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Phytochemical Screening, Proximate Analysis and Antioxidant Vitamins of Green Tea (*Camellia sinensis*) Leaves Consumed in Sokoto Metropolis, Sokoto-State, Nigeria

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Green tea is widely known for its numerous health benefits which include fat burning, weight loss, improved brain function, and lowering the risk of diabetes. However, there is paucity of information on its nutritional composition. This study qualitatively screened green tea leaves for the presence of phytochemicals and also determined the proximate and antioxidant vitamin contents of the leaves using standard analytical procedures. The study showed that the leaves contain alkaloids, saponins, tannins, terpenoids, flavonoids, phenols and sterols. The proximate analysis and levels of some antioxidant vitamins (vitamins A, C and E) revealed that green tea contains high fibre content (48.58%) and significantly ($p<0.05$) higher concentration of vitamin A (2212.85 ± 20.02 mg/dl) and vitamin E (532.51 ± 0.87 mg/dl) compared to vitamin C (1.06 ± 0.03 mg/dl). The results suggest that consumption of green tea by humans can serve as a rich source of vitamin A and E. The tea can also be used extensively for its ethnomedicinal benefits.

Keywords: Phytochemicals, Proximate analysis, Antioxidant vitamins, Green tea

1. Introduction

Traditional medicinal plants have been used for many years by different people in the world for different purposes. In Nigeria alone, medicinal plants are continually consumed due to its low toxicity and efficacy in the treatment of diverse ailments. One of such plants is the green tea (*Camellia sinensis*). An infusion or decoction can be prepared from the leaves, and then used as medicine (Namita *et al.,* 2012).

Camellia sinensis commonly called tea plant belongs to the Family - Theaceae. It originated from China but its production and manufacture today has spread to many other countries (Parmar *et al*., 2012). Green tea leaves contain a relatively small amount of caffeine which when taken in excess, can cause sleeplessness and irritability. Also, through its action on diuretic acts to remove nutrients from the body (Bown, 1995; Li *et al.,* 2008). The leaves also contain high amounts of antioxidants found in any tea (Pizzorno and Murray, 2012). It contains natural chemicals called polyphenols which are antioxidants that help protect the body against heart diseases, stroke and cancer (Bown, 1995; Micheal, 1999; John, 2008).

Among the chemical compounds found in green tea are catechins which include epigallocatechin (EGC), epigallocatechin gallate (EGCG), epicatechin gallate (ECG), and gallate epicatechin (GEC) (Hilal *et al*., 2007; Unachukwu 2010). The leaves are used in the treatment of diarrhoea, dysentery and hepatitis (Duke and Ayensu, 1985; Bown, 1995). The consumption of the extracts of green tea leaves lower total and low density lipoprotein cholesterol concentrations in the blood (Larsson, 2014). Interestingly, there is no conclusive scientific evidence that support the numerous benefits of the leaves (USNIH, 2016; USNLM, 2017). Therefore, this study investigates the phytochemicals, proximate and antioxidant vitamin contents of green tea leaves

2. Materials and Methods

2.1 Sample Collection, Preparation and Extraction

The green tea (*Camellia sinensis*) leaves were obtained from Shehu Shagari Market, Sokoto

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State, Nigeria. The leaves were thoroughly washed with cleaned with water to remove dirts and other contaminants. They were then air dried under shade for two weeks and pulverized into fine powder with the aid of a mechanical pulverizer. 100 g of the powdered sample was soaked in 400 mL methanol for 72 hrs, with occasional stirring. The extracts were filtered using muslin cloth and the filtrate re-filtered using Whatman No. 42 (125 mm) filter paper. The filtrates collected were evaporated to dryness using water bath at 40^{o}C and then stored in an airtight container for further analysis.

2.2 Qualitative Phytochemical Analysis

The crude methanol leaf extract was subjected to phytochemical screening for the presence of secondary metabolites such as alkaloids, saponins, flavonoids, tannins, terpenoids, phenols and steroids using standard procedures described by Harborne (1973), Trease and Evans (1989) and Sofowara (1993).

