Blended Beverage from Wire Grass (Paragis) (*Eleusine indica*), Sweet Potato Leaves (Ipomoea batatas) and Ginger (*Zingiber officinale*)

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Abstract

With the advent of functional drinks in the Philippine market, lots of locally available grass and leaves can be utilized as a composite beverage. This study aimed to formulate and evaluate the quality of blended beverage from wire grass (Eleusine indica), sweet potato leaves (Ipomoea batatas) and ginger (Zingiber officinale) in terms of color, aroma, taste, after taste, and general acceptability; determine the pH and Total Soluble Solids (TSS) of the blended beverage; determine the cost of production of the product; and determine the market potential of the product through consumer assessment test. The study utilized a Randomized Complete Block Design (RCBD) with different levels of wire grass (40%, 50%), sweet potato leaves (30%, 40%) and ginger (20%, 30%) infusion. Treatments were subjected to sensory evaluation using 9-point Hedonic Scale. Analysis of Variance results showed no significance difference on the sensory acceptability of the product. Treatment combination with 50% wire grass, 30% sweet potato leaves and 30% ginger infusion had the highest TSS content. Treatment with 40% wire grass, 30% sweet potato leaves and 30% ginger infusion had the highest pH value. Variables used did not significantly affected the pH and TSS value of the blended beverage. For consumer testing the blended beverage was liked by 70% consumers while calamansi juice was liked by 56.67% of the consumers. The Chi Square test shows that there is no significant difference among Blended Beverage and Calamansi Juice consumer acceptability. The consumers' preferences revealed that blended beverage was preferred by 56.67% of consumers over calamansi juice. Production cost ranged from Php84.48– Php93.98.

Keywords: wire grass, sweet potato leaves, ginger, Randomized Complete Block Design (RCBD)

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Introduction

Natural, functional and convenient products that can deliver nutritional benefits without sacrificing taste continue to tap into major trends currently driving the thriving healthy beverage market. According to recent analysis from market research firm Mintel, nutritional and performance drinks are becoming an increasingly popular meal option due to evolving dietary habits of on-the-go consumers and positive functional attributes (Molouhney, 2016).
An interesting way to improve the nutritional quality of traditional products is through mixing two or more kinds of fruits, vegetable, and any kinds of herbs. Blended drinks combine new taste and sensory characteristics can result in a new product with more vitamins and minerals (Vista and Dumlao, 2016).

Producing healthy and refreshing drink help the consumer's health because wire grass has a component that are used as to relieve dysuria, fever, inflammation, jaundice, centipede and scorpion poisoning (Stuart, 2018). On the other hand, Sweet potato leaves promotes good health especially to people who were ill or who had undergone a medical treatment (Islam, 2006 ; Nelz, 2017) and Ginger it is loaded with nutrients and bioactive compounds that have powerful benefits for your body and brain (Corbo, 2014).

Thus this study was conducted in order to formulate and evaluate the sensory attributes, physico-chemical character and consumer acceptance of a blended beverage from wire grass (Eleusine indica), sweet potato leaves (Ipomoea batatas) and ginger (Zingiber officinale).

Generally, this study aimed to evaluate and formulate a blended beverage from wire grass (*Eleusine indica*), sweet potato leaves (Ipomoea batatas) and ginger (*Zingiber officinale*). Specifically, this study aimed to evaluate the sensory quality of the blended beverage in terms of color, aroma, taste, after taste, and general acceptability; determine the physico-chemical properties of the blended beverage; determine the cost of production of the product; and determine the market potential of the product through consumer assessment test.

Materials and Methods

Research Design
The study utilized experimental method. The eight treatments was triplicated were arranged in Randomized Complete Block Design (RCBD) through draw lots

Analysis/Procedure
The products were subjected to sensory evaluation such as color, aroma, taste, after taste, and general acceptability; and determination of physico-chemical properties total soluble solid (TSS) and power of hydrogen (pH), cost of production and consumer acceptance.

