Research Article

Nutritional composition and sensory quality evaluation of Philippine Choco Chiffon Cake

Journal of Tourism, Hospitality & Culinary Arts (JTHCA)
2020, Vol. 12 (1) pp 446-455

Submit date: 10th June 2019
Accept date: 16th August 2019
Publish date: 29th February 2020

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Proposed citation:

Moreno, R. B. (2020). Nutritional composition and sensory quality evaluation of Philippine Choco Chiffon Cake. *Journal of Tourism, Hospitality & Culinary Arts, 12*(1), 446-455.

Abstract

This study was conducted to determine the nutritional composition, sensory qualities, and general acceptability of the chiffon cake with different levels of cacao (Theobroma cacao Linn.) powder. There were five different samples labeled A, B, C, D and E with ratios of 100:0, 90:10, 80:20, 70:30, 60:40, respectively: each representing the percentage of wheat flour and cacao flour mixed together to produce the flour mixtures. Treatment A has a pure 100 % wheat flour sample and served as the control. Based on the results of nutritional analysis, the percentage of moisture content, ash, crude protein, total fat, carbohydrate and energy were 34.6 %, 1.33 %, 5.71 %, 13.5 %, 44.9% and 324 Kcal respectively for Treatment B - composed of 90 % wheat flour and 10 % cacao powder –which happened to be the most acceptable treatment based on the sensory evaluation conducted. In majority, the sensory acceptability level of chiffon cake enriched with different levels of cacao bean powder in terms of appearance, aroma, texture, taste and general acceptability were ranged from liked very much to like extremely. The findings of this study will definitely be beneficial to health-conscious consumers since it will fortify the ingredients for making chiffon cake - going on a healthier and guilt-free path. After all, the results of adding cocoa powder into chiffon cake aimed to make a baseline database - using the information obtained – which will be beneficial for further studies and/or other parallel researches.

Keywords:

Cacao powder; Chiffon cake; General acceptability; Nutritional analysis; Sensory quality evaluation

1 Introduction

Cake is one of the most common bakery products consumed by people in the world. It is made from various combinations of refined flour, shortening, sweetening, eggs, milk, leavening agent, and flavoring. Cake ingredients are soft wheat of cake flour and variable levels of fat, sugar, eggs, milk, baking powders, emulsifiers and other commonly used ingredients such as cocoa powder, nuts, fruits, icings, and certain flavorings which are used for specialty cakes (Ruzaid et al, 2005).

Cocoa is a food rich in polyphenols (flavonoids and phenolic acids). Its main flavonoids are flavan-3-ols, epicatechin, and catechin. Total polyphenols in raw cocoa are up to 60% in monomeric and oligomeric forms (Ranneh et al, 2016). Cocoa contains approximately 380 known chemicals and 10 psychoactive constituents. Its seeds contain fixed oil, 40-56 %; theobromine; glucose, saccharose; vitamin A, 825-1400 I.U. per 100 gm; cellulose, 2.8-5.4%; water, 5-7%; ash, 3-5%; starch, 5% and a glucoside, cacarine. Seeds yield about 2% theobromine, 40 to 60% solid fat while shell contains about 1 percent theobromine (Ackar et al, 2013).

Cacao is high in magnesium as well as in antioxidants - approximately 40 times higher than blueberries. It is also high in polyphenols, with three main groups: catechins (37%), anthocyanins (4%) and proanthocyanidins (58%). The main catechin is (-)-epicathechin with up to 35% of polyphenol content (Katz et al, 2011). A study has yielded various polyphenolic compounds, viz., simple phenols, benzoquinones, phenolic acids, acetophenones, phenylacetic acids, hydroxycinnamic acids, phenylpropenes, coumarines, chromones, naphthoquinones, xanthones, stilbenes, anthraquinones, flavonoids, lignans, and lignins (Hii et al, 2009).

2 Literature Review

The feel-good sensation with chocolate is attributed to the chemical phenylethylamine (PEA) which might be partly responsible for the release and potentiation of brain dopamine. Higher concentrations of PEA are found in some cocoa beans and high-quality cocoa powder (Halliwell, 2009).

