DETERMINATION OF THE POTENTIAL OF KAMIAS (AVERRHOA BILIMBI) FLOWERS FOR TEA DEVELOPMENT

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Abstract

Three methods of drying, namely: sun drying, freeze drying, and cabinet drying, were applied to Kamias leaves (Averrhoa bilimbi), a traditional herbal medicine.The leaves were then made into tea and its acceptability was tested through sensory evaluation. Several tests were also applied to determine the potential of kamiasas a tea. These tests include phenolic content determination, radical scavenging activity determination, and reducing power assay. After the evaluation of sensory attributes of kamias flower teas from three drying methods, the sun-dried kamias flower tea received the highest score in all attributes compared to the cabinet- and freeze-dried kamias flower teas. The sun-dried kamiasflower tea was compared with rose flower tea based on their sensory properties and antioxidant activities. For the sensory evaluation, the results showed that kamias flower teamay have had weaker aroma than rose, but their general acceptability attribute had equal scores.Chemical analyses for antioxidant activity such as DPPH radical scavenging activities, total phenolic and flavonoid contents determination, and reducing power assay, were conducted on sun-dried kamias and rose flower teas. Kamias flower tea had higher phenolic and flavonoid contents and stronger reducing power compared to rose flower tea, but rose flower tea had higher radical scavenging activity than kamias flower. This suggested that kamiasflower tea had more reducing than scavenging antioxidants. Nevertheless, both flowers were found to have antioxidant activities.The results from sensory evaluation and chemical analyses proved that kamias flowers can be used in flower tea development since it contained antioxidants and was equally acceptable as rose flower tea.

Keywords: *Flower tea, Tea, Herbal medicine and Kamias*

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1. INTRODUCTION

According to the World Health Statistics released by the World Health Organization (2015), the life expectancies at birth of Filipinos in 2013 are 65 for male and 72 for female, compared with the 1990 records, 63 and 70, respectively. However, statistics also showed that, for every 100,000 Filipinos, the mortality rates were 227 from communicable diseases and 720 from non-communicable diseases (NCDs). NCDs are not contagious but can greatly affect a person's life, and, if not given proper attention, they can lead to death. According to the Department of Health, of the top causes of mortality in the Philippines, four are NCDs, namely, cardiovascular diseases, cancers, diabetes mellitus, and chronic obstructive pulmonary disease. These diseases, generally, can be traced from unhealthy diet and poor lifestyle.

To cure NCDs, aside from taking prescription drugs, some Filipinos also take herbal medicines or drinks. Knowing that the demand is slowly shifting to organic and natural products, there is now an increasing number of products of plant origin, such as tea and other herbal infusions. Originally, tea was discovered in China when some leaves of *Camellia sinensis*fell in a pot of hot water. Tea is a rich source of methylxanthines, volatile compounds, and polyphenolic compounds that are believed to prevent cancer and some cardiovascular diseases [1]. However, over time, people have discovered other plant sources and used other plant parts that can serve as infusions or decoctions. One of the traditional herbal medicines is *kamias* (*Averrhoa bilimbi)*. However, this plant, especially its fruits, is underutilized despite its medical and culinary uses. *Kamias* leaves can be made into an infusion as a tonic or into paste applied to cure itches, mumps, and rheumatism. Its infusion is also believed to cure cough and thrush. Also, with its high oxalic acid content, *kamias* fruit is used as a stain remover. Moreover, it has anti-diabetic and anti-hyperlipidaemic activities, as well as antimicrobial property [2], [3].

The main objective of this study is to determine the potential of *kamias* as flower tea. The specific objectives are as follows: (1) to identify which drying method will yield the most acceptable*kamias*flower tea through sensory evaluation, (2) to compare the sensory properties of *kamias* and conventional rose flower teas through sensory evaluation; and (3) to determine its antioxidant activities and compare them with the antioxidant activities of rose flower tea.

