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Anti-nutient Contents of Nigerian Green and Black Tea and their impact on Humam health

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Abstract

Background: Those who regularly drink black and green tea report positive effects such as lower blood sugar and cholesterol, increased intelligence, and better cardiovascular management, particularly for the elderly. However, younger people report normal agility that fades quickly along with accompanying headaches and discomforts like stomach bites and kidney pain, especially when taken over an extended period. Tea's anti-nutrient components are not disclosed on product labels during production. To inform consumers, our effort attempts to identify some of these phytochemical components and their relative proportions. **Methodology**: The established procedure of the Association of Official Analytical Chemists was followed to determine the phytochemical components of the tea sample both qualitatively and quantitatively. **Results:** The findings showed that green and black tea contained alkaloids, saponins, flavonoids, tannins, glycosides, nicotine, caffeine, and phenols, both qualitatively and quantitatively expressed in mg/g. In green tea and black tea respectively, the highest concentrations of flavonoids were 86.00±0.58 and 65.00±3.5, whereas the **least** concentrations of nicotine were 78.00±0.58 and 63.00±1.21. Green tea had more flavonoids than black tea, while black tea had more flavonoids overall. **Conclusion:** Given that both caffeine and nicotine are among the medications that people are advised against its consumption due to their potential health risks, the high concentrations of these substances in the tea samples suggested that they may be harmful to human health if consumed in excess. Customers of the two tea brands are cautioned to use their discretion, particularly about liver and kidney health.

Key words: Anti-nutrients, Beneficial ,*Camellia sinensis*,Composition, Management

1.Introduction

Green tea is made from *Camellia sinensis* leaves and buds that have not undergone the same oxidation and withering processes as oolong and black teas (Khan and Mukhtar ,2013). It was reported to have originated from China by Heiss *et al.*(2011), where the beverage was named hong cha (Chinese: 紅茶, "red tea"), due to the color of the oxidized leaves when processed

consumption and harvesting, including Indonesia, Japan, Korea and Singapore Nanien *et al*.(2019). According to USNLM (2015), simple black tea contains a small number of calories and nutrients, however, it does include caffeine. Despite extensive studies on the potential health benefits of routinely drinking green tea, there is little proof that doing so has any positive effects on health (NCCIH (2016). Green tea contains flavanols, epicatechin gallate, epicatechin gallate, and epigallocatechin gallate (EGCG) (Khan and Mukhtar, 2013). The leaves of the shrub (or small tree) *Camellia sinensis* are used to make oolong, yellow, white and green teas, and frequently less oxidized than black tea also referred to as red tea in some East Asian languages, however, *Camellia sinensis* is also not used very often (Liu *et al*., 2013).

Filippini *et al*.(2020), reported a few possible side effects, including gastrointestinal issues, elevated liver enzyme levels, and less frequently, skin reactions, insomnia, and elevated blood pressure, however, the research has demonstrated that there is insufficient evidence to support the use of green tea in the prevention or treatment of cancer in humans. There is conflicting or insufficient evidence to determine if drinking green tea increases the chances of developing some malignancies such as stomach cancer and non-melanoma skin cancers (Hou, 2013; Caini *et al*., 2017). Those taking boronic acid-based proteasome inhibitors, such as bortezomib (Velcade), for chemotherapy, should refrain from consuming green tea, because it interferes with these drugs (Jia and Liu (2013)). One cup of green tea per day was linked to a marginally lower risk of dying from cardiovascular causes, according to a meta-analysis of observational studies (Tang *et al*., 2015).