The concentration of flavanols in any chocolate depends on both the flavanol content of the cacao plant and the procedures used for transforming the cocoa into chocolate. Then, the accurate assessment of the flavanol content is pertinent to interpreting its biological effects (Hung et al, 2004).

Cacao (Theobroma cacao L.) is a small tree, growing to 3 to 5 meters high. Leaves are alternate, entire, oblong-ovate to oblong, 15 to 40 centimeters long, 5 to 20 centimeters wide, with a pointed tip and rounded base. Flowers are solitary or fascicled on the trunk and branches; yellowish or nearly white, about 1 centimeter in diameter. The fruit is oblong, 10 to 15 centimeters long, prominently wrinkled, yellow or purplish. Seeds are numerous and embedded in whitish pulp; when ripe they rattle in the capsule when shaken.

Malaysian cocoa polyphenol extract has a potential of being an insulin-mimetic agent. Further studies are suggested to elucidate the underlying mechanisms for its glucose reduction and insulin mimicking activities (Guo, 2014).

Therefore, there is a need to develop certain food products, such as cakes enriched with cacao bean powder to cater to consumers whose health has been compromised because they may be suffering from hypertension, diabetes, cardiovascular diseases and the like, although, until now, there have not been any large-scale intervention studies to assess these potential benefits.

This study aims to formulate and develop a chiffon cake enriched with cacao bean powder and determine its nutritional composition, sensory qualities, and general acceptability for the consumers. Specifically, it will determine the nutritional composition of chiffon cake with different percentage levels of cacao powder as to moisture content, ash, crude protein, total fat, carbohydrate and energy. It will also try to find out the level of sensory acceptability of chiffon cake with different levels of cacao powder as to appearance, aroma, taste, texture, and general acceptability.

3 Materials and Methods

The study utilized an experimental method to determine the nutritional composition of the prepared cacao powder (specifically made by the researcher from the cacao beans collected) and its application in baking. The sensory acceptability of the cacao chiffon cake produced was also determined.

In the preparation of the sample, ripe cacao fruits were gathered from the researcher's backyard in Calinog, Iloilo, Philippines. Wheat flour and other ingredients in making the cake were purchased from a local bakery supplier. In choosing the cacao to be utilized for this study, the husk needs to be scraped and if the color is either yellow or white, that is the indication that it's ripe. Local cacao (Theobroma cacao L.) was chosen because of its accessibility and its potential property to enhance the nutritional content and appearance of products such as the chiffon cake. Moreover, there comes a time when there is overproduction which makes the selling price of these products go down. This is one way to help the cacao farmers' income since this process of developing post-harvest cacao will transform it into a more stable form, with longer storage life.

For the preparation of the cacao powder, the beans were removed from the pod, drained inlined banana leaves and were left to ferment for a week, turning it on both sides regularly to ensure optimum results. This method of pod storage is convenient for farmers as it can allow them to collect pods over several harvests or sources until they have enough to conduct fermentations. Results also demonstrated that fermentation of beans from stored pods is more rapid and has higher brown bean counts than other methods (Guehi et al, 2010).

When fermentation is completed, the beans were dried using a net under direct sunlight for one week. Then, the dried beans were cracked to separate the nibs from shells. The nibs were later roasted in an oven at a temperature of 120 degrees Celsius before they were eventually processed for milling.

After milling, the ground cacao powder was kept in an air-tight container for the next process, which is the preparation of the composite flours. The flour mixtures were prepared by substituting whole wheat flour with cacao powder at different proportional levels (0%, 10%, 20%, 30% and 40%), using a miller machine. The first flour sample with 100% whole wheat served as the control.

For the formulation of the wheat and cacao composite flours, there were five different samples tagged as A, B, C, D and E. These samples have the ratios of 100:0, 90:10, 80:20, 70:30, 60:40, respectively, which represented the percentage of wheat flour and cacao flour to produce the flour mixtures, with the pure 100 % wheat flour sample as the control, tagged as Treatment A.

Table 1 shows the actual measurement of each of the five samples. It also indicates the different ingredients and their specific measurements.

Table 1: Formulation of wheat and cacao composite flours.

