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Phytochemical Analysis and Functional Properties of Lemon Grass Tea Supplemented with Ginger Powder

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Abstract: Herbal teas are used as therapeutic vehicles in many forms of traditional medicine and are popular global beverage. The purpose of this study was to assess the qualitative and quantitative phytochemical composition, functional properties and sensorial attributes of different formulations of lemon grass teas supplemented with ginger powder as supporting and activating herbs using standard analytical methods of Association of Official Analytical Chemist. Data was analyzed using one way analysis of variance and results expressed as mean ±standard deviation of triplicate determinations. The qualitative phytochemical analysis indicated the presence of alkaloids, tannins, flavonoids, phenols, saponins and quinones. The quantitative determination of these phytoconstituents revealed that the alkaloid content ranged from (0.27-0.28mg/g), tannins (0.04-0.05 mg/g), saponins (0.17-0.18mg/g), flavonoids (0.28-0.30g/cm^3) and phenol (0.47-0.49g/cm^3). The results obtained for functional properties revealed that pH ranged from (6.26-6.30), reconstitution index (6.00-6.40 g/cm^3), swelling index (2.3-3.1g/cm^3), wettability (35.00-49.00 sec.), bulk density (0.27-0.31 g/cm^3) and water absorption capacity (72.26-78.35). Mean scores of sensory evaluations for taste ranged from: (6.0-7.0), colour (6.0-7.0), flavour (7.0-8.3), consistency (5.0-6.0) and overall acceptance (7.0-8.0).in conclusion, based on the results of this study, lemon grass teas supplemented with ginger powder are good reservoir of phytoconstituents with potential nutritional health benefits.

Keywords: Herbal tea, Phytoconstituents, Functional Properties and Nutritional Benefits.

RESEARCH PAPER

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INTRODUCTION

Tea is an aromatic beverage commonly prepared by pouring hot or boiling water over crude leaves of the *Camellia sinensis*, an evergreen shrub (bush) native to East Asia [1]. The habitual consumption of black and green tea derived from the plant Camellia sinensis dates back several thousand years, and the medical benefits of the main polyphenoliccatechins and teaflavin compounds are well defined [2]. Alongside the ever-popular green and black varieties, tea can be made with water infusions of the roots, leaves, flowers and other component parts of a hugely diverse range of plant species. These 'herbal teas' contain a wealth of compounds and could play a significant role in delivering nutrients and chemicals to compensate for low quality diets [2]. The health benefits of tea have been demonstrated in both *in vivo* and *in vitro* studies and it was reported that it contains bioactive compounds [3]. Bioactive compounds in tea exhibit antioxidant, antimutagenic, anticarcinogenic, antiatherosclerotic and antibacterial activity [4].

Ginger originated from Maritime Southeast Asia. It is true cultigens and does not exist in its wild state. In 2016, global production of ginger was 3.3 million tonnes, led by India with 34% of the world total. Nigeria, China, and Indonesia also had substantial production [5]. 100 grams of raw ginger is composed of 79% water, 18% carbohydrates, 2% protein, and 1% fat. Ginger modulates genetic pathway, acts on tumour suppression of genes and modulates biological Activities [6]. Besides these, ginger has been reported as a pain relief for arthritis, muscle soreness, chest pain, low back pain, stomach pain, and menstrual pain. It can also be used for treating upper respiratory tract infections, cough, and bronchitis. As an anti-inflammatory agent, it is recommended for joint problems [7]. Ginger is also used as a flavoring agent in foods and beverages and as a fragrance in soaps and cosmetics [7].

