

Microbiological Determination, Proximate Analysis And Sensory Evaluation of Aloe Vera Gel (*Aloe Barbadensis* Miller,) Enriched Butterscotch Cookies

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Abstract: The possibility of making butterscotch cookies of good nutritional, microbiological and sensory attributes was examined. Aloe vera gel enrichment of .75 cup (255 g), .50 cup (170 g) and .25 cup (85 g) used in the production process. The proximate analysis, sensory evaluation and aerobic plate count (APC) of the butterscotch cookies samples were determined. Result of proximate analysis of butterscotch cookies enriched with aloe vera gel samples showed that crude protein contents (%) of 8.68, 7.95 and 6.49 was recorded. Crude protein increased with the increase in the aloe vera gel proportions. A contrast trend was observed in crude fat contents (%) with the lowest value of 5.90 recorded for the .75 cup (255 g) and the highest value of 9.49 was obtained for the .25 cup (85 g) aloe vera gel proportions. Crude fiber do not show the increasing or decreasing trend (%), result shows that the highest percentage was obtained from .75 cup (255 g) and the lowest percentage was from .50 cup (170 g) of aloe vera gel proportion. Ash contents (%) of 1.41, 1.75 and 1.40 were obtained for the .75 cup (255 g), .50 cup (170 g) and .25 cup (85 g) aloe vera gel proportions. The moisture content (%) increased with increase in the aloe vera gel proportions, with the highest value of 24.50 recorded for the .75 cup (255 g). The sensory evaluation indicated that butterscotch cookies enriched with aloe vera gel were no significantly different (p 0.01) with respect to color, aroma, volume, flavour and general acceptability of probability level. The aerobic plate counts (log CFU/g) ranged from 1.00⁴ to 1.80⁷ which means that its within a good and acceptable microbiological level. It is indicated that the nutritional quality of butterscotch cookies could be enhanced by aloe vera gel, especially in terms of crude protein, crude fat, and moisture. Butterscotch cookies of acceptable organoleptic attributes could be produced in ¾ cup (255 g), ½ cup (170 g) and ¼ cup (85 g) aloe vera gel level. This would be of economic importance in many developing countries, such as the Philippines, and the world as a whole in promoting the use, utilization and processing of local crops.

Key Words: Aloe Vera Gel, Microbiological Determination, Proximate Analysis, Sensory Evaluation

1. INTRODUCTION

The semi-tropical plant, Aloe Vera, has a long and illustrious history dating from biblical times. It has been mentioned throughout recorded history and given a high ranking as an all-purpose herbal plant (The International Aloe Science Council, 2002). Recently, extract of *Aloe barbadensis* Miller (1768) commercially known as "aloe vera" been reported to be genotoxic in bacterial as well as in mammalian systems (Paes-Leme, Motta, De Mattos, Dantas & Bezerra, 2005 & Ahmet, Ayşe, Eyyüp, Erman, Hasan & Mehmet, 2010.).

In food industry, Aloe vera has been utilized as a source of functional food, especially for the preparation of healthy food drinks and other beverages, including tea (Ahmet, et. al., 2010.). Intake of aloe juice has also been linked with improved blood glucose level in diabetes patients (Ray, Kiran, Swami, & Prema, 2013). Moreover, aloe extract has been reported to even cure cancers (Bunyapraphatsare, Yohgchaiyudha, Rungpitarangsis & Chokeyaiaroenporn, 1996.). Research has proven that adding *Aloe vera* to one's diet improves digestion.

As a general health tonic drink, *Aloe vera* is a useful source of a large range of vitamins - even vitamin B12, Vitamin A, contains B-Group vitamins, Vitamin C, Vitamin E and folic acid (Surjushe, Vasani, & Saple, 2008). *Aloe vera* gel contains important ingredients including 19 of the 20 amino acids needed by the human body and these amino acids just cannot be made synthetically. It was found out further that many inflammatory conditions of the digestive system and other internal organs, including the stomach, small intestine, colon, liver, kidney and pancreas. Moreover, about 23 polypeptides are present in Aloe juice which helps to control a broad spectrum of immune system diseases and disorders. Polypeptides plus the anti-tumor agents such as, Aloe emodin and Aloe lectins, are now also used in treatment of cancer (Hamman, 2008).

