
Quality Assessment of Some Tea Samples Commonly Sold in FCT, Abuja-Nigeria

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Abstract: Background: Tea is a name given to a lot of brews; they are categorized as green tea, black tea, white tea, oolong tea and pu-erh tea which are derived from *Camellia sinensis* plant and herbal tea. They are made from herbs, fruits, seeds or roots and usually steeped in hot water and widely consumed worldwide as laxative or food. Tea varieties include ginger, hibiscus, ginkgo biloba, rosehip, jasmine, mint, Echinacea, rooibos and chamomile. The colour, brightness, strength and flavor of tea infusion are determined by chemical constituents and the plant used. Objective: The study aimed to assess the presence of chemicals contents and microbial load to ascertain quality of the tea samples using standard methods. Methodology: This study was carried out on twenty (20) brands of commonly consumed tea samples randomly collected from major markets in Federal Capital Territory, Abuja, Nigeria. The samples were processed and analyzed for phytochemicals, proximate, elements and microbial loads using Treas and Evans, AOAC, AAS and Agar dilution methods respectively. Results: The results showed the presence of alkaloids, tannin, saponin, flavonoids, and anthraquinones, reducing sugars, steroids, terpenoids and carbohydrates. The proximate value of the samples ranges from 0.014-93.63%. While the micro-elements ranges from 1.25-12801.45µg/g and the macro-elements ranges from 1.00-332.55µg/g where as Copper, Chromium and lead were not detected in all the samples analyzed. The microbial load of all the samples fell within the acceptable limits according to the World Health Organization recommendations which allows a maximum 10⁷ per gram (aerobic bacteria), yeasts and moulds, maximum 10⁴ per gram, *Escherichi acoli*, maximum 10² per gram, other *entero* bacteria, maximum 10⁴ per gram, *clostridia*, absence per 1gram, *Salmonellae*, absence per 1gram and *Shigella*, absence per 1gram.

Keywords: Proximate, Phytochemicals, Microbial Load, Mineral Content

1. Introduction

Tea is one of the most popular beverage drinks widely consumed in Nigeria and other parts of the world as laxative or food, it is the second most consumed drinks on earth after water. The four main known types of teas are; green tea, black tea, white tea, oolong tea and post-fermented tea. Oolong tea activates enzymes that cut down triglycerides; black tea is one of the most highly caffeinated classes of tea, with about 40 milligrams of caffeine per cup, it also contains minerals such as calcium, phosphorous, iron and vitamins. The word 'tea' is also applicable to herbal infusions obtained from plants apart from *carmellis* [1]. Some of the teas are

mixture of recipes of flowers, leafs, fruits, seeds, stem, roots or bark and other additions, while others are just a herbs which are usually used for alleviating certain conditions such as cholesterol, obesity, diabetes due to various chemical contents which includes L-theanine, theophylline, bound caffeine and other bioactive chemicals such as alkaloid, flavonoids, steroids, terpenoids; the chemical contents are also responsible for appearance, aroma, flavour, taste and heighten calm alertness most especially when consumed early in the day [2-4]. Scientist from other parts of the world had also researched into chemical composition and sensory evaluation of teas [5]. The infusion of tea in sub-boiling temperature may not be able to eliminate all pathogens and

spores of bacteria, therefore contamination with pathogenic microorganism during processing and storage is certain if not properly handled. It is therefore imperative to evaluate the phytochemical content, nutritive value, mineral content and microbial load of the teas in order to ensure they are safe and chemically accepted for consumption. The study aimed to assess the presence of chemicals and microbial load of tea samples in order to ascertain the quality.

2. Materials and Methods

2.1. Materials and Reagents Used

All the reagents used were of analar grades, appropriate type and sizes of glass-ware were selected, properly washed using detergents and rinsed with deionised water. Other equipments used are; micro-kjedahl apparatus (S. W. Germany), Muffle furnace (Korl-kolb, Germany), Moisture balance (OHAUS/MB200, England), AAS (GBC AvantaGF300, Switzerland), weighing balance (OHAUS Analytical plus, England), soy agar and Sabouraud Dextrose Agar (SDA) plates.