	Samples				
Ingredients (%)	**A** (100 % Wheat Flour) Control	**B** (90% Wheat Flour- 10% Cacao Powder)	**C** (80 %Wheat Flour -20% Cacao Powder)	**D** (70% Wheat Flour -30% Cacao Powder)	**E** (60 % Wheat Flour- 40% Cacao Powder)
Batter:					
Cake flour (g)	250	225	200	175	150
Cacao Powder (g)	0	25	50	75	100
Sugar (g)	200	200	200	200	200
Baking Powder (g)	12.5	12.5	12.5	12.5	12.5
Salt (g)	2.5	2.5	2.5	2.5	2.5
Eggyolks (g)	125	125	125	125	125
Corn Oil (g)	125	125	125	125	125
Water (g)	175	175	175	175	175
Meringue:					
Eggwhites (g)	250	250	250	250	250
Sugar (g)	125	125	125	125	125
Cream of Tartar (g)	2.5	2.5	2.5	2.5	2.5
Total Batter Weight (g)	**1,267.5**	**1,267.5**	**1,267.5**	**1,267.5**	**1,267.5**

For the preparation of the cacao chiffon cake, the muffin method of cake preparation was used. This is to help ensure the finished product remains tender and

fluffy. The dry ingredients, such as the cake flour, cacao powder, sugar, baking powder and salt were blended and placed in the respective mixing bowls. After that, the egg yolks, water and corn oil were added. Using a paddle, the mixer was set to high speed for one minute and was shifted to medium speed for 3 minutes thereafter, until a smooth texture was achieved. It was then set aside for the next procedure.

For the meringue, egg whites and cream of tartar were placed in a mixing bowl. Using high speed, the two ingredients were mixed for 30 seconds and sugar was added gradually, and they were mixed continuously for 2 minutes until meringue is smooth and has reached a soft peak consistency. The batter was then cut and folded to the meringue mixture. After that, it was poured into paper-lined baking pans before it was finally baked at 177 degrees Celsius for 50 minutes.

For the nutritional composition to be determined, a laboratory test called nutritional analysis was made. This process on the Philippine chocolate chiffon cake was performed independently by adopting Official Methods of Analysis International (Horwitz, 2005). Moisture content was determined by indirect method (AOAC method 930.22); crude protein by Kjeldahl Method using Block Digestion and Steam Distillation; Total fat by Acid Hydrolysis and Solvent Extraction using Soxtec System HT2 and Petroleum Ether as Solvent; and ash content by Direct Method (AOAC 2010 method 930.22). Carbohydrate content was calculated by difference (100 – Sum of Moisture, Ash, Protein and Fat) and Energy in kilocalories per 100 g is the sum of protein, fat and carbohydrate multiplied by the general Atwater factors 4-9-4 respectively. This was done at Regional Standards and Testing Laboratory, Department of Science and Technology VI, Philippines.

On the other hand, the sensory evaluation was done on the finished products, in terms of appearance, aroma, texture, taste, and general acceptability using a modified sensory evaluation score sheet based on a 5-point hedonic scale with one representing the least score and 5 as the highest score. The evaluation was done by thirty panelists from the Food Technology Department, WVSU-Calinog Campus, Calinog, Iloilo, Philippines. The respondents were composed of ten faculty members, ten food technology students and ten food enthusiasts. The panelists were instructed to rinse their mouths with water between sample evaluations.

Finally, for the statistical analysis, the mean was used in determining the level of sensory acceptability of the product as to appearance, aroma, texture, taste, and general acceptability.

The following continuum was used in the interpretation of data where 4.20-5.00 for liked extremely, 3.40 - 4.19 for liked very much, 2.60 - 3.39 for liked moderately, 1.80 -2.59 for liked slightly and 1.00 -1.79 for disliked very much.

4 Results and Discussion

In Table 2, the proximate analysis of chiffon cake different proportional levels of cacao powder was presented. The proximate analysis included the moisture content, ash content, crude protein content, crude fat content, total carbohydrates content and energy content. These analyses are important for the determination of food quality, microbial stability and can be used for nutritional labeling.

Based on the results of proximate analysis of the product, the percentage of moisture content, ash, crude protein, total fat, carbohydrate and energy were 34.6 %, 1.33 %, 5.71%, 13.5 %, 44.9 % and 324 Kcal, respectively.

Table 2: Nutritional composition of chocolate chiffon cake as to moisture, ash, crude protein, total fat, carbohydrate and energy.

