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INVESTIGATION ON THE MEDICINAL AND NUTRITIONAL POTENTIALS OF SOME VEGETABLES CONSUMED IN EKITI STATE, NIGERIA

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ABSTRACT: *Nine medicinally important vegetables consumed in Ekiti State, Nigeria were analyzed to determine their proximate and phytochemical contents using standard analytical procedure. These vegetables are Corchorus. olitorious L., Cnidoscolus acontifolius Mill., Vernonia amygdalina L., Cucurbita pepo L., Ocimum gratissimum L., Senecio biafrae Olive & Heirn., Moringa oleifera L., Telfaria occidentalis Hook. F. and Hibiscus asper Hook. F.. The phytochemical analysis revealed the presence of reducing sugar in all the plant samples analyzed. Saponins and tannins were discovered in four of the plant samples. Seven of the nine plants have philobatannins and cardiac glycosides while alkaloids and steroids were detected in two samples. Anthroquinine was absent in all the vegetable plants. Quatitative phytochemical analysis further revealed reducing sugar, tannins, flavonoids, saponins alkanoids and phenols composition in different proportions, with values ranging from 141.88 mg/100g to 210.07 mg/100g, 44.05 mg/100g to 70.89 mg/100g, 11.71 mg/100g to 41.08 mg/100g, 0.76 mg/100g to 5.88 mg/100g, 163.77 mg/100g to 269.86 mg/100g, and 110.43 mg/100g to 116.68 mg/100g respectively. The percentage proximate values for moisture content, ash, crude fat, crude protein crude fibre and carbohydrate content in the leaves ranged from 50.20% to 88.30%, 7.67% to 10.17%, 1.53% to 4.99%, 13.70% to 24.90%, 10.10% to 21.81% and 40.99% to 53.04% respectively. The results of the study lend credence to the significance of the nine vegetables in the treatments and prevention of various ailments and diseases. Furthermore, high protein, fibre, carbohydrates and low fat contents justify their nutritional importance in human daily diet.*

KEYWORDS: Proximate, phytochemical, medicinal plants, vegetables

INTRODUCTION

Medicinal plants are plants used in treating and preventing specific ailments and diseases that affect plants and human beings. Medicine from plant sources have been in use throughout ages and thus play significant role among the rural dwellers. About 80% of the people in the developing countries relied on the use of botanicals for their primary health care (Muthu *et al*., 2006). Interestingly, some medicinal plants are known to be good vegetables. They have both the medicinal and nutritional properties. They are cheap source of protein, vitamins and essential amino acids (Amaechi, 2009). There had been an increased interest in various disciplines on the importance of medicinal plants and the contribution of phytomedicine to the well-being of great number of the world's population (Bimpa *et al*., 2007). According to Sofowora (1996); Edeoga and Okwu (2005), medicinal plants contain some biological active chemical substances such as,

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flavonoids, saponins, tannins, alkaloids and phenolic compounds that produce definite physiological and biological actions in the human body. Wargovich (2000) described fruits and vegetables as a treasure house of variety of nutrients and bioactive phytochemicals which are the important component of human daily diet. Wild vegetables in particular, play significant roles in the livelihood of many communities in the developing countries of the world as food and for medicinal purposes (Arowosegbe, 2013) Vegetables have relative high nutritional values and their consumption gives diversity to daily food intake (Ahuhuendo *et al*., 2012). Nigeria is blessed with abundant supply of both cultivated and non-cultivated vegetables that grow seasonally (Oyeyemi and Tedela, 2014). Many of these vegetables are underutilized because of inadequate scientific knowledge of their nutritional potentials (Awobajo *et al*., 2010) as well as their medicinal uses (Jimoh *et al*., 2010). Many of the medicinal plants, especially in Nigeria have been documented (Gills, 1992). However, there is a need to investigate what confer the medicinal and nutritional properties of these vegetables particularly the ones found in Ekiti State.

Telfairia occidentalis Hook. F (Fluted pumpkin) is a species of Cucurbitaceae family in the tropics largely consumed in Nigeria. The plant is a large dioecious perennial with luxuriant edible green leaves which are rich in iron and vitamins. Stem of the plant have branching, long twisting tendrils and the leaves are divided into three to five leaflets with terminal leaflets up to 15cm long. The plant is grown principally for its leaves and seeds which are important vegetables. It is mostly propagated using the seeds. It survives drought and can retain its life in the root even after many years (Balogun *et al*., 2007). The plant is used for the treatment of anaemia, curing of heart disease, hypertension, and diabetes and even in fatal cases of meningitis (Gills, 1992).

