ISSN No:-2456-2165

Quality Evaluation of Tea Produced from Bamboo, Plantain and Zobo Leaves

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Abstract:- Bambusa (*Bambusa vulgaris*), plantain (*Musa parasidiaca*), banana (*Musa acuminate)* and Zobo (*Hibiscus sabdariffa)* leaves. The samples were collected from a farm in Abeokuta, Ogun State Nigeria. They were washed, dried and blended. The standard analytical methods (AOAC, 2000) were used to analyzed the samples The results of the physical properties showed that the pH values of *Musa acuminata* (banana) and *Musa parasidiaca* (plantain) tea leaf (Banana) was basic, bamboo leaf tea (*Bambusa vulgaris*) was neutral (7.16) while that of H*ibiscus sabdariffa* tea leaf (Zobo) was strongly acidic (2.66). *Bambusa vulgaris* had least specific gravity of 0.010. The anti-nutritional factor showed that the highest Tannin content was observed in *Musa parasididia* tea leaf 2.15 mg/g while the tannin content observed in *Hibiscus sabdariffa* tea leaf (Zobo) was the least (0.72 mg/g) all the samples had traces of saponin, phytate and oxalate. Caffeine was observed to be present in *Musa acuminata* and Bambus vulgaris tea leaves but absent in *Hibiscus sabdariffa* (Zobo) and *Musa parasididia* tea leaf. The statistical analysis indicated that were no significant differences between the number of participants as regards colour, aroma and tastes of the prepared tea leaves against the reference sample. The tea leaves were acceptable to consumers and therefore it can serve as alternatives to imported green tea.

I. INTRODUCTION

Tea is a beverage mostly consumed in the world, it is commonly prepared by pouring hot or boiling water over certain plant parts like leaves, grounded roots and bark. These parts are used for different purposes, such as energy improvement, sedative, stimulant, antihypertensive, depression, detoxifying actions and promotion of longetivity (Lee *et al*, 2016). Consumed Tea beverages have potential to prevent chronic communicable and non-communicable diseases. Most of teas have functional properties because they are sources of potent compounds which include simple; Phenols, Polyphenols, Flavonoids, Anthocyanins, Tannins (Aniohange *et al*., 2006).. There are different types of tea namely: white, green and black tea. Oxidation level of the leaves makes a different among them. White tea consists of young barely oxidized tea leaves this makes colour remains light Black tea leaves are dark because the leaves hav been full oxidized, this also give it a stong . Green tea is produced by steaming freshly picked leaves, this has little period for oxidation which retains chlorophyll levels and the natural green colour (Zhank *et al*., 2018). Among the popular non-alcoholic beverages in Nigeria are zobo drink, an aqeous extracts of calyx of rosella, a reddish purple, acid-succulent calyces of the flower of *Hibiscus sabdariffa*. Zobo is made from the dried sepal of the hibiscus plant flowerwhich is mostly cultivated in the northern part of Nigeria because of the weather (Essien *et al*., 2011). The dried red sepals consist of organic acids, sugars and anthocyanin pigment. The Hibiscus tea is used as natural diuretics and mild medicine traditionally. It was also reported consuming hibiscus tea helped to lower blood pressure in a group of per hypertensive and mildly hypertensive adults (Adebayo and Samuel, 2000). Bamboo, initially was used in wood applications like : furniture, flooring, fence posts, decorations, artworks, and others. Researchers have shown that bamboo tea made from dried leaves of herbal decoction has been used as medicine in the olden days. Bamboo tea has many health benefits among which are source of fibre, silica, anti-oxidant, detoxifier, anti inflammatory, lowering of blood sugar levels, reduces menstrual pain and skin health is promoted (Chabi *et al*., 2018)

Plantain, is a green, weedy plant native to North America, Europe and Asia. Many ethnic groups in the world have used the plantain leaf to help relive health ailments for millennia. The major contents of plantain are irridoid glycosides (particularly aucubin), mucilage, and tannins. Together they are belived to reduce irritation, quell harmful organisms and exhibits expectorants actions (Miconi *et al*., 1997). In Nigeria today, there are varieties of tea leaves made by multinational companies, examples are lipton tea, top tea, green tea, china tea among others. Tea leaves have high polyphenols, which acts as anti-oxidants, prevents cardiovascular diseases. The presence of fluorine helps strengthening bones and teeth. Tea generally boosts body defense, therefore, it becomes imperative to prepare local tea leaves to meet the needs of citizens who may not be able to afford the imported teas.