2. MATERIALS AND METHODS

2.1 Time and Place of Study

The sensory evaluations and chemical analyses were done at the Institute of Food Science and Technology, UPLB, on October 2016 to April 2017.

2.2 Raw Materials

Mature *kamias* flowers were picked by hand at 6 to 10 am from San Roque, Sto. Tomas, Batangas and from the garden of Post-Harvest Institute, UPLB. The *kamias* trees were chosen because of their being distant from the major roads to ensure minimum absorption of emissions from vehicles.

2.3 Drying

For sun drying, *kamias* flowers were laid in a clean, stainless tray, covered with metal screen wire and were placed under direct sunlight from morning until afternoon (9 h). Freeze drying was done by pre-freezing the *kamias* flowers before it was brought to Crop Protection Cluster at the Institute of Biological Sciences, UPLB. The frozen flowers were placed in paper bag poked with holes before it was subjected to freeze drying to facilitate sublimation of water molecules. The process started at 8:00 am and ended at 4:30 pm. Lastly, cabinet drying was done in the Pilot Plant of the Institute of Food Science and Technology. The flowers in trays and placed in the dryer set at 40°C for 13 hours. The dried flowers from each drying method were then separately placed in glass jars and stored at cool temperature.

2.4 Sensory Evaluation

Flower teas from different drying methods were evaluated by 25 tea drinkers by quality scoring. To avoid biases, each sample was assigned with random code numbers. The judges rated each tea based on their color, aroma, flavor, aftertaste, and general acceptability. The flower tea sample from the drying method with the highest general acceptability was compared with a commercial rose flower tea, based on their sensory evaluation and antioxidant activities. The aroma, flavor, aftertaste, and general acceptability of *kamias* and rose flower teas were evaluated by 25 tea drinkers using quality scoring.

2.5 Total Phenolic and Flavonoid Determination

The total phenolic and flavonoid content determination was done using Folin-Ciocalteu assay based on [4]. 0.20 mL of the sample was added with 0.5 mL of 50% Folin-Ciocalteu reagent and 3 mL of 10% sodium carbonate. It was stood for 10 minutes and added with 10 mL of distilled water. The mixture was subjected to a vortex mixer before its absorbance was read in a spectrometer set at 700 nm. Gallic acid was used as the reference for plotting the standard curve. Linear regression was used to determine the concentration of the sample, which will be used to compute for the Gallic Acid Equivalent (GAE) and Quercetin Equivalent for flavonoid, using the formula:

$$GAE = \frac{Concentration\ from\ Standard\ Curve * Volume\ of\ sample}{Mass\ of\ dry\ material\ used}$$

$$QE = \frac{Concentration\ from\ Standard\ Curve * Volume\ of\ sample}{Mass\ of\ dry\ material\ used}$$

2.6 DPPH Radical Scavenging Activity Assay

The DPPH radical scavenging activity assay used was based on the procedure of [5]. The *kamias*and rose flower teas were prepared by separately steeping the flowers in freshly boiled water for 2 minutes. Then, 1 mM of DPPH was freshly prepared. In a covered tube, one mL of each sample was added with 4 mL of water and 1 mL of DPPH solution. It was stood for 30 minutes in a dark room. A blank was also made. The absorbance of each sample was read using a spectrometer set at 517 nm. The following formula was used:

$$\%DPPH\ scavenging\ activity = \left(1 - \frac{sample\ absorbance}{blank\ absorbance}\right) * 100$$

2.7 Reducing Power Assay

The reducing power assay was performed using the method of [6]. 0.1 mL of samples were added with 0.5 mL distilled water, 1.5 mL phosphate buffer and 1.5 mL potassium ferricyanide. It was then put in a water bath (50°C) for 20 minutes, and added with 2.5 mL of 10% trichloroacetic acid. The tubes were then centrifuged at 3000 rpm for 10 min, and 0.5 mL of supernatant was taken and transferred to another tube. Supernatant was then added with 1.5 mL distilled water and 0.3 mL of ferric chloride. The absorbance was then read at 700 nm using a spectrometer. The % reducing power was calculated by using the formula:

$$\%\ Reducing\ Power = \left(\frac{Absorbance_{sample}}{Absorbance_{blank}} - 1\right) * 100$$

