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Rauwolfiaserpentina Tea: Its Development and Potency

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Abstract:
Tea is one of the most consumed beverages around the world and commonly produced from Camellia sinensis. This study developed and analyzed the physicochemical qualities of tea from serpentina (Rauwolfiaserpentina) leaves. Further, the developed tea with the best sensory evaluation was tested in Syrian hamsters (Mesocricetusauretus) to determine its potency. Utilizing the experimental research design, the study revealed that sun-dried white tea obtained the highest water total dissolved solids (TDS) value parts per million (ppm) with 381.00 mg/L and the freeze-dried white tea acquired the highest water conductivity with 769.00 mcS/cm. The highest scores for the color, taste, aftertaste, bitterness, and astringency were obtained from freeze-dried yellow tea and for the aroma, it was obtained from sun-dried yellow tea. The potency revealed that after 12 hours the blood glucose level of hamsters fall from 16.30 mmol/L to 8.20 mmol/L and after 24 hours the blood glucose level fall from 10.53 mmol/L to 5.63 mmol/L. The chemical properties like TDS value ppm and electrical conductivity were affected by tea processing but not by the drying methods. The physical properties such as aroma, color, taste, aftertaste, bitterness, and astringency were not affected by the tea processing and drying methods. The levels of blood glucose after the treatment of serpentina tea from different concentrations significantly affected by the time since after 12 and 24 hours the blood glucose levels of the Syrian hamsters were lowered.

Keywords*: development, potency, serpentine tea.*

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INTRODUCTION

Tea is one of the most important beverages in the world and it is well consumed after water [1]. Commonly, tea is produced from the leaves of *Camellia sinensis*[2]. However, other species of plants have been studied as tea such as *Thunbergialaurifolia*Lindl. [3], *Lippiamultiflora*Moldenke [4], *Cymbopogoncitratus*[5], *Lagerstroemia speciosa*L. Pers. [6], *Curcuma longa* [7], *Morus spp.* [8], and *Hibiscus sabdariffa*L. [9]. The tea became famous and popular as important drinks because of its health benefits including different types of cancer, heart disease, diabetes, liver disease, etc. [10].

In the Philippines, the leaves of *Rauwolfiaserpentina* are utilized as herbal drinks against hypertension and diabetes [11]. Utilization and consumption of herbal drinks are common among people in remote areas like Subanen tribe in Zamboangadel Sur [12] and AtiNegrito indigenous group in Guimaras Island [13]. *Rauwolfia spp.* (Apocynaceae) are medicinal plants acknowledged worldwide due to its strong bioactive monoterpeneindole alkaloids (MIAs) such as reserpine, ajmalicine, ajmaline, serpentina and yohimbine and these are great antihypertensive, tranquilizing agents used for hypertension [14]. *Rauwolfiaserpentina* as an important medicinal plant has an extensive spectrum of valuable therapeutic actions mainly effective in the treatment of hypertension and psychological disorders like schizophrenia, anxiety, insomnia, and insanity [15]. It is also reported for use in the treatment of skin cancers, burns, eczema, and snake bite [16]. Various indole alkaloids and related constituents have been

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isolated from the leaves which have significant biological activities [17]. The leaf extract was found effective in the treatment of gastrointestinal disorders like diarrhea, dysentery, cholera, andeven breast cancer. Though, therapeutic effects of *Rauwolfia* with incomplete hypoglycemic action in diabetic patients, diabetic hypertensive patients and in anesthetized cats were brief [18].Thus, in continuation of this research idea the researchers considered the benefits of *Rauwolfiaserpentina*and the fact that this plant has all been utilized conventionally, it is the time now to process this plant and develop into tea and test its potency against diabetes. As cited in the study of Hu [19], Type 2 diabetes is a global public health crisis that threatens the economies of all nations, particularly developing countries. Fueled by rapid urbanization, nutrition transition, and increasingly sedentary lifestyles, the epidemic has grown in parallel with the worldwide rise in obesity. According to Millen et al. [20], nutritional needs should be met primarily from foods. People should aim to meet their nutrient needs through healthy eating patterns that include nutrient-dense foods which contain essential vitamins and minerals and also dietary fiber and other naturally occurring substances that may have positive health effects. While there may be a need to supplement our diet at certain times in our lives, the safety of taking a supplement also needs to be considered [21]. One way to avoid rapid death is to take some medicine as an additional supplement to make the body healthy every day.

OBJECTIVES OF THE STUDY

This study was conducted to develop tea from *Rauwolfiaserpentina*leaves. Specifically, it aims to determine if the leaves of *Rauwolfiaserpentina* used to produced tea and the tea processes and drying methods affect the water total dissolved solids value parts per million, water electrical conductivity, and physical qualities like aroma, color, taste, aftertaste, bitterness, and astringency. It also aims to determine if the best-produced tea with different concentrations as applied in Syrian hamsters can lower the blood glucose level.

