

Assessment of the Phytochemical Contents and Antioxidant Activities of Some Herbs and Spices in South-Eastern Nigeria

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ABSTRACT

The phytochemical contents and the antioxidant activities of extracts of some herbs and spices (*Glycyrrhizaglabra*, *Tetrapleuratetra* *Monodoramyristica*, *Xylopii* *aethiopia*, and *Gongronemalatifolium*) consumed mostly in South East, Nigeria, were assessed. The determination of the antioxidant capacities of the group of phytochemicals present in the selected culinary herbs and spices was based on different radicals and mechanisms of reaction, using AOAC methods and common assays. The assays include 2-2 Diphenyl - 1- picrylhydrazyl (DPPH) free radical scavenging activity and Ferric Reducing Antioxidant Power (FRAP). The phytochemicals assessed and the range of values obtained in mg/100g were: Flavonoid (0.095 to 0.493); Phenol (0.082 to 0.285); Tannin (18.08 to 39.74); Anthocyanin (0.002 to 0.0053); Carotenoid (0.11 to 0.33); Alkaloid (0.013 to 0.063); Phytate (0.22 to 0.55); Oxalate (0.013 to 0.02); and Saponin (3.4 to 5.00). These phytochemical values differed significantly ($P > 0.05$) among the herbs and spices with except Anthocyanin. The extracts from the *Tetrapleuratetra* (*Aidan* fruit) had the highest value for tannin, carotenoid, alkaloid, and oxalate. Out of the five samples evaluated *Xylopii* *aethiopia* (92.5mg/100g) had the best free radical scavenging activity followed by *Gongronemalatifolium* (88.7mg/100g) and *Monodoramyristica* (77.6mg/100g). The FRAP values (217.15 – 675.42) mg/ml varied significantly among the herbs and spices. The FRAP analysis indicated that *Aidan* fruit had the highest antioxidant activities thus is capable of scavenging free radicals and reducing the risk of cancer and chronic diseases. The study, therefore, recommends the greater use of the *Aidan* fruit extract in food applications.

Keywords: Herbs, Spices, Phytochemicals, Antioxidant, Activities.

INTRODUCTION

Spices and culinary herbs are key dietary ingredients used across cultures, worldwide. The rural and urban population in Nigeria has resorted to natural food ingredients particularly because they are readily available, safe and much more so, due to prevalence of diseases and numerous side effects of synthetic medicine. Spices and herbs are large group of such natural ingredients, made up of the leaves, roots, bark, berry, rhizomes, buds, seeds and the Stigma of a plant or flower used for the purpose of cooking. Their usage are primarily associated with the enhancement of the flavour of foods including meats, sauces, vegetables and deserts (Tapsellet *et al.*, 2006). They have been widely used as preservatives, medicine and to improve organoleptic properties of food. Beyond acting as a replacement for salt, the nutritional contribution of these dietary plants has in the past been deemed negligible probably because of the relatively small, although increasing amounts consumed (Carlsenet *et al.*, 2011; Pérez-

Jiménez *et al.*, 2011). However, the literatures indicate that within the last decade, this view is beginning to change, research into their role as contributors of dietary polyphenols, known to possess a number of properties associated with reducing the risk of developing chronic non-communicable diseases has increased. Being that these foods are consumed, normally in small quantities and in combination with other foods, it is still unclear what their true benefits are from a health perspective. Studies have shown that herbs and spices are rich in phytochemicals and can be consumed or used.

These phytochemical compounds are produced by plants through primary and secondary metabolisms. Many of these compounds convey known nutritional, biological and pharmacological benefits (Mama and Jyoti 2012; Okwu, 2004). Recently, the impact of the phytochemical properties of food on human health and their preventive actions against diseases has caught the world's attention (Gruenwald *et al.*, 2010; kim; *et*

al., 2012). Spices and herbs have been extensively studied in different countries because of the high antioxidant activity in certain spices and their beneficial effects on human health (Baselga – Escudero *et al.*, 2017; Patra *et al.*, 2016). According to Charles, (2013) and Srinivasan, (2014), spices and herbs as part of our diet in addition to fruits and vegetables could provide us with additional sources of natural antioxidant compounds, sulphur containing compounds, tannins, alkaloids, phenolic diterpenes and vitamins etc. These compounds demonstrate different antioxidant activities. For example, flavonoids have the ability to scavenge with catalytic metal ions rendering them inactive.