2.8 Statistical Analysis

To determine if there are significant differences in the sensory attributes between the *kamias*flower tea from three drying methods, and between the most acceptable *kamias* flower tea and rose flower tea, Analysis of Variance (ANOVA) in Randomized Complete Block Design, and Tukey's Honest Significant Difference test (when a minimum difference was observed) were employed using Statistical Tool for Agricultural Research (STAR) software. While, for the antioxidant activity analyses, one-sample T-test was used to determine if the *kamias* flower tea is significantly different from rose flower tea.

3. RESULTS AND DISCUSSION

3.1 Sensory Evaluation

3.1.1 Sensory Evaluation among Three Drying Methods

After 25 judges had evaluated kamias flower tea prepared by three drying methods, the scores were encoded and analyzed with Statistical Tool for Agricultural Research (STAR) software using randomized complete block design (RCBD). The results, as shown in Table 2, showed that there were no significant differences among the attributes of the three samples except for their flavor attribute.

Table 2: Results of ANOVA for the attributes of *kamias* flower tea from three drying methods.

Attribute	**F-value**	**Pr(> F)**	
Color	3.15	0.0519	ns
Aroma	0.22	0.8020	ns
Flavor	4.95	0.0111	s
Aftertaste	2.00	0.1462	ns
General Acceptability	0.84	0.4366	ns
*ns= not significantly different; s= significantly different			

With the significant difference detected in the flavor attribute, Tukey's Honest Significant Difference (HSD) Test was employed to assess this difference. As shown in Table 3, samples with same letter show no significant difference between them. Thus, the flavor of freeze-dried *kamias* flower tea is not significantly different from those of the other samples. However, those of the cabinet- and sun-dried *kamias* flower teas are statistically different from each other.

Table 3: Tukey's HSD test on the flavor of *kamias* flower tea

Drying Method	Mean s	Error Mean Square	Critica l Value	Test Statistic	HS D
Cabinet drying	2.92	1.7039	3.4203	0.8929	b
Freeze-drying	3.56				ab
Sun drying	4.08				a
*Samples with the same letter are not significantly different.					

From Table 3, although the sun- and freeze-dried *kamias* flower teas were not statistically different in flavor, the sun-dried *kamias* flower tea had a higher mean score. Also, from Fig. 3, the sun-dried *kamias* flower tea had the highest score among all the three *kamias*flower tea samples in all the attributes evaluated. This served as the main basis for choosing the sun-dried *kamias* flower tea for comparison with conventional rose flower tea. Another reason for choosing this sample was that, if proved to contain a high antioxidant activity, then people with *kamias* trees can easily manufacture kamias flower tea since sun drying is a feasible and an easily available drying method even in rural areaswith no access to modern drying technologies.

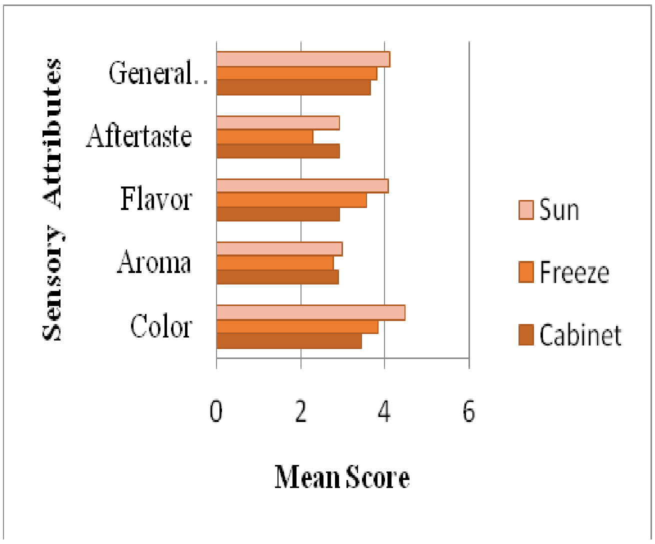

Fig 1: Mean scores of sensory attributes of *kamias* flower teas from three drying methods.