Lemongrass is a popular plant and an abundant source of lignocellulose material composed of around 39.5% cellulose, 22.6% hemicellulose and 28.5% lignin [8]. Initially, lemongrass was used to flavour foods in Thai and Vietnamese cooking. It has a beneficial use in

African and South American regions for flavouring tea. It is also popular in alcoholic and non-alcoholic drinks [9]. In addition, a number of biological properties of lemongrass are reported over the years, including but not limited to antibacterial, antifungal, antiprotozoal, anti-inflammatory, antioxidant, anti-carcinogenic, cardio-protective and anti-rheumatic activities [10]. However, the applications of lemongrass are mostly reported on the basis of its biological and correlated activities with its developments in medical science, food science, and cosmetics, as well as agriculture [10]. Therefore, the current study evaluated the phytochemical profile, functional and sensory attributes of lemon grass teas supplemented with ginger powder in order to produce a composite blend with superior flavour, nutritional and health benefits.

MATERIALS AND METHODS

Procurement of Ingredients and Authentication

The lemon grass and ginger were purchased from local retailers in Birnin Kebbi market, Kebbi State, Nigeria and all the materials were authenticated by the Department of Plant Science and Biotechnology, Kebbi State University of Science and Technology, Nigeria.

Standardization of processing methods of lemon grass

The lemon grass and ginger were sorted manually to remove dirt and damaged ones. The lemon grass leaves was washed to remove the dirt and soak in 1% normal saline (NaCl) for 5mins to get rid of microbes. The ginger was peeled and cut into thin slices. Then the lemon grass and sliced ginger were shade dried to avoid loss of nutrients. The dried lemon grass and ginger were grounded and sieve using 1mm pore sieve.

Table 1: Percentage composition of the ingredients in the formulation

PARAMETERS	Z1	Z2
LEMON GRASS	60	80
GINGER	40	20

Preparation of Herbal Tea Infusion

The mango herbal tea was prepared by infusing tea bag which contained 3g of the composite blend in 150cm^3 boiling water for 3 minutes [11].

METHODS

Phytochemicals evaluation of the blends were carried out using standard procedures as described by El-Olemy *et al.,* [12].

The procedure for the evaluation of various phytoconstituents is stated below:

Test for tannins

To the sample (0.5cm^3), 1cm^3 of distilled water was added and stirred. Few drops of 10% ferric chloride reagent were also added. Blue color indicates presence of Gallic tannins and green black color indicates presence of catecholic tannins.

Test for saponnins

The extract was shaken with little quantity of distilled water. Foaming or frothing which persisted for about ten minutes or on warming was taken as evidence for presence of saponins.

Test for flavonoids (alkaline reagent test)

The sample (5cm^3) was treated with (5cm^3) 10% sodium hydroxide solution. Formation of intense or creamy yellow color indicates the presence of flavonoids.

Test for trepenoids (salkowski test)

The samples (5cm^3) was mixed with 2cm^3 chloroform and 3cm³ concentrated H_2SO_4 was carefully added to form a layer. A reddish brown coloration shows the presence of terpenoids.

Test for cardiac glycosides (keller-killani test)

The sample (5cm^3) was treated with 2cm^3 glacial acetic acid and one drop of ferric chloride solution. A brown ring appears at the interface, while in the acetic acid layer, a greenish ring may appear which confirms presence of cardiac glycosides.

Test for anthraquinones (borntragers test)

Extract (0.5g) was shaken with 10cm^3 of chloroform for 5 minutes. The extract was filtered and equal volume of ammonia was added and shaken. A bright pink colour indicates the presence of free anthraquinones.

Test for alkaloids

To the sample (0.5g), 1% aqueous hydrochloric acid (3cm^3) was added and stirred on a steam bath. This was filtered and filtrate (1cm³) was treated with a few drops of hager's reagent. The reaction was observed for the formation of precipitate which indicates the presence of alkaloids.

Determination of Total Flavonoids

2cm^{3}of 2% $AlCl_3$ in ethanol was mixed with 2cm^3 of varying concentrations of the standard (0.1-1.0mg/cm^3), in methanol. The extract at a concentration of 2cm^3 of 1mg/cm^3 was also mixed with the 2% $AlCl_3$ in ethanol. The absorbance was measured at 420 nm after one hour incubation at room temperature. Similar concentrations of quercetin, the positive control were used. The total flavonoid content was calculated as mg quercetin equivalent /g (QE) of extract [13].