Food fortification has been shown to be one of the safest and most cost-effective measures to improve the nutritional value of a diet. It has already been applied for decades to improve the nutritional status of target populations in various countries by adding value to simple, affordable staple foods. Indeed, in many countries fortification of staples such as wheat flour is mandatory to replace nutrients

lost through food processing or to reduce the prevalence of identified deficiencies (Rajeswari, Umadevi, Sharmila Rahale, Pushpa, Selvavenkadesh, Sampath Kumar & Bhowmik, 2012).

This study was aimed at using Aloe vera gel as enrichment for cookies and examines its added value through proximate analysis as well as sensory and microbiological qualities. The use of Aloe vera gel for butterscotch cookies will help to promote by taking out its benefit as food enrichment. It will also lead to increase in its output to be ready for market introduction, thereby enhancing the utilization of the plant.

2. METHODOLOGY

2.1 Research design

The study tested the Butterscotch cookies with different proportions of Aloe vera gel, Treatments: A – 0.75 cup (255 g), B – 0.50 cup (170 g), C – 0.25 cup (85 g) and D – 0 cup (0 g).

A survey using a pre-designed questionnaire was used to find out the level of sensory characterization of butterscotch cookies enriched with Aloe vera gel as to color, aroma, volume, flavor and general acceptability (Canillas, 2016). Proximate analysis and microbiological analyses were done in an experimental design in the study (Olaoye & Onilude, 2008).

2.2 Respondents

The respondents who served as the expert taste panel were 25 randomly selected staff and faculty. The level of sensory evaluation of butterscotch cookies enriched with aloe vera gel as to color, aroma, volume, flavor and general acceptability were evaluated by the respondents using the Five-Point scale (1 as Extremely Liked and 5 as Very Much Disliked). The aloe vera leaves used in this study was planted and cultivated purposely by the researchers.

The experiment was divided into four phases: the preparation of Aloe vera gel, the standardization of the recipe, the preparation of the butterscotch cookies with Aloe vera gel, and the evaluation of the cookies by the panel of evaluators.

Phase I. Preparation of extraction of aloe vera gel

Aloe vera leaves were thoroughly washed to remove any dirt and unwanted materials. They were then peeled and Aloe vera gel was removed manually. The extracted gel was stored inside the container ready to be mixed into butterscotch cookies mixture. Figure 1 illustrates the whole extraction process of Aloe vera gel.



Figure 1: Flow chart for the production of Aloe vera gel

Phase II. Baking Process and Standardization of the Recipe

The recipe of butterscotch cookies was adapted from procedure of Depra (2001) shown in Table 1 and was modified in this study by adding aloe vera gel. The following proportions and steps in the procedure will be followed in preparing the butterscotch cookies. Conversion of cups measurement into grams was based on <http://dish.allrecipes.com/cup-to-gram-conversions/>

Table 1. The Modified Recipe of Butterscotch cookies

Ingredients	Measurements
Butter	227 g (1 bar)
Large Egg	5 pcs.
Rhum/Vanilla	37.5 g (3 tbsp.)
Baking Powder	12.5 g (1 tbsp.)
Glucose	12.5 g (1 tbsp.)
Ground Peanuts	255 g (¾ cup)
Brown Sugar	(301 g (1 ½) c
Wash Sugar	301 g (1 ½) c
Muscovado Sugar	603 g (3 cups)
All Purpose Flour	603 g (3 cups)
Raisin	255 g (¾ cup)
Water	255 g (¾ cup)
Aloe vera gel	
Treatment A	0.75 cup (255 g) Aloe vera gel
Treatment B	0.50 cup (170 g) Aloe vera gel
Treatment C	0.25 cup (85 g) Aloe vera gel
Treatment D	0 cup (0 g) Aloe vera gel

Phase III. Preparation of Butterscotch Cookies with Different Measures of Aloe vera Gel

Put all the ingredients in a mixing bowl and beat until smooth and well blended. Set aside. Then, measure the Aloe vera gel then add to the butterscotch cookies mixture. After mixing the Aloe vera gel, drop ½ teaspoonful of the mixture into aluminum baking powder pan with, wax paper. Press with tines of fork with sugar to flatten. Bake in a pre-heated oven of 250°C for 25 – 30 minutes.