Curcubita pepo L. also called summer squash, vegetable marrow or pumpkin belongs to the family curcubitaceae. The plant is an annual climber, strongly branched with angular and often grooved stem. Leaves are alternate, simple and without stipules. *C. pepo* is used in treatment of headache, hypertension, and erysipelas (Gurib.Fakim *et al.*, 1996*).* The seed is also used in prevention of kidney stones, while the seed oil is used as salad oil (Ghirmay *et al.*, 2002*).*

Corchorus olitorious L. is an annual much branched herb belonging to the family Malvaceae; it grows in grass land and fallow or abandoned fields. It is called jute mallow, bush okra, tossa jute or Jew's mallow. Stems are glabrous, leaves are 6-10 cm long, 3.5-5 cm broad, elliptic-lanceolate. Flowers are pale yellow, bracts lanceolate, pedicles are 1-3and very short. Seeds are trigonous and black (Kirtikar and Basu, 1975). Root scraping of *C. olitorous* are used for the treatment of toothache, and root decoction as tonic (Schippers, 2000). The leaves are used for the treatment of gonorrhea and as purgative and febrifuge (Burkill, 2000).The plant has also been reported to have phytoremediation ability in petroleum-contaminated soils (Kelechi *et al*., 2012)

Moringa oleifera L. is a pan-tropical species that is known as drumstick, kelor or marango. (Fahey, 2005). It belongs to the family Moringaceae. *M. oleifera* can be grown in a variety of soil condition. However, it prefers well drained sandy or loamy soil that is slightly alkaline (Abdul, 2007, Anjorin *et al*., 2010). The tree is rather slender with dropping branches that grow to about 10 m in height. The plant is considered one of the World's most useful trees, as almost every part of the tree can be put to some beneficial uses. Various parts of the plants acts as cardiac and circulatory stimulants, possess antitumor, antiepileptic, anti-inflammatory, antiulcer, cholesterol lowering, antidiabetic, antibacterial and antifungal properties (Fahey, 2005).

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Hibiscus asper Hook. F. of the family Malvaceae is widely distributed throughout tropical Africa. (Baerts and Lehmann, 2002). It grows in fallow fields, grassland and edges of gallery forest. It is a perennial herb up to 2 m tall, stems are with five prickles and simple or stellate hairs. Leaves are alternate, simple and stipules up to 6 mm long; petiole 0.5-18 cm long; blade lanceolate to ovate, unlobed or shallow to deep palmately 3-5 lobed up to 18 cm × 14 cm. The flowers are auxillary solitary or clustered. The plant is used to treat urethutis as well as anaemia and jaundice (Baerts and Lehmann, 2002). It is also used to treat malaria, painful and irregular menstruation (Burkill, 1997). *H. asper* Calyx is eaten as a boiled vegetable. *Senecio biafrae* Olive & Hiern belongs to the family Asteraceae and tribe Scenecioeceae. The common name is Bologi. It is a perennial climbing herb, with stem up to 3 m long. It is a strongly branched and succulent plant. The leaves are alternate, simple or deeply pinnately lobed, more or less succulent, stipule absent, with petiole 1-10 cm long. The flower is a headed structure with many flowers, homogamous, peduncle 5-10 cm long, involucral bracts 4-6 with bisexual flowers. It occurs naturally in the forest zone most especially in Cocoa plantation. *S. biafrae* leaf extract is used to stop bleeding from cuts or injury and treatment of eye sores (Adebooye, 2001). It is also used in treatment of pile, hypertension, low sperm count and dysentery (Kadiri *et al*., 2012).

