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Phytochemical composition of some underutilised green leafy vegetables in nsukka urban Lga of Enugu State

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Abstract

The use of underutilised vegetables by rural consumers is stemmed on their perceived nutritional and therapeutic properties. Hence the need to add to the growing list of these beneficial plants in order to create more varieties in the food menu of the Nigerian populace. This study examined the quantitative and qualitative phytochemical compositions of some lesser known leafy vegetables consumed in Nsukka local government area of Enugu State Nigeria. Three kilograms each, of the fresh green leafy vegetables were handpicked to remove foreign particles. Each of the vegetables was then divided into three equal parts of one kilogram each. One part was washed, drained and shade dried at room temperature for seven days. After drying, the vegetables were pulverized into powder and labelled as shade dried. Chemical analysis of the GLVs were carried out using standard AOAC methods. The result revealed that all the phytochemicals analyzed for were present in most of the vegetables. Apart from *Mucunapruriens*, alkaloid was present in all the vegetables. Anthocyanin, carotenoid, flavonoids, oxalate and tannin were also present in all the vegetables. *Myrianthus arboreus* and *vitex doniana* are the only vegetables which contained all the phytochemicals. Quantitative phytochemical analysis result shows that the phytochemical contents of the vegetables were affected by processing. Alkaloid ranged from 0.04-3.47g/100g, anthocyanin ranged from 0.03-0.24 g/100g, that of carotenoid was 0.04-0.53g/100g, flavonoid ranged from 0.07-3.20g/100g, glycosides ranged from 0.04-0.52 g/100g, oxalate ranged from 0.03-1.95g/100g, saponin ranged from 0.26-4.89 g/100g and that of tannin was 0.01- 3.34 g/100g. In conclusion, *Ficus capensis* (Akokoro), *Pterocarpus santalinoides* (Nturukpa), *Vitex doniana* (Uchakiri), *Ficusthon ningii* (Ogbu), *Mucuna pruriens* (Agbara) and *Myrianthus arboreus* (Ujuju) are rich in most of the phytochemicals analysed. They may be utilized for various therapeutic purposes as claimed by the rural consumers in their raw forms and can also be used in preparation of various soups and pottages.

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Introduction

The universe is endowed with vast varieties of underutilized species especially in the family of fruits and vegetables which are found in localised regions and are been consumed by the rural populace for various perceived health benefits without any scientific proof. Consequently there is a decrease in the consumption rates of various underutilized vegetables like *Ficus capensis* (Akokoro), *Pterocarpus santalinoides* (Nturukpa), *Vitex doniana* (Uchakiri), *Ficus thonningii* (Ogbu), *Mucuna pruriens* (Agbara) and *Myrianthus arboreus* (Ujuju) and a consequent shift to consumption of conventional ones like *Telfairia occidentalis* 'ugu' and spinach (efo). These underutilised vegetables are lesser known but are still utilized for therapeutic reasons and in food preparation in the local palance. They are abundant during the dry season when most common vegetables are scarce.

Fruits, vegetables, herbs and spices contain a wide variety of biologically active, non-nutritive compounds known as phytochemicals (Sheetal and Jamuna, 2009). Phytochemicals have been described as bioactive, non-nutrient compounds in fruits, vegetables, grains and other plant foods that have been linked to reducing the risk of major degenerative diseases (Liu, 2004). They are also known as plant-derived chemicals, which are beneficial to human health and disease prevention (Onyeka and Nwambekwe, 2007). Fruits and vegetables contain vitamins and pro-vitamins, as well as these bioactive plant components whose presence has been considered of crucial nutritional importance in the prevention of chronic diseases such as cancer, cardiovascular disease and diabetes (Aruoma, 2003). In addition, phytochemicals can have complementary and overlapping actions including antioxidant, modulation of detoxification enzymes, stimulation of the immune system, reduction of inflammation, modulation of steroid metabolism, antibacterial, antihelmintic and antiviral effects in humans (Johana, 2003).