Determination of Total Tannins

To 1cm^3 of extract (1mg/cm^3) and standard solution of tannic acid (10-150 µg/cm^3) was made up to 7.5cm^3 with distilled water. Then 0.5cm^3 Folin-Denis reagent and 1cm^3 of 7.5 % Na_2CO_3 solution were added. The volume was made up to 10cm^3 with distilled water

and absorbance was measured at 700nm. The total tannin content was expressed as mg of Tannic Acid equivalent /g (TAE) of extract [14].

Saponin Determination

The samples were grounded 20g of each plant samples were dispersed in 200cm^3 of 20% ethanol. The suspension was heated over a hot water bath for 4 hours with continuous stirring at about 55°C. The mixture was filtered and the residue re-extracted with another 200cm^3 of 20% ethanol. The combined extracts were reduced to 40cm^3 over water bath at about 90°C. The concentrate was transferred into a 250cm^3 separator funnel and 20cm^3 of diethyl ether was added and shaken vigorously. The aqueous layer was recovered while the ether layer was discarded. The purification process was repeated. 60cm^{3}of n-butanol was added. The combined n-butanol extracts were washed twice with 10cm^3 of 5% aqueous sodium chloride. The remaining solution was heated in a water bath. After evaporation, the samples were dried in the oven to a constant weight. The saponins content was calculated in percentage [15].

Phenol Determination

For the extraction of the phenolic component, the fat free sample was boiled with 50cm^3 of ether for 15 minutes. 5cm^3 of the extract was pipette into a 50cm^3 flask, and then 10cm^{3}of distilled water was added, 2cm^3 of ammonium hydroxide solution and 5cm^{3}of the extract was pipette into a 50cm^{3}flask, and then 10cm^{3}of distilled water was added, 2cm^3 of ammonium hydroxide solution and 5cm^3 of concentration amyl alcohol were also added. The samples were left to react for 30 minutes for colour development. The absorbance of the solution was read using a spectrophotometer at 505 nm wavelengths (spectrophotometric).

Alkaloid Determination

5g of the sample were weighed into a 250cm^3 beaker and 200cm^3 of 20% acetic acid in ethanol was added and covered to stand for 4 hours. This was filtered and the extract was concentrated using a water-bath to one quarter of the original volume. Concentrated ammonium hydroxide was added drop wise to the extract until the preparation was complete. The whole solution was allowed to settle and the precipitate was collected by filtration and weighed [11].

$$Alkaloid\ (\%) = \frac{W3 - W2}{W1} \times 100$$

Where,
W1= initial weight of sample,
W2= weight of the extract and
W3= final weight of the residue

Water absorption capacity (WAC) determination

From the ground sample, 1g was weighed into conical graduated centrifuge tubes of known weights and mixed with 10cm^3 of distilled water for one minute with a glass rod. The tubes were centrifuged at 5000 rpm for 30 min. The volume of free water (the supernatant) was discarded and each tube together with its content was reweighed as water absorbed per gram of sample. The gain in mass was the water absorption capacity of the flour sample. The volume difference represents the volume of water absorbed by 1g of the test sample. Absorption capacity is expressed in grams of water absorbed per gram of sample [16].

$$WAC = \frac{\text{Density of water} \times \text{Volume absorbed}}{\text{Weight of sample}}$$

Reconstitution index (RI)

From the ground sample, five grams of each sample was dissolved in 50cm^3 of boiling water. The mixture was agitated for 90 seconds and then transferred into a 50cm^3 graduated cylinders and the volume of the sediment was recorded after settling for 30 minutes [16].

$$RI\ (g/ml) = \frac{\text{Volume of sediment}}{\text{Weight of sample}}$$

P^H measurement

The P^H of the samples was determined according to the method of Mathew *et al*., [17]. The samples (10%W/V) were suspended in distilled water. The suspension was mixed thoroughly in a 100cm^3 beaker before the P^H is taken. This was repeated three times and the average was calculated [17].