Due to the paucity of information on health benefits of herbs and spices which have been used for centuries as flavoring ingredients in many traditional dishes, prominent Nigerian herbs and spices such as Bushbuck (*Gongronemalatifolium*) African Nutmeg (*Monodoramyristica*) Negro pepper (*Xylopiiathiopica*) liquorice (*Glycyrrhizaglabra*) and Aidan fruits (*Tetrapleuratetraptera*) commonly used in the South East Nigeria need to be evaluated for their phytochemical composition and antioxidant properties for broader application in food processing and preservation.

The medicinal value of plants lies in some chemical substances that produce a definite physiological action on the human body. The knowledge from this study will elucidate the usefulness and further confirm their individual attributes towards keeping the body healthy as we consume them. The information will serve to encourage more and versatile application of these herbs and spices, thus enlarge the value chain.

MATERIALS AND METHODS

The samples: Bushbuck (*Gongronemalatifolium/utazi*), Negro pepper (*Xylopiiathiopica/uda*), Liquorice (*Glycyrrhizaglabra/oburumgbede*), African nutmeg (*Monodoramyristica/Ehuru*) and Aidan fruits (*Tetrapleuratetraptera/ Oshorisho*) were purchased from from a local market at Onuimo Local Government Area, Imo State, Nigeria. The samples were later sorted at the laboratory of food science and technology Imo State University.

Sample Preparation

The leafy Bushbuck was thoroughly washed with water and air dried (ambient temperature, $31 \pm 3^\circ\text{C}$) for 72 hours. The leaves were pulverized using a mechanical grinder.

The seeds of African nutmeg were sorted and cracked to recover the nibs. The Negro pepper was sorted. The fruits of Aidan were cleaned and the peels were further dried at ambient condition. The roots of liquorice were thoroughly washed under a running water to remove sand and sun dried for 72 hours. The five dried samples of herbs and spices were separately pulverized into powder using a mechanical grinder, ready for further analysis.

Determination of Phytochemical Compositions

The total flavonoid content of each extract was determined using a slightly modified method reported by Meda *et al.*, (2005), with caffeic acid as a standard solution. The total phenolic contents of the extracts were determined using the method described earlier by Singleton and Rossi (1965), expressed as gallic acid equivalents (mg/100g) of the extract.

The Follin-Denis spectrophotometric method described by Onwuka (2005) was used to determine the tannin contents of the extracts. The titration method described by Onwuka (2018), was used to determine the oxalate (% oxalic acid) contents.

The total anthocyanin content (TAC)(mg/L) was determined by the pH differential method (Giusti and Wrolstad, 2001). The phytate content (phytic acid (%)) was determined using the method of Onwuka (2005).

The Spectrophotometric method explained by Onwuka (2005), was used to determine the saponins of the extracts (% Saponins). The alkaloid content (% Alkaloid) was determined gravimetrically by method of Harborne, (1973). The Carotenoid content was determined using the method AOAC (2000).

Determination of Antioxidant Properties of Samples

Antioxidant Activity

Ferric Reducing Antioxidant Power (FRAP ASSAY)

The FRAP Assay was carried as described by Benzie and Strain (1996). With minor modifications for assay on a 96-well microplate.

Determination of Total Antioxidant Activity

The 2, 2- Diphenyl-1-Picrylhydrazyl Free Radical Scavenging Activity (DPPH Assay)

Was estimated using the method described by Sahin *et al.*, (2004).

Statistical Analysis

All analyses were performed in triplicates. Data were analyzed using SPSS (statistical packages for social science, version 16.0, IBM Corporation, NY, WA, USA). Statistical analysis of the data was conducted using Tukey's test. $P < 0.05$ was considered statistically significant.

Table 1. Phytochemical composition of five culinary herbs and local spices

Samples(mg/100g)	Flavonoid	Phenol	Tannin	Anthocyanin	Carotenoid	Alkaloid	Phytate	Oxalate	Saponin
Liquorice	0.0950 ^c	0.1860 ^c	18.08 ^c	0.0035	0.11 ^c	0.019 ^b	0.37 ^d	0.019 ^b	4.7137 ^b
Aidanfruit	0.1950 ^d	0.0820 ^e	39.74 ^a	0.0021 ^a	0.30 ^a	0.063 ^a	0.22 ^e	0.02 ^a	5.0 ^a
African nutmeg	0.4930 ^a	0.1140 ^d	18.90 ^d	0.0041 ^a	0.31 ^a	0.013 ^b	0.55 ^a	0.113 ^c	3.4 ^d
Negro pepper	0.2660 ^c	0.2850 ^a	20.39 ^b	0.0045 ^a	0.33 ^a	0.017 ^b	0.50 ^b	0.017 ^c	4.44 ^c
Bush buck	0.3970 ^b	0.2460 ^b	18.44 ^c	0.005 ^a	0.21 ^b	0.016 ^b	0.44 ^c	0.016 ^d	4.9a ^b
LSD	0.0686	0.02186	0.13562	0.0556	0.0882	0.0160	0.04196	0.00038	0.2516

Mean having different superscripts along the same column are significantly different ($p \geq 0.05$).