Ocimum gratissimum L. is an aromatic perennial shrub which belongs to family Lamiaceae (USDA, 2008). It is widely distributed in the tropics of Africa and Asia (Effraim *et al*, 2001). *O. gratissimum* is a perennial plant with an average height of 1-3 m. It has broad and narrowly ovate leaves usually 5-13 cm long and 3-9 cm wide. In Folklore medicine, *O. gratissimum* is extensively used throughout West African as a febrifuge, anti-malaria and anti-convulsant. The crushed leaf juice is used in the treatment of convulsion, stomach pain and catarrh (Ezekwesili *et al*., 2004). In the Eastern part of Nigeria, it is also used in the management of baby's cord and in the treatment of fungal infections, fever and cold (Iwu, 1993). *O. gratissimum* is used in the treatment of epilepsy (Osifo, 1992), high fever (Oliver, 1980) and diarrhea (Sofowora, 1993). Decoctions of the leaves are used to treat mental illness (Abudulralman, 1992). *Vernonia amygdalina* L. is a perennial shrub that belongs to the family Asteraceae. The plant grows throughout tropical Africa. The leaves are ellstoc and with a characteristics odour and bitter taste. The plant has been domesticated in many part of West Africa (Igile *et a*l., 1994). In some parts of Nigeria, the stems are used as chewing sticks for oral hygiene and for the management of some dental problems (Igile *et al*., 1994). Its leaves are used for treating malaria fever and cough as well as for tropical treatment of wounds (Iwu, 1986). It is also used by traditional birth attendants to aid the expulsion of the placenta after birth.

Cnidoscolus aconitifolius Mill. belongs to the family Euphorbiaceae. It is an evergreen, drought-tolerant deciduous shrubs, up to 6 m in height with alternate palmate lobed leaves. It has a succulent stems which exude a milky sap when cut. The plant is commonly known as Khaya. Nutritionally, *C. aconitifolius* is one of the richest sources of nutrients among the green leafy vegetables with high levels of proteins, calcium, iron and carotene (Ross-Ibarra and Molina Cruz, 2002). *C. aconitifolius* is used as food and medicine. It cures wide range of skin infections and serves as anti-inflammatory for veins. It helps in stimulation of liver and promotes good blood circulation (Ross-Ibarra and Molina Cruz, 2002).

MATERIALS AND METHODS

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The materials used were nine medicinally important vegetable plants collected from Iworoko Ekiti and Ifaki Ekiti in Ekiti State. These towns are situated at about 3 km and 9 km respectively from the campus of Ekiti State University, Ado Ekiti, (7^0 29^1N, 5^0 13^1E). These vegetables are *Corchorus. olitorious* L. (Ewedu), *Cnidoscolus acontifolius* Mill. (Iyana Ipaja), *Vernonia amygdalina* L. (Ewuro), *Cucurbita pepo* L. (Elegede), *Ocimum gratissimum* L. (Efirin), *Senecio biafrae* Olive & Heirn. (Worowo), *Moringa oleifera* L. (Ewe Igbale), *Telfaria occidentalis* Hook. F (Aproko). and *Hibiscus asper* Hook. F. (Isapa). Authentication of the plants was done in the herbarium of Plant Science Department, Ekiti State University, Ado Ekiti.

Preparation of the Plant Samples

The leaf samples taken from mature plants were air dried at room temperature for two weeks and ground into fine powder using a milling machine (Miller's blender). The aqueous extract of each sample was prepared by soaking 100 g in 300 ml of distilled water and kept in the dark for 96 h. The extracts were filtered and the filtrates were collected for the analysis.

Phytochemical Screening

Basic phytochemical screenings were carried out on the aqueous extract and the dried samples using standard procedures to identify the chemical constituents as described by Sofowora (1993), Tease and Evans (2005), Obadoni and Ochuko (2001), Singleton *et al*. (1999), Atoui *et al*. (2005) and Amakura *et al*. (2009). The presence of active constituents such as tannins, alkaloids, philobatanins, flavonoids, terpenoids, cardiac glycosides, saponins, terpenoids and reducing sugar were investigated.

Test for Tannins

About 0.5g each of the dried samples was boiled in 20 ml of distilled water in a test tube and then filtered. A few drop of 0.1% ferric chloride was added and observed for brownish green or blue coloration (Tease and Evans, 2005), indicating the presence of tannins.

Test for Saponins

About 2 g each of the powdered samples was boiled in 20 ml of distilled water in a water bath and filtered. 10 ml of the filtrate was mixed with 5 ml of distilled water and shaken vigorously for a stable persistent froth. The frothing was mixed with 3 drops of olive oil, shaken vigorously, and then observed for the formation of emulation (Sofowora, 1993).