ISSN No:-2456-2165

II. MATERIALS AND METHODS

❖ *Collection of sample leaves and preparation*

Sample leaves are collected from their parent plants at the botanical garden of Moshood Abiola Polytechnic, Ojere, Abeokuta,Ogun State, Nigeria. The leaves were washed, slightly heated to deactivate the enzymes responsible for oxidation, this helps to remove undesireable scents from the leaves after the leaves are macerated to breakdown the structures of the leaf cells. hence, the leaf juices are released in this process, the macerated leaves (tea) are then subjected to drying.

❖ *Chemical Analysis*

➢ *Determination of Caffeine*

50 g of the prepared tea was weighed into a beaker, 150 ml of distilled water was added to it. The mixure was boiled. The resulting mixture was filtered, lead II acetate ($Pb(CH_3COO)_2$) was added to the filtrate forming a brown precipitate. Lead II acetate was added till no more precipitate formed (Gurolla et,al., 2019).

➢ *Determination of pH*

The pH was determined using a glass electrode pH meter, the instrument was calibrated using standard buffers before taking the measurement (Essien, 2011).

➢ *Determination of Specific Gravity (Density)*

The specific gravities of the extracted samples were measured using density bottles. The initial weight of the bottles were taken, weight of the bottles with the extracts were also determined. The difference in both weights gave the specific gravity of the extract (Essien, 2011)

➢ *Determination of Phytate*

Was used for phytate was determined using the method described by AOAC. 2g of each extracts was weighed into 250ml conical flask, 100 ml of dil. HCl was introduce into each flask and left overnight. The mixture was filtered through a double layer whatman filter paper. 50 ml of the filtrate was put in 250ml beaker, 107 ml of distilled water was added to each flask followed by 10 ml of Ammonium thiocyanate solutionwhich served as indicator. The mixture was titrated with F_eCl_3 solution until the colour of the mixture turned brownish yellow which persisted for persiste 5mins. ().

Phytate concentration can be determine using this expression

% phytic acid = X x 1.1 x 100

Where X = titre value, 1.1 = a constant

➢ *Determination of Tannin*

5ml of each extract was transferred to a Erlenmeyer flask (500 ml) , 250 ml of 0.1N iodine and 10 ml of 4 % NaOH solution were added. The resulting mixture was kept in the dark room for 15 mins, water (H_2O) was added and 10 ml of 4 % H_2SO_4 to acidified the mixture. The mixture was titrated with 0.1N Sodium thiosulphate solution using starch solution as indicator. The number of 1ml of 0.1N $Na_2S_2O_3$ used corresponds to the sum of tannin and pseudo-tannins. 25 ml of fresh extracts was mixed with 15ml of gelatin solution in a 100ml measuring flask and complete to volume with water and filtered. To the 20ml filtrate, 25ml of 0.1N iodine and 10ml of 4% NaOH was added. This was mixed and kept in the dark for 15minutes. The mixture was diluted with 100ml water and acidified with 4% H_2SO_4 (10ml) it was then titrated against 0.1N Sodium sulphate using starch as indicator, the voume (mls) of 0.1N NaS_2O_3 used correspond only to pseudotannin content (B). A Blank experiment was carried using distilled water(Essien, 2011).

Calculations

% True tannin = (A-B) = g% W/V.