MATERIALS AND METHODS

Research Design

This study utilized experimental design specifically 3x3 two-factor factorial experiment in complete randomized design with three replications to test the physicochemical properties of *Rauwolfiaserpentina*tea. The teas were produced based on the three tea processes (green, white and yellow) and drying methods (sun, oven, and freeze). The quality of tea was determined through physicochemical evaluation such as water total dissolved solids value parts per million, water electrical conductivity, and sensory evaluation like aroma, color, taste, aftertaste, and astringency. The study also utilized 1x4 factorial experiments with three replications to test the potency of the tea. The potency of the tea was determined through checking the blood glucose level of hamsters after exposure to the different concentrations. The blood glucose levels were determined after twelve and twenty four hours.

Special Techniques and Procedure

Collection of Raw Materials

Rauwolfiaserpentina plants were requested from the Office of the Provincial Agriculturist Demonstration Farm atBrgy. Calios, Sta. Cruz, Laguna. The collection of leaves was done one point at a time. The five youngest leaves at the tip of *Rauwolfiaserpentina* stems were picked during the collection.

Preparation of the Processing Conditions for Rauwolfiaserpentina Tea Production

The leaves were cleaned with water. Traditional withering practices were called for, manually spreading the leaves in thin layers and exposing them to the open air for 18 hours. Different tea processing for green tea, yellow tea and white tea were made and different drying methods were used such as freeze dry, oven dry and sundry.

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The production of green tea involves withering the leaves, killing the green by boiling the leaves with 500 ml of water about 30 minutes in a low heating pot, and letting the leaves dry. For the yellow tea productionit constitutes withering, killing the green, heaping using a small rake to let the leaves roll in the circular basket, and letting it dry. In white tea production the leaves are left to wither and dry. To dry the leaves the different drying methods were used. In freeze drying,the leaves are removed from the stems and dried on a flat tray. The bunch of leaves was placed in a plastic square container and freezes for about 3 days at 0°F. For the oven drying theleaves are placed in an aluminum plate covered by a paper towel and placed in an oven on low heat – less than 180 degrees °F or 82 °C for 5 minutes. In sun dryingthe leaves are placed in a clean circular basket for about 6 hours for three (3) days. The leaves were crushed with the use of blender for 5 minutes using number 1 speed only. The leaves were eventually torn into smaller pieces. Afterwards, the leaves were placed in a clean plastic square container and simultaneous preparation of tea was done.

Measuring and Packaging

The process of measuring and packing of tea leaves was limited up to 2 grams. The tea leaves were repacked into tea bags for quality control.

Analysis of Tea

The physical properties of *Rauwolfiaserpentina* tea such as aroma, color, taste, aftertaste, astringency and general acceptability were determined through organoleptic tasting or evaluation of consumer acceptability of tea. To assess the consumer acceptability of the final product, 35 respondents acted as taste panelists were selected through purposive sampling to evaluate the produced tea using a 5-point Hedonic Scale Quality Scoring. Respondents were asked to rate the tea samples using the score sheet rubrics as they perceive it. Most of the taste panelists were invited and screened based on their health conditions. The twenty tea samples were served to the respondents for three days. Water and cassava chips for mouth rinsing were provided to balance their taste. Prior to the evaluation, a session was held to familiarize the panelists with the tea samples. The questionnaires were distributed and the panelists were asked to read through it. The meaning of each attribute (aroma, color, taste, aftertaste, astringency and general acceptability) was explained to the taste panelists to avoid any misinterpretation. Taste panelists were not allowed to discuss their scores with one another during the evaluation session. The respondents were relaxed for about 2 to 3 minutes before they begun tasting the tea. Purified water was used for all types of teas given to the respondents. The respondents used 1 tea bag per cup with 2 ounces of water. In green tea (Day 1), 1 to 2 minutes was the tea infusion with about 158°F to 176°F. Yellow tea (Day 2) needed 3 minutes steeping time in 75°F to 80°F. Though, white tea (Day 3) required also 3 minutes but with about 176°F to 185°F. To test the chemical properties of the tea, the researchers used Total Dissolved Solids (TDS) water quality tester that included the water TDS value parts per million (ppm) and electrical conductivity microsiemens per centimeter (mcS/cm) to determine the purity of water in the tea.