Flavonoid Content

The total flavonoid content of liquorice, aidan fruit, African nutmeg, Negro pepper and Bushbuck, were presented in Table.1 as 0.0950, 0.1950, 0.4930, 0.2660 and 0.3970 (mg/100g). The African nutmeg (Ehuru) contained more flavonoid (0.4930) than the other samples while liquorice (Oburumgbede) had the least (0.0950). The value obtained for Aidan fruit (0.1950) was relatively higher than 0.05 to 0.07mg/100g reported by Ugwuona, (2014). Flavonoids are widespread plant secondary metabolites, namely flavones, flavonols. Flavonoids in human diets may reduce the risk of various cancers as well as prevent menopausal symptoms (Ross and Kasum, 2002). Epidemiological studies suggest that consumption of fruits, vegetable and spices which contains lots of flavonoids was effective in lowering the risk of coronary heart diseases (Rice- Evans *et al.*, 1996).

Phenol Content

The total phenol content of the samples ranged from 0.082 to 0.285mg/100g, with significant differences. The Negro pepper(Uda) had the highest phenolic content of 0.285mg/100g while liquorice had the least (0.082mg/100mg). Phenols are one of the major groups of non-nutritive dietary components that have been associated with the inhibition of cancer, arteriosclerosis, as well as ameliorating age- related degenerative brain disorder (Wang *et al.*, 1998; Chang *et al.*, 2002).

Tannin Content

The values of the total tannin extracted from the herbs and spices were presented in table 1 as

RESULTS AND DISCUSSIONS

Phytochemical Composition of Culinary Herbs and Local Spices

The phytochemical compositions of selected culinary herbs and local spices commonly used in Nigeria were studied and the values obtained presented in Table 1. The herbs and spices that were studied include Oburumgbede, Oshorisho, Ehuru, Uda and Utazi.

18.08, 39.74, 18.90, 20.39 and 18.44(mg/100g) for liquorice, Aidan fruit, African nutmeg, Negro pepper and bushbuck respectively. The Aidan fruit had the highest concentration (39.74mg/100g) of tannin while liquorice had the least (18.08mg/100g).

The presence of tannins in these spices and herbs supports their uses in traditional medicine for the treatment of different diseases like diarrhea and dysentery. This was corroborated by Smirnoff (2000), who reported that edible plant materials containing tannins are astringent and are used for treating intestinal disorder such as diarrhea and dysentery.

Anthocyanin Content

The concentration of anthocyanin in the herbs and spices as were extracted ranged from 0.002 to 0.005mg/100g. In spite of the insignificant differences in the anthocyanin content of the samples, bushbuck had the highest concentration while aidan fruit had the least. SUgwuona (2014) reported varied anthocyanin values(0.01 – 0.05mg/ 100g) of selected spices. Anthocyanins are known to inhibit LDL oxidation and LOL-mediated macrophage apoptosis, serving as a chemo-preventive agent (Tseng *et al.*, 1992). Anthocyanins may be useful in preventing the deleterious consequences of oxidative stress; and that is the main reason for increasing interest in the protective biochemical functions of many natural bioactives, including anthocyanin in spices, herbs and medicinal plants (Osawa and Namiki,1981).

Carotenoid Content

The carotenoid contents of the samples were: 0.11, 0.30, 0.31, 0.33 and 0.21mg/100mg for samples liquorice, aidan fruit, African nutmeg, Negro pepper and bushbuck respectively, (Table 1). The aidan fruit, African nutmeg and Negro pepper similar carotenoids contents.

Alkaloid Content

The alkaloid contents of the extracts were: 0.019, 0.063, 0.017 and 0.016mg/100g for samples liquorice, aidan fruit, African nutmeg, Negro pepper and bushbuck respectively. All the extracts had similar value, except that of the Aidan fruit which varied significantly. Alkaloids are secondary metabolites which has been associated with numerous physiological activities in human cells. Mishra *et al.*, (2009) and Ujowundu *et al.*, (2010), reported that plants containing alkaloids and flavonoids have diuretic, antispasmodic, anti-inflammatory and analgesic effects.