Phase IV. Evaluation of the Butterscotch Cookies with Different Measures of Aloe vera gel

The finish products were subjected to sensory evaluation by the group of respondents to determine the level of acceptability of Butterscotch cookies with Aloe vera gel in terms of color, aroma, volume, flavor and general acceptability. The evaluators will be instructed on how to evaluate the cookies. Each evaluator will then be requested to drink water after every testing of the product to rinse their mouth so that assessment of the taste will be more accurate (Depra, 2011).

Proximate Analysis

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

Microbiological Examination

The aerobic plate count was carried out on the butterscotch cookies samples using the method of multiple tube technique. Ten grams of each sample was taken aseptically and homogenized in 90 ml sterile distilled water, manually for about 2 minutes. Serial dilutions (using 1 ml of homogenates) were made in 9 ml sterile distilled water, dispensed in test tubes. One milliliter of each dilution was pour plated in sterile Petri dishes using the plate count agar (PCA, oxoid), incubated at 37°C for 24-36 hrs. Counts of visible colonies were made and expressed as log CFU/g sample (Johnson, & Case, 1992).

3. RESULTS AND DISCUSSION

Color of cookies

Table 2 presents the summary table of the obtained means of the Butterscotch cookies with Aloe vera gel in different Treatments.

Table 2. Mean rating of Butterscotch Cookies Enriched with Aloe Vera Gel in Terms of Color

Treatment	Mean	Interpretation
A	3.88	Liked Very Much
B	4.00	Liked Very Much
C	3.68	Liked Very Much
D	3.88	Liked Very Much

ANOVA showed that there was no significant difference on the level of acceptability of the Butterscotch cookies with Aloe vera gel as to color of the four treatments. The obtained F-value of .476 and the p-value of 0.700 is greater than the alpha level 0.01; this means that there was no significant difference on the level of acceptability of the Butterscotch cookies with Aloe vera gel as to color. This implies that in terms of color the Butterscotch cookies with Aloe vera gel, were almost the same. Considering the colorless property of Aloe vera gel, it made the color of the four treatments almost the same to each other.

Among the experimental treatments, Treatment B (Butterscotch Cookies with 0.50 cup/170 g of Aloe vera gel) obtained the highest mean, which means liked very much. This implies that the color was liked very much because the Aloe vera gel did not affect any changes in color of the Butterscotch cookies. Findings further imply that the Aloe vera gel was properly blended with other ingredients because of even shape, appealing color and glossy.

The result of the study was similar to the study of Paragados (2013) in the sense that the appealing color, uniform shape and pleasing to the eyes of cookies with canistel fruit flour were all acceptable to the respondents. In the present study, the Butterscotch cookies with 0.50 cup/170 grams Aloe vera gel were liked very much by the respondents.

Aroma of cookies

Table 3 presents the summary table of the obtained mean of Butterscotch cookies with Aloe vera gel in different treatments as perceived by the group of evaluators as to its aroma.

Table 3. Mean Rating of Butterscotch Cookies Enriched with Aloe Vera Gel in Terms of Aroma.

Treatment	Mean	Interpretation
A	3.88	Liked Very Much
B	3.56	Liked Very Much
C	3.60	Liked Very Much
D	3.28	Liked Moderately

To find out if there was a significant difference among Treatments A, B, C and D as to

aroma; ANOVA was computed at 0.01 level of significance. The result showed that there was a no significant difference on the level of acceptability of the Butterscotch cookies with Aloe vera gel as to aroma of the four treatments ($F(3,96)=2.339$, $P=0.078$). This implies that in terms of aroma the Butterscotch cookies with Aloe vera gel, were similar to each other.

Similar to the findings of Prudente (2007) because her study revealed that the squash flour blended well with the other ingredients that scent was not so apparent.

Volume of cookies

Table 4 presents the summary table of the obtained mean of Butterscotch cookies with Aloe vera gel in different treatments as perceived by the group of evaluators as to its volume.

Table 4. Mean Rating of Butterscotch Cookies Enriched with Aloe Vera Gel in Terms of Volume

Treatment	Mean	Interpretation
A	3.92	Liked Very Much
B	3.24	Liked Moderately
C	3.24	Liked Moderately
D	3.64	Liked Very Much

ANOVA result computed at 0.01 level of significance showed that there was a no significant difference on the level of acceptability of the Butterscotch cookies with Aloe vera gel as to volume of the four treatments ($F(3,96)=2.229$, $P=0.090$). This implies that in terms of volume the Butterscotch cookies with Aloe vera gel, were similar to each other.