Test for Steroids

About 2 ml each of concentrated H_2SO_4 and Acetic Anhydride were poured into 5ml each of the aqueous extract samples. The colour changed from violet to blue or green in some samples indicating the presence of steroids (Tease and Evans, 2005).

Test for Alkaloids

Five grams each of the crude powdered samples was defatted with 5% ethyl ether for 15 min and extracted for 20 min with 5 ml aqueous HCL on a boiling water bath. The resultant mixture was centrifuged for 10 min at 3000 rpm. One milliliter (1 ml) of the filtrate was treated with few drops

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of Mayer's reagent and another 1 ml with Dragendoff's reagent. Creamish/ Brown/ Red/ Orange precipitate show the presence of alkaloids.

Test for Terpenoids

About 5 ml of each extract was mixed in 2 ml of chloroform and 3 ml of concentrated H_2SO_4 was carefully added to form a layer. A reddish brown coloration of the interface was formed to show positive results for the presence of terpenoids (Tease and Evans, 2005).

Test for Flavonoids

A portion each of the powdered plant samples was put in each test tube, heated with 10 ml of ethyl acetate over a steam bath for 3 min. The mixture was filtered and 4 ml of the filtrate was shaken with 1 ml of dilute ammonia solution. A yellow coloration was observed, indicating a positive test for flavonoids (Sofowora, 1993).

Test for Anthraquinone

About 5 g of each powdered sample was boiled in 10 ml of aqueous HCL and filtered while hot. The filtrate was shaken with 5 ml of benzene. The layers were separated and 5 ml of 10% ammonia solution was added. A pink or red coloration was observed in the lower phase which indicates the presence of anthraquinone.

Test for Philobatannins

Deposition of a red precipitation when an aqueous extract of each plant sample was boiled with 1 % aqueous hydrochloric acid was taken as an evidence for the presence philobatannins.

Test for Cardiac Glycosides

About 5 ml of each extract was treated with 2 ml of glacial acetic acid containing one drop of ferric chloride solution. This was underplayed with 1 ml of concentrated sulphuric acid. A brown ring of the interface indicates a deoxysugar characteristic of cardenolides. A violet ring may appear below the brown ring while in the acetic acid layer, a greenish ring may form just gradually throughout the thin layer (Tease and Evans, 2005).

Test for Reducing Sugar

About 5 g each of the dried samples was introduced into a test tube and equal amount of Fehling's solution A and B were added. The mixture was boiled over a burner. Observation of colour were made. The colour changed from deep blue to brick red, indicating the presence of reducing sugar (Sofowora, 1993).

Quantitative Analysis

The quantitative amount of phytochemicals found in the plants extracts were determined using standard procedure as described by Singleton (1999), Obadoni and Ochuko (2001), Tease and Evans (2002), Atoui *et al*. (2005) and Amakura *et al*. (2009).

Proximate Analysis

Proximate composition (moisture, crude protein, crude fat, ash and crude fiber) were determined by the standard methods of the Association of Official Analytical Chemist (AOAC, 1990) with little modification. Moisture content was determined by heating 2.0 g of the powdered sample to

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a constant weight in a crucible placed inside ovum at temperature of 105℃. The dry matter was used in the determination of the other parameters. The crude protein content was calculated by multiplying the total organic nitrogen by 6.25 (AOAC, 2005). Crude fat was obtained by exhaustively extracting 5.0 g of the sample in a Soxhlet apparatus using petroleum boiling range 40-60 ℃ as the extract. Ash content was determined by incineration 10.0 g of each sample placed in a muffle furnace maintained at 550 ℃ for 5 h. Crude fiber was obtained by digesting 2.0 g of sample with H_2SO_4 and NaOH and incinerating the residue in a muffle furnace maintained at 550 ^{0} C for 5 h. Carbohydrate content was determined according to Onwuka (2005) calculation equation i.e Available carbohydrates = (% moisture+ % Ash + % protein + % fibre). Each analysis was carried out in triplicate.

Statistical Analysis

Samples were analyzed in triplicates and Analysis of variance (ANOVA) was conducted to determine significant differences, while means were separated using Duncan's Multiple Range Test (DMRT).

