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RESEARCH ARTICLE

Evaluation of the chemical composition of *Tetrapleura tetraptera* (Schum and Thonn.) Taub. accessions from Cross River State, Nigeria

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Abstract: *Tetrapleura tetraptera (Schum. and Thonn.)* plays vital roles in home remedies. It is also cherished as a spice in many Nigerian dishes. However, knowledge on its bioactive components is highly inadequate. In this study, dry pods of twenty accessions of *T. tetraptera*, collected from six local government areas in Cross River State, Nigeria, were evaluated for phytochemical, proximate, vitamin, and mineral compositions. Appreciable concentrations of various nutrients namely, ash (2.86 to 4.81%), fiber (2.79 to 4.81%), fat (11.79 to 21.71%), protein (5.48 to 7.84%) and carbohydrate (51.17 to 66.29%) were obtained which differed significantly (P<0.01) among the accessions. Mean vitamin composition ranged from 1.01mg/100g in vitamin C to 3.34% in vitamin A while mineral composition ranged from 0.80mg/100g in Zinc to 250.73 mg/100g in Potassium. Lower values were obtained for tannin (0.24 to 0.64%), sterol (0.04 to 0.14%), phenol (0.05 to 0.12%) and saponin (0.44 to 0.8%). The values obtained for hydrogen cyanide (3.64 to 5.25%), alkaloid (1.73 to 2.76%) and flavonoid (1.63 to 3.84%) were appreciably high with accessions AKA1, AKA2, AKP3, AKP7, AKP10, ODU1 and ODU2 having the best combinations. The relative abundance of many biologically important compounds in this plant thus justifies the numerous roles it plays in traditional medicine.

Keywords: Minerals; phytochemicals; proximate composition; *Tetrapleura tetraptera*; vitamins.

Introduction

Tetrapleura tetraptera (Schum and Thonn), commonly known as Aidan tree, is deciduous and belongs to the family fabaceae. Many reports are available on the use of this plant as a spice and in home remedies for the treatment of many human illnesses (Adewunmi 1991, Akah and Nwabie 1993, Essien et al. 1994, Noamesi et al. 1994, Enwere 1998, Burkill 1997, Edeoga and Eriata 2001, Edeoga et al. 2003, Okwu 2003, Ojewole and Adewunmi 2004, Aladesanmi 2007, Omokhua and Ukoimah 2008, Osuagwu 2008). Unfortunately, knowledge on its bioactive component is scanty and highly inadequate. Available information on the bioactive composition of *T. tetraptera* is limited to studies based on a few accessions (Osagie and Eka 1998, Abii and Elegalam 2007, Dike 2010, Bouba et al. 2012). In addition, available reports vary with soil type and location. To justify and possibly standardize the use of this plant in traditional medicine, it is important to make a detailed quantification of the crude chemical and other bioactive constituents present in this plant, using many accessions from different zones. Thus, this research was aimed at examining in detail, the proximate, phytochemical, vitamin and mineral contents of dry fruits in twenty accessions of *Tetrapleura tetraptera* collected from different parts of Cross River State, Nigeria.

Materials and Methods

Mature pods of twenty accessions of *Tetrapleura