3.1.2 Sensory Evaluation between Kamias and Rose Flower Teas

Quality scoring was again used in comparing the *kamias* and rose tea, however, the color attribute was not evaluated since their colors were not comparable. The results from this sensory evaluation were also analyzed using the same statistical treatment in the initial evaluation. Rose and *kamias* flower teas were significantly different in terms of their aroma, yet no statistically significant difference was observed in their flavor, aftertaste or general acceptability.

Table 4: Results of ANOVA for the attributes of *kamias* and rose flower teas

Attribute	F-value	Pr (> F)	
Aroma	13.94	0.0010	s
Flavor	1.84	0.1879	ns
Aftertaste	2.30	0.1426	ns
General Acceptability	0.00	1.0000	ns
*ns= not significantly different; s= significantly different			

The aromas of the two samples were then subjected to Tukey's HSD test, and the results, in Table 5, showed that the intensity of their aroma is significantly different. Judges had found *kamias* flower tea to have weaker aroma than rose. However, as seen on Figure 4, both flower teas have equal mean score for general acceptability.

Table 5: Tukey's HSD test on the aroma of *kamias* and rose flower teas

Sample	Mean	Error Mean Square	Critical Value	Test Statistics	
Rose	5	2.4117	2.9188	0.9066	a
Kamias	3.36				b
*Samples with same letter are not significantly different.					

3.2 Antioxidant Analyses

Since one of the reasons to drink tea is because of the antioxidants it contains, the rose and kamias flower teas were subjected to three chemical analyses, namely, DPPH radical scavenging activity, total phenolic (TPC) and flavonoid (TFC) content determinations and reducing power assay (RPA), to assess its antioxidant activity.

Table 6: Summary of analyses on antioxidant activity of *kamias* and rose flower tea

Sample	Total Phenolic Content(GAE)	Total Flavonoid Content (QE)	Reducing Power (%)	DPPH Scavenging Activity (%)
Kamias	0.082555	0.245539	66.7582	19.67034
Rose	0.005289	0.038372	4.509902	51.86814
t-test	s	s	s	s

*s= significantly different

As seen in Table 3, *kamias* flower tea had higher total phenolic (in galic acid equivalent) and flavonoid (in quercetin equivalent) contents, and reducing power compared to rose. However, rose flower tea had higher DPPH radical scavenging than *kamias*. This suggests that the *kamias* flower tea had antioxidants with reducing mechanisms, while rose flower tea had radical-scavenging antioxidants.

4. SUMMARY AND CONCLUSION

After the evaluation of sensory attributes of *kamias* flower teas from three drying methods, the sun-dried *kamias* flower tea received the highest score in all attributes compared to the cabinet- and freeze-dried *kamias* flower teas. The sun-dried *kamias*flower tea was compared with rose flower tea based on their sensory properties and antioxidant activities. For the sensory evaluation, the results showed that *kamias* flower tea may have had weaker aroma than rose, but their general acceptability attribute had equal scores.

Chemical analyses for antioxidant activity such as DPPH radical scavenging activities, total phenolic and flavonoid contents determination, and reducing power assay, were conducted on sun-dried *kamias* and rose flower teas. *Kamias* flower tea had higher phenolic and flavonoid contents and stronger reducing power compared to rose flower tea, but rose flower tea had higher radical scavenging activity than *kamias* flower. This suggested that *kamias*flower tea had more reducing than scavenging antioxidants. Nevertheless, both flowers were found to have antioxidant activities.

The results from sensory evaluation and chemical analyses proved that *kamias* flowers can be used in flower tea development since it contained antioxidants and was equally acceptable as rose flower tea.

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BIOGRAPHIES

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