In ethno medicinal practice, the above named lesser known vegetables have been used for various purposes. For instance, women of Ngwo village in Udi local government area applied the whitish exudates of freshly plucked *Ficusthon ningii* leaves to boils and fresh injuries. They also squeezed out juice from the leaves of *Mucuna pruriens* to boost blood level. Juice obtained from squeezing the leaves of *Pterocarpus santalinoides* is been used in the treatment of diarrhoea in the area. This would have been because of the bioactive substances that are present in them. Bioactive substances such as phenolic compounds, tannins, alkaloids and flavonoids have provided the scientific basis for the efficacy of many plants used in folk medicine to treat infections (Ćirković et al., 2012). Lutein and zeaxanthin are carotenoids found in dark green leafy vegetables. They concentrate in the eye lens and muscular region of the retina, protecting the eye from cataract and age related muscular degeneration (Criag, 2008). *Vitex doniana*, commonly called black plum and *Uchakiri* in Igbo, is widely distributed in different parts of Nigeria. Various parts of the plant are used by traditional medicine practitioners in Nigeria for the management and treatment of several disorders which include rheumatism, hypertension, cancer, and inflammatory diseases (Sofowora, 1993). Aqueous extract of *Vitex doniana* contains pharmacologically active substances with antidiarrhoeal properties (Ukwuani et al, 2012); the analgesic activities of the leaf extract have also been reported (Iwueke, et al., 2006).

Various medicinal plants have been implicated to cure different disease conditions (Mensa et al, 2008; Isaiah et al., 2012). Most of these plants are consumed as vegetables in some localities for their nutritional and therapeutic purposes. However, there is paucity of scientific literature to back-up these claims. Hence the aim of this study was to analyze *Telfairia occidentalis* (well known) and some lesser known green leafy vegetables: *Ficus capensis*, *Pterocarpus santalinoides*, *Vitex doniana*, *Ficusthon ningii*, *Mucuna pruriens* and *Myrianthus arboreus* for their phytochemical potential and to what extent

they are contained in their cooked form, shade dried form and in the raw form; for comparative purposes and useful phytochemical data generation.

Materials and methods

Materials

Tenderleaves of *Ficus capensis* (Akokoro), *Pterocarpus santalinoides* (Nturukpa), *Vitex doniana* (Uchakiri), *Ficus thonningii* (Ogbu), *Mucuna pruriens* (Agbara) and *Myrianthusarborescens* (Ujuju) were used for this study.

Collection of samples

Green leafy vegetable samples were harvested from different parts of Nsukka Local Government Area of Enugu State. *Ficuscapensis* (Akokoro) was obtained from Green House gate, University of Nigeria, Nsukka. *Pterocarpussantalinoides* (Nturukpa), *Vitexdoniana* (Uchakiri) and *Mucunapruriens* (Agbara) were obtained from Hill-Top gate University of Nigeria, Nsukka. *Ficusthonningii* (Ogbu) and *Myrianthusarborescens* (Ujuju) were obtained from odim; all within Nsukka Local Government Area. The vegetables were identified at the plant science and technology department of the school.

Preparation of samples

Three kilograms each, of the fresh green leafy vegetables were handpicked to remove foreign particles and rinsed in de-ionized water to remove dust and dirt. Each of the vegetables was then divided into three equal parts of one kilogram each. One part was washed, drained and shade dried at room temperature for seven days. After drying, the vegetables were pulverized into powder and labelled as shade dried. The second part was washed, drained, cut and blended to a uniform pulp in the laboratory mortar and was labelled as raw. The third part was washed, drained, cut and blanched for five minutes without any seasoning.

Phytochemical analysis

Qualitative and quantitative screenings were both carried out on the raw, cooked and shade dried leaves. Qualitative screening was carried out to

determine the presence of alkaloids, anthocyanin, carotenoid, flavonoid, glycoside, saponin, oxalate and tannin phytochemicals in the leaves using the methods described by Trease and Evans (1996).

