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(Research Article)

Phytochemical and antioxidant properties of herbal tea blends

Judith Uchenna Chima *

Department of Food Technology, Akanu Ibiam Federal Polytechnic Unwana, Ebonyi state, Nigeria.

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Abstract

The demand for functional tea is progressively increasing due to some prevailing health issues in human. Tea has been used extensively as a vehicle for prevention and restoration from ill health. This study investigated the feasibility of formulating herbal tea from lemongrass, independent leaf and sensitive leaf composite. The results showed that the pH of the tea ranged between 5.61 and 5.76, alkaloids (5.71 – 11.64mg/100g), flavonoids (22.20-28.37mg/100g), steroid (9.26-13.22 mg/100 g), glucosides (3.85-7.12mg/100g), and total phenolic (1213.10-1351.40 mg GAE/100g). The sensory property using 9-point hedonic rating showed taste as 6-6.33, aroma (6.16-6.60), and general acceptability of 6.00-6.96. Tea formulated with 40% independent leaf, 40% lemongrass, and 20% sensitive leaf proved to be the best mixture. The production steps outlined in this study is scalable, and it could be used both industrially and on a small scale for self-entrepreneurs.

Keywords: Herbal Tea; Phenolic Compounds; Sensory Evaluation; Sensitive Leaf; Independent Leaf

1. Introduction

Tea is a valuable commodity that has both health and economic advantages. Tea drinking is ingrained in the cultures of many nations, including China, Indonesia, Japan, and the United Kingdom. Tea variations commonly referred to as "herbal tea" have resulted from the use of plants and plant extracts in the manufacturing of tea. Blends of herbs, fruits, seeds, leaves, or plant extracts from different plants are brewed to create herbal tea (Ravikumar, 2014). Herbal teas have become more and more popular in recent years, as evidenced by this. This is in line with the current worldwide trend of herbal therapies becoming more and more popular; as a result, they are a part of the quickly expanding wellness beverage market. Due to polyphenolic components, tea and herbal infusions offer medicinal as well as stimulating qualities.

According to Ananthi and Sagaya (2018), phytochemicals are what give plants their therapeutic properties. These biochemicals naturally accumulate in plants that contain defence systems and can fend against a variety of illnesses. Phytochemicals have a major role in medicine and make up the majority of expensive medications. These biochemicals, which are helpful to the conventional medical system, are frequently referred to as secondary metabolites. Numerous factors related to growing environments and production procedures can impact the content and quality of tea; these factors also have an impact on the profile of bioactive components (Yadav *et al*., 2020). This study investigated the potential of formulating herbal tea from lemongrass, sensitive leaf and independent leaf.

* Corresponding author: Judith Uchenna Chima.

2. Materials and Methods

2.1. Preparation of materials

Freshly picked leaves of lemongrass, independent leaf, and sensitive leaf were procured from Unwana, located in Ebonyi State, Nigeria. For the purpose of removing dirt and other unnecessary materials, the leaves were separated, de-stalked, and cleaned in potable water (1:90, w/v). After 30 minutes of letting the leaves drip through a plastic filter, the lemongrass was hand chopped into 6 mm pieces. The leaves were steamed and dried using a hot air oven (SM9053, Uniscope, England). The dried leaves were ground in an attrition mill and sieved through a 212 μm screen. Then, using various mix ratios, the ground samples from lemongrass, independent leaf, and sensitive leaf were combined to create a herbal tea. After being prepared, the mixtures were packaged in tea bags and sealed using an electric impulse sealer (ME-200H, China).

2.2. Phytochemical properties of herbal tea

The levels of tannin, saponin, oxalate, alkaloids, and glycoside were measured in accordance with Raji *et al.* (2019). The procedures for total phenolic and total flavonoid were followed as described by Naheed *et al*. (2017).

2.3. Antioxidant properties of herbal tea

The procedures described by Naheed et al. (2017) was followed for the DPPH and FRAP. The modified Xie *et al.* (2008) method was used to measure the samples' metal (iron) chelating activity (MCA). The Folin–Ciocalteu method of Hoff and Singleton (1977) was used for the total phenolic content (TPC) of each extract.

2.4. Physicochemical property

The physicochemical property of the herbal tea was carried out as discribed by Olawoye and Gbadamosi (2020) and Oni *et al.* (2023).

