Evaluation of Physicochemical, Microbial and Sensory Properties of Sponge Cakes Made with Oyster Mushroom *(Pleurotusostreatus* (Jacq.) Kummer*)* Powder

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Abstract –*In response to the mandate of the government, The Department of Education with its Order No. 17 s.2008 and to facilitate the proper implementation of it which bans junk foods in all Public Elementary and High School canteens. It is stated in the order that only fortified foods will be served to the learners to curb malnutrition. Thus, the possibility of making sponge cake of good sensory determination and its proximate analysis was examined. The sensory determination indicates that sponge cake with oyster mushroom powder show a significant difference (p=0.01) in terms of shape, outside color, volume, crust, inside color, grain, and general sensory determination with non-treated sponge cake. Results of the proximate analysis show that crude protein contents (%) increased with oyster mushroom powder treatment record A(6.27), B(6.67), C(7.23) and D(7.43) while percentage ash contents result show that increased with oyster mushroom powder treatment record A(0.6), B(0.9), C(1.06) and D(1.11). On the other hand, crude fat does not show any correlation with the amount of oyster mushroom powder. Percentage crude fiber also shows irregular interrelationships with A90.73), B(0.18), C(0.44), and D(0.24) while moisture content with A(38.55), B(36.57), C(41.18) and D(43.55).*

Keywords *–fortified foods, oyster mushroom powder, proximate evaluation, Sensory determination, sponge cake*

INTRODUCTION

Enjoyed by Queen Victoria with her afternoon tea, a typical sponge cake is paired with raspberry jam and whipped double cream or vanilla cream [1].

Sponge cake is a light cake made without a shortening. A traditional sponge cake is very easy to make as it consists of just three very basic ingredients: flour, sugar and eggs. Per 100 g / mL serving the food Sponge cake within the category Cakes & Pies has a total of 297.0 calories and the following nutrition facts: 7.3 g protein, 57.7 g carbohydrates and 4.3 g fat.

In Asia and many parts of the world, mushrooms have been used for both medicinal and culinary purposes. Furthermore, both eastern and western medicine associated mushrooms with many pharmacological properties. With significant role in human health, nutrition and disease, edible mushrooms are widely consumed as an important food item. The functions include reducing cholesterol [2], lowering the pressure of blood, boost immune system against diseases [3], fighting tumors [4] and improves liver function [5]. Oyster mushrooms besides of their nutritional and medicinal value, are also easiest and least expensive making it more popular to cultivate [6].

The government strategized and recognizes that food enrichment could improve the health of the people. Simple diets based on staple food are often deficient in certain nutrients. Thus, nutrient supplementation of food is the present thrust of our government [7].

Consuming sponge cake incorporated with Oyster mushroom will benefit people with health issues such as cardiovascular diseases, and at the same time a cheaper and organic option for their nutritional needs.

It is important to maximize the utilization of Oyster mushroom such as by making an alternative pastry ingredient that is cheap, readily available and rich in nutrients and that is the focus of the present study.

OBJECTIVES OF THE STUDY

This study aimed to determine the sensory characteristics and level of acceptability of sponge cake with oyster mushroom powder as to shape, outside color, volume, crust, inside color, grain, aroma and

general quality. Physicochemical analysis and microbial determination will be sought further.

MATERIALS AND METHODS

Research design

Sponge cake with different treatment of oyster mushroom powder incorporated, A-no oyster mushroom powder, B-85. 0 g oyster mushroom powder, C-170.0 g oyster mushroom powder and D-255.0 g oyster mushroom powder was tested for sensory quality using different parameters. The different groups that considered as the possible consumer assessed the sponge cake based on the try-out recipe. The level of quality determination of sponge cake in different treatments of oyster mushroom powder was evaluated by the respondents using the five-point scale (1 as disliked very much and 5 as extremely liked).