The treatments were arranged in Randomized Complete Block Design (RCBD). The results of the sensory evaluation were analyzed by the Analysis of Variance (ANOVA) using F-test and results were interpreted at both 5% and 1% levels of significance. The Duncan's Multiple Range test (DMRT) was used to locate significant mean differences. The best product was subjected to consumer testing to evaluate its acceptability and was compared to locally available cookies. The total cost of production was computed by adding all the expenses incurred. The price of ingredients was based on the unit selling price in a specific location where it was purchased. The cost of production was based on the total cost of direct and indirect materials used.

Results and Discussion

Sensory Evaluation of Blended Beverage from Wire Grass, Sweet Potato Leaves and Ginger

Color. Color acceptability ratings of the product as shown in Table 1 range from 7.60–7.83 with an overall response mean of 7.73 which falls within the "liked moderately" score in the 9-point Hedonic scale. Treatment 6 (50% wire grass, 30% sweet potato leaves and 20% ginger infusion) got the highest sensory mean rating while Treatment 7 (40% wire grass, 40% sweet potato leaves and 20% ginger infusion) had the lowest sensory score. The color of the blended beverage was perceived by panelist as "pink to dark pink" as shown in Figure 1. Analysis of Variance using F-test revealed no significant difference among the treatment means. This implies that the amount of wire grass, sweet potato leaves and ginger infusion in each treatment did not affect the color acceptability of the blended beverage.

Table 1. Quality description and mean acceptability ratings for color of blended beverage from wire grass, sweet potato leaves and ginger.

Trt	% WG	% SPL	% G	Quality Description	Mean Acceptability Rating	Verbal Interpretation
1	50	40	30	pink	7.68	liked moderately
2	50	30	30	darkish pink	7.80	liked moderately
3	40	40	30	darkish pink	7.80	liked moderately
4	40	30	30	pink	7.72	liked moderately
5	50	40	20	pink	7.72	liked moderately
6	50	30	20	darkish pink	7.83	liked moderately
7	40	40	20	pink	7.60	liked moderately
8	40	30	20	pink	7.64	liked moderately
		Grand Mean			7.73^{ns}	liked moderately

Trt-treatment   WG-wire grass   SPL-sweet potato leaves
G-ginger   Blue=highest mean   red=lowest mean
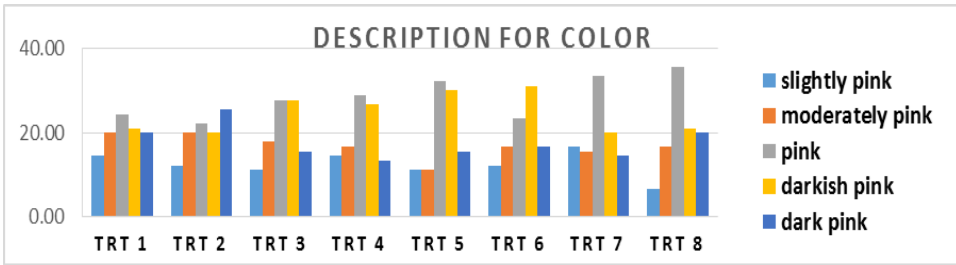ns-not significant

Figure 3. Summary of frequencies of the descriptive scores for color of blended beverage from wire grass, sweet potato leaves and ginger.

Aroma. Aroma acceptability ratings of the blended beverage as shown in Table 2 range from 7.64–7.88 with an overall response mean of 7.78 which falls within the "liked moderately" score in the 9–point Hedonic scale. Treatment 3 (40% wire grass, 40% sweet potato leaves and 30% ginger infusion) and Treatment 6(50% wire grass, 30% sweet potato leaves and 20% ginger infusion) got the highest sensory mean while Treatment 7 (40% wire grass, 40% sweet potato leaves and 20% ginger infusion) had the lowest sensory mean acceptability rating. The aroma of the blended beverage was perceived by panelists as "well blended calamansi, ginger, sweet potato leaves and wire grass to slightly perceptible calamansi and sweet potato leaves" as shown in Figure 3. Analysis of Variance using F-test revealed no significant difference among the treatment means. This implies that the varying levels of wire grass, sweet potato leaves and ginger infusion in each treatment did not affect the aroma acceptability of the blended beverage.