Potency of Rauwolfiaserpentina Tea

To test the potency of *Rauwolfiaserpentina* tea against diabetes, different concentrations from the best tea (freeze-dried yellow tea) were used in twelve (12) Syrian hamsters to find out if there would be changes in their blood sugar level. The researchers, together with the veterinarian, bought twelve female hamsters with the same age and breed. To ensure the common genetic background in comparisons, heterozygous mating pairs were used to generate control and experimental animals. Because hamsters were nocturnal, the hamsters were housed in rooms with light-dark cycle that fitted the needs for the observation. This enabled metabolic

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tests that were conducted during the hours that were convenient for the hamsters (daytime) and that also occur during the metabolically active period for hamsters (dark cycle). After buying the hamsters from the pet shop, seven (7) days of resting period was allotted for the hamsters to adapt in the battery cage where they were placed. Hamsters were provided with feeding and drinking containers. High fat diet foods were provided to elicit changes in body composition (e.g. increased fat mass) and to precipitate insulin resistance in hamsters. The veterinarian recommended feed the hamsters using the BMEG Premium Super Biik Booster + Milk Formula which were guaranteed analysis per kilo of feed. These were crude protein (20.00% min.), crude fiber (2.50% max.), crude fat (4.00%), calcium (0.90-1.00%), phosphorous (0.55% min.), lactose (10.00% min.) and moisture (12.00% max.). A scoop of infant formula Abbott scooper which contains 8.70 grams per day was also served to the hamsters. Unlimited water feeding was allowed by the veterinarian because of the hot weather during the observation of the hamsters. Primary screening tests were done to evaluate the control blood sugar level of the hamsters. The veterinarian shared a technique in handling the hamster and how to get the blood glucose level. The leg part of the hamster was massaged before getting its blood. The blood was obtained from the lower left and right foot of the hamster using disposable syringe with 1 cc/ml. A tissue (1-2 mm) was cut from the paw of the hamster with the needle of the syringe and the blood was obtained by direct flow of small amount of blood to the glucometer. The data were recorded everytime the veterinarian gets the blood of the hamster. After the blood was obtained from the hamster, they were allowed to rest in their respective battery cage. The hamsters became diabetic using the D-Glucose Monohydrate MonDEX Water Soluble Powder which contains 99.9% glucose monohydrate. It is given to the animals as an energy supplement, rebuilding stamina and used as an aid in providing energy to sick and recovering animals. One ml of water was mixed every gram of glucose powder. It was suggested by the veterinarian to have unlimited water-glucose feeding for the hamsters. The hamsters were treated for 4 days with water-glucose feeding. The treatment produced significant changes of activity in the diabetic mice. The blood glucose content was measured using Sannuo glucometer. After a series of getting samples from the hamster, the blood glucose level rose above 11.1 mmol/L. The hamsters were rested for an hour and were let to drink water after getting their blood glucose level. Different concentrations of *Rauwolfiaserpentina* tea (freeze-dried yellow tea) were offered every hour. After 12 hours of drinking tea from the different concentrations per hour, the blood sugar content of hamsters was measured again and data were noted. For another 12-hour treatment to complete the 24 hours, tea was served and the blood sugar level of the hamsters was monitored.

RESULTS AND DISCUSSION

Chemical Characteristics of *Rauwolfiaserpentina* Tea

Water TDS value ppm

According to Edition [22], TDS refers to the “total dissolved solids” and it includes organic salts. The acceptability of TDS in drinking water depends on the palatability levels of water. To understand the waterTDS level, less than 300 mg/L is considered excellent to drink; 300 mg/L to 500 mg/L was good, 600 mg/L to 900 mg/L was fair, 900 mg/L – 1200 mg/L constitutes poor palatability, and above 1200 mg/L was unacceptable range. The average water TDS value parts per million (ppm) of *Rauwolfiaserpentina* tea was presented in Table 1, of which ppm (parts per million) refers to the concentration of minerals and soluble matter in the tea during infusion. The method with highest water TDS value ppm was sun-dried white tea with 381.00 mg/L, which the lowest water TDS value ppm value was the freeze-dried yellow tea with 29.00 mg/L.

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Table 1. Average water TDS value ppm in mg/L of *Rauwolfiaserpentina* Tea

TEA PROCESSING	DRYING METHODS			
	Freeze Dry	Oven Dry	Sun Dry	Mean
Green Tea	186.67[a]	188.67[a]	155.33[a]	176.89[b]
Yellow Tea	29.00[a]	195.00[a]	101.33[a]	108.44[b]
White Tea	371.67[a]	372.00[a]	381.00[a]	374.89[a]
AWM	195.78[a]	251.89[a]	212.55[a]	

*means that do not share a letter are significantly different ** type of tea (p=0.00), drying process (p=0.415), interaction (p=0.488)

Source	Mean Square	F-Value	P-Value	Interpretation
Tea Processing	172321.926	23.855	0.006	Significant
Drying Method	7465.593	1.033	0.435	Not Significant
Interaction	7223.870	0.893	0.488	Not Significant