RESULTS

Table 1: The qualitative phytochemical constituents of the leaves of some vegetables consumed in Ekiti State, Nigeria.

Medicinal plant	Sap.	Terp.	Alkl.	Philob.	Ster.	Flav.	Tann.	C. glyc.	Anthr.	Red. sugar
T. occidentalis. Hook. F	+	+	-	-	-	+	+	+	-	+
C. olitorious L.	-	+	-	-	-	+	-	+	-	+
C. pepo L.	-	-	-	+	-	-	-	-	-	+
M. oleifera L.	-	-	-	+	-	+	-	-	-	+
O. gratissimum L.	+	+	+	+	-	+	+	+	-	+
V. amygdalina L.	-	+	-	+	+	+	+	+	-	+
C. acontifolius Mill.	+	+	-	-	-	-	+	-	-	+
H. asper Hook.F	-	+	+	+	-	+	-	+	-	+
S. biafrae Olive & Hiern	+	+	-	-	+	+	-	+	-	+

Sap.- Saponnis, Terp.- Terpenoids, Alkl.- Alkaloids, Philob. - Philobatanins, Ster. - Steroids, Flav.- Flavonoids, Tann. – Tannins, C. glyc. – Cardiac glycosides, Anthr. – Anthraquinone, Red. Sugar – Reducing sugar. (+) Presence, (-) absence of the respective phytochemicals

Table 2: The quantitative phytochemical composition of the leaves of some vegetables consumed in Ekiti State, Nigeria.

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Medicinal Plant	**Tannins (mg/100g)**	**Flavonoids (mg/100g)**	**Saponins (mg/100g)**	**Alkaloids (mg/100g)**	**Phenols (mg/100g)**	**Reducing Sugar (mg/100g)**
T. occidentalis. Hook. F	53.47±0.20^{e}	4.03±0.06^{g}	2.97±0.03^{a}	0.00±0.00^{c}	112.53±0.13^{c}	147.79±1.12^{e}
C. olitorious L.	0.00±0.00^{e}	41.08±0.08^{a}	0.00±0.00^{d}	0.00±0.00c	0.00±0.00^{c}	148.48±1.01^{e}
C. pepo L.	0.00±0.00^{e}	0.00±0.00^{h}	0.00±0.00^{d}	0.00±0.00c	0.00±0.00^{c}	141.88±0.54^{g}
M. oleifera L.	0.00±0.00^{e}	11.71±0.15^{f}	0.00±0.00^{d}	0.00±0.00c	0.00±0.00^{c}	187.76±0.30^{b}
O. gratissimum L.	68.71±0.20^{b}	24.14±0.16^{e}	5.88±0.13^{a}	269.86±0.13^{a}	0.00±0.00^{c}	210.07±0.09^{a}
V. amygdalina L.	70.89±1.95^{a}	30.91±0.14^{c}	0.00±0.00^{d}	0.00±0.00^{c}	110.4±0.60^{a}	165.12±0.30^{d}
C. acontifolius Mill.	44.05±0.10^{d}	0.00±0.00^{h}	0.76±0.02^{c}	0.00±0.00^{c}	115.59±0.16^{a}	145.02±1.86^{f}
H. asper Hook.F	0.00±0.00^{e}	29.86±0.15^{d}	0.00±0.00^{d}	163.77±0.27^{b}	116.68±0.09^{a}	185.67±3.23^{b}
S. biafrae Olive & Hiern	0.00±0.00^{e}	36.76±0.13^{b}	2.05±0.05^{b}	0.00±0.00^{c}	0.00±0.00^{c}	170.19±0.23^{c}

Values with the same letter within the column (±SE) are not significantly difference at P<0.05 by Duncan's Multiple Range Test (DMRT).

Table 3: Proximate composition of the leaves of some vegetables consumed in Ekiti State, Nigeria.