2.5. Sensory evaluation

The protocols for the sensory study was reviewed and approved by the Akanu Ibiam Federal Polytechnic Unwana Ethics Committee (IRB) and informed consent was obtained from each participant prior to their participation in the sensory evaluation. Tea infusion was prepared and sensory examination of the tea was done using 50 trained panellists. The tea infusion was graded on a nine-point hedonic scale, with nine representing "like extremely," eight representing "like mostly," seven representing "liked moderately," six representing "liked," five representing "neither liked nor disliked," four representing "disliked," three "disliked" moderately," two representing "disliked mostly," and one representing "disliked extremely." The taste, appearance, and overall acceptability of the tea were evaluated. The panellists were given water to rinse their mouth after each sample.

2.6. Statistical analysis

Systematic errors were prevented by using a completely randomised experimentation technique. Using SPSS version 23, the Duncan Multiple Range Test was used to evaluate significant differences among means at a 5% significant level.

3. Results and Discussion

3.1. Physicochemical property of herbal tea

The results (Table 1) exhibited variations across several parameters, shedding light on the impact of leaf composition on the final tea product. The bulk density measurements, both loosely packed and packed, revealed intriguing trends. The I30:40L:30S blend stood out with the highest loosely packed bulk density, suggesting a denser arrangement of particles. Conversely, the 40I:40L:20S blend exhibited the lowest, indicative of a looser structure. Packed bulk density follows a similar pattern, further emphasizing the influence of leaf proportions on tea density.

Porosity percentages provided additional insights into the compactness of the blends. As expected, the 30I:40L:30S blend, with the highest bulk densities, displayed the lowest porosity. This indicated a potential correlation between bulk density and porosity, highlighting the interplay between these two factors in determining tea blend characteristics.

The pH values varied across the blends, with 20I:40L:40S showcasing the highest acidity and 40I:40L:20S displaying the lowest. These differences may influence the sensory experience of the tea, impacting taste and flavour profiles.

Total dissolved solids (TDS) concentrations revealed a distinct pattern, with the 30I:40L:30S blend containing the highest amount. This suggested that the proportion of independent leaves, lemongrass, and sensitive leaves significantly influenced the solubility of solids in the tea, potentially affecting its strength and richness.

The colour parameters L*, a*, and b* exhibited noteworthy distinctions among the blends. The 20I:40L:40S blend stood out with the highest L* and a* values, indicating a brighter and more intense colour. Conversely, the 30I:40L:30S blend showed the lowest L* and a* values but has a higher b* value, suggesting a shift towards the blue spectrum. These colour variations may be attributed to the unique chemical compositions of the individual leaves in each blend (Zhang *et al.,* 2015).

Table 1 Physicochemical Properties of Tea Blends from Lemongrass, Sensitive Plant and Independent Leaves

Parameter	40I:40L:20S	20I:40L:40S	30I:40L:30S
Loosed packed bulk density (g/ml)	0.255±0.001^{b}	0.253±0.002^{b}	0.259±0.01^{a}
Packed bulk density (g/ml)	0.336±0.02^{a}	0.328±0.001^{c}	0.332±0.002^{b}
Porosity (%)	24.45±0.01^{a}	23.13±0.03^{b}	21.72±0.02^{c}
pH	5.61±0.01^{c}	5.76±0.02^{a}	5.68±0.01^{b}
Total dissolved solids (mg/g)	3.82±0.02^{c}	4.16±0.01^{b}	5.92±0.01^{a}
Colour			
*L	74.64±0.47^{b}	80.87±0.69^{a}	69.05±0.93^{c}
*a	-2.05±0.04^{b}	1.04±0.01^{a}	-3.30±0.01^{c}
*b	12.42±0.02^{b}	14.37±0.02^{a}	11.51±0.36^{c}

Result expressed as mean values ± standard deviation, of three replicates means in the same row with different superscript are significantly difference (P<0.05). 40I:40L:20S – 40% independent leaf + 40% lemongrass leaf + 20% sensitive leaf; 20I:40L:40S – 20% independent leaf + 40% lemongrass leaf + 40% sensitive leaf; 30I:40L:30S – 30% independent leaf + 40% lemongrass leaf + 30% sensitive leaf

3.2. Phytochemical property of herbal tea blends

Table 2 Phytochemical composition of the herbal tea blends (mg/100g)