➢ *Determination of Saponin*

50ml of prepared tea was placed in a 50 ml cornical flask, 300 ml of 50% alcohol was added, the content refluxed for 30 mins and filtered while hot through a whatman filter paper. 2 g of charcoal was added to the filtrate, boiled and filtered while hot. The charcoal decolour ized the mixture. The filtrate was cooled and acetone was added which aided the precipitate of saponin. The precipitated saponin was collected by decantation methodit was later dissolved in small amount of boiling alcohol (95%) , the content was filtered while hot. The filtrate was allow to cool at room temperature , this enable pure saponin form to separate. The filterate was dried and weighed (Lu *et al.*, 2012).

Calculation
Weight of Filter paper (S_1) = 1g
Weight of residue (S_2) = 1.24 g
% of true Saponin = S_2 - S_1

➢ *Determination of Oxalate*

Oxalate determination was carried out using the method reported by Ejikeme *et al*. (2014) . 20 cm^3 of con. HCl was introduced to 2.5 g each extract 50 ^{0}C for 1 hour and the constituent was constant stirred . 1.0 cm^3 of Ammonium solution was added to 50 ml of extract to ensure alkalinity. Two drops of phenolphthalein indicator and three drops of glacial acetic acid with 1.0cm^3 of calcium chloride. The mixture was allowed to stand for 3 hours this was followed by centrifugation (3000 rpm for 15 mins). the precipitate was washed with hot water. 2.0 cm of Conc H_2SO_4 was added to dissolve the precipitate formed. This was titrated against freshly prepared KMnO4 until the first pink color appears in the solution. The resulting solution was allowed to stand until it turned colorless, after, it was warmed on an electric hot plate at 70 ^{0}C for 3 minss and titration was repeated until a pink color appeared which persisedt for at 30 seconds (((Lu *et al.*, 2012).

Calculation
1ml 0.05 $KMnO_4$ = 2.2 mg Oxalate

ISSN No:-2456-2165

III. RESULTS AND DISCUSSION

The result of the physical properties of the prepared tea are presented in (Table 1). The pH value ranged between 2.66 (*Hibiscus sabdariffa)* and 8.15 (*Musa parasidiaca)* (. The tea of *Musa acuminata* (Banana) was observed to be basic, this result is higher than 4.9 -5.5 reported for black tea *Camellia sinesis* but agreed with the pH range of 7-10 reported for green tea (Arnarson, 2017). The *Hibiscus sabdarrifa* tea (Zobo) was strongly acidic which agreed with the pH range of 2-3 reported for lemon tea (Natalie butler, 2017). Under this condition, most bacteria cannot survive with the exception of aciduric bacteria such as *Lactobacillus species* which are found in low pH food (Aniohange *et al.*, 2006). This observation is in accordance with the report of Ogundapo *et al.*, 2014who reported that teas with a pH above 7.2, like green teas, are safe for the teeth and can help maintain a normal weight.. A few studies have even pointed to the possibility that higher pH might help people get rid of heart disease, cardiovascular ailments, Parkinson's disease and Alzheimer's.

The specific gravity for *Musa Acuminata* tea (Banana) and *Hibiscus Sabdariffa* tea (Zobo) was 0.06 g/ml and 0.04 g/ml respectively which are similar to specific gravity of 0.48 g/ml reported for black tea (Ruth Hong *et al.*, 2018). Specific gravity is also known as weight or density of a liquid as compared to the density of an equal volume of water at a specified temperature.

Tannin content ranged from 1.79 mg/g and 0.72 mg/g for *Musa acuminata* leaf (Banana) and *Hibiscus sabdariffa* leaf (Zobo) respectively. Tannin contents in these two tea leaves were lower than those reported by some researchers ;Zhang *et al.*, 2019), Ryou *et al*, (2012) in black tea. Edible plants materials containing tannins are known to be astringent and are used for treating intestinal disorders such as diarrhea and dysentery (Sharma *et al.*, 2018). The presence of tannin in *Musa acuminata* leaf (banana) and *Hibiscus sabdariffa* leaf (Zobo) supports their use in traditional curing of much different disease. Liu *et al.* (2019); luo *et al*. (2019) reviewed the biological activities of tannin and observed that tannin have remarkable activity in cancer prevention and anticancer activities. The results also support the use of *Musa acuminata* leaf (banana) and *Hibiscus sabdariffa* leaf (zobo) in many herbal remedies. Saponin content obtained ranged from 1.04mg/g to 1.75mg/g in *Musa acuminata* leaf (banana) and *Hibiscus sabdariffa* leaf (Zobo) respectively. The results showed that both tea leaves contained saponin in abundance which is different from work of Horn and Hasser, (2016) who reported the absence of saponin in black tea. Saponin reduces the uptake of glucose and cholesterol at the gut through intra lumenal physicochemical interaction against heart disease (Riberro, 2013).