2.2. Samples Collection

Twenty (20) brands of tea samples were purchased from different supermarkets in FCT-Abuja, Nigeria and kept at room temperature prior to analysis. The samples which includes; zobo tea, immune booster tea-A, immune booster tea-B, anti-malaria tea, black seeds tea, hypertension/blood sugar reducing tea, ginseng tea, hibiscus and ginger red tea, mistletoe life tea, antioxidants tea, organic green tea slimming formula, green life Chinese royal tea, enhancer tea, mistletoe teas, immune booster tea-C, anti-malaria tea-B, ginger drink tea, Nescafe breakfast tea, Chinese cift tea, Chinese tea were labeled and coded 1-20 respectively.

2.3. Sample Processing for Microbial Analysis

One gram (1g) of each brand of the tea sample was dissolved in 10ml of sterile tryptic soy broth (TSB) and allowed to stand for 3h. One milliliter of the stock was serially diluted in 9ml of TSB up to 10^{-5} . One hundred microliters of the diluted samples were plated out on triptic soy agar and Sabouraud Dextrose Agar (SDA) plates in duplicate and were incubated at 37°C 24-48 hrs for bacteria growth while the SDA plates were incubated at 25 to 28°C for fungal growth [6]. The colonies observed after incubation were sub-

cultured on nutrient agar for purity and identified using standard biochemical tests [7].

2.4. Proximate Analysis

The recommended methods of the Association of Official Analytical Chemists were used for the proximate analysis [8, 9].

2.5. Phytochemical Screening

The samples were analyzed for the presence of alkaloids, carbohydrates, glycosides, saponin, steroids, terpenoids, phenols, tannins and flavonoids according to the methods outlined by Treas and Evans [10].

2.6. Sample Preparation and Analysis for Elemental Content

The samples were ash and digested with a mixture of concentrated nitric acid and hydrochloric acid (1:10), filtered into 50cm³ volumetric flask through Whatman filter paper, made-up to mark with deionized water and transferred into capped plastic bottle. The same digestion process was used for blank sample preparation. The solution of the digested tea samples were analyzed for Calcium (Ca), Chromium (Cr), Manganese (Mn), Magnesium (Mg), Iron (Fe), Lead (Pb), Sodium (Na) and Zinc (Zn) using Atomic Absorption Spectrometer (AAS) after optimization and calibration followed by blank, sample analysis and data processing according to the method used by Mustapha *et al.* [11].

3. Results and Discussion

Results of the phytochemicals and microbial loads in the different brands of the tea samples analyzed were reported as present (+) or absent (-), while the proximate and elemental contents were presented in Tables 1 and 2. The following phytochemicals were identified present (+) in seventeen samples (Tannin), fifteen samples (Flavonoids), twelve samples (Steroids), nine samples (cardiac glycoside), seven samples (saponin and terpenoids), five samples (alkaloids) and two samples (anthraquinones). The microbial load result indicated presence (+) for *A. niger*, *Bacillus sp*, *Salmonella typhi* and *Staph aureus*, in nine samples and absent (-) in eleven samples. The presence of *Staph aureus* in four samples (8, 9, 14 and 17), *Bacillus sp* in three samples (1, 3 and 12), *A. niger* in one sample (1) and *Salmonella typhi* in one sample (1) were identified.

Table 1. Proximate Value of the Tea samples (% dry matter, DM).