Respondents

The respondents who served as the expert taste panel were thirty (30) randomly selected residents of Roxas City, Capiz, Philippines. It was composed of 10 children below 12 years old, 10 teenagers aged 13-19 and 10 adults aged 20-60 years old. The chosen respondents are sponge cake eaters or one of their favourite food is sponge cake. Survey sheets were given to them. The respondents were instructed to drink water to cleanse the palate before doing the taste test for each sample.

Research instrument

The evaluation score sheets was used in this study. It was composed of seven criteria such as shape, outside color, volume, crust, inside color, grain, aroma and general sensory quality. The score sheets were validated by food expert and consultant from University of San Agustin, General Luna Street, Iloilo City, Philippines.

Raw Materials

Measurement	Ingredients
384 g	cake flour
1 g	baking powder
2.8 g	salt
237 ml	water
8 pcs	egg yolks
200 g	sugar
59 ml	oil
5 ml	vanilla
150 g	sugar
8 pcs.	egg white
0.36 g	cream of tartar

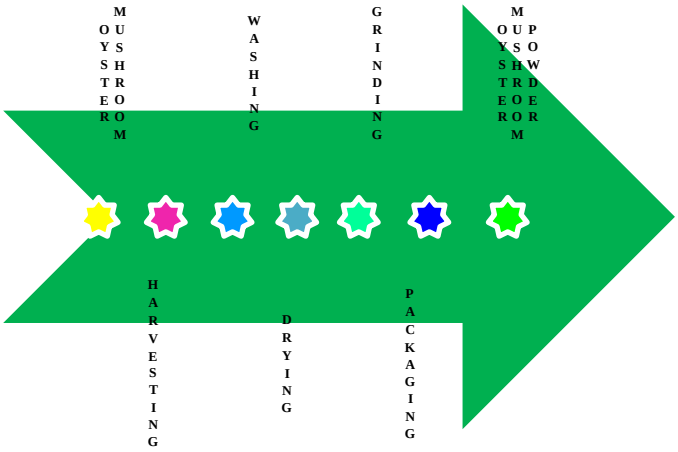

Fig. 1. Diagram outlining the process of preparing the oyster mushroom powder

Harvesting

Cultured Oyster mushrooms were harvested from Mama Jean's mushroom laboratory, New Road Banica, Roxas City, Capiz, Philippines.

Washing

After harvesting, the mushrooms were washed thoroughly with clean running tap water.

Drying

The mushrooms were put into the plastic tray covered with aluminium foil and were sun dried for 6-8 days or until golden brown and brittle.

Grinding

After the mushrooms were dried, it was grinded using the mortar and pestle, in order to achieve its powdered form; it was grinded further using a kitchen food blender.

Packaging

The powdered Oyster mushroom was put into a clean designated zip lock bags for labelling. It will be is ready to be incorporated into sponge cake mixture.

Baking process

A standardized recipe for making sponge cake was used. First, combine all dry ingredients in a mixing bowl. (cake flour, baking powder, and salt). Different proportions of powdered Oyster mushroom will be added for every prepared mixture. Second, combine all liquid ingredients in a mixing bowl. (water, egg yolks, sugar, oil, and vanilla). Make a well and pour all the liquid ingredients, mix until well blended. Set aside.

Third, beat egg whites until stiff and fluffy then gradually add sugar. Fourth, cut and fold with batter mixture. Fifth, pour in a cake pan lined with oil paper. Lastly, bake in a pre-heated oven at 250 degrees Celsius for 15 minutes.

Disposal of Waste Materials

After baking, all materials that were not used were disposed properly with the supervision of the personnel of MCarsi Culinary School, Roxas City, Capiz, Philippines.

Labelling

Let the sponge cake cool down, it was sliced and placed into zip lock bags. Each zip lock was labelled according to the amount of incorporated Oyster mushroom powder. Treatment A has no Oyster mushroom powder, Treatment B has 85.0 g Oyster mushroom powder, Treatment C has 170.0 g Oyster mushroom powder, and Treatment D have 255.0 g Oyster mushroom powder.