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Medicinal Plant	Moisture content (%)	Ash content (%)	Crude Fat (%)	Crude Protein (%)	Carbohydrate (%)	Crude Fibre (%)	Energy (KJ)
T. occidentalis. Hook. F	65.60±0.16^{c}	9.80±0.03^{ab}	3.50±0.04^{b}	19.05±0.05^{ef}	50.38±0.04^{a}	10.19±0.05^{cd}	311.60±0.28^{a}
C. olitorious L.	50.20±0.02^{f}	8.35±0.05^{de}	3.50±0.02^{b}	13.70±0.05^{i}	53.04±0.06^{a}	16.41±0.04^{b}	298.47±0.02^{b}
C. pepo L.	51.30±.03^{ef}	8.42±0.02^{d}	2.02±0.04^{d}	15.81±0.05^{h}	46.80±0.04^{b}	21.81±0.05^{a}	268.58±0.13^{cd}
M. oleifera L.	53.20±0.04^{e}	10.17±0.03^{a}	2.01±0.03^{d}	20.80±0.05^{cd}	42.78±0.05^{cd}	18.98±0.05^{a}	272.31±0.04^{c}
O. gratissimum L.	85.30±0.03^{b}	7.67±0.03^{h}	1.53±0.03^{e}	20.15±0.05^{de}	43.31±0.03^{c}	18.85±0.06^{a}	266.58±1.24^{cd}
V. amygdalina L.	65.00±0.04^{c}	8.04±0.06^{fg}	2.00±0.01^{d}	24.90±0.04^{a}	43.93±0.10^{ab}	14.67±0.07^{b}	293.48±0.24^{b}
C. acontifolius Mill.	88.30±0.07^{ab}	9.26±0.04^{c}	4.99±0.02^{a}	18.03±0.03^{g}	40.99±0.02^{d}	13.88±0.05^{b}	293.08±0.03^{b}
H. asper Hook.F	86.10±0.27^{ab}	8.46±0.02^{d}	2.01±0.02^{d}	23.82±0.03^{ab}	45.67±0.03^{bc}	11.31±0.04^{bc}	296.02±0.04^{b}
S. biafrae Olive & Hiern	62.20±0.03^{d}	8.11±0.02^{f}	2.50±0.0^{c}	21.77±0.03^{c}	43.28±0.03^{c}	10.10±0.03^{cd}	281.96±1.17^{bc}

The results obtained for the qualitative and quantitative phytochemical composition of nine medicinal plants used as vegetables in Ekiti State, Nigeria are presented in Tables 1 and 2 respectively. Phytochemical screening (Table 1) showed that all the leaves of the plants investigated contained reducing sugar while seven samples contained terpenoids and cardiac flavonoids. Phlobatanins and cardiac glycosides were found in six samples. Saponins and tanins were discovered in four samples. Alkaloids and steroids were present in two samples each. However, Anthroquinone was absent in all the plant samples investigated.

The quantitative phytochemical results revealed appreciable amount of reducing sugar in all the leaves screened. The highest reducing sugar content was recorded for *Ocimum gratissimum* (210.07±0.09 mg/100g) and the lowest content of 141.88±0.54mg/100g for *Cucurbita pepo* (Table 2). The results further showed that the highest level of tannins (70.89±1.9 5mg/100g), flavonoids (41.08±0.08 mg/100g), saponins (5.88±0.13 mg/100g), alkanoids (269.86±0.13 mg/100g) and Phenols (116.68±0.09 mg/100g) were found in *V. amygdalina*, *C. olitorious*, *O. gratissimum* and *Hibiscus asper* respectively. The lowest concentration of tannins (44.05±0.10 mg/100g), flavonoids 4.03±0.06 mg/100g), Saponins (0.76±0.02 mg/100g), alkaloids (163.77±0.27 mg/100g) and Phenol (110.43±0.06 mg/100g) were recorded in *C. acontifolius*, *T. occidentalis*, *C. acontifolius*, *H. asper* and *V. amygdalina* respectively (Table 2).

The highest moisture content of 88.3±0.07% was obtained for *C. acontifolius* while *C. olitorious* had the lowest moisture content of 5.02±0.02% (Table 3). *M. oleifera* had the highest ash content of 10.17±0.03% while *O. gratissimum* had the lowest ash of 7.67±0.03%. The value of crude fat ranged from 4.99±0.02% in *C. acontifolius* and 1.53±0.03% in *O. gratissimum* leaves. This further revealed that, *V. amygdalina* had the highest percentage crude protein value of 24.90±0.04% while

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C. olitorious had the lowest crude protein value of 13.70±0.05% (Table 2). Highest percentage carbohydrate value of 53.04±0.06% was recorded for *C. olitorious* while *C. acontifolius* had the lowest carbohydrate content of 40.99±0.02%. *C. pepo* had the highest crude fiber content of 21.81±0.05% while *S. biafrae* had the least crude fiber content of 10.10±0.03%. The energy value ranged from 311.60±0.28KJ in *T. occidentalis* and 266.58±1.28KJ in *O. gratissimum*.