Swelling index (SI) determination

The method as described by Onwuka, [16] was used in the determination of the swelling index. Three gram portions (dry basis) of each sample were transferred into clean, dry, graduated (50cm^3) cylinders. The samples were gently leveled and the volumes noted. Distilled water (30cm^3) was added to each sample. The cylinder was swirled and allowed to stand for 60 min while the change in volume (swelling) was recorded every 15min. The ratio of the initial volume to the final volume was taken as the swelling index.

$$SI = \frac{\text{Change in volume of sample}}{\text{Original weight of sample}}$$

Wettability

Triplicate samples were weighed and in each case, 1.00 g was introduced into a 25 cm^{3}measuring cylinder with a diameter of 1cm and a finger was placed over the end of the cylinder. The mixture was inverted and clamped at a height of 10cm from the surface of a 250 cm^3 beaker containing 100 cm^3 of distilled water. The finger was removed to allow the test material to be dumped. In this case, the wettability was taken as the time required for the sample to become completely wet [18].

Bulk density

Bulk density was determined as described by Mathew *et al*., [17]. The bulk density (g/cm^3) was calculated as weight of sample (g) divided by volume (cm^3) of sample.

$$Bulk\ density\ (\frac{g}{cm^3}) = \frac{\text{Weight of sample}}{\text{Volume of sample}}$$

SENSORY EVALUATION

The lemon grass tea supplemented with ginger powder samples were presented to 15 semi-trained panellists using the method described by Mathew *et al*., [17]. The panellists was asked to indicate their observations using a 9 point hedonic scale for attributes like colour, texture, aroma, taste, flavour and overall acceptability. Mean scores of sensory evaluation were expressed as: 9- Like extremely, 8- Like very much, 7- Like, 6-Like slightly, 5- Neither like nor dislike, 4- Dislike slightly, 3- Dislike moderately, 2- Dislike and 1- Dislike extremely respectively.

STATISTICAL TOOL

Values were analyzed statistically using Instant statistical software (Sandiago USA). Values were presented as mean±standard deviation. Data obtained were subjected to one-way analysis of variance (ANOVA). Significant difference was established at $P > 0.05$.

RESULTS AND DISCUSSION

The results of phytoconstituents of the formulated teas with lemon grass powder at different blending ratio are given in Table 2.

Table 2: Phytoconstituents of the Formulated Teas with lemon grass powder

Phytochemicals	Sample Z1	Sample Z2
Alkaloids	+	++
Flavonoids	+	+
Tannins	+	+
Steroids	+	+
Phenols	+	+
Saponins	+	+
Quinones	++	+

(+ = presence; - = not detected).

Table 3: Quantitative Value of Phytoconstituents of the Formulated Teas

PHYTOCHEICALS	Sample Z1	Sample Z2
Alkaloids (mg/g)	0.27^{a}±0.01	0.28^{a}±0.02
Flavonoid (mg/ml)	0.30^{b}±0.03	0.28^{b}±0.01
Saponins (mg/g)	0.18^{c}±0.02	0.17^{c}±0.03
Phenol (mg/ml)	0.47^{d}±0.01	0.49^{d}±0.02
Tannins (ug/ml)	0.04^{e}±0.01	0.04^{e}±0.02

Values are mean± standard deviation of triplicate determinations, values bearing same superscript in a row are not significantly different at $P>0.05$.