Table 2. Quality description and mean acceptability ratings for aroma of blended beverage from wire grass, sweet potato leaves and ginger.

| Trt	% WG	% SPL	% G	Quality Description	Mean Acceptability Rating	Verbal Interpretation
1	50	40	30	Well blended	7.68	liked moderately
2	50	30	30	Well blended	7.80	liked moderately
3	40	40	30	Well blended	7.80	liked moderately
4	40	30	30	Moderately perceptible calamansi & SPL	7.72	liked moderately
5	50	40	20	Well blended	7.72	liked moderately
6	50	30	20	Well blended	7.83	liked moderately
7	40	40	20	Moderately perceptible calamansi & SPL	7.60	liked moderately
8	40	30	20	Well blended	7.64	liked moderately
	Grand Mean				7.78^{ns}	liked moderately
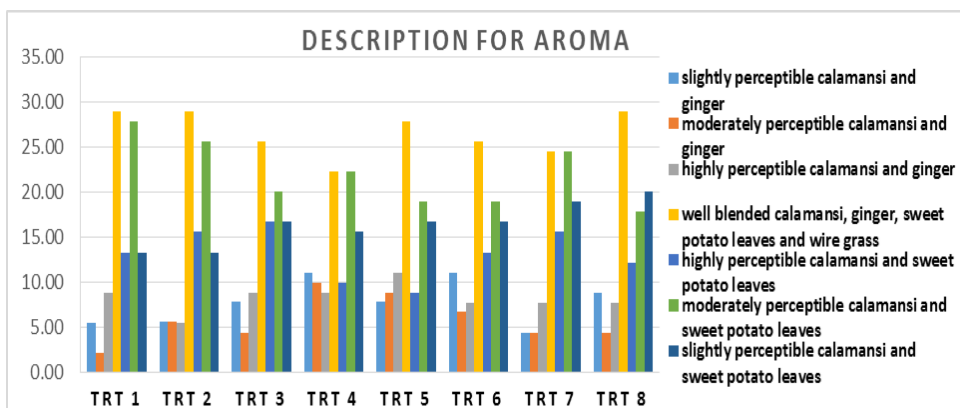
Figure 2. Summary of frequencies of the descriptive scores for aroma of blended beverage from wire grass, sweet potato leaves and ginger.

Taste. Taste acceptability of the blended beverage as shown in Table 3 and Table 11 ranges from 7.69–7.94 with an overall response mean of 7.79 which falls within the "liked moderately" score in the 9–point Hedonic scale. Treatment 5 (50% wire grass, 40% sweet potato leaves and 20% ginger infusion) got the highest sensory mean while Treatment 7 (40% wire grass, 40% sweet potato leaves and 20% ginger infusion) had the lowest sensory mean acceptability rating. The taste of the blended beverage was perceived by panelist as "well blended sweet and sour taste to slightly perceptible sour taste" as shown in Figure 3. Analysis of Variance using F-test revealed no significant difference among the treatment means. This implies that the varying levels of wire grass, sweet potato leaves and ginger infusion in each treatment did not affect the taste acceptability of the blended beverage.

Table 3. Quality description and mean acceptability ratings for taste of blended beverage from wire grass, sweet potato leaves and ginger.

| Trt	% WG	% SPL	% G	Quality Description	Mean Acceptability Rating	Verbal Interpretation
1	50	40	30	Well blended	7.73	liked moderately
2	50	30	30	Well blended	7.80	liked moderately
3	40	40	30	Well blended	7.77	liked moderately
4	40	30	30	Well blended	7.78	liked moderately
5	50	40	20	Well blended	7.94	liked moderately
6	50	30	20	Moderately perceptible sour taste	7.80	liked moderately
7	40	40	20	Slightly perceptible sour taste	7.69	liked moderately
8	40	30	20	Well blended	7.82	liked moderately
		Grand Mean			7.79^{ns}	liked moderately
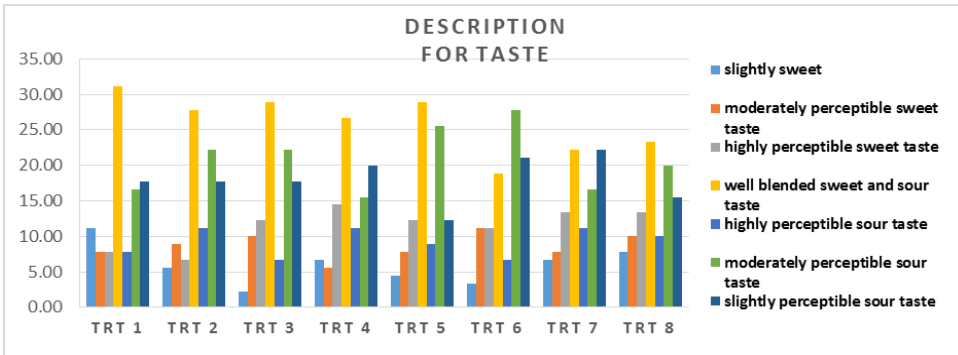
Figure 3. Summary of frequencies of the descriptive scores for taste of blended beverage from wire grass, sweet potato leaves and ginger.