DISCUSSION

Phytochemical composition

The phytochemicals present in the nine analyzed vegetables are known to perform different biological activities. Alkaloids are the most effective phytochemical compounds in therapeutic uses (Okwu, 2005; Ayoola and Adeyeye, 2010). Several authors have reported the analgesic (Harbone, 1973; Okwu and Okwu, 2004), antispasmodic and antibacterial (Stray, 1998) activities of alkaloids. Actions of alkaloids are also felt in respiratory system, gastrointestinal tract, malignant diseases and malaria (Trease and Evans, 1989).

Saponins found in some of the plants are known to lower the cholesterol level and also produce inhibitory effect on inflammation (Just *et al*., 1998). More so, saponins have also been reported to be useful as expectorants, cough suppressants (Sofowora, 1993 and Okwu, 2005), diuretic, analgesic and promotion of wound healing (Arawande, *et al*., 2013).

The presence of tannins in the vegetables indicated that the astringent properties helps in the healing of wound and inflamed mucus membrane (Farquar, 1996).Also, tannins have antimicrobial properties and protects the kidneys from inflammation.Flavonoids are effective antioxidant and show strong anticancer activities (Salah *et al*., 1995; Okwu, 2004) as well as antimicrobial and antitumor properties (Manikandan *et al*., 2006). Cardiac glycosides are cardioactive compounds belonging to triterpenoids class of compounds (Brian *et al*., 1985). They are natural substances that act on the heart by regulating its contractions without increasing the amount of oxygen in the heart muscle (Ayoola and Adeyeye, 2010).

The phenolic compounds are one of the largest and most important groups of secondary metabolites and bioactive compounds in plants (Kim *et al*., 2003; Sigh *et al*., 2007). several workers have described the antioxidant properties of several medicinal plants which are rich in phenolic compounds (Brown and Rice–Evans, 1998; Krings and Berger, 2001). The antioxidant properties of phenols which prevent oxidative damage to biomolecules like DNA, lipids, and protein play great role in the prevention of chronic diseases such as cancer and cardiovascular diseases (Oyedemi *et al*., 2012).

Proximate composition

The moisture content of the leaves of the nine medicinal plants ranged from 50.20±0.02% to 88.30±0.07%. There were significant differences in the values recorded for the leaf samples (Table 3). The moisture content obtained in this study for the respective vegetables were lower than those reported for *Corchorus olitorious* (79.98%), *Telfaria occidentalis* (83.46%) by Adeniyi and Abiodun (2012) and *S. biafrae* (89.00%) by Adeleke and Abiodun (2010). The values of our

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findings are higher compared to the reports of Mensah *et al*. (2008) for *V. amygdalina* (21.60%), *C. olitorious* (27.00%) and *O. gratissimum* (31.50%). The high moisture content recorded in this study might be due to the fact that the plants were harvested during the peak of the raining season. The ash content values ranged from 10.17±0.03% to 7.67±0.03%. For the leaves of the nine vegetables investigated. The values obtained in this study were higher than the values reported for some leafy vegetables such as *C. olitorious* (0.64%). *O. gratissimum* (0.83%) , *Talilum fruticosum* (0.55%), *T. occidentalis* (0.49%) by Adeniyi *et al*., (2012), sweet potato leaves (1.80%) by Asibey-Berko and Tayle, (1999) and *Tribulus terrestrial* leaves by Nwaogu *et al*. (2000) but lower than some other commonly consumed leafy vegetables in Nigeria such as *Amaranthus asper* (18.50%), *Amaranthus hybridus* (17.70%) and *C. pepo* (156.20%). The ash content is an indication of the level of inorganic elements such as calcium, magnesium, zinc, potassium, copper and phosphorus in the vegetable. The ash content showed that the leaves are rich in mineral elements.