Phytate value of prepared tea from *Musa acuminata* (Banana) and *Hibiscus sabdariffa* (Zobo) ranged between 0.38 mg/g and 0.90 mg/g respectively. These values were recorded to be lower than 27.67 mg/g and 20.21 mg/g reported for black tea and green tea respectively (Kumar,1991). The presence of phytate in food has been associated with reduced mineral absorption from the food due to the formation of complexes with most mineral. However, the presence of phytate in high fiber food may reduce the incidence of breast cancer and cardiovascular disease (Akinyosoye 1991).

Oxalate contents of prepared tea from *Musa acuminata* leaf (Banana) and *Hibiscus sabdariffa* leaf (Zobo) ranged from 0.57 mg/g and 0.85 mg/g respectively. These values were recorded to be lower than 4.68 mg/g and 1.15mg/g reported for black tea and green tea respectively (Chabi *et al*., 2018). The presence of high content of oxalate is an indication of toxicity level. Therefore, oxalate at low level confers antioxidant activity in both food and human (Garcia-valle, 2109)

Table 1: Physical Property of Prepared Tea

Parameters	***Bambusa vulgaris***	***Musa parasidiaca***	***Musa acuminate***	***Hibiscus sabdariffa***
pH	7.16	8.15	8.13	2.66
Specific Gravity	0.010	0.014	0.06	0.04

Table 2: Chemical constituents of Prepared Tea

CONSTITUENTS	Zobo	Plantain mg/100g	Banana	Bamboo
Moisture	75.6	8.79± 0.04	4.73	10.43
Protein	2.78	17.34 ± 0.2	15	19.39
Fat	1.87	1.76 ± 0.3	0.01	1.75
Ash	0.89	8.65 ± 0.02	12.5	11.96
Fibre	9.60	7.98 ± 0.12	0.08	27.89
Carbohydrates	0.36	59.48	67.68	28.58
Calcium	0.16	0.42±0.03	19.20	43.67
Phosphorus	0.02	0.30 ± 0.04	14.30	0.18
Iron	BDL	2.90± 0.02	0.61± 0.22	3.42
Potassium		435.20± 0.03	70.12 ± 0.89	0.17

Table 3: Anti-nutritional Content of the Prepaid Tea.

Parameters	*Bambusa vulgaris* (mg/g)	*Musa parasidiaca*(mg/g)	*Musa acuminata*	*Hibiscus sabdariffa*
Tannin (mg/g)	0.77	0.92	1.79	0.72
Saponia (mg/g)	1.95	2.15	1.04	1.75
Phytate (mg/g)	0.55	1.05	0.38	0.90
Oxalate(mg/g)	1.31	0.34	0.57	0.85

Caffeine was observed to be present in *Musa acuminata* tea (banana) *Musa acuminate* (plantain) but absent in *Hibiscus sabdariffa* tea (Zobo) and *Bambusa vulgaris* (bamboo leaves) . The observation made on the former is in agreement with Lin et al., 2018; they reported the presence of caffeine in green tea. The tea from M*usa acuminata* and *Musa acuminate* contained caffeine, which can help boost the body's metabolic rate and actually burn fat (Herman-lara *et al*., 2019).Caffeine is a stimulant that occurs naturally in some foods. The Food and Drug Administration (FDA) recommends a maximum intake of 400 mg a day, or two to three cups of coffee. A moderate intake of coffee can enhance weight loss, cognitive function, and alertness. On the other hand, Caffeine may have a negative impact on pregnancy, fertility, glucose control, and other aspects of health.