Consumption of green tea may be associated with a lower risk of stroke (Kromhout *et al*., 2016; Zhang *et al*., 2015). According to meta-analyses of randomized controlled studies, drinking green tea for three to six months, may result to modest drops in systolic and diastolic blood pressure (about two to three mm Hg each) (Liu *et al*., 2014; Khalesi *et al*., 2014; Kromhout *et al*., 2016 and Mozaffarian, 2016). Green tea consumption or supplementation reduces blood levels of LDL cholesterol (about 2 mg/dL) and total cholesterol (around 3.7 mg/dL),however, it has no effect on HDL or triglyceride concentrations (Larsson, 2014 and Onakpoya *et al*., 2014). Overindulgence in green tea extract has been linked to liver failure and hepatotoxicity, according to studies by Mazzanti *et al*. (2015) and Hartley *et al*. (2013), drinking black tea regularly over an extended period, only marginally reduced systolic and diastolic blood pressure (by roughly 1-2 mmHg). Due to the presence of calcium carbonate and oxidized polyphenols, the visible film that frequently forms on black tea is more noticeable when the tea is brewed with hard water (Giacomin and Fischer, 2021). According to Hartley *et al*. (2013), black teas made from the *Camellia sinensis* plant contain polyphenols called flavonoids, whose potential to affect blood pressure and blood lipids—risk factors for cardiovascular disease—are currently being studied.

In Nigeria, a variety of elite household types frequently drink tea as a beverage. Sowunmi *et al*. (2009), reported that drinking black tea in Nigeria is not limited to consumer homes, but rather occurs at bus stops, and vehicle parks, as well as, bought and consumed by a variety of socioeconomic levels who rely on this source of income. They also added that the majority of tea consumers liked black tea, and that those at 65 years of age and above consume a lot of tea. From our interactions with people who regularly drink black and green tea, some have

admitted to positive health benefits– such as lower blood sugar and cholesterol, physical smartness, improved memory and cardiovascular management, especially, for the elderly.

However, some younger people have complained of unusual agility that disappears quickly, along with headaches and discomforts like intestinal bites and kidney pain, especially, when consumed for an extended length of time. Anti-nutrient of tea components are not disclosed on product labels. When compared to the consumption of other types of beverages, these negative impacts may have had an impact on the quantity and categories of people who desire the two types of tea products.

While research on the anti-nutrient compositions of these two tea brands consumed in various countries has been conducted, not much has been done to compare the anti-nutrient composition of the two brands consumed in Nigeria to identify which of the two brands that contains more anti-nutrients that are more beneficial to health. The purpose of this study was to determine which brand of green and black tea that would be more useful, in terms of anti-nutrient content, by comparing their anti-nutrient composition.

2.Materials and Methods

Two Nigerian-produced tea samples, one each of black and green, were obtained from His Grace supermarket in Abakaliki, Ebonyi State, carefully packed, and delivered to the Project Development Institute (PRODA) in Enugu, Enugu State, Nigeria for analysis.The duration of this study was from January- February, 2022.

2.1 Analysis of the various anti-nutrients in the two tea samples using qualitative and quantitative methods

The Association of Official Analytical Chemistry's (AOAC) (2010) methodology, was employed.

2.2 Statistical analysis and experimental design

Data analysis was performed, using SPSS version 20.0. Mean values of anti-nutrients of green and black tea samples were obtained and compared, using an independent sample T-test. The level of significance was set at (p<0.05). Each sample was replicated three times.

3. Results

As shown in Table 1, the results of the qualitative analysis indicated the presence of the following anti-nutrients: alkaloids, saponins, flavonoids, tannins, glycosides, and phenols. Only ethyl acetate in its crude form was observed to have alkaloids; ethanol and water both had saponins; n-hexane, ethanol and ethyl acetate all had flavonoids; and all four of the solvents that were utilized contained tannins. Steroids, phytates, and terpenoids were not observed in any of the four solvents that were employed. However, glycosides were observed

in both ethanol and water, while phenols only were observed in water. the presence of steroids, phytates and terpenoids were not observed in any of the four solvents used.

Results of the quantitative analysis indicated the presence of the following anti-nutrients in mg/g: alkaloids, saponins, flavonoids, tannins, glycosides, nicotine, caffeine, and phenols in the two tea samples, whereas phytates, terpenoids, and steroids were not detected in any of them, as shown in table 2.There was no significant difference in the mean quantity of flavonoids, tannins, glycosides, nicotine and caffeine between the two tea samples $p<0.05$, though the quantity of saponins, flavonoids, tannins, glycosides, nicotine, caffeine and phenols were higher in the green tea than the black. However, there was a significant difference between the quantity of alkaloids, saponins, and phenols in the green and black tea samples $p<0.05$, though the quantity of flavonoid in the black tea was higher than as recorded in the green .