Quantitative analysis: the raw, cooked and shade dried leaves were subjected to qualitative phytochemical analysis using the methods of Harborne (1973) for alkaloid and anthocyanin, Dolunay et al (2008) for carotenoid, Boham and Kocipai-Abyazan (1994) for Flavonoid, Onwuka (2005) for glycoside, Obadori and Ochuko (2001) for Saponin, Pearson (1976) for Oxalate and Kirk and Sawyer (1998) method for Tannin using the Fohn-Denis calorimeter.

Statistical Analysis

The design of this work was completely randomized design (CRD). Fisher's least significant difference (LSD) was used to compare the different means ($p < 0.05$).

Results

The result of qualitative phytochemical analysis of the lesser known green leafy vegetables is presented in Table 1. The result showed that alkaloids are present in all the samples except for *M. pruriens*. Anthocyanin, carotenoids, flavonoids, oxalate, saponin and tannins are present in all the samples tested but glycoside was present only in *F. capensis* and *M. pruriens*.

Table 2 shows the quantitative phytochemical analysis of the vegetables in their raw, cooked and shade dried forms. The result showed highest alkaloid content of 4.29 g/100g in *F. capensis* while the smallest was 0.90 g/100g in *P. santalinoides*. Flavonoid content in *M. pruriens*, *F. thonningii*, and *F. capensis* were 3.76, 2.88, and 2.77 g/100g respectively. *M. pruriens* had the highest saponin and tannin content (5.86 and 3.61 g/100g).

Table 1. Qualitative phytochemical analysis of some lesser known green leafy vegetables consumed in Nsukka area of Enugu State.

Vegetables	Phytochemicals							
	Alkaloids	Anthocyanin	Carotenoid	Flavonoids	Glycoside	Oxalate	Saponin	Tannin
<i>F. capensis</i>								
Raw	+	+	+	+	+	+	-	+
Cooked	+	+	+	+	+	+	-	+
Shade dried	+	+	+	+	+	+	-	+
<i>F. thonningii</i>								
Raw	+	+	+	+	-	+	+	+
Cooked	+	+	+	+	-	+	+	+
Shade dried	+	+	+	+	-	+	+	+
<i>P. santalinoides</i>								
Raw	+	+	+	+	-	+	+	+
Cooked	+	+	+	+	-	+	+	+
Shade dried	+	+	+	+	-	+	+	+
<i>M. pruriens</i>								
Raw	-	+	+	+	+	+	+	+
Cooked	-	+	+	+	+	+	+	+
Shade dried	-	+	+	+	+	+	+	+
<i>M. arboreus</i>								
Raw	+	+	+	+	+	+	+	+
Cooked	+	+	+	+	+	+	+	+
Shade dried	+	+	+	+	+	+	+	+
<i>V. doniana</i>								
Raw	+	+	+	+	+	+	+	+
Cooked	+	+	+	+	+	+	+	+
Shade dried	+	+	+	+	+	+	+	+
<i>T. occidentalis</i>								
Raw	+	+	+	+	-	+	+	+
Cooked	+	+	+	+	-	+	+	+
Shade dried	+	+	+	+	-	+	+	+

Table 2. Quantitative phytochemical analysis of some lesser known green leafy vegetables consumed in Nsukka area of Enugu State.