The crude fat content was low, ranging from 4.99±0.02% to 1.53±0.03%). However, the values are high compared to the values reported for *Anchomanes difformis* leaves (0.49%) by Oyeyemi and Tedela (2014), *Spinacia oleracea* (0.3%) and *Cnidoscolus aconitifolius* (0.4%) as reported by Nwaogu *et al*. (2000). The value of the crude fat for the leaves of the vegetables studied were moderate when compared to the values reported for *Talinium fruticosum* (5.90%), *Baseila alba* (3.71%), *Amaranthus hybridus* (4.80%) by Akindahunsi and Salawu (2005), *C. olitorus* (5.07%), *O. gratissimum* (3.89%) and *T. occidentalis* (4.22%) by Adeniyi *et al*. (2012). Low fat foods are reported to reduce the level of cholesterol and obesity (Gordon and Kessel, 2002). Therefore the low crude fat values recorded in this study suggest that the vegetables can serve as part of weight reducing diet. The result showed that the leaves contained appreciable amount of crude proteins that ranged from (23.82±0.03% to 13.70±0.05%). The protein content values agree with what has been reported for some known leafy vegetables such as *M. oleifera* (20.72%) (Lockette *et al*., 2000) and *Curcubita pepo* leaves (21.80%) (Okoli and Mgbeogu, 1983; Hassan and Umar, 2006). However, they were found to be higher than what was reported for O. *gratissimum* (8.00%), *Hibiscus esculentus* (8.00%) (Akindahunsi and Salawu, 2005) and *Abelmoschus esculentus* (8.65%) (Raimi *et al*., 2014). Protein is an important component of human diet needed for the growth of children as well as for constant replacement of worn out tissues. (Obahiagbon and Erhabor, 2010). The high crude protein contents of the vegetables in this study could be good, rich and cheap sources of plant protein.

The carbohydrate content value of the vegetables in this study ranged from 53.04±0.06% to 40.99±0.02% and was significantly higher than that of *Ochthocharis dicellandroides* (11.73%) reported by Andzouaroa and Mombouli, (2012) and *Fruticosum triangulare* (3.17%), *O. gratissimum* (4.45%) *T. occidentalis* (5.65%) and *C. olitorus* (6.25%) reported by Adeniyi *et al*. (2012). However, the carbohydrate contents in the tested plants favourably compared with the 41.25% value obtained for *Abelmoscus esculentus* (Raimi *et al*., 2004), 48.80% for *Amaranthus asper* (Jimoh *et al*., 2010) and the 52.18% for *Amaranthus hybridus* (Akubugwo *et al*., 2007). The higher carbohydrate content of these vegetables establishes that they can be ranked as carbohydrates rich leaves and considered as a potential source of energy.
The crude fiber content was estimated to be between 21.81±0.05% and 10.10±0.03% in the leaves investigated and surpass the values for some commonly utilized vegetables such as *C. olitorus* (0.33%), *O. gratissimum* (3.89%), *F. triangulare* (2.57%) and *T. occidentalis* (4.22%) reported

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by Adeniyi *et al*. (2012). The value also compared favourably well with *Myriathus arboreus* leaves (11.60%) (Amata, 2010), *C. pentandra* (21.69%) and *A. esculentus* (17.55%) (Raimi *et al*., 2014), *V. calvaona* (7.63%) (Igile *et al*., 2013), *V. amygdalina* (6.5%) (Akindahunsi and Salawu, 2005). The high crude fiber may aid digestion, lower serum cholesterol level thus reducing the risk of cardiovascular diseases (Iheanacho and Udebuani, 2009). It also help in combating hypertension, diabetes and breast cancer.(Rao and Netwmark, 1998; Ishida *et al*., 2000). More so, the metabolizing energy content of the nine plants was calculated to range from 311.60±0.28KJ to 266.58KJ. The results of this study suggest that the vegetables could also be an important source of dietary calories.

CONCLUSION

The nine plants investigated in this study could be regarded as medicinally important due to the presence of various phytochemicals which are biologically active substances. These could contribute to the prevention and treatment of various diseases and ailments. The results further revealed that the leaves of the plants contained appreciable amount of crude fiber, crude protein, carbohydrate and energy hence, their consumption could contribute significantly to the nutrient requirements and health benefit of the people of Ekiti State and should be recommended as such.

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