Sample codes	Moisture (%)	Ash (%)	Protein (%)	Fiber (%)	Fat (%)	Carbohydrate (%)
1	6.90	11.00	1.28	12.00	2.00	66.82
2	12.00	8.00	3.11	10.00	3.00	63.89
3	12.00	12.00	3.19	6.00	12.00	54.81
4	8.20	5.00	3.67	8.00	1.65	73.84
5	9.10	1.00	9.58	7.00	1.57	71.75
6	15.00	7.00	14.09	10.00	1.70	52.21
7	9.00	2.00	0.28	ND	2.30	86.42
8	14.00	-	1.04	2.00	0.014	82.94

Sample codes	Moisture (%)	Ash (%)	Protein (%)	Fiber (%)	Fat (%)	Carbohydrate (%)
9	10.00	8.00	4.79	2.00	1.17	74.04
10	9.00	-	-	4.00	1.80	85.20
11	6.90	2.00	12.00	10.00	1.13	67.97
12	8.00	2.00	-	10.00	0.70	76.30
13	10.00	19.00	0.46	11.00	0.46	56.27
14	6.00	10.00	5.59	5.00	7.01	66.40
15	9.00	11.00	1.12	4.00	2.08	72.80
16	12.00	8.00	0.04	ND	3.67	75.93
17	12.00	8.00	0.04	ND	3.67	75.93
18	4.00	2.00	ND	ND	0.37	93.63
19	10.00	1.00	0.09	8.00	14.68	66.23
20	12.00	4.00	ND	6.00	7.67	70.31

ND means not detected

Table 2. Mean Concentration of Mineral Content ($\mu\text{g/g}$).

S/N	Elements								
	Na	Mn	Mg	Fe	Zn	K	Cu	Cr	Pb
1	221.65	250.9	505.70	229.45	89.90	ND	ND	ND	ND
2	1681.50	82.45	98.05	332.55	12.00	354.85	ND	ND	ND
3	1304.80	55.15	87.20	232.25	12.45	335.05	ND	ND	ND
4	143.75	57.00	144.60	45.22	27.95	1150.90	ND	ND	ND
5	ND	23.37	137.05	46.53	28.55	ND	ND	ND	ND
6	150.80	23.37	98.30	46.3	34.00	9628.35	ND	ND	ND
7	15.60	38.8	ND	ND	ND	101.20	ND	ND	ND
8	ND	38.8	ND	ND	ND	ND	ND	ND	ND
9	ND	50.2	46.70	35.80	1.00	4672.60	ND	ND	ND
10	73.15	23.37	115.95	182.65	37.10	12801.45	ND	ND	ND
11	ND	17.82	ND	ND	ND	ND	ND	ND	ND
12	1.25	23.39	67.00	143.05	23.45	1289.10	ND	ND	ND
13	255.35	128.25	29.45	193.20	23.45	751.60	ND	ND	ND
14	254.60	100.95	242.85	267.00	27.35	694.62	ND	ND	ND
15	542.05	62.65	199.15	46.20	43.15	604.91	ND	ND	ND
16	825.00	84.9	110.70	46.47	20.45	244.44	ND	ND	ND
17	337.80	ND	11.60	46.45	9.25	751.70	ND	ND	ND
18	2594.15	ND	2.00	168.65	32.40	2405.30	ND	ND	ND
19	150.65	23.40	91.8	73.35	59.20	268.51	ND	ND	ND
20	221.05	23.44	74.25	46.67	82.64	10976.40	ND	ND	ND

ND means not detected

3.1. Phytochemical Content

The presence (+) of the phytochemicals; tannins, flavonoids, steroids, cardiac glycosides, saponin, terpenoids, alkaloids and anthraquinones in the tea samples analyzed follow similar trends with results of a study reported by Samali *et al*, 2012 [12] which indicated the presence of tannin in most of the samples and alkaloids in few. The presence of these phytochemicals in the tea samples indicated that, they possess bioactive compounds that can fight cancer, lower cholesterol, treat urinary tract infection, inflammatory, enhances cell growth and testosterone levels, treat congestive heart failure and cardiac arrhythmias [13, 14].