Vegetables	Phytochemicals (g/100g)							
	Alkaloids	Anthocyanin	Carotenoid	Flavonoids	Glycoside	Oxalate	Saponin	Tannin
<i>F. capensis</i>								
Raw	4.29	0.21	0.46	2.77	0.13	1.63	0.00	1.13
Cooked	1.20	0.18	0.29	1.25	0.13	0.55	0.00	0.84
shade dried	4.94	0.35	0.85	3.26	0.34	2.00	0.00	1.34
<i>F. thonningii</i>								
Raw	2.78	0.11	0.14	2.80	0.00	0.92	0.22	0.72
Cooked	0.87	0.09	0.11	0.73	0.00	0.01	0.08	0.34
shade dried	3.21	0.24	0.30	3.16	0.00	1.14	0.48	0.91
<i>M. pruriens</i>								
Raw	0.00	0.02	0.40	3.76	0.46	0.17	5.86	3.61
Cooked	0.00	0.02	0.40	1.15	0.37	0.08	2.36	0.95
shade dried	0.00	0.04	0.52	4.69	0.73	0.27	6.44	4.24
<i>M. arboreus</i>								
Raw	1.60	0.08	0.05	0.14	0.03	0.03	0.65	3.76
Cooked	0.47	0.08	0.05	0.08	0.02	0.02	0.55	1.38
shade dried	1.68	0.10	0.08	0.36	0.05	0.06	1.91	4.88
<i>P. santalinoides</i>								
Raw	0.90	0.04	0.06	0.08	0.00	1.18	2.40	0.19
Cooked	0.17	0.04	0.05	0.34	0.00	0.12	1.50	0.15
shade dried	0.90	0.04	0.10	0.24	0.00	2.73	3.28	0.35
<i>V. doniana</i>								
Raw	1.08	0.02	0.07	1.17	0.07	1.93	1.01	0.86
Cooked	0.84	0.13	0.07	0.66	0.02	1.05	0.51	0.65
shade dried	1.77	0.03	0.18	2.44	0.12	2.87	2.11	1.28
<i>T. occidentalis</i>								
Raw	0.85	0.02	0.03	0.04	0.00	0.06	0.80	0.14
Cooked	0.41	0.01	0.02	0.02	0.00	0.04	0.07	0.12
shade dried	0.95	0.13	0.07	0.15	0.00	0.17	1.21	0.23
LSD (P<0.05)	0.09	0.01	0.02	0.12	0.03	0.05	0.21	0.05

Table 3. Mean quantitative phytochemical analysis of some lesser known green leafy vegetables consumed in Nsukka area of Enugu State.

Vegetable	Phytochemicals (g/100g)							
	Alkaloids	Anthocyanin	Carotenoid	Flavonoids	Glycoside	Oxalate	Saponin	Tannin
<i>F. capensis</i>	3.47	0.24	0.53	2.43	0.20	1.38	0.00	1.10
<i>F. thonningii</i>	2.29	0.15	0.18	2.23	0.00	0.69	0.26	0.66
<i>M. pruriens</i>	0.00	0.03	0.43	3.20	0.52	0.17	4.89	2.93
<i>M. arboreus</i>	0.91	0.09	0.06	0.19	0.04	0.03	1.03	3.34
<i>P. santalinoides</i>	0.71	0.04	0.07	0.22	0.00	1.34	2.39	0.23
<i>V. doniana</i>	1.23	0.06	0.11	1.42	0.07	1.95	1.21	0.93
<i>T. occidentalis</i>	0.04	0.06	0.04	0.07	0.00	0.09	0.72	0.01
LSD (p<0.05)	0.05	0.01	0.01	0.07	0.02	0.03	0.12	0.02

Discussion

The result of qualitative phytochemical analysis of the lesser known green leafy vegetables is presented in Table 1 below. The result revealed that all the phytochemicals analyzed for were present in most of the vegetables. Apart from *Mucuna pruriens*, alkaloid was present in all the vegetables. Anthocyanin, carotenoid, flavonoids, oxalate and tannin were present in all the vegetables. Tannin is toxic to filamentous fungi, yeast and bacteria (Jones *et al*, 1994); while flavonoids provide protection against diseases such as cancer, ageing, inflammation, atherosclerosis, ischaemic injury and neuro-degenerative diseases (Onyeka and Nwambekwe, 2007). Saponin was absent in *F. capensis* but present in the other vegetables. Saponins have been reported to have hypocholesterolic effect (James *et al.*, 2010).

Myrianthus arboreus and *vitex doniana* are the only vegetables which contained all the phytochemicals. Sap from the leaves of *M. arboreus* is applied topically for toothache and to the chest for bronchitis. The leaves also have good antibacterial activity and could be used in traditional medicine as therapeutic agent for controlling pathogenic bacteria (Agwa, Chuku and Obichi, 2011). The vast therapeutic uses of *V. doniana*

have been reported (Sofowora, 1993; Ukwuani *et al*, 2012; Iwueke, Nwodo and Okoli, 2006).