Detection of Alkaloids: To 2 mL of the extract was added few drops of Meyer's reagents respectively. The appearance of a white or creamy precipitate indicated the presence of alkaloids.

Detection of Saponins: To 2 mL of the extract was added 2 mL of distilled water and shaken vigorously for 5 mins. Formation of foam which persisted for 10 mins indicated the presence of saponins.

Detection of Tannins: To 2 mL of the extract was added 2 drops of 0.1% ferric chloride solution. Appearance of bluish-black colour confirmed the presence of tannins.

Detection of Flavonoids: To 2 mL of the extract was added 1 mL of NaOH solution. Formation of intense yellow colour which disappeared upon addition of concentrated HCl indicated the presence of flavonoids.

Detection of Glycosides: To 2 mL of the extract was added 2 mL chloroform and concentrated H_2SO_4. Appearance of a reddish brown colour indicated the presence of glycosides.

Detection of Triterpenoids: To 2 mL of the extract was added 1 mL of chloroform followed by careful addition of 1 mL concentrated sulfuric acid. The formation of reddish-brown colour indicated the presence of triterpenoids.

Detection of Steroids: To 1 mL of the extract was added few drops of acetic anhydride and concentrated sulfuric acid. The solution was allowed to stand at room temperature for 5 mins. The formation of deep blue/green color indicated the presence of steroids.

2.3 Proximate Analysis

The proximate analysis (moisture, lipid, fibre, ash and protein) of the fresh leaves was determined according to AOAC (2000) method. However, the carbohydrate content was determined by the difference, that is, subtracting the sum of all other proximate content, from 100.

Percentage carbohydrate = 100 – (% moisture + % lipid + % fibre + % ash + % protein)

2.4 Antioxidant Vitamins Analysis

The vitamin contents (vitamin A, C and E) of the methanolic plant extract were analyzed according to the method described by AOAC (1995).

2.5 Statistical Analysis

The results obtained from all the experiments were analyzed using Graphpad Instat version 3.0 USA. Values obtained are expressed as mean ± standard deviation.

3. Results and Discussion

3.1 Phytochemical screening

The results of the phytochemical screening of green tea (*Camellia sinensis*) leaves consumed in Sokoto metropolis is presented in Table 1.

Table 1. Phytochemicals in methanolic extract of green tea (*Camellia sinensis*) leaves.

Phytochemicals	Extract
Alkaloids	+
Saponins	+
Tanins	+
Terpenoids	+
Cardiac glycosides	+
Phenols	+
Steroids	+
Flavonoid	+

(+) Detected (-) Not detected

The results show that green tea leaves contain alkaloids, saponins, tannins, terpenoids, flavonoids, phenols and sterols. Plants rich in alkaloids are used for their antibacterial and antidiabetic properties (Santi and Sengottuvel, 2016). The caffeine content of the plant as reported by Li *et al*., (2008) can be attributed to the presence of alkaloid. Caffeine is a purine alkaloid that can cause sleeplessness and irritability when consumed (Li *et al*., 2008). As

such, the plant can be used as a stimulant due to the caffeine content. Previous studies have shown that alkaloids and flavonoids from natural products and plant materials are effective antidiabetic and antioxidant agents (Jung *et al*., 2006; Yesmin *et al*., 2008; Chen *et al*., 2013). The presence of flavonoids in green tea leaves indicates the leaves possess antioxidant and antihypertensive activities (Oliveira *et al*., 2016). Saponin has immune boosting and anti-inflammatory properties (Kenner and Requena, 1996). In addition, saponins have been reported to possess antidiabetic, anti-inflammatory and antioxidant properties (Lu *et al*., 2000; Zheng *et al.*, 2012). Phenols and phenolic compounds are used in disinfections (Akinyeye *et al*., 2014). The results from this study shows that green tea (*Camellia sinensis*) leaves contain diverse phytochemicals which could be responsible for its numerous medicinal uses.