Two-way ANOVA detected significant main effects among the processing tea and water TDS value ppm of *Rauwolfiaserpentina* tea. However, it failed to detect any significant interaction effects form the different drying method and the interaction (p>0.05). Further analysis using Fisher's Least Significant Difference (LSD) test showed that the mean average water TDS value ppm of the sun dried whitetea was significantly higher than the average water TDS value ppm of all other treatments. The higher the water TDS value ppm, the higher the contaminate minerals of volume of water in tea. Water containing more than 500ppm of TDS is not considered desirable for drinking water supplies [23]. These findings were supported by the study of Murugesh [23] about the impact of water quality on the nutritional and sensory characteristics of green tea infusion. The total soluble tea solids, catechins and l-theanine concentrations were significantly higher in infusions prepared from water having lower total dissolved solids (TDS, 0.59 mg/L to 13.0 mg/L). The major catechins reduced (84–93%) in the infusions prepared from water with higher TDS (315 mg/L to 338 mg/L), accompanied with undesirable color changes during storage following the first-order kinetics. The study recommended water with low TDS for hot-infusions and beverages.

Water Electrical Conductivity

According to Charnock andTenison[24], electrical conductivity is a measure of the saltiness of the water and is measured on a scale from 0 to 50,000 µS/cm. Electrical conductivity is measured in microsiemens per centimeter (µS/cm). Measures of sustainability ranges from 0 – 800 µS/cm which is good drinking water for humans, 800 – 2,500 µS/cm can be consumed by humans, 2,500 –10,000 µS/cm was not recommended for human consumption, although water up to 3,000 µS/cm can be consumed and over 10,000 µS/cm was not suitable for human consumption or irrigation. The average water electrical conductivity of *Rauwolfiaserpentina* tea was presented in Table 2. Freeze-dried white tea acquired the highest water conductivity value with 769.00 µS/cm and the lowestobtained water conductivity went to freeze-dried yellow tea with 61.33 µS/cm.

Table 2. Average Water Electrical Conductivity in µS/cm of *Rauwolfiaserpentina* Tea

TEA PROCESSING	DRYING METHODS			
	Freeze Dry	Oven Dry	Sun Dry	Mean

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Green Tea	426.00	430.00	363.33	406.44
Yellow Tea	61.33	414.67	216.00	230.67
White Tea	769.00	749.00	764.00	760.67
AWM	418.78	531.22	447.78	

*means that do not share a letter are significantly different.** type of tea (p=0.00), drying process (p=0.478), interaction (p=0.511)

Source	Mean Square	F-Value	P-Value	Interpretation
Tea Processing	655906.815	19.301	0.009	Significant
Drying Method	30671.593	0.903	0.475	Not Significant
Interaction	33982.259	0.852	0.511	Not Significant

Results of ANOVA showed that the water electrical conductivity of *Rauwolfiaserpentina* tea was significantly affected by the tea processing. Fisher's Least Significant Difference (LSD) test showed that the freeze-dried white tea yields higher water conductivity than those of the other tea processing and drying method. On the other hand, the difference indicated that the water electrical conductivity of the tea was not significantly affected by the drying method and interaction. The above indicated results are similar to the findings of Murugesh et al. [23] that the total soluble tea solids ofcatechins and l-theanine concentrations were significantly higher in infusions prepared from water having water electrical conductivity of 1.12 to 26.20 µS/cm. The infusions prepared from water with higher water electrical conductivity of 630 to 679 µS/cm produced undesirable color changes during storage. The study recommended water with low water conductivity for hot-infusions and beverages.

Sensory Characteristics of Serpentina Tea

The average scores for the sensory characteristics of the *Rauwolfiaserpentina* tea were shown in Tables 3 and 4. The highest aroma score was obtained from sun-dried yellow tea with an average of 3.67 and the lowest aroma score of 3.18 was obtained from sun-dried white tea. All the mean scores indicated that the taste panelists slightly like the aroma of tea since it has a pleasant odor. The highest average color score was obtained from freeze-dried yellow tea with an average of 3.70 and the least score was 3.31 and was obtained from sun-dried white tea process. These values show that the teas in terms of color were liked moderately by the taste panelists because of its clear appearance. Freeze-dried yellow tea yielded the highest mean score for taste with a value of 3.15 and the lowest taste score of 2.02 was obtained from sun dried white tea which is dislike moderately by the taste panelist. All the tastes of the tea were only liked slightly by the taste panelists because of its bitter taste. The table also exhibited that freeze-dried yellow tea produced the highest aftertaste with mean score of 3.30 and the lowest aftertaste score of 1.93 was obtained from sun-dried white tea. These values showed that the tea was liked slightly in terms of aftertaste because of its bitterness. The uppermost average score for bitterness of tea was recorded under freeze-dried yellow tea with 3.30 and the bottommost average score for bitterness was attained by sun-dried white tea with 1.99. All the mean scores of the taste panelists slightly liked the bitterness of the tea since it has balance bitter taste. Freeze-dried yellow tea generated the highest astringency mean score of 3.17 and the lowest obtained by freeze-dried white tea with 2.12 average score. All the astringency of the tea was only slightly liked by the taste panelists because of its rough sandpapery sensation. Freeze-dried yellow tea generated the highest general

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acceptability mean score of 3.17 and the lowest mean score of 2.43 was obtained by sun-dried white tea. All the teas produced from the experiment were liked slightly by the taste panelists.