Table 2 shows the quantitative phytochemical analysis of the vegetables in their raw, cooked and shade dried forms. The result shows that the phytochemical contents of the vegetables are affected by processing. The phytochemical contents of most of the vegetables in their raw forms increased when shade dried and decreased when cooked; except in a few cases where they remained constant. However, the values of phytochemicals in the cooked forms of the vegetables are still very high. Onyeka and Nwambekwe, (2007), observed a similar trend in their study on phytochemical profile of some green leafy vegetables in South-East Nigeria. They observed that fresh vegetables had higher phytochemical contents (anthocyanin and alkaloids) when compared to boiled ones. In this study, it was observed that the anthocyanin value in *Pterocarpussantalinoides* remained constant at the raw, cooked and shade dried states. A similar result was also seen in *Mucuna pruriens* and *Myrianthu sarboreus* whose anthocyanin values increased for the shade dried form but remained constant for the raw and cooked forms; it was also seen in *Ficus capensis* which exhibited an increase in the shade dried form and constant values for the raw and cooked forms. Other

vegetables showed a reduction or an increase in their cooked or shade dried forms respectively. *Vitex doniana* was the only vegetable that showed an increase in phytochemical (anthocyanin) content in the cooked form in this study.

Table 3 below, shows the mean phytochemical composition of the lesser known green leafy vegetables. *Ficus capensis* (Akokoro) and *Mucuna pruriens* (Agbara) contained the highest quantities of the phytochemicals analyzed. *Ficus capensis* had the highest alkaloid, anthocyanin and carotenoid value while *Mucuna pruriens* had the highest flavonoid, saponin and glycoside value. *Vitex doniana* had the highest quantity of oxalate while *Myrianthus arboreus* had the highest quantity of tannin. Tannins have been reported to have antimicrobial, anti-diarrheal, anti-parasitic and anti-irritant property (Mensah, Okoli and Obaju- Obodo, 2008; Williamson *et al*, 1997; Lewis and Elvin-Lewis, 1998). Oxalic acid, dicarboxylic acid or its salts (oxalates) are widely distributed in plant food. These oxalates are mostly calcium salts. Rich sources of oxalate are green leafy vegetables, green vegetables and some legumes (Virginia, Swati, Sushma and Ajit, 2012).

The well-known and commonly consumed *Telfairia occidentalis* 'ugu' is ranked high by consumers despite its high cost (Mensah *et al*, 2008). The results of this study showed that *T. occidentalis* did not contain glycoside and ranked least in 50% of the phytochemicals analyzed. It was the least in alkaloids, carotenoids, flavonoids and Tannin. According to Uwakwe and Onyeka, (2007) *T. occidentalis* is one of the most cherished vegetables in South-East Nigeria but is not very rich in most phytochemicals, it ranked least in the values of anthocyanin and flavonoid phytochemicals in their study. In addition to phytochemicals, Schipper and Budd, (1994); Schipper, (2004) stated that traditional leafy vegetables have proven nutritive value in terms of having more protein, minerals, carbohydrates and vitamins than some 'exotic' vegetables. Glycoside was absent in *T. occidentalis*, *P. santalinoides* and *F. thonningii* but was present in the other vegetables.

Glycosides have been used for more than two centuries as stimulants in treatment of cardiac failure and cardiac disease (Olayinka *et al*, 1992).

The least value of the other phytochemicals: anthocyanin, oxalate and saponin were recorded for *M.pruriens*, *M. arboreus* and *F. thonningii* respectively. Saponin was richly distributed in the vegetables, except for *F. capensis* where it was absent. Saponins have been reported to have hypocholesterolic effect (James *et al.*, 2010). Saponins and tannins contribute to the ability of herbs to improve dyslipidemia (Nimenibo-uadia, 2003; Asaolu *et al*, 2012).