Sensory Evaluation

Thirty (30) respondents are randomly selected for sensory evaluation. It is composed of 10 children below 12 years old, 10 teenagers aged 13-19 and 10 adults aged 20-60 years old. Survey sheets will be given. Respondents will first drink water to cleanse the palate before each sample will be tasted.

Analysis of Data

All data in the form of numerical arbitrary scores were subjected to a one way ANOVA (Analysis of variance). Tukey test was used to discriminate the differences among individual treatments means (α=0.05). The t-test was conducted using SPSS (Statistical Package for Social Sciences) version 20.0 of IBM (International Business Machine), 1 New Orchard Road Armonk, New York 10504-1722, United States of America.

Table 1. The arbitrary scale used for data interpretation of the mean.

Scale Value	Interpretation
4.20 - 5.00	Liked Extremely
3.40 - 4.19	Liked Very Much
2.60 - 3.39	Liked Moderately
1.80 - 2.59	Disliked Slightly
1.00 - 1.79	Disliked Very Much

Proximate Analysis

The proximate composition of the sponge cake samples was determined using standard method of Association of Official Analytical Chemist (AOAC, 2016). The samples were analyzed for crude protein, crude fat, crude fiber, moisture and ash (by percentage)

Microbial Analysis

Microbiological analyses were performed according to the protocol described by Manguiat and Fang [20]. A 25 g sample was diluted in 225 ml of peptone water (Merck KGaA, Germany). The mixture was macerated in a sterile Stomacher bag for two minutes. The supernatant representing the stock solution was then diluted up to 10-6 using sterile physiological water and the corresponding plate agar media were seeded. Counts (colony-forming units per gram) were expressed as a logarithm (log cfu g-1).

RESULTS AND DISCUSSION

Table 2 presents the summary evaluation obtained for the shape by means of the Sponge cake with Oyster mushroom powder in different treatments.

Table 2. Mean rating of sponge cake with oyster mushroom powder in different treatments as to shape

Treatments	Mean	Interpretation
A (Control)	4.07	Like Very Much
B	3.73	Like Very Much
C	3.67	Like Very Much
D	3.43	Like Very Much

As shown in the Table 2, among experimental treatments, Treatment A (sponge cake with no oyster mushroom powder) obtained the highest mean, which means liked very much. This implies that the shape was liked very much because the oyster mushroom powder did not affect any changes in shape of sponge cake.

ANOVA results indicate that there is no significant difference between treatments at confidence level of 0.01 ($F(3,116)=1.893$, $p=0.135$). This implies that in terms of shape the sponge cake with oyster mushroom powder are almost the same. Findings further imply that the oyster mushroom powder was properly blended with other ingredients because of even shape, appealing color and glossy.

The most important factors for the classification and grading in relation to commercial quality and organoleptic properties of agricultural products such as

fruit, vegetables and grain is its appropriate in shape [8].

According to Spence and Ngo [9], consumers reliably match a variety of tastes (bitterness, sweetness, and sourness), oral-somatosensory attributes (carbonation, oral texture, and mouth-feel), and flavours to abstract shapes varying in their angularity. A typical match that more angular shapes such as triangles and stars is associated with bitter and/or carbonated foods and beverages. However, more rounded forms such as circles with sweet tastes. Suggestions in the labelling and/or packaging of food and beverage products that shape symbolic associations could be incorporated in order to subconsciously set up specific sensory expectations in the minds of consumers. Provided that a means for companies to gain a competitive advantage in the marketplace where consumers normally prefer those food and beverage products that meet their sensory expectations, compared to those that give rise to a disconfirmation of expectation of consumers. Latest evidence in consumer's sensory-discriminative and hedonic responses to food and beverage products demonstrates through the shapes a consumer sees on the label and even the shape of the packaging of the food.

Table 3. Mean rating of sponge cake with oyster mushroom powder in different treatments as to outside color.