The findings of the present study were closely similar with the results of the study of Ranasalva, & Visvanathan, (2014). The lower levels of gluten network in the dough and consequently less ability of the dough to rise; due to the weaker cell structure. However, the specific volumes of the 10, 15 and 20% levels of substitutions were not significantly different from each other.

Flavor of cookies

The mean ratings showed that Treatments A, B, C and D were liked very much by the respondents.

Table 5. Mean rating of Butterscotch Cookies Enriched with Aloe Vera Gel in Terms of flavor.

Treatment	Mean	Interpretation
A	4.16	Liked Very Much
B	4.00	Liked Very Much
C	3.76	Liked Very Much
D	3.76	Liked Very Much

The result ANOVA showed that there was a no significant difference on the level of acceptability of the Butterscotch cookies with Aloe vera gel as to flavor of the four treatments ($F(3,96)=0.936$, $P=0.427$). This implies that in terms of flavor the Butterscotch cookies with Aloe vera gel, were similar to each other. There was no significant difference in the level of acceptability of butterscotch cookies enriched with Aloe vera gel in different treatments as to flavor.

According to the study of Bertagnolli, Silveira, Fogaça, Umann, & Penna, (2014), the increase in Guava Peel Flour levels did not result in differences in the parameters color, flavor, and appearance; whereas flavor was positively affected by the increase in GPF amount.

General acceptability OF COOKIES

Table 6 presents the summary table of the obtained means with the Butterscotch cookies with Aloe vera gel in different treatments as perceived by the group of evaluators as to its general acceptability.

Table 6. Mean rating of Butterscotch Cookies Enriched with Aloe Vera Gel in in Terms of General Acceptability.

Treatment	Mean	Interpretation
A	3.96	Liked Very Much
B	3.70	Liked Very Much
C	3.57	Liked Very Much
D	3.64	Liked Very Much

ANOVA result show that there was no significant difference on the level of acceptability of Butterscotch cookies with Aloe vera gel as to general acceptability of the four treatments ($F(3,96)=1.786$, $P=0.155$). This implies that in terms of general acceptability the Butterscotch cookies with Aloe vera gel, were similar. This further implies that the Butterscotch cookies with Aloe vera gel did differ from each other in terms of color, aroma, volume and texture.

The same result was revealed in the study of Srivastava (2012). Sweet potato flour was well blended with wheat flour in ratio of 10%, 20%, 30%, 40% and 50%. There were evaluated for sensory

analysis that include color, flavor, taste, volume and over all acceptability.

Table 7 shows the proximate composition of Butterscotch Cookies enriched with Aloe vera gel. The crude protein increased with increase in the proportion of the Aloe vera gel in Butterscotch cookies mixture. The highest crude protein (%) of 8.68 was recorded for the A, 0.75 cup (255 g) of Aloe vera gel enriched Butterscotch cookies, and this value decreased gradually to the lowest value of 6.49 recorded for the C, 0.25 cup (85 g) of Aloe vera gel enriched Butterscotch cookies.. The percentage of crude protein did not follow a trend since, the D, 0 cup (0 g) of aloe vera gel obtained a percentage of 7.05.

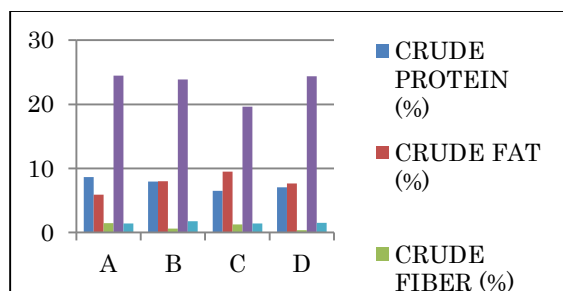
The fat content (%) of the Butterscotch cookies enriched with Aloe vera gel assumed a reverse trend with crude protein, though the decrease with increase in the amount of aloe vera gel proportion was very minimal. The highest value of 9.49 was obtained for the $\frac{1}{4}$ cup (85 g) while lowest value of 5.90 was recorded for the $\frac{3}{4}$ cup (225 g). While, the 0 cup (0 g) of Aloe vera gel Butterscotch cookies obtained a percentage of 7.65 fat content.