Parameter	40I:40L:20S	20I:40L:40S	30I:40L:30S
Saponin	2.02±0.01^{b}	2.22±0.03^{a}	1.94±0.02^{c}
Alkaloids	8.82 ±0.01^{b}	6.71±0.01^{c}	11.64±0.01^{a}
Oxalate	0.18±0.01^{c}	1.05±0.00^{b}	1.12±0.01^{a}
Tannin	6.13±0.02^{a}	6.10±0.02^{b}	6.02±0.02^{c}
Flavonoid	26.53±0.02^{b}	22.20±0.03^{c}	28.37±0.03^{a}
Steroid	10.88±0.01^{b}	9.26±0.03^{c}	13.22±0.02^{a}
Glucosides	5.32±0.04^{b}	7.12±0.02^{a}	3.85±0.01^{c}

Result expressed as mean values ± standard deviation, of three replicates means in the same row with different superscript are significantly difference (P<0.05). 40I:40L:20S – 40% independent leaf + 40% lemongrass leaf + 20% sensitive leaf; 20I:40L:40S – 20% independent leaf + 40% lemongrass leaf + 40% sensitive leaf; 30I:40L:30S – 30% independent leaf + 40% lemongrass leaf + 30% sensitive leaf

The phytochemical results are presented in Table 2. Saponin content displayed significant differences among the blends, with 20I:40L:40S showing the highest concentration and I30:40L:30S exhibiting the lowest. Saponins are known for their potential health benefits, and the observed variations suggested that the specific blend composition played a crucial role in determining the presence of these bioactive compounds. The higher saponin content in the 20I:40L:40S blend may indicate a potential for enhanced medicinal properties in comparison to the other formulations.

Alkaloid concentrations also varied significantly across the blends, with 30I:40L:30S displaying the highest amount. Alkaloids contribute to the physiological effects of herbal teas, and the observed differences underscore the importance of carefully selecting the leaf ratios to achieve specific health-related objectives. The 30I:40L:30S blend, with its elevated alkaloid levels, may offer unique characteristics or potential health benefits compared to the other blends.

Oxalate levels showed notable differences, with 30I:40L:30S having the highest concentration and 40I:40L:20S the lowest. Oxalates can have health implications, especially for individuals prone to kidney stones. The variations in oxalate content emphasized the need for meticulous control over blend compositions to cater to diverse health considerations.

Tannin concentrations exhibited moderate differences among the blends, with 4I0:40L:20S displaying the highest value. Tannins contribute to the astringency of tea and possess antioxidant properties. The variations observed in tannin content suggested that the choice of blend composition could influence the sensory characteristics and potential health benefits of the herbal tea.

Flavonoid content showed significant differences among the blends, with 30I:40L:30S having the highest concentration. Flavonoids are known for their antioxidant properties and potential health-promoting effects. The findings underscore the importance of precise control over blend compositions to optimize the flavonoid content in herbal tea blends for potential health benefits.

Steroid levels varied among the blends, with 30I:40L:30S displaying the highest concentration. Steroids in herbal teas may have diverse physiological effects and potential health implications. The results highlighted the need for a nuanced understanding of how different leaf proportions influenced these bioactive compounds.

Glucoside content differs significantly across the blends, with 20I:40L:40S having the highest concentration and 30I:40L:30S the lowest. Glucosides contribute to the bioactivity of herbal teas, and the observed variations underscore the importance of understanding how different leaf proportions influence these compounds (Gemede, 2014; Karami and Akbari-Adergani, 2029; Granato *et al.,* 2020; Maqsood *et al.,* 2020) .

3.3. Antioxidant content of herbal tea

The antioxidant content of the herbal tea is presented in Table 3. In terms of total phenolic content, 40I:40L:20S exhibited the highest value at 1351.40 mg GAE/100g, followed by 20I:40L:40S (1282.80 mg GAE/100g) and 30I:40L:30S (1213.10 mg GAE/100g). This suggested that the blend with a higher proportion of independent and lemongrass leaves has a greater concentration of phenolic compounds, which are known for their antioxidant properties.

Moving on to DPPH radical scavenging activity, 40I:40L:20S again outperformed the other blends with a value of 8923.30 µmol TEAC/100g, while 20I:40L:40S and 30I:40L:30S showed lower values of 4216.50 and 4005.60 µmol TEAC/100g, respectively. This indicated that I40:40L:20S has a superior ability to neutralize free radicals compared to the other blends.