Aftertaste

Aftertaste acceptability ratings of the blended beverage as shown in Table 4 range from 7.68–7.88 with an overall response mean of 7.78 which falls within the "liked moderately" score in the 9–point Hedonic scale. Treatment 5 (50% wire grass, 40% sweet potato leaves and 20% ginger infusion) got the highest sensory mean while Treatment 7 (40% wire grass, 40% sweet potato leaves and 20% ginger infusion) and Treatment 8 (40% wire grass, 30% sweet potato leaves and 20% ginger infusion) had the lowest sensory mean acceptability rating. The aftertaste of the blended beverage was perceived by panelists as "moderately perceptible to extremely perceptible aftertaste" as shown in Figure 4. Analysis of Variance using F-test revealed no significant difference among the treatment means. This implies that the measurement of wire grass, sweet potato leaves and ginger infusion in each treatment did not affect the aftertaste acceptability of the blended beverage.

Table 4. Quality description and mean acceptability ratings for aftertaste of blended beverage from wire grass, sweet potato leaves and ginger.

| Trt	% WG	% SPL	% G	Quality Description	Mean Acceptability Rating	Verbal Interpretation
1	50	40	30	Highly perceptible	7.86	liked moderately
2	50	30	30	Highly perceptible	7.72	liked moderately
3	40	40	30	Highly perceptible	7.80	liked moderately
4	40	30	30	Highly perceptible	7.84	liked moderately
5	50	40	20	Highly perceptible	7.88	liked moderately
6	50	30	20	Highly perceptible	7.80	liked moderately
7	40	40	20	Moderately perceptible	7.68	liked moderately
8	40	30	20	Highly perceptible	7.68	liked moderately
	Grand Mean				7.78^{ns}	liked moderately
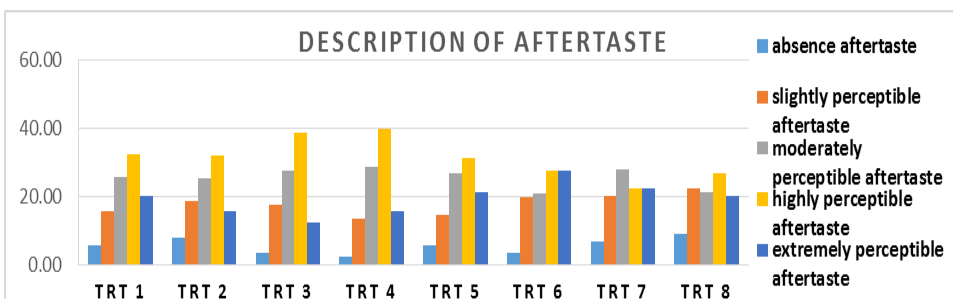
Figure 4. Summary of frequencies of the descriptive scores for aftertaste of blended beverage from wire grass, sweet potato leaves and ginger.

General acceptability. General acceptability ratings of the blended beverage as shown in Table 5 range from 7.96–8.21 with an overall response mean of 8.08 which falls within the "liked very much" score in the 9-Hedonic scale. Treatment 6 (50% wire grass, 30% sweet potato leaves and 20% ginger infusion) got the highest sensory mean while Treatment 7 (40% wire grass, 40% sweet potato leaves and 20% ginger infusion) had the lowest sensory mean acceptability rating. Analysis of Variance using F-test revealed no significant difference among the treatment means. This implies that the measurement of wire grass, sweet potato leaves and ginger infusion in each treatment did not affect the general acceptability of the blended beverage.