Table 1: Results of the qualitative tests for bioactive compounds in the two tea samples

Observation				
Green tea	**Ethylacetate**	**Ethanol**	**N-Hexane**	**Water**
Alkaloids	+	-	-	-
Saponins	-	+	-	+
Flavonoids	+	+	+	-
Tannins	+	+	+	+
Cyano Glycosides	-	-	-	+
Phenols	-	-	-	+
Steroids	-	-	-	-
Phytates	-	-	-	-
Terpenoids	-	-	-	-
Black tea				
Alkaloids	+	-	-	-
Saponins	-	+	-	+
Flavonoids	+	+	-	+
Tannins	+	+	+	+
Cyano Glycosides	-	+	-	+
Phenols	-	-	-	+
Steroids	-	-	-	-
Phytates	-	-	-	-
Terpenoids	-	-	-	-

(+) = Present (-) = Absent

Table 2: Result of the quantitative analysis of the phytochemical compound in Green tea and Black tea.

Phytochemical	**Green tea (mg/g)**	**Black tea (mg/g)**	**value**
Alkaloids	4.00±1.73	6.00±0.87	379^{ns}
Saponins	6.00±1.73	5.00±0.58	630^{ns}
Flavonoids	6.00±0.58	5.00±3.52	028^{*}
Tannins	50.00± 0.029	10.00±0.029	0001^{*}
Cyano Glycosides	23.00±0.0013	9.00±0.00017	006^{*}
Phenols	5.40±8.49	6.00±1.16	148^{ns}
Nicotine	8.00±0.58	3.00±1.21	$.001^{*}$
Caffeine	6.00±0.87	9.00±0.75	.006*
Steroids	D	D	D
Phytates	D	D	D
Terpenoids	D	D	D

ns = No significant difference *= There is significant difference ND= Not detected

4.Discussion

The screening of green and black tea samples for anti-nutrients showed the presence of alkaloids, phenols, saponins, glycosides, tannins, caffeine, nicotine, and flavonoids. There was no presence of steroids, phytate, and terpenoid, but Onyeneke (2021), reported its presence in black tea, though in trace amounts, but absent in green tea. The absence of terpenoids was in agreement with the work of Tariq and Reyaz (2012), who did not observe the presence of terpenoids in the samples of green and black tea samples used. However, the presence of glycosides and saponins in this study, was in disagreement with what they reported in their work. The saponin contents of the two types of tea as reported by Kim and Wampler(2009), were higher than those obtained in this work. Kopjar *et al*. (2015), reported the presence of phenolics, flavonoids, and tannins in green and black tea .

Pacheco-Coello *et al.*(2020), reported the highest concentration of total phenolics, flavonoids, and antioxidant capacity in the infusion of artisanal green tea from China. The tannin content of green tea reported in this work was greater than that reported by Sabahelkhier *et al.*(2020), while that of black tea in this work was lower than that reported in their work. The alkaloid content of black tea was higher than that of green tea, though not significantly higher, but those reported by Sabahelkhier *et al.* (2015), were far lower than the result obtained in this work and that of Onyeneke(2021), but corroborates the result of this work that flavonoid content of green tea was greater than that of black tea. The phenolic content of green tea was greater than those in black tea and other anti-nutrients in both green tea and black tea, except nicotine and flavonoid. The results agree with the result obtained by Nassar *et al.*(2019), that the phenolic content of green was higher than that of black tea.

Caffeine and nicotine contents of green tea were greater than those in black tea, and this is in agreement with Ramdani *et al.*(2022), who reported a higher concentration of caffeine in green tea, as compared to black tea, and that of Jayeeta (2015), who reported that a cup of green tea contained between 15 and 50 mg of caffeine. The quality of black tea is strongly associated with the amount of caffeine content for the formation of colored precipitates during the infusion process Jarosz *et al.*(2009).