Table 3 Antioxidant Activity of Herbal Tea Blends

Parameter	**40I:40L:20S**	**20I:40L:40S**	**30I:40L:30S**
Total phenolic (mg GAE/100g)	1351.40±0.99 [a]	1282.80± 2.40[b]	1213.10±1.26 [c]
DPPH (µmol TEAC/100g)	8923.30±0.03 [a]	4216.50±1.51[b]	4005.60±0.2.61[c]
Ferric Reducing power (mmol Fe^{2+} /100g)	10.79±0.01 [a]	8.92±0.03 [b]	7.30±0.01 [c]
Metal chelating (%)	58.25 ±0.03[a]	54.12±0.02 [b]	49.37±0.02[c]

Result expressed as mean values ± standard deviation, of three replicates means in the same row with different superscript are significantly difference (P<0.05). 40I:40L:20S – 40% independent leaf + 40% lemongrass leaf + 20% sensitive leaf; 20I:40L:40S – 20% independent leaf + 40% lemongrass leaf + 40% sensitive leaf; 30I:40L:30S – 30% independent leaf + 40% lemongrass leaf + 30% sensitive leaf; DPPH: 2,2-diphenyl-1-picrylhydrazyl.

The ferric reducing power followed a similar trend, with 40I:40L:20S having the highest value (10.79 mmol Fe^{2+} /100g), followed by 20I:40L:40S (8.92 mmol Fe^{2+} /100g) and 30I:40L:30S (7.30 mmol Fe^{2+} /100g). This suggested that the blend rich in independent and lemongrass leaves possessed stronger reducing power, indicating its potential to counter oxidative stress.

Finally, the metal chelating ability showed a decrease in percentage from 40I:40L:20S (58.25%) to 30I:40L:30S (49.37%). This parameter measures the blend's capacity to bind metal ions, inhibiting their harmful effects. The results suggested that 40I:40L:20S is more effective in metal chelation compared to the other blends (Oni *et al*., 2023, Pang *et al*., 2018).

3.4. Sensory evaluation of herbal tea

The sensory characterstics of the herbal tea is presented in Table 4. Firstly, it is notable that there were variations in the mean values across the sensory attributes for each tea sample. For instance, the sample 40I:40L:20S demonstrated a relatively high score in aroma (6.60) and general acceptance (6.96), suggesting a favorable perception in terms of fragrance and overall liking. On the other hand, the same sample exhibited a comparatively lower score in mouthfeel (5.70), indicating a less satisfying tactile experience.

Interestingly, the 20I:40L:40S composition revealed a distinct pattern with a lower rating in mouthfeel (5.10) and aftertaste (5.26). This suggested that despite having an appealing aroma and taste, this particular blend may lack in terms of the lingering sensation and overall texture.

Table 4 Sensory property of herbal tea

Samples	Colour	Aroma	Taste	Mouthfeel	Aftertaste	Gen. Accept
40I:40L:20S	$6.30±1.78^{ab}$	$6.60±1.38^{a}$	$6.00±1.36^{ab}$	$5.70±1.78^{a}$	$5.86±2.10^{b}$	$6.96±1.22^{a}$
20I:40L:40S	$6.86±1.50^{ab}$	$6.16±1.90^{ab}$	$6.00±1.80^{ab}$	$5.10±2.06^{a}$	$5.26±1.70^{b}$	$6.23±1.57^{a}$
30I:40L:30S	$6.23±1.87^{ab}$	$6.26±1.86^{ab}$	$6.33±1.56^{ab}$	$5.23±1.96^{a}$	$5.53±2.24^{b}$	$6.00±1.62^{a}$

Result expressed as mean values ± standard deviation, of three replicates means in the same row with different superscript are significantly difference (P<0.05). 40I:40L:20S – 40% independent leaf + 40% lemongrass leaf + 20% sensitive leaf; 20I:40L:40S – 20% independent leaf + 40% lemongrass leaf + 40% sensitive leaf; 30I:40L:30S – 30% independent leaf + 40% lemongrass leaf + 30% sensitive leaf

Furthermore, the 30I:40L:30S sample stood out with relatively balanced scores across all sensory attributes, particularly in taste (6.33) and aftertaste (5.53). This equilibrium in sensory properties might contribute to a well-rounded and satisfying tea-drinking experience.