Table 5. Mean acceptability ratings for general acceptability of blended beverage.

Trt	% WG	% SPL	% G	Mean Acceptability Rating	Verbal Interpretation
1	50	40	30	7.97	liked moderately
2	50	30	30	8.09	liked very much
3	40	40	30	8.11	liked very much
4	40	30	30	8.03	liked very much
5	50	40	20	8.20	liked very much
6	50	30	20	8.21	liked very much
7	40	40	20	7.96	liked moderately
8	40	30	20	8.07	liked very much
	Grand Mean			8.08^{ns}	liked very much

Trt-treatment WG-wire grass   SPL-sweet potato leaves
G-ginger   Blue=highest mean red=lowest mean   ns-not significant

Physico-chemical Characteristics of Blended Beverage from Wire Grass, Sweet Potato Leaves and Ginger

Total Soluble Solids (TSS). The Total Soluble Solids content is a measure of the concentration of sugar in the product. It is determined by the index of refraction using refractometer (Vista and Dumlao, 2016).

Total Soluble Solids (TSS) of the blended beverage from wire grass, sweet potato leaves and ginger infusion as shown in Table 6, Treatment 2 (50% wire grass, 30% sweet potato and 30% ginger infusion) obtained the highest Total Soluble Solid (TSS) content of 16.4, while Treatment 1 (50% wire grass, 40% sweet potato and 30% ginger infusion) got the lowest TSS content of 12.1. The result showed that blended beverage with the increased level of wire grass, sweet potato leaves and ginger infusion had the sweetest taste as indicated by the highest total soluble solid (TSS) content. Analysis of Variance using F-test revealed that blended beverages made from different levels from wire grass, sweet potato leaves and ginger infusion were not significantly different from one another. The levels of wire grass, sweet potato leaves and ginger infusion added to blended beverage were not able to cause significant difference in the TSS of the blended beverage.

Power of Hydrogen (pH). The concept of acidity is not only related to the sensory perception of sourness but also to a chemical effect called power of hydrogen (pH) of substance. Foods differ in pH because of their acid content which produce hydrogen ions. These ions can be detected by hydrogen sensitive electrode in a device called pH meter (Murano, 2003). The pH corresponds to the intensity of acidity where the intensity is contributed by factors such as nature of the individual acids present, the total amount of acid present and the influence of certain other materials present such as minerals (Vista and Dumlao, 2016). As shown in Table 6, the average pH value of all the treatments ranged from 4.26 to 4.34 with a total response mean of 4.32. Generally, pH increases with an increased level of wire grass, sweet potato leaves and ginger infusion while pH a decreases as the level of wire grass, sweet potato leaves and ginger infusion decreases. Analysis of Variance using F-test revealed that blended beverage made from different levels from wire grass, sweet potato leaves and ginger infusion were not significantly different from one another.

Table 6. Total Soluble Solid and pH of blended beverage from wire grass, sweet potato leaves and ginger infusion.

Treatment	% WG	% SPL	% G	TSS	pH
1	50	40	30	12.1	4.26
2	50	30	30	16.4	4.29
3	40	40	30	14.6	4.31
4	40	30	30	12.2	4.34
5	50	40	20	12.6	4.32
6	50	30	20	12.5	4.33
7	40	40	20	13.6	4.33
8	40	30	20	13.1	4.31
Grand Mean				13.39	4.32