ANOVA failed to detect any significant interaction effects from the different factors used on the sensory characteristics scores of the teas ($p>0.05$). Likewise, no significant main effects were detected ($p>0.05$). These imply that the sensory characteristics scores of*Rauwolfiaserpentina* tea could not be significantly affected by tea processing and drying methods. These results are in contrast with the study of Wang et al. [25] about the processing technologies affecting the aroma but not the taste of teas. It evaluated the effect of the processing technology utilized on the quality of teas, the major water-soluble and volatile components of 24 Biluochun and regular green teasamples obtained in different production areas and determined using the sensory evaluation. There were small differences between the contents of the major water-soluble compounds identified in the samples. This study suggests that, although the geographical origin and cultivar influenced the aroma andcharacteristics of tea products somewhat, processing technologies played an important role on tea aroma. The findings werealso in contrast with the study of Laddi et al. [26] who discussed about the influence on color attributes of freshly brewed tea with time due to variations in temperature condition. It is suggested in the study that after brewing, the tea samples undergo a colorchange. The change in the color was found less prominent and it is concluded that the color changes rapidly after brewing and can pose difficulty in quality assessment of tea samples by tea tasters during visual inspection. Likewise, the findings do not conform to the result obtained by Zhang, et al. [27] that sweet aftertaste was significantly increased with the extension of the hydrolyzing treatment. A 2.5:1 (EGC/EC) ratio with a total concentration of 3.5 mmol/L gave the most satisfying sweet aftertaste, and the astringency significantly inhibited the development of the sweet aftertaste. The resultsalso in contrast to the study of Zou et al. [28] showed that there is a significant values between some sensors and the bitterness were greater than 0.05. The sensors were not conducive to the prediction of the bitterness and astringency of the tea. Therefore, a new sensor array was obtained to predict the bitterness and astringency of the tea infusion.

Table 3. Sensory Characteristics Scores of *Rauwolfiaserpentina* Tea (Descriptive)

TEA PROCESSING	DRYING METHODS			Mean
	Freeze Dry	Oven Dry	Sun Dry	
Aroma				
Green Tea	3.52	3.52	3.42	3.49
Yellow Tea	3.58	3.22	3.67	3.49
White Tea	3.21	3.22	3.18	3.20
Mean	3.44	3.32	3.42	3.39
Color				
Green Tea	3.66	3.53	3.50	3.56
Yellow Tea	3.70	3.44	3.58	3.57
White Tea	3.36	3.40	3.31	3.36
Mean	3.57	3.46	3.46	3.50
Taste				
Green Tea	2.82	2.80	2.61	2.74

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Yellow Tea	3.15	2.73	3.03	2.97
White Tea	2.30	2.30	2.02	2.20
Mean	2.76	2.61	2.55	2.64
Aftertaste				
Green Tea	3.10	2.90	2.70	2.90
Yellow Tea	3.30	2.70	3.04	3.01
White Tea	2.34	2.30	1.93	2.19
Mean	2.91	2.63	2.56	2.70
Bitterness				
Green Tea	2.94	2.92	2.69	2.85
Yellow Tea	3.30	2.63	2.90	2.94
White Tea	2.21	2.28	1.99	2.16
Mean	2.82	2.61	2.53	2.65
Astringency				
Green Tea	2.95	2.89	2.78	2.87
Yellow Tea	3.17	2.52	2.94	2.88
White Tea	2.12	2.35	2.13	2.20
Mean	2.75	2.59	2.62	2.65
General Acceptability				
Green Tea	3.17	3.10	2.95	3.07
Yellow Tea	3.37	2.87	3.19	3.14
White Tea	2.59	2.64	2.43	2.55
Mean	3.04	2.87	2.86	2.92

*tea processing x drying method ($p>0.05$) tea processing ($p>0.05$), drying method ($p>0.05$)

**1.00 – 1.80 (Dislike Very Much), 1.81 – 2.60 (Dislike Moderately), 2.61 – 3.40 (Like Slightly), 3.41 – 4.20 (Like Moderately), 4.21 – 5.00 (Like Very Much)

However, the findings of this study were similar to the study of Franks et al. [29] that in investigating changes to the green tea's flavor properties, panelists found no significant difference in astringency, sourness, or vegetal flavor (all $p > 0.05$).