Sample Description	Parameter	Result
25 g. sample of cacao	Moisture	34.6 %.
chiffon cake with 90 %	Ash	1.33 %
Wheat Flour and 10 %	Crude Protein	5.71 %
Cacao Powder*	Total Fat	13.5 %
	Carbohydrate	44.9 %
	Energy	324 Kcal

**Sample was chosen based on the results of the sensory acceptability test*

The protein content is a key specification for wheat and flour purchasers since it is related to many processing properties, such as water absorption. Protein content can also be related to finished product attributes, such as texture and appearance. When proteins were combined with water, it forms gluten (Shewry, et al, 2002).

The crude fiber was a measure of the quantity of indigestible cellulose, pentosans, lignin, and other components of this type in present foods ("Crude Fiber, “2009, April 24", Introduction," para. 1).

Fat content determines the free fatty lipids of flour. This property can be used as the basis in determining processing temperatures as well as auto-oxidation which can lead to rancidity and can also affect the flavor of the food.

Ash content refers to the mineral content of the flour. Bakers need to know the quantity of ash as it will have an impact on water absorption, nutrition (mineral content), and fermentation activity. Ash in flour can also affect color, imparting a darker color to finished products. Some specialty products requiring particularly white flour call for low ash content while other products have high ash content (Salkić et al,2009).

The moisture provides the measure of water content and the total solid content of flour. It also determines the storage ability and quality of the flour. The higher moisture content above 14% attracts mold, bacteria, and insects all of which cause deterioration during storage. Organisms naturally present in the flour will start to grow at high moisture, producing off-odors and flavors.

Below are the levels of acceptability and quality of chiffon cake with cacao powder in terms of appearance, aroma, texture, taste and general acceptability when proportioned into the following: a.) treatment A 100% wheat flour or controlled variable; b.) treatment B enriched with 90 % wheat flour and 10% of cacao powder; c.) treatment C enriched with 80 % wheat flour and 20% of cacao powder; d.) treatment D enriched with 70 % wheat flour and 30% of cacao powder; and e.) treatment E enriched with 60 % wheat flour and 40% of cacao powder.

Table 3: Sensory acceptability level of chiffon cake enriched with different levels of cacao bean powder in terms of appearance, aroma, texture, taste and general acceptability

Treatment Samples	Appearance		Aroma		Texture		Taste		General Acceptability	
	Mean	Description	Mean	Description	Mean	Description	Mean	Description	Mean	Description
Treatment A (100 % Wheat Flour) Control	4.73	Liked extremely	4.43	Liked extremely	4.53	Liked extremely	4.67	Liked extremely	4.53	Liked extremely
Treatment B (90 % Wheat Flour – 10 % Cacao Powder)	4.47	Liked extremely	4.40	Liked extremely	4.33	Liked extremely	4.50	Liked extremely	4.50	Liked extremely
Treatment C (80 % Wheat Flour – 20 % Cacao Powder)	3.97	Liked very much	3.93	Liked very much	3.83	Liked very much	4.43	Liked extremely	4.13	Liked very much
Treatment D (70 % Wheat Flour – 30 % Cacao Powder)	4.03	Liked very much	3.93	Liked very much	3.87	Liked very much	4.20	Liked extremely	4.33	Liked extremely
Treatment E (60 % Wheat Flour – 40 % Cacao Powder)	4.03	Liked very much	3.73	Liked very much	4.03	Liked very much	4.27	Liked extremely	4.20	Liked extremely

Appearance is the way that someone or something looks, closely related to color, which is a property causing a visual sensation that depends on the light that they reflect and is perceived as red, blue, green and other shades. The following table determines the sensory acceptability level of chiffon cake enriched with different levels of cacao bean powder in terms of appearance. Treatments A and B were “liked extremely” (Ms=4.73 and 4.47) while treatment C, D and E were “liked very much”, (Ms=3.97, 4.03 and 4.03) respectively. Compared to that of the control, we can say that although the mean scores of the other treatments were low, the general appearance is still within acceptable ranges.