Table 4: Functional Properties of the formulated teas

Functional properties	Sample Z1	Sample Z2
PH	6.30^{a}±0.10	6.26^{a}±1.00
Reconstitution Index (g/ml)	6.00^{b}±0.50	6.40^{b}±0.30
Swelling Index (ml/g)	2.30^{c}±0.10	3.10^{c}±0.20
Water Absorption Capacity (WAC)	72.26^{d}±1.00	78.35^{e}±2.00
Bulk density (g/cm^3)	0.31^{f}±0.01	0.27^{f}±0.01
Wetability (sec.)	35.00^{g}±2.00	49.00^{h}±1.00

Values are mean± standard deviation of triplicate determinations, values bearing same superscript in a row are not significantly different at $P>0.05$.

Table 5: Sensory attributes of the teas formulated

Sensory test	Sample Z1	Sample Z2
Appearance and Color	6^{a}±0.05	7^{a}±0.05
Flavour	7^{b}±0.35	8^{b}±0.50
Taste	6^{c}±0.12	7^{c}±0.05
Consistency	5^{a}±0.25	6^{a}±0.15
Over all acceptance	8^{b}±1.00	7^{b}±1.00

Values are mean± standard deviation of triplicate determinations, values bearing same superscript in a row are not significantly different at $P>0.05$.

Table 6: Ranking of the Formulated Herbal Teas based on Nutritional and Functional Properties

PARAMETERS	Sample Z1	Sample Z2
BD	2	1
WAC	1	2
Swelling Index	1	2
Wettability	1	2
Appearance and Color	1	2
Flavour	1	2
Taste	1	2

PARAMETERS	Sample Z1	Sample Z2
consistency	1	2
Over all acceptability	1	2
TOTAL	**10**	**17**

Most desirable (1) to least desirable (2)

DISCUSSION

Phytochemicals are plant constituents which are beneficial to human health. The current study revealed that the tea under investigation contain some Phytoconstituents which are; alkaloid, flavonoids, saponins, tannins and phenol. The quantitative determination of the Phytoconstituents revealed that the values of alkaloid, phenols and tannins were higher in sample Z2 than sample Z1, this is due to the higher percentage composition of lemon grass in sample Z2. The result obtained from the samples also revealed higher value of saponins and flavonoids in sample Z1 than sample Z2 and this is due to higher percentage of the ginger powder in sample Z1.

The presence of tannins and flavonoids suggest that the composite blend is a reservoir of anti-oxidant [19]. Tannins were found to be present in all teas samples with the results of the qualitative evaluation. They also aid digestion, however, if tannins are ingested in excessive quantities, they inhibit absorption of minerals such as iron; this may lead to anemia over a long period of time [20]. Tannins can cause regression of tumors but if ingested excessively over time they can also cause tumors in healthy tissues [20].

The result of the functional properties indicated that values obtained for reconstitution index, swelling index, wettability and water absorption capacity were higher in Z2 while values obtained for pH and bulk density were higher in Z1. However, there was significant difference ($p>0.05$) in wettability and water absorption capacity between the two samples. It is pertinent to note that high swelling index implies that high amount of water would be needed to prepare the tea infusion. Bulk density is a measure of heaviness of flour or powdered food sample. Nutritionally, low bulk density promotes digestibility, particularly among children with immature digestive system [21]. The results for the sensorial attributes of the formulations indicated that the composite blends differ in all sensorial attributes evaluated. The results indicated that Z1 was rated higher. The scores for overall acceptability indicated that the products were highly accepted by the panellist.

CONCLUSION

The nutritional and health benefits of herbal teas are under-exploited in West Africa, especially in Nigeria. The current study established that the investigated tea is a reservoir of large variety of phytochemicals. These phytochemicals have beneficial effect in the prevention of various metabolic diseases in humans. The functional properties of the composite blend formulated suggest that, the samples could be prepared using a small amount of water yet achieving the desired flavor and colour. The result of the sensory evaluation as revealed by the panelists point to acceptability of the tea prepared. Equally, the study revealed that the herbal tea brewed from Z1 is preferable. Hence, the composite blend of lemon grass tea supplemented with ginger powder may serve as alternative to other commercially available teas.

Conflict of Interest: The authors declare no conflict of interest.

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