Table 4. Sensory Characteristics Scores of *Rauwolfiaserpentina* Tea (Inferential)

Sensory Characteristics	MSE	f-Value	p-Value	Interpretation
Aroma				
Drying Method	0.01328	0.01	0.916	Not Significant
Tea Processing	0.49612	0.41	0.663	Not Significant
Interaction	0.05233	0.04	0.957	Not Significant
Color				

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Drying Method	0.76442	0.68	0.411	Not Significant
Tea Processing	0.49341	0.44	0.646	Not Significant
Interaction	0.07022	0.06	0.940	Not Significant
Taste				
Drying Method	2.3258	1.42	0.235	Not Significant
Tea Processing	1.5764	0.96	0.384	Not Significant
Interaction	0.1031	0.06	0.939	Not Significant
Aftertaste				
Drying Method	6.7465	4.38	0.037	Not Significant
Tea Processing	2.3564	1.53	0.218	Not Significant
Interaction	0.1113	0.07	0.930	Not Significant
Bitterness				
Drying Method	3.7227	2.12	0.146	Not Significant
Tea Processing	3.7273	2.12	0.121	Not Significant
Interaction	0.2782	0.16	0.854	Not Significant
Astringency				
Drying Method	0.8023	0.60	0.440	Not Significant
Tea Processing	3.9479	2.94	0.054	Not Significant
Interaction	0.2737	0.20	0.816	Not Significant
General Acceptability				
Drying Method	0.7753	0.75	0.387	Not Significant
Tea Processing	2.6626	2.57	0.078	Not Significant
Interaction	0.4553	0.44	0.644	Not Significant

*tea processing x drying method (p>0.05) tea processing (p>0.05), drying method (p>0.05)

**1.00 – 1.80 (Dislike Very Much), 1.81 – 2.60 (Dislike Moderately), 2.61 – 3.40 (Like Slightly), 3.41 – 4.20 (Like Moderately), 4.21 – 5.00 (Like Very Much)

Potency of *Rauwolfiaserpentina* Tea

The potency of *Rauwolfiaserpentina* tea based on blood sugar levels of experimental Syrian hamsters was shown on Table 5. The average scores of highest blood sugar level of Syrian hamsters without having a treatment was 7.50 mmol/L followed by 6.95 mmol/L,6.53 mmol/L and 6.37. The blood sugar levels are below the considered blood glucose level of mice to become diabetic. After 4 days of water-glucose feeding Alonso et al. [30], the hamsters gained the glucose level that reached its level to become diabetic. The highest average score obtained was 16.30 mmol/L followed by 14.10 mmol/L and 12.07 mmol/L and the lowest average score was 11.50 mmol/L. All of the blood glucose level at this point described that all hamsters were diabetic. According to the study of Joarder et al. [31], mice with blood glucose levels above 200 mg/L (or 11.1 mmol/L) were considered diabetic. Differentconcentrations were treated for the hamster every hour, after 12 hours of drinking tea data noted

that the blood glucose level of the hamster are fall from 10. 53 mmol/L, followed by 10.05 mmol/L, 9.50 mmol/L and 8.20 mmol/L. The data revealed that after administering the tea, a quick response in the body of the hamsters would lower its blood sugar levels.Another 12 hours of treatment to complete the 24 hours conduct was implemented, and drinking tea proved the lowest blood level was obtained from the hamsters with 8.93 mmol/L, 5.77 mmol/L, 5.63 mmol/L and 4.10mmol/L.

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Table 5. Potency of *Rauwolfiaserpentina* Tea Based on Blood Sugar Level in mmol/L of Experimental Syrian Hamster

Treatment	BLOOD GLUCOSE			
Pre-Treatment	7.60	8.10	10.40	7.90
	9.50	5.90	7.40	10.30
	2.00	5.60	4.70	6.00
Weighted Mean	6.37	6.53	7.50	6.95
With Glucose Powder[a]	17.60	11.50	11.40	11.70
	20.20	12.00	11.70	11.70
	11.10	18.80	11.40	12.80
Weighted Mean	16.30	14.10	11.50	12.07
With Serpentina Tea (Freeze Dried Yellow Tea) after 12 hours[b]	8.20	9.40	7.20	5.60
	10.90	11.10	8.20	10.80
	9.20	11.10	10.80	10.40
Weighted Mean	10.05	10.53	9.50	8.20
WithSerpentina Tea (Freeze Dried Yellow Tea) after 24 hours[b]	4.50	8.20	4.80	3.70
	8.20	9.00	4.30	9.00
	3.70	9.60	8.20	4.20
Weighted Mean	4.10	8.93	5.77	5.63

*concentration_2 (p=0.074), treatment_2 (p=0.001), interaction (p=0.374)