The aroma is a distinctive, typically pleasant smell (olfaction) and trigeminal nerve stimulation (registering the different types of smell). There are few things better than sitting in a kitchen as it fills with the smell of baking. Over time the smells get darker, richer and more caramelized. Baking time and oven temperature play a vital role in the acceptability of the cake’s aroma. The table shows the sensory acceptability level of chiffon cake enriched with different levels of cacao bean powder in terms of aroma. Treatments A and B were “liked extremely” (Ms=4.43 and 4.40) while treatment C, D and E were “liked very much”, (Ms=3.93, 3.93 and 3.73, respectively). In contrast to the study above, the lower the concentration of the cacao powder, the higher the acceptability in terms of aroma.

Next would be the sensory acceptability level of chiffon cake enriched with different levels of cacao bean powder in terms of texture. Texture refers to the feel and appearance of a surface, its roughness or smoothness. In food, it is the structure of the substance when felt, touched or chewed. Mouthfeel, on the other hand, is the substance’s physical and chemical interaction in the mouth, an aspect of food rheology, which covers many areas related to the testing and evaluating of foodstuffs from initial perception on the palate, to the first bite, through mastication to swallowing and aftertaste. Some food enthusiasts, however, use the traditional term texture. Based on the results, Treatments A and B were “liked extremely” (Ms=4.53 and 4.33) while treatment C, D and E were “liked very much”, (Ms=3.83, 3.87 and 4.03) respectively.

Taste, a sensation produced when a small quantity of something eaten, drunk or sampled to assess its effect on the sensory receptors or when a substance in the mouth reacts chemically with taste receptor cells, is located on taste buds in the oral cavity, mostly on the tongue. In the table, it portrays the sensory acceptability level of chiffon cake enriched with different levels of cacao bean powder in terms of taste. All treatments from A to E were “liked extremely” (Ms=4.67, 4.50, 4.43, 4.20 and 4.27).

When something is considered to be socially okay or within the realm of what is appropriate, or something that is tolerable but not necessarily desired, then that is generally acceptable. More specifically, food acceptability is affected by many factors, which may be related to the individual, the food, or the environment in which the food is consumed. The table above also indicates the sensory acceptability level of chiffon cake enriched with different levels of cacao bean powder in terms of its general

acceptability. Treatments A, B, D and E were “liked extremely” (Ms=4.53, 4.50, 4.33 and 4.20) while treatment C was “liked very much”, (Ms=4.13) respectively. Although it was not straightly proportional, the less percentage of cacao bean powder, the higher is the general acceptability of the treatment.

5 Conclusion

Based on the results of nutritional analysis, each of the different treatments turned out to be significantly beneficial to our health. The percentage of moisture content, ash, crude protein, total fat, carbohydrate and energy were very suggestive of this product is a potent source of high nutritional value.

The sensory acceptability level of chiffon cake enriched with different levels of cacao bean powder in terms of appearance, aroma, texture, taste and general acceptability were ranged from “liked very much” to “liked extremely”. The most acceptable treatment was Treatment B, composed of 90 % wheat flour and 10 % cacao powder and this was determined using the modified sensory evaluation score sheet based on a 5-point hedonic scale where the scores for this treatment were overwhelmingly high. Therefore, we can conclude that the lower the percentage of the cacao power added, the higher is the acceptability level. The findings in the study implied that cacao powder can be used in making chiffon cake as long as it will not overpower the main ingredient which is wheat flour, taking into consideration the quality and general acceptability of the chiffon cake.

6 About the Author

Dr.Raymund B. Moreno is a former Dean of the College of Business and Management of West Visayas State University – Calinog Campus. A multi-awarded researcher who has acquired patents and utility models for his innovations in the food processing technology field, his works have been published in reputable publications internationally.

He earned his bachelor’s degree in Hotel and Restaurant Technology at the Iloilo Science and Technology University, a state university located in Iloilo City, Philippines while he holds a Master of Science in Business Administration Major in Hotel and Restaurant Management and a Doctor in Business Management specializing in Hospitality Management both at the Philippine Women's University in Manila, Philippines.

His works have been praised both locally and internationally and he has been invited numerous times as a presenter/ participant in different fora, conferences and conventions in the Philippines and abroad. He is currently the Chairperson of the Food Technology Department of West Visayas State University – Calinog Campus and also an assessor of National Certificate (NC) 2 in Cookery for the Technical Education and Skills Development Authority (TESDA).

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