Consumer Testing

The summary of data gathered from consumer testing on the acceptability of blended beverage from wire grass, sweet potato leaves and ginger infusion compared to calamansi juice involving 120 random consumers shown in Figure 5. The panelists were composed of 30 consumers from Mambusao East National High School, 90 consumers from Mambusao, Capiz and 30 consumers from Capiz State University-Mambusao Satellite College. The data show that blended beverage was liked by most consumers with 70% and disliked by 30% while calamansi juice was liked by 44.17% and disliked by 55.83% of the consumers. Chi Square test showed that there was no significant difference among blended beverage and calamansi juice when offered to the market. Consumers' preferences as shown in Figure 6 show that 56.67% of the consumers preferred the blended beverage due to its acceptability and availability in public places, and food and drinks establishments. Nevertheless, 43.33% of the consumers preferred calamansi juice. Thus, there is a market potential for blended beverage of wire grass, sweet potato leaves and ginger infusion. Production of developed product is possible and may be more welcomed by consumers especially when the nutritional content and the more natural color and preservatives are known.
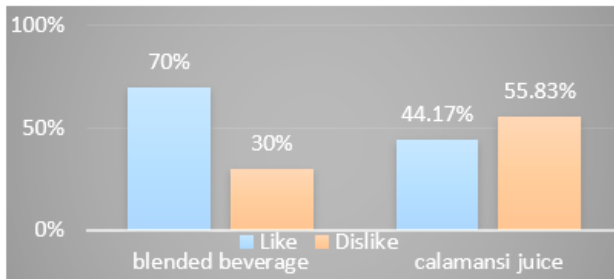

Figure 6. Graphical representation of likeness between blended beverage and calamansi juice
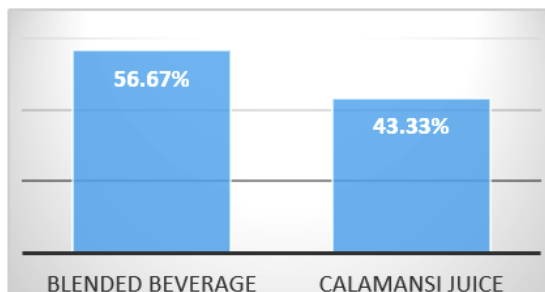

Figure 7. Graphical representation of consumer preference.

Cost Analysis

The production cost sums up the total cost of raw materials and utilities incurred in producing the beverage. The cost of producing blended beverage as affected by varying levels of wire grass, sweet potato leaves and ginger infusion as shown in Table 7. Treatment combination with low level of wire grass, sweet potato leaves and ginger infusion had the lowest cost at ₱ 84.48 while the treatment with highest cost at Php93.98 is the treatment with high level of wire grass, sweet potato leaves and ginger infusion. The results imply that whenever the treatment has the highest levels of the different variables, it will have the highest cost, and if it has the lowest level combinations it will have the lowest cost. This is due to the fact that when high levels are used, yield is higher and cost per unit reduces.

Table 7. Production cost of blended beverage.

Treatment	% WG	% SPL	% G	Cost (Php)
1	50	40	30	₱ 93.98
2	50	30	30	₱ 88.98
3	40	40	30	₱ 91.48
4	40	30	30	₱ 86.48
5	50	40	20	₱ 91.98
6	50	30	20	₱ 86.98
7	40	40	20	₱ 89.48
8	40	30	20	₱ 84.48

Conclusions and Recommendations

Conclusions

Based on the findings of the study, the researcher have drawn the following conclusions: The different levels of wire grass, sweet potato leaves and ginger infusion combinations did not significantly affect the color, aroma, taste, aftertaste and general acceptability of the beverage. Treatment combination with 50% wire grass, 30% sweet potato leaves and 30% ginger infusion had the highest TSS content. Treatment with 40% wire grass, 30% sweet potato leaves and 30% ginger infusion had the highest pH value. Variables used did not significantly affected the pH and TSS value of the blended beverage. Treatment combination with high level of wire grass, sweet potato leaves and ginger had a higher cost of production. There is a market potential for blended beverage of wire grass, sweet potato leaves and ginger infusion. Production of developed product is possible and may be more welcomed by consumers especially when the nutritional content and the more natural color and preservatives are known.

Recommendations

Based on the result of the study, the researchers recommend the following: Use 50% wire grass, 30% sweet potato leaves and 20% ginger treatment combination to obtain the best color, aroma, aftertaste and general acceptability. Nutritional analysis of the product must be done on the most acceptable product. Evaluate the shelf life of developed products. Identification of the dominant spoilage microorganism. A further study on purchasing intentions on the developed product as the product presents potential for commercialization.

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