The crude fiber (%) of 1.45, 0.63, 1.28, and 0.37 were obtained for the Aloe vera treated Butterscotch cookies, $\frac{3}{4}$ cup (255 g), $\frac{1}{2}$ cup (170 g), $\frac{1}{4}$ cup (85 g), 0 cup (0 g) Aloe vera gel respectively. The result shows that the amount of Aloe vera gel treated into Butterscotch cookies does not increase nor decrease the percentage of the crude fiber.

The moisture content increased with increase in the treatment of Aloe vera gel in the Butterscotch cookies. The highest value of 24.50 was observed for the $\frac{3}{4}$ cup (255 g) while the lowest 1.40 was obtained for the $\frac{1}{4}$ cup (85 g). However, the 0 cup (0 g) of Aloe vera gel Butterscotch cookies obtained a percentage of 24.4 moisture content. The respective value obtained for the $\frac{1}{2}$ cup (170 g) 1.75 % moisture content.

The highest ash content (1.75%) was obtained for the $\frac{1}{2}$ cup (170 g), the result was showing that there was no increase or decrease on the ash content level as the amount of Aloe vera gel increases respectively. The ash contents of 1.41, 1.75, and 1.40 were recorded for the Butterscotch cookies treated with Aloe vera gel samples with $\frac{3}{4}$ cup (255 g), $\frac{1}{2}$ cup (170 g), and $\frac{1}{4}$ cup (85 g), treatment levels respectively. On the other hand, the 0 cup (0 g) of Aloe vera gel obtained a percentage of 1.50 ash content.

Table 7. Proximate composition of Butterscotch Cookies Enriched with Aloe Vera Gel in Different Treatments



The aerobic plate count, APC, (log CFU/g) of the Butterscotch cookies treated with Aloe vera gel ranged from 1.00^4 to 1.80^7 , with the highest being recorded for the $\frac{3}{4}$ cup (225 g) of Aloe vera gel while the lowest was obtained for the $\frac{1}{2}$ cup (170 g). Counts of 5.40^6 and 1.80^6 were obtained for the respective $\frac{1}{4}$ (85 g) and 0 cup (0 g) aloe vera gel enriched Butterscotch cookies. The aerobic plate count of Butterscotch cookies Enriched with Aloe vera gel in different treatments are acceptable and good under the NSW Food Authority (2009) microbiological quality of ready-to-eat foods that are fully cooked with further handling or processing before consumption (Category B).

Table 8. Aerobic plate count of Butterscotch Cookies Enriched with Aloe Vera Gel in Different Treatments

Treatments	Value (APC log CFU/g)	Interpretation
A	1.80^7	Acceptable
B	1.00^4	Good
C	5.40^6	Good
D	1.80^6	Good

4. CONCLUSIONS

Based on the findings the following conclusions were made. The Butterscotch cookies treated with Aloe vera gel were generally acceptable as snacks and dessert. Moreover, the evaluators' rated as liked very much the Butterscotch cookies with 0.50 cup/170 grams of Aloe vera gel since it has a better color, aroma, volume, flavor and general acceptability. Furthermore, Butterscotch cookies treated with Aloe vera gel were noted to have no significant differences in terms of color, aroma, volume, flavor and general acceptability. While findings of proximate analysis indicated that the

nutritional quality of butterscotch cookies could be enhanced by aloe vera gel, especially in terms of crude protein, crude fat, and moisture. Butterscotch cookies of acceptable sensory evaluation could be produced in 0.75 cup (255 g), 0.50 cup (170 g) and 0.25 cup (85 g) aloe vera gel level. Lastly, the aerobic plate counts of the butterscotch cookies enriched with aloe vera gel were minimal and within safe and acceptable levels.

Shelf life studies are very important in food processing. Although shelf life studies are yet to be carried out, the butterscotch cookies treated with Aloe vera gel samples obtained during the course of this research work may have good and reasonable shelf life, and this work intends to be done further on this study. Moreover, researchers were highly encouraged to toxicity test the Aloe vera before enriching it to cookies or other food products for safe consumption. Since aloe vera will be taken from different environmental conditions, it is necessary to subject it to toxicity test. Furthermore, it is recommended that the result of this study be disseminated to encourage food scientist, housewives, researchers and other food experts to treat the butterscotch cookies and other food products with Aloe vera gel to increase its acceptability and nutritive value. Lastly, a parallel study is also recommended using higher levels of Aloe vera gel to establish its higher limit.

5. ACKNOWLEDGMENTS

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