3.2. Proximate Content

The percentage (%) proximate composition of the tea samples shown in Table 1 indicated the decreasing order of the level of the proximate values as follows; carbohydrate > ash > moisture > protein > fiber which are within the following ranges; 52.21-93.63%, 1.00-19.00%, 4.00-15.00%, 0.09-14.09% and 2.00-12.00% respectively. The moisture content of all the samples analyzed were within WHO permissible

limits (<15.0%), while the ash content of 25% of the samples were above WHO limits (<8.0%). Microbial activities and fungal growth surface whenever moisture content exceeds the permissible limit. The ash values obtained in this study is lower compared to result of similar study reported by Samali *et al*, 2012 [12]. The health benefits of the presence of fiber, protein and carbohydrate in the tea samples may result to stimulation of bowel movement, prevention of colon cancer, reduction of heart disease incidence, enhance digestion; production of essential amino acids and provision of glucose to the body [15, 11]. The dietary reference intake [16] of protein, fiber and carbohydrate for adult male and female within the age group of 9-70 years ranges as follows; 34-56g/day and 34-46g/day, 30-38g/day and 34-46g/day, and 130g/day respectively. This indicated that none of the tea samples analyzed could be depended upon to meet the daily requirements of these proximate parameters.

3.3. Mineral Content

The mineral content of the analyzed tea sample presented in Table 2 indicated the presence of Na, Mn, Mg, Fe, Zn and

K in eleven of the samples (2, 3, 4, 6, 10, 12, 13, 14, 15, 19 and 20) with mean concentration within the ranges of 1.25-2594.15µg/g, 17.82–250.90µg/g, 2.00–505.70µg/g, 35.80-332.55µg/g, 1.00–89.90µg/g, 101.20–12801.45µg/g respectively, while Cu, Cr and Pb were not detected in all the tea samples analyzed. The mineral content obtained from this study were higher compared to result of similar study reported by Muhammad *et al*, 2013 [5]. The level of mineral content in the samples analyzed was in the following order $8 < 11 < 7 < 5 < 1, 18 \& 17$. The dietary reference intake of Na, Mn, Mg, Fe and Zn for adult male and female within the age groups 9-70 years ranges from 1.5–1.2g/day, 1.9-2.3mg/day and 1.6-1.8 mg/day, 240-210 mg/day and 240-230 mg/day, 8-11mg/day and 8-18 mg/day and 8-11mg/day and 8-9mg/day respectively [16]. The mineral needs of both sexes can hardly be met by most of the samples since the quantity of the tea consumed per day may not be able to provide the required dietary intake of these minerals.

3.4. Bio-burden

The results of the bio-burden indicated the total viable aerobic bacterial count ranged from 1.0×10^3 - 2.8×10^6 cfu/g, while the total fungal count was 8.0×10^3 cfu/g. The pathogenic organisms isolated include *Bacillus sp*, *S. aureus*, *S. typhi* and *Aspergillus niger*, while *Escherichia coli* was absence. The presence of *Bacillu spp.*, *S. Aureus*, *A. niger* and *S. typhi* identified could be attributed to the storage, process or distribution chains of the samples. The bio-burden levels of all the samples fell within the acceptable limits according to the World Health Organization recommendation which allows a maximum 10^7 per gram (aerobic bacteria), yeasts and moulds, maximum 10^4 per gram, *Escherichia coli*, maximum 10^2 per gram, other *entero bacteria*, maximum 10^4 per gram, and *clostridia*, *Salmonellae* and absence per 1 gram [17]. However, the presence of *S. typhi* in sample 4 is an indication of faecal contamination from the handlers or the production process. As with the closely related bacterium *Escherichia coli*, *Salmonella* are potential enteric pathogens which causes bacterial food borne illness and also implicated a spectrum of other diseases, including typhoid fever [18].

4. Conclusion

The outcome of the study identified presence of phytochemicals in the tea samples which possess bioactive compounds that can fight different disease conditions such as cancer, urinary tract infection, inflammatory, congestive heart failure and cardiac arrhythmias. The proximate and mineral content values obtained were lower as compared to daily recommended dietary allowance; therefore they cannot be depended upon solely as source of diet. The samples are free from contamination by Lead (Pb) and bio-burden status are within WHO acceptable limit with the exception of sample 4, therefore the samples are safe for consumption. However, there is need for periodic assessment by regulatory agencies like NAFDAC to ensure adequate safety of the products for public consumption.

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