Treatments	Mean	Interpretation
A (Control)	2.6000	Like Moderately
B	3.3000	Like moderately
C	3.3667	Like moderately
D	3.7000	Like very Much

Table 3 presents the summary table of the obtained mean of sponge cake with oyster mushroom powder in different treatments as perceived by the group of evaluators as to its outside color.

The result shows that there is significant difference in the level of quality of the sponge cake with oyster mushroom powder as to outside color of the four treatments ($F(3, 116)=5.357$, $p=0.002$). This implies that the outside color of sponge cake in Treatments A, B, and C were not comparable to each other.

Treatments with added oyster mushroom powder are described as "like moderately". Moreover, as the amount of added oyster mushroom powder increases, it also gives a more appealing color.

Single-parent families, working mothers and the elderly used food that are being processed to create visually appealing food that also tastes good [10].

Table 4. Mean rating of sponge cake with oyster mushroom powder in different treatments as to volume

Treatments	Mean	Interpretation
A (Control)	3.1667	Liked moderately
B	3.2000	Liked moderately
C	3.2333	Liked moderately
D	3.2000	Liked moderately

Table 4 presents the summary table of the obtained mean of sponge cake with oyster mushroom powder in different treatments as perceived by the group of evaluators as to its volume.

The result showed that there was a no significant difference on the level of quality of sponge cake with oyster mushroom powder as to volume of the four treatments.

Result shows that there is no significant difference in the level of quality of the sponge cake with oyster mushroom powder as to volume of the four treatments, $F(3, 116)=0.020$, $p=0.996$. This implies that in terms of volume the sponge cake with oyster mushroom powder, were similar to each other. However, sponge cake with 170.0 g of oyster mushroom powder obtain the highest mean, described as like moderately. This implies further that the oyster mushroom powder is properly blended with other ingredients because the cake is not airy and proportioned.

In the study about chickpea flour added to cake, it was observed that with the different levels of chickpea flour addition the cake volume increased sharply up to 25.0% chickpea flour addition and the volume changes from 84% to 116% of the S1. Chickpea flour in terms of cake volume has an inverse relationship with rice flour. Moreover, in S4 sample which contains 25% chickpea flour and 5% rice flour showed that the highest volume of cake was achieved. For the sample S2 and S3, the cake volume was 84% and 108% respectively. The volume of the cake increases (S2, S3 and S4) due to the higher fiber content as the Chickpea flour increase while the rice flour decreases. There was variation in weight of the cakes due to compositional variation for the level of inclusion of chickpea flour and rice flour. Variation in specific volume of the cakes was detected from the S1 cakes due to the variation in volume and weight of the cakes. Chickpea flour and

rice flour and other ingredients were same for each formulation gave variations to the results [11].

Table 5. Mean rating of sponge cake with oyster mushroom powder in different treatments as to crust.

Treatments	Mean	Interpretation
A (Control)	3.7333	Like very much
B	3.3667	Like moderately
C	3.3333	Like moderately
D	3.3000	Like moderately

The mean ratings showed that treatments A, B, C and D were liked very much by the respondents. There was no significant difference in the level of quality of sponge cake with oyster mushroom powder in different treatments as to crust $F(3,116)=1.183$, $p=0.319$. This implies that in terms of crust the sponge cake with oyster mushroom powder were similar to each other. However, among the experimental treatments, Treatment with no oyster mushroom powder obtains the highest mean because the incorporation of oyster mushroom enhances the very pleasant formation of the crust.

The development of a dry surface crust usually done during baking. Baking is considered a simultaneous heat and mass transfer process. It is usually characterized by a rapid increase of the core temperature. Several chemical reactions and physical changes increase the internal temperature. It is associated and responsible for both the transformation of the cake batter into crumb and the product volume expansion. The baking process is considered as a decisive factor in producing high-quality baked goods. All quality attributes were affected by baking process conditions—oven temperature, baking time, and oven humidity [12].

Table 6. Mean rating of sponge cake with oyster mushroom powder as to inside color.