4. Conclusion

Herbal tea was formulated using lemongrass, sensitive leaf and independent leaf. The tea has good phytochemical, antioxidant, and sensory qualities. Tea formulated with 40% independent leaf, 40% lemongrass, and 20% sensitive leaf proved to be the best mixture. The production steps outlined in this study is scalable, and it could be used both industrially and on a small scale for self-entrepreneurs.

Compliance with ethical standards

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Disclosure of conflict of interest

There is no competing interest.

Statement of informed consent

Informed consent was obtained from each participant prior to their participation in the sensory evaluation.

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

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References

[1] Ananthi, J & Sagaya, G. R (2018) Screening of Bioactive Compounds of Green Tea (camellia sinensis) WJPMR, 4(9), 222-226

[2] Gemede, H. F. (2014). "Potential health benefits and adverse effects associated with phytate in food: a review". *Global Journal of Medical Research: K Interdisciplinary*, vol. 14, No. 3, pp 22-31.

[3] Granato, D., Barba, F. J., Bursać Kovačević, D., Lorenzo, J. M., Cruz, A. G., & Putnik, P. (2020). Functional foods: Product development, technological trends, efficacy testing, and safety. Annual review of food science and technology, 11, 93-118.

[4] Karami, Z., & Akbari-Adergani, B. (2019). Bioactive food derived peptides: A review on correlation between structure of bioactive peptides and their functional properties. Journal of food science and technology, 56, 535-547.

[5] Maqsood, S., Adiamo, O., Ahmad, M., & Mudgil, P. (2020). Bioactive compounds from date fruit and seed as potential nutraceutical and functional food ingredients. Food chemistry, 308, 125522.

[6] Naheed, Z., Cheng, Z., Wu, C., Wen, Y. & Ding, H. (2017). "Total polyphenol, total flavonoids, allicin, and antioxidant capacities in garlic scape cultivars during controlled atmosphere storage". *Postharvest Biology and Technology,* vol. 131, pp 39-45.

[7] Nurminah, M., Ginting, S., & Sitorus, C. J. (2019). Physicochemical properties of egg roll from composite flour of wheat and purple flesh sweet potato. In IOP Conference Series: Earth and Environmental Science (Vol. 305, No. 1, p. 012029). IOP Publishing.

[8] Olawoye, B., & Gbadamosi, S. O. (2020). Influence of processing on the physiochemical, functional and pasting properties of Nigerian Amaranthus viridis seed flour: A multivariate analysis approach. *SN Applied Sciences*, *2*(4), 607.

[9] Oni, K., Uchegbu, N. N., Fasuan, T. O., & Idowu-Adebayo, F. (2023). Development of instant tea from Cymbopogon citrates, Zingiber officinale and moringa oleifera extracts. Journal of Food Measurement and Characterization, 17(2), 1735-1747.

[10] Pang, Y., Ahmed, S., Xu, Y., Beta, T., Zhu, Z., Shao, Y. & Bao, J. (2018). "Bound phenolic compounds and antioxidant properties of whole grains and bran of white, red, and black rice". *Food Chemistry,* vol. 240, pp 212-221.

[11] Raji, R., Samrot, A. V., Keerthana, D. & Karishama, S. (2019). Antibacterial activity of alkaloids, flavonoids, saponins, and tanninsmediated green synthesized silver nanoparticles against *Pseudomonas aeruginosa* and *Bacillus subtilis*. *Journal of Cluster Science,* vol. 30, pp 881-895.

[12] Ravikumar, C. (2014). Review on Herbal Teas. *Journal of Pharmaceutical Sciences and Research*, 6(5), 236-238.

[13] Xu, B. J. Yuan, S. H., & Chang, S. K. (2007). "Comparative analyses of phenolic composition, antioxidant capacity, and colour of cool-season legumes and other selected food legumes". *Journal of Food Science*, vol. 72, No. 2, pp S167-S177.

[14] Yadav, K.C. , Ashok, P., Bishnu, B. K & Lila, D. S (2020). Phytochemicals and Quality of Green and Black Teas from Different Clones of Tea Plant. *Journal of Food Quality* Volume 2020, Article ID 8874271, 13 pages https://doi.org/10.1155/2020/8874271

[15] Zhang, B., Deng, Z., Ramdath, D. D., Tang, Chen, P. X., Liu, R., & Tsao, R. (2015). "Phenolic profiles of 20 Canadian lentil cultivars and their contribution to antioxidant activity and inhibitory effects on α-glucosidase and pancreatic lipase". *Food Chemistry,* vol. 172, pp 862-872.