**concentration_3 (p=0.103), treatment_3 (p=0.000), interaction (p=0.172)

***means that do not share a letter are significantly different

Results of ANOVA showed that the level of blood glucose after treatment of *Rauwolfiaserpentina* tea from the different concentrations is significantly affected by the time of serving to the Syrian hamsters. Fisher's Least Significant Difference (LSD) test showed that after 12 hours and 24 hours of taking tea, the Syrian hamster got lower its blood glucose level. This research is similar to the study of Shetti et al. [32] about the investigation carried out to evaluate the antidiabetic effect of ethanolic leaf extract of *Phyllanthusamarus* in alloxan induced diabetic mice. Blood glucose levels and body weights of control and diabetic mice were monitored. Oral administration of ethanolic leaf extract (400 mg/kg body weight) for 45 days resulted in a significant ($P<0.05$) decline in blood glucose from 310.20 to 141.0 mg/dl and significantrecovery in body weight of diabetic mice. There was also a significant ($P<0.05$) reduction in the activities of glucose-6-phosphatase and fructose-1-6-disphosphatase in liver, further there was significant ($P<0.05$) increase in the activity of glucokinase in liver of diabetic mice when compared with that of diabetic control. The study clearly shows that the ethanolic leaf extract of *Phyllanthusamarus* possesses potent antidiabetic activity.

CONCLUSION AND RECOMMENDATION

The study revealed that the water TDS value ppmand water electrical conductivity of *Rauwolfiaserpentina* tea were significantly affected bytea processing. The aroma, color, taste, aftertaste, bitterness, and astringency of the developed tea were not significantly affected by tea processing and dryingmethods.The blood glucose levels of the Syrian hamsters were significantly affected by the time of administration of different concentrations of tea. This study recommends that *Rauwolfiaserpentina* leaves can be used as raw materials in tea production, yellow tea processing and freeze drying are recommended to be used in the

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production of tea, *Rauwolfiaserpentina* tea can be used as drinks to lower blood sugar level, and further studies on the potency of Rauwolfia*serpentina* tea using other variables is highly recommended.

References

1. Cheng, T. O. (2004). Will green tea be even better than black tea to increase coronary flow velocity reserve?.*American Journal of Cardiology*, *94*(9), 1223.
2. Taylor, S. (2003). Tea: types, production, and trade. *Encyclopedia of Food Sciences and Nutrition*, 2nd edition. Academic Press, New York, 5737-5743.
3. Chan, E. W. C., Eng, S. Y., Tan, Y. P., Wong, Z. C., Lye, P. Y., & Tan, L. N. (2012). Antioxidant and sensory properties of Thai herbal teas with emphasis on ThunbergialaurifoliaLindl. *Chiang Mai J Sci*, *39*(4), 599-609.
4. Ekissi, A. C., Amoin, G. K., Yao-Kouame, A., Bonfoh, B., & Kati-Coulibaly, S. (2014). Sensory evaluation of green tea from LippiamultifloraMoldenke leaves. *European Scientific Journal*, *10*(3).
5. Dzah, C. S. (2015). Sensory performance, proximate and antioxidant activity of tea from composite formulation of Cymbopogoncitratus, Lippiamultiflora and Ganodermalucidum. *Journal of Food and Nutrition Sciences*, *3*(3), 131-138.
6. Medina, R. C. (2000). The health wonders of banaba tea. *Philippine Daily Inquirer*, 4.5.
7. Chan, E. W. C., Lim, Y. Y., Wong, S. K., Lim, K. K., Tan, S. P., Lianto, F. S., & Yong, M. Y. (2009). Effects of different drying methods on the antioxidant properties of leaves and tea of ginger species. *Food chemistry*, *113*(1), 166-172.
8. Pothinuch, P., &Tongchitpakdee, S. (2011). Melatonin contents in mulberry (Morus spp.) leaves: effects of sample preparation, cultivar, leaf age and tea processing. *Food chemistry*, *128*(2), 415-419.
9. Mohamed, B. B., Sulaiman, A. A., &Dahab, A. A. (2012). Roselle (Hibiscus sabdariffa L.) in Sudan, cultivation and their uses. *Bull. Environ. Pharmacol. Life Sci*, *1*(6), 48-54.
10. Sinija, V. R., & Mishra, H. N. (2008). Green tea: Health benefits. *Journal of Nutritional & Environmental Medicine*, *17*(4), 232-242.
11. Fiscal, R. R., & Chavez, A. C. (2016). Ethnobotanical profiling of commonly utilized plants for hypertension and diabetes in the Province of Laguna, Philippines. *International Journal of Science and Research*, *5*(9), 152-154.
12. Pizon, J. R. L., Nuñeza, O. M., Uy, M. M., &Senarath, W. T. P. S. K. (2016). Ethnobotany of Medicinal Plants Used by the Subanen Tribe of Lapuyan, Zamboangadel Sur. *Bull. Env. Pharmacol. Life Sci*, *5*, 53-67.
13. Ong, H. G., & Kim, Y. D. (2014). Quantitative ethnobotanical study of the medicinal plants used by the AtiNegrito indigenous group in Guimarasisland, Philippines. *Journal of ethnopharmacology*, *157*, 228-242.
14. Kumar, S., Singh, A., Bajpai, V., Srivastava, M., Singh, B. P., & Kumar, B. (2016). Structural characterization of monoterpeneindole alkaloids in ethanolic extracts of Rauwolfia species by liquid chromatography with quadrupole time-of-flight mass spectrometry. *Journal of pharmaceutical analysis*, *6*(6), 363-373.
15. Dey, A., & De, J. N. (2011). Ethnobotanical aspects of Rauvolfiaserpentina (L). Benth. exKurz. in India, Nepal and Bangladesh. *Journal of Medicinal Plants Research*, *5*(2), 144-150.
16. Harisaranraj, R., Suresh, K., Saravanababu, S., &Achudhan, V. V. (2009). Phytochemical based strategies for pathogen control and antioxidant capacities of Rauwolfiaserpentina extracts. *Recent Research in Science and Technology*, *1*(2), 67-78.
17. Itoh, A., Kumashiro, T., Yamaguchi, M., Nagakura, N., Mizushina, Y., Nishi, T., &Tanahashi, T. (2005). Indole alkaloids and other constituents of Rauwolfiaserpentina. *Journal of natural products*, *68*(6), 848-852.
18. Azmi, M. B., &Qureshi, S. A. (2012). Methanolic root extract of Rauwolfiaserpentinabenth improves the glycemic, antiatherogenic, and cardioprotective indices in alloxan-induced