The Food and Drug Administration (FDA) takes caffeine to be both drug and food additive. Foods containing caffeine can also help to restore mental alertness. Caffeine's use as an alertness aid should only be occasional. It is an alternative to replace sleep and should not regularly be used for this purpose (Essien *et al*., 2011).

Table 4: Showing the Caffeine Test

Parameters	*Bambusa vulgaris*	*Musa parasidiaca*	*Musa acuminate*	*Hibiscus sabdariffa*
Caffeine	-ve	+ ve	+ve	-ve

IV. STATISTICAL ANALYSIS

The participants observed no difference in the colour of prepared tea (111) and reference (p = 0.209) . Some participants preffered the colour of the the prepared teas (124, 211 and 224) but the difference is not significant (p = 0.854; 0.917 and 1.000). The aroma was preferred by majority of the participants while few observed no difference in the aroma of tea 111 and 211 with the reference. On the contrary, tea 224 had less no of participants who preferred it to reference while majority observed no difference. Some participants preferred the taste of the reference to prepared tea (214), some observed no difference while few preferred prepared tea (214). Some participants preferred the taste of the reference to prepared tea (111), some observed no difference while few preferred prepared tea (111).some participant less preferred tea 124 to reference, while many observed no difference between the prepared tea and reference. The entire participant observed no difference in tea 214 and reference On the contrary, tea 224 had few participants who less preferred it to reference while majority observed no difference.

Table 5: Colour

Participant's Choice	mean±Stdev	Homogeneiety of variance	p-value	F Statistics	p-value
LP (111)					
S	4.88± 3.04	1.225	0.3	1.869	0,.209
P	8.00 ±1.41				
Total	5.50 ±3.03				
124					
LP					
S	5.67±3.01	0.174	0.688	0.041	0.854
P	5.25±3.50				
Total	5.50±3.03				
211					
LP					
S	5.33±2.08	2.192	0.177	0.012	0.917
P	5.57± 3.51				
Total	5.50±3.03				
224					
LP					
S	5.50±2.08	8.000	0.022	0.000	1.000
P	5.57±3.51				
Total	5.50±3.03				

L P – less preferred, S-Same, P- preferred

ISSN No:-2456-2165

Table 6 : Aroma

Participant's Choice	mean±Stdev	Homogeneiety of variance	p-value	F Statistics	p-value
LP (111)					
S	5.40± 3.65	1.883	0.207	0.01	0.920
P	5.60 ±2.70				
Total	5.50 ±3.03				
124					
LP	6.00±2.92	0.377	0.699	1.38	0.312
S	3.33±2.52				
P	7.50±3.54				
Total	5.50±3.03				
211					
LP					
S	6.00±3.54	0.615	0.455	0.25	0.631
P	5.00± 2.74				
Total	5.50±3.03				
224					
LP					
S	5.83±3.06	0.000	1.000	0.165	0.695
P	5.00±3.37				
Total	5.50±3.03				

L P – less preferred, S-Same, P- preferred

Table 8: Taste

Participant's Choice	mean±Stdev	Homogeneiety of variance	p-value	F Statistics	p-value
LP (**111**)	7.50±3.54				
S	4.80± 3.11	0.041	0.96	0.512	0.62
P	5.33 ±3.22				
Total	5.50 ±3.03				
124					
LP	5.33±3.22				
S	5.50±3.51	0.132	0.727	0.014	0.99
P	6.00±3.03				
Total	5.50 ±3.03				
211					
LP					
S	8.00±1.00	1.949	0.2	3.846	0.09
P	4.43 ± 2.99				
Total	5.50±3.03				
224					
LP	5.50±1.29				
S	5.50±3.94	24.000	0.001	0.000	1.000
P					
Total	5.50±3.03				

L P – less preferred, S-Same, P- preferred

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