In the present study, high caffeine content was observed in green tea as compared to black tea. This could be attributed to the use of more younger leaves in the production of the tea, which is in line with previous results of Faupel *et al.*(2013), who described the elevated levels of caffeine in young leaves. The difference in caffeine content of green tea and black tea samples might have been due to differences in plucking season, variety, and climatic conditions of the leaves used in the production of the tea samples. The results obtained from the present study are in line with the results obtained by Kristjansson *et al.*(2009), who suggested that the caffeine content of the commercial tea samples should be restricted to less than 40mg/g to maintain a better quality of the product, and also in agreement with Muhammad *et al.*(2013), who reported higher concentration of caffeine in green tea, as compared to black tea. In the present study, high caffeine content was observed in green tea, as compared to black tea. This may be attributed to the use of younger tea leaves in their production, and it is in line with previous results of Yao *et al.*(2012), who described the elevated levels of caffeine in young leaves, and that the caffeine content of black tea is also

affected by clone, stage of plucking, season, geographical locations, late harvesting, and also more mature leaves for commercial tea production. Despite the importance of caffeine in tea, it could also lead to adverse effects on the body when used regularly for a long time. Though caffeine is a substance that is used daily, it is still a drug and a stimulant that has been linked to negative health outcomes such as raised blood pressure and panic attacks. According to reports from Faupel *et al*. (2013) and Kristjansson *et al*. (2013), caffeine may potentially contribute to aggressive conduct.

Nicotine was also observed in a larger quantity than caffeine in the two tea samples, and also could have a great effect on the body system when consumed regularly for a long time. It could also affect the function of the liver and kidney. Scientific claims surrounding the levels of nicotine in tea range from negligible/non-existent to 285 nanograms of nicotine per gram of tea in green tea, and 100 nanograms per gram of black tea (whether regular or decaf) (Tariq and Reyaz (2012). Ikka *et al.*(2018), observed that the nicotine contents of tea leaves differ among producing regions and cultivars, and that nicotine contents of black tea (0.024–0.694 μg g−1 DW) were significantly higher than those of green tea (0.011–0.40 μg g−1 DW). Thrane *et al.*(2015), also reported that the highest nicotine contents (>0.6 μg g−1DW), as observed in samples from India and China, Taiwan, Indonesia, and Vietnam were significantly higher than those of Green tea from Japan and Taiwan and that tea samples from Japan had contents below 0.19 μg g−1 DW.

However, findings, in this work have shown that the sample and brand used have a high quantity of nicotine, green tea (78mg/g) and black tea (63mg/g), and in contrast with the result of Ikka *et al.*(2018), but corroborates the report of [Thrane *et al.*,2015 and Ikka *et al.*,2018] that nicotine content of teas varies among regions and countries. Constant and habitual infusion of this tea will surely have some harmful effects on health. If they should be taken, it should be for medicinal purposes, as may be directed by the physician, as caffeine and nicotine are both stimulants and it is not clear which drug is leading to these negative health outcomes, though several scientists have confirmed that nicotine has severe health defects as evidenced in cigarette smoking.

Conclusion

This study has provided better knowledge regarding the quality of tea beverages used in Nigeria as compared to other regions of the world. The level of all the anti-nutrients is higher in green tea than in black tea, however, the high level of caffeine and nicotine, in particular, observed in these two tea samples gives a health risk alert. The values of anti-nutrients, especially, caffeine and nicotine in green and black tea taken in Nigeria are higher than those taken in some other countries. The high content of toxic chemicals in these two tea samples must have resulted in less demand for them, compared to other beverages.

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The authors declare that they have no conflict of interest.

Ethical issues

The authors declare that there were no ethical issues involved.

Author Contributions

Ibiam, O. F A Conceptualized , supervised the project and wrote the work

Ukwa, N.P and Akpa, S. O conducted the experiment

Akanu-Ibiam, A. C. -Procured the samples and did the interrogation of the users of the two tea products

Nwaru, E.C Carried out the plagiarism and grammar check

Nwosu, S. C and Okeke,T . E -Carried out the statistical analysis

All the authors read the work and approved it before publication.