Phytate Content

The Phytic acid contents of the herbs and Spices were: 0.37, 0.22, 0.55, 0.50 and 0.44mg/100g (Table1) for liquorice, Aidan fruit, African nutmeg, Negro pepper, and bushbuck respectively. Phytate is a very stable and potent chelating food component that is considered to be an antinutrient by the virtue of its ability to chelate divalents metals and prevent their absorption (Oboh, 2006). However, it has been shown to have anticancer and antioxidant activity.

Oxalate Content

The concentration of oxalate extracted from the selected herbs and spices were shown to be 0.019, 0.020, 0.013, 0.017 and 0.016 mg/100g four samples liquorice, Aidan fruit, African nutmeg, Negro pepper and bushbuck respectively. The oxalate concentration in the samples are low and advantageously confers antioxidant activity in humans. Dietary oxalate has also been shown to complex with calcium, magnesium and iron, forming insoluble oxalate salts which cause oxalate stone (Oke, 1966). Oxalic acid Chelate radical-initiating divalent metals thereby reducing incidence of oxidative degenerative diseases in human.

Saponin Content

The Saponin contents of the various herbs and spices were: 4.17, 4.99, 3.39, 4.44 and 4.9mg/100g. The saponin content of Aidan fruit was the

highest, while there was no significant variations in the saponin contents of liquorice and bushbuck. The saponin content of 0.16 to 0.60mg/100g and 0.01 to 0.74mg/100g were reported by Ugwuona (2014), for Oshorisho and Ehuru respectively and the values are low when compared to all values obtained in this present work. Saponins constitute a key ingredient in traditional Chinese medicine and are responsible for many of the attributed biological effects (Ugwuona, 2014). They reduce uptake of glucose and cholesterol through intraluminal physiochemical interaction during food transition in the gut. This could confer chemoprotection against heart diseases.

Antioxidant Activities of the Culinary Herbs and Spices

The antioxidant activities of the extracts were evaluated using two common assays based on different radicals and mechanism of reaction, in order to assess the antioxidant capacities of the group of phytochemicals present in the herbs and spices.

Table 2. Antioxidant activities of culinary herbs and spices

Samples	Scavenger (FRAP)	Antioxidant (DPPH)
liquorice	217.1500 ^c	0.000 ^d
Aidan fruit	675.4200 ^a	0.000 ^d
African nutmeg	316.4700 ^c	77.6000 ^c
Negropepper	283.5600 ^d	92.5000 ^a
Bushbuck	568.2700 ^b	88.7000 ^b

Mean having different superscripts along the same column are significantly different ($p \geq 0.005$)

The 2, 2-diphenyl-1-picrylhydrazyl (DPPH) radicals were widely used in model system to investigate the scavenging activities of several natural compounds such as flavonoids and phenols. The results showed that the highest free radical scavenging activity was observed in the Negro pepper (92.5mg/ml) followed by bushbuck (88.7mg/ml) and African nutmeg (77.6mg/ml). Liquorice and Aidan fruit were found to be without scavenging activities. There were significant differences ($p < 0.05$) among samples where free radical scavenging activities were observed. Negro pepper had the highest antioxidant which is capable of scavenging free radicals thereby reducing the risks of cancer and chronic diseases.

The FRAP analysis is a measure of antioxidant activity according to the reducing ability or antioxidant power of the extracts. In this present study, the FRAP values of the extract of all

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culinary herbs and spice used ranged from 217.15(liquorice) to 675.42(mg/100g)(Aidan fruit), with significant ($P < 0.05$) difference among the samples.

CONCLUSION

The results obtained in this work, have shown that the five spices and culinary herbs possessed varying levels of different phytochemical constituents. The Aidant fruit (Oshorisho) had the highest tannin, alkaloid, oxalate, saponin contents and but was insignificantly different in its anthocyanin content, when compared to other samples. Consequently, it had the highest antioxidant activities (from FRAP value) and is therefore capable of scavenging free radicals as well as reduce the risk of cancer and chronic diseases. Secondly, the Negro pepper (Uda) had high phytochemical compositions and free radical scavenging abilities. These herbs and spices could thus, be used to manage free radical-related degenerative diseases by exploiting them as natural antioxidants in food systems.

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