3.2 Proximate analysis

Table 2 gives the proximate composition of the methanolic extract of green tea (*Camellia sinensis*) leaves consumed in Sokoto metropolis.

Table 2. Proximate composition of methanolic extract of green tea (*Camellia sinensis*) leaves

Constituents	% Composition
Ash	5.11 ± 0.01
Lipid	4.50 ± 0.09
Moisture	11.20 ± 0.29
Crude protein	0.61 ± 0.04
Fibre	48.58 ± 0.74
Carbohydrate	30.00 ± 0.60

Values are mean ± SD

The result reveals the plant is rich in fibre (48.58%) compared to moringa leaves of 18.64% fibre as reported by Okafor and Ogbobe (2015). According to Okanlawon (2000), crude fibre stimulates the movement of the bowel and helps to prevent constipation. High fibre content in diets have been reported to result in increased removal of carcinogens, potential mutagens, steroids, bile acids and xenobiotics (Ayoola and Adeyeye, 2009). The ash content can provide an estimate of the quality of the product. The high values of the ash (5.11%) were indicative of high mineral content of the leaves. This study also reveals that green tea (*Camellia sinensis*) contains low moisture content of 11%. This agrees with the findings of Okafor and Ogbobe (2015) that green tea leaves contain low levels of moisture (10.37%). According to Mohammed and Suleiman (2009), high moisture content aids microbial growth. As such, controlling the moisture content of tea products is an important factor in tea preservation, particularly for the inhibition of microbial growth (Heong *et al*., 2011). The amount of carbohydrate found in this study shows green tea (*Camellia sinensis*) leaves could be a good source of energy to humans.

3.3 Antioxidant vitamins

The antioxidant vitamin content of the methanolic extract of green tea (*Camellia sinensis*) leaves consumed in Sokoto metropolis is presented in Table 3.

Table 3. Antioxidant vitamins of methanolic extract of green tea (*Camellia sinensis*) leaves

Antioxidant vitamins	Concentration (mg/dl)
Vitamin A	2212.85 ± 20.02
Vitamin C	1.06 ± 0.03
Vitamin E	532.51 ± 0.87

Values are mean ± SD

This study showed that green tea leaves have high content of vitamin A (2212.85 mg/dl) and Vitamin E (532.51 mg/dl). Studies have revealed that dietary vitamin A supplementation can improve learning and ameliorate cognitive decline associated with normal aging (Olson and Mello, 2010). Vitamin A is necessary for vision mediated by the rod cells, so deficiency often presents as night blindness, the first symptom of Vitamin A deficiency (Solomon *et al*., 2004). The leaves were also observed to contain flavonoids which can be responsible for the high antioxidant vitamin A content. The main function of Vitamin E is as an antioxidant, in particular a membrane antioxidant associated with lipid membrane structure. It provides protection from the action of peroxides by converting them to a product that is, conjugating with glucuronic acid and excreted in bile (Solomon *et al*., 2004). Vitamin E also helps prevent the oxidation of low-density lipoprotein (LDL). Oxidized LDL may be more atherogenic than native LDL, and there is some evidence that Vitamin E may protect against atheromatous coronary heart disease (Barbara and Lynn, 2001; Solomon *et al*., 2004). The vitamin C content, although very small, is required for different biological processes, such as resistance to infection (Igwenyi and Elekwa, 2014). The results suggest that green tea (*Camellia sinensis*) leaves contain antioxidant vitamins which are important in the fight against diseases.

4. Conclusion

The phytochemical screening of the leaves revealed the presence of alkaloids, saponins, tanins, terpenoids, cardiac glycosides, phenols, sterols and flavonoids which might contribute to the efficacy of the plant in the treatment of diseases. The proximate analysis revealed high

content of fibre, needed for preventing constipation, and ash which is indicative of high mineral content. The high content of vitamin A and E observed in the leaves are indicative of the plant's ability to scavenge free radicals and protect the body against diseases. Thus, this study concludes that green tea (*Camellia sinensis*) leaves are of enormous benefit to humans.

Conflict of interest

The authors declare no conflict of interest.

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