing using the score sheets. To ensure a reliable result, the respondents was given enough time to rate the products. They were instructed to drink water to clean their palate each time they tasted a specific treatment. They were assured that their answers are going to remain confidential. Ethical standards to safeguard the rights of the respondents were observed throughout the study. All collected data were tabulated using the spreadsheet, IBM Amos version 23, and were treated accordingly with the aid of IBM SPSS version 26 to facilitate analysis and interpretation. The most preferred and acceptable blended breadnut coffee formulation will be analyzed for chemical analysis in the laboratory.

Ethical Considerations

This study sought approval from the University Research Ethics Committee (UREC) of the Cebu Technological University. Voluntary participation was assured. Informed consent letters were obtained from all respondents. Subjects were ensured that the data collected are confidential and anonymous and that the researcher will only use it for the present study.

Statistical Treatment

The data from the score sheets for descriptive and acceptability preference testing were statistically treated. The treatment utilized the percentage for the respondents' profile. The weighted mean was employed for the description and acceptability level of the products and the analysis of variance for the difference between and among treatments. Computation and analyses of data will be done through SPSS version 26.

Scoring Procedure

To interpret the panelists' descriptions on the sensory attributes of the different blended breadnut coffee (BBC) formulations, the five-point scale was used.

IV. RESULTS

For the sensory evaluation of the blended breadnut coffee formulations based on descriptive and acceptability, the different levels of concentration of the breadnut coffee powder creates noticeable changes in color, odor, taste, body and aftertaste but in general the four treatments were all acceptable to the respondents. Moreover, based on general acceptability, aside from the control, Treatment 3 (75% breadnut seed powder & 25% brewed coffee powder) emerged as the most acceptable formulation.

With regards to chemical compositions of the most accepted blended breadnut coffee formulation contains crude protein (13.2), ph (5.09 @23°C), moisture content (7.65%), and crude fat (6.88). Its microbial, contents are as follows: *E. coli*

(Negative) and *coliform count* (<10CFU/g). Therefore, based on results, the formulated blended breadnut coffee was safe for consumption as all microbial parameters conformed to the standard limits set by FDA.

Statistics showed that there were significant differences existed among treatments in each of the attributes based on description and also acceptability. However, there was no significant differences in their ratings based on their age and gender.

V. CONCLUSION

Based on the findings of this study, it is concluded that the breadnut coffee powder formulations are nutritious and with acceptable sensory attributes that can be used as substitute for other commercial coffee products. Moreover, Treatment 3 with the mixture of 75% breadnut seed powder and 25% brewed coffee powder is said to be more acceptable by the respondents, aside from the control. Based on the physicochemical and microbial analysis, the acidity and fat content of a coffee has been reduced due to the nutrients produced as the breadnut coffee powder added. Moreover, a 75% mixture of breadnut seed powder and 25% brewed coffee powder is proven to be filled with enough nutrients and is safe to consume by the consumers.

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