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ISSN: 0193-4120 Page No. 10267 - 10278

diabetic mice. *Advances in pharmacological sciences*, *2012*.

19. Hu, F. B. (2011). Globalization of diabetes: the role of diet, lifestyle, and genes. *Diabetes care*, *34*(6), 1249-1257.
20. Millen, B. E., Abrams, S., Adams-Campbell, L., Anderson, C. A., Brenna, J. T., Campbell, W. W., & Perez-Escamilla, R. (2016). The 2015 Dietary Guidelines Advisory Committee scientific report: development and major conclusions. *Advances in nutrition*, *7*(3), 438-444.
21. Wolfram, Taylor. (2018, July 6). Vitamins, minerals and supplements: Do you need to take them? Retrieved fromhttps://www.eatright.org/food/vitaminsandsupplements/dietarysupplements/vitamins-minerals-and-supplements-do-you-need-to-take-them
22. Edition, F. (2011). Guidelines for drinking-water quality. *WHO chronicle*, *38*(4), 104-8.
23. Murugesh, C. S., Manoj, J. B., Haware, D. J., Ravi, R., & Subramanian, R. (2017). Influence of water quality on nutritional and sensory characteristics of green tea infusion. *Journal of food process engineering*, *40*(5), e12532.
24. Charnock, P., &Tenison, K. Measuring water salinity.
25. Wang, C., Lv, S., Wang, J., Qiu, X., Wu, Y., &Meng, Q. (2017). Processing technologies affect the aroma but not the taste of teas: A study of Yunnan Biluochun, Jiangsu Biluochun, and other regular green teas. *International Journal of Food Properties*, *20*(6), 1404-1421.
26. Laddi, A., Sharma, S., Kumar, A., & Rup, N. (2011). Influence on Color Attributes of Freshly Brewed Tea with Time due to Variations in Temperature Conditions. *International Journal of Computer Applications*, *34*(7).
27. Zhang, Y. N., Yin, J. F., Chen, J. X., Wang, F., Du, Q. Z., Jiang, Y. W., &Xu, Y. Q. (2016). Improving the sweet aftertaste of green tea infusion with tannase. *Food chemistry*, *192*, 470-476.
28. Zou, G., Xiao, Y., Wang, M., & Zhang, H. (2018). Detection of bitterness and astringency of green tea with different taste by electronic nose and tongue. *PloS one*, *13*(12), e0206517.
29. Franks, M., Lawrence, P., Abbaspourrad, A., &Dando, R. (2019). The Influence of Water Composition on Flavor and Nutrient Extraction in Green and Black Tea. *Nutrients*, *11*(1), 80.
30. Alonso, L. C., Yokoe, T., Zhang, P., Scott, D. K., Kim, S. K., O'Donnell, C. P., & Garcia-Ocaña, A. (2007). Glucose infusion in mice: a new model to induce β-cell replication. *Diabetes*, *56*(7), 1792-1801.
31. Joarder, M. H. H., Islam M. U., Ahamed K., Yameen M. B., Sharmin R., Alam A. H. M. K., &Islam A. (2019). *MikaniaScandens* Leaves Possess Potent & Prolong Antidiabetic Effect in Alloxan Induced Diabetes Mice. *J Biomed Pharm Sci*, 2(1): 117
32. Shetti, A. A., Sanakal, R. D., &Kaliwal, B. B. (2012). Antidiabetic effect of ethanolic leaf extract of Phyllanthusamarus in alloxan induced diabetic mice. *Asian journal of plant science and research*, *2*(1), 11-15.