Phytochemicals have varying amounts in leafy vegetables. Levels of plant chemicals may vary depending on specie and varieties of green leafy vegetables (Onyeka and Nwambekwe, 2007). The following ranges were the result of the quantitative analysis of the vegetables: alkaloid ranged from 0.04-3.47g/100g, anthocyanin ranged from 0.03-0.24 g/100g, that of carotenoid was 0.04-0.53g/100g, flavonoid ranged from 0.07-3.20g/100g, glycosides ranged from 0.04-0.52 g/100g, oxalate ranged from 0.03-1.95g/100g, saponin ranged from 0.26-4.89 g/100g and that of tannin was 0.01- 3.34 g/100g. These high values indicate that the lesser known vegetables are rich in phytochemicals and may be utilized just like the conventional vegetables like *T. occidentalis* are used in food preparation.

Ficus capensis, is known as *Uwaryarain* Hausa, *Opoto* in Yoruba, *Rima bichehi* in Fulani, *Obada* in Edo language (Ayinde and Owolabi, 2009) and *Akokoro* in Igbo. Among the Igede people of Benue State, Nigeria, the leaves of *Ficus capensis* is used in treating diarrhoea using decoction method (Igoliet *et al.*, 2005). The plant leaves are also used in treating dysentery, oedema, epilepsy and rickets in infants among some tribes in Edo- Delta areas Gill (1992). *Ficus thonningii* is called *Ogbu* in Igbo. It is used to treat colds, sore throats, diarrhoea and wounds and to stimulate lactation (Ochulayi and Anekwe, 2013). *Mucuna pruriens* belongs to the family

Fabaceae and has been described as a multipurpose plant which is used extensively both for its nutritional and medicinal properties. All parts of *M. Pruriens* possess valuable medicinal properties (Adepoju and Odubena, 2009). It is known as velvet bean (English), Agbara (Igbo), Yerepe (Yoruba), Karara (Hausa) (Manyham *et al*; 2004). The effects of the leaves and seeds on man have been widely explored. For instance, its analgesic and anti-inflammatory activities (Adepoju and Odubena, 2009), anti-neoplastic, anti-epileptic and anti-microbial (Sathiyarayanan and Arulmozhi, 2007) and its use as a fertility agent in men (Buckles, 1995) have been reported. Furthermore, leaf extract of the plant have been reported to have significantly reduced serum levels of total cholesterol, triglyceride and low-density lipoprotein and increased serum levels of high-density lipoprotein in Alloxan-induced diabetic Wistar rats (Ezeet *al*; 2012). *Pterocarpus santalinoides* is called Nturuksa in Igbo. Its leaves possess analgesic activity (Anowi *etal*; 2012). *Myrianthus arboreus* is an indigenous wild plant used for food and medicine. The young leaves are eaten as vegetable. Within the continents of Africa, such as Nigeria and Congo, the leaves serve as an analgesic given to young children against fever and are applied as an enema to treat pain in the back and loins. Chopped leaves are eaten raw with salt for heart troubles, pregnancy complications, dysmenorrhea, incipient hernia and a plaster made of beaten leaf applied to boils (Agwa, Chuku and Obichi, 2011).

In conclusion, the result of this study showed that the lesser known green leafy vegetables: *Ficus capensis* (Akokoro), *Pterocarpus santalinoides* (Nturuksa), *Vitex doniana* (Uchakiri), *Ficus thonningii* (Ogbu), *Mucuna pruriens* (Agbara) and *Myrianthus arboreus* (Ujuju) are rich in most of the phytochemicals analyzed. They may be utilized for various therapeutic purposes as claimed by the rural consumers in their raw forms and can also be used in preparation of various soups and pottages. In addition, these lesser known vegetables are fresh and abundant during the dry seasons; their consumption

will reduce the cost of purchasing the well-known and commonly consumed leafy vegetables like *T. occidentalis* (which are scarce in dry seasons) and will bring about variety in our diets.

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