Treatment	Mean	Interpretation
A (Control)	1.7333	Disliked very much
B	2.9333	Liked moderately
C	2.9667	Liked moderately
D	3.8667	Liked very much

Table 6 presents the summary table of the obtained means of sponge cake treated with oyster mushroom powder as perceived by the group of respondents as to color.

The result showed that there was significant difference on the level of quality of the sponge cakes with oyster mushroom powder as to inside color of four treatments $F(3, 116), = 20.804$, $p=.000$. This implies in terms of inside color the sponge cakes with oyster mushroom powder were not the same.

Treatment D obtain the mean of 3.8667 was described as "liked very much" while sponge cakes with 85.0 g and 170.0 g of oyster mushroom powder where described as "liked moderately". Sponge cake with no oyster mushroom powder was described as "disliked very much".

People associate different foods with different colors. Customer perception on how the food taste will have a detrimental effect due to the color of the food [13].

Table 7. Mean Rating of Sponge cake Enriched with Oyster Mushroom Powder as to Grain.

Treatment	Mean	Interpretation
A (Control)	4.1000	Liked extremely
B	3.8667	Liked very much
C	3.3000	Liked moderately
D	3.2000	Liked moderately

Table 7 presents the summary table of the obtained means of sponge cake treated with oyster mushroom powder as perceived by the group of respondents as to grain.

The result showed that there was significant difference on the level of quality determination of the sponge cakes with oyster mushroom powder as to grain of four products $F(3,116)= 6.661$, $p=.000$. This implies that in terms of grain the sponge cakes with oyster mushroom powder were not the same.

The obtain mean of sponge cakes with no oyster mushroom powder and 85.0 g of oyster mushroom powder were described as "liked very much". On the other hand, 170.0 g and 255.0 g of oyster mushroom powder were described as "liked moderately".

Chronic disease can be prevented by taking whole grain food. It is a key component of a healthy diet and is an important step for better prevention of some diseases [14].

Table 8. Mean rating of sponge cake enriched with oyster mushroom powder as to aroma

Treatment	Mean	Interpretation
A (Control)	3.3667	Liked moderately
B	3.4667	Liked very much
C	3.5333	Liked very much
D	3.8333	Liked very much

Table 8 presents the summary table of the obtained means of sponge cake treated with oyster mushroom powder as perceived by the group of respondents as to aroma.

The result showed that there was no significant difference on the level of quality of the sponge cakes with oyster mushroom powder as to aroma of four treatments $F(3, 116)= 0.763$, $p=0.517$. This implies in terms of aroma the sponge cakes with oyster mushroom powder were almost the same.

Treatment B with 85.0 g and no oyster mushroom powder was described as "liked very much" while sponge cake with 170.0 g and 255.0 g of oyster mushroom powder were described as "liked very much".

However, among the experimental products, sponge cake with 255.0 g oyster mushroom powder obtained the highest mean, which means very acceptable. This implies that the aroma was moderately liked because they were extremely pleasant oyster mushroom powder smell.

Commonly the smell of freshly-baked bread is a guide for consumers towards the bread department and increase sales. Bread aroma is one of the possible strategies to increase the bread consumption. Supermarkets and bakeries in general have long been using bread aromas to facilitate sales of bread. It have been scientifically tested, that the bread aroma such as improving mood [15].

More in general, food aromas irrespective of hunger state have been shown to increase food appetite for congruent products, in terms of both taste and energy density, [16]. Food aromas also affected food choice [17]. Also, behavior in restaurants have been found to be affected by aromas [18] and shops [19].

Table 9. Mean rating of sponge cake with oyster mushroom powder in different treatments as to general quality.

Treatment	Mean	Interpretation
A (Control)	2.8143	Liked moderately
B	3.1627	Liked moderately
C	3.2477	Liked moderately
D	3.5853	Liked very much

Table 9 presents the summary table of the obtained means with the Sponge cake with Oyster mushroom powder in different treatments as perceived by the group of evaluators as to its general quality.

As shown in Table 9, the obtained mean of sponge cake with oyster mushroom powder as perceived by the group of evaluators as to general quality.

The result showed that the obtained mean of sponge cake with 255.0 g oyster mushroom (Treatment D=3. 5853), 170.0 g oyster mushroom powder (Treatment C=3.3477), 85.0 g oyster mushroom powder (Treatment B=3.1627) and no oyster mushroom powder (Treatment A=2.8143).

However, among the experimental treatments, Treatment D, with 255.0 g of oyster mushroom powder obtained the highest mean, which means very acceptable.

Proximate analysis

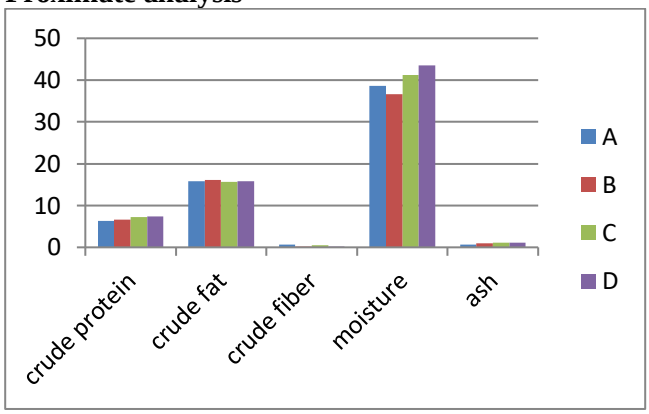

Figure 2. Proximate composition of sponge cake enriched with oyster mushroom powder

Results of the proximate analysis show that crude protein contents (%) increased with oyster mushroom powder treatment record 6.27, 6.67, 7.23 and 7.43 for A, B, C and D respectively while percentage ash contents result show that increased with oyster mushroom powder treatment record 0.6, 0.9, 1.06 and 1.11 for A, B, C and D respectively. On the other hand, crude fat does not show any correlation with the amount of oyster mushroom powder. Percentage crude fiber also shows irregular interrelationships with 0.73, 0.18, 0.44, and 0.24 while moisture content with a 38.55, 36.57, 41.18 and 43.55 for A, B, C and D respectively.

Microbial Determination

Table 4. Aerobic plate count of sponge cake enriched with oyster mushroom powder

Treatment	Value (CFU/g sample)	Interpretation
A (Control)	560	Good
B	750	Good
C	250	Good
D	8 900	Good

The aerobic plates count of the sponge cake enriched with oyster mushroom powder were minimal and within safe and good level.

CONCLUSION AND RECOMMENDATION

Based on the findings the following conclusions were made. The sponge cake treated with oyster mushroom powder was generally acceptable as snacks and dessert. Moreover, the evaluators' rated as liked very much the sponge cake with 255.0 g of oyster mushroom powder since it has a better shape, outside color, volume, crust, inside color, grain, aroma and general quality. Furthermore, sponge cake incorporated with oyster mushroom powder was noted to have no significant differences in terms of shape, volume, crust and aroma. While findings of proximate analysis indicated that the nutritional quality of sponge cake could be improved by oyster mushroom powder, especially in terms of crude protein and ash. Sponge cake of acceptable sensory determination could be produced in 85.0 g, 170.0 g and 255.o g oyster mushroom levels.

Shelf life studies are very important in food processing. Although shelf life studies are yet carried out in this research, the sponge cake enriched with oyster mushroom powder samples obtained during the duration of this study may have good and acceptable shelf life. This parameter could be further explored. Furthermore, the result of this study is recommended to be disseminated to encourage food scientist, housewives researchers and other food experts to treat the sponge cake and other bakery items with oyster mushroom powder to increase its quality and nutritional value. Lastly, a parallel study is also recommended using the higher levels of oyster mushroom powder to establish its higher capacity. Sustainability of oyster mushroom should be considered. Moreover, the availability of sponge cake eaters as respondents will be taken into consideration also. Greater sample size and the methodology should be reviewed further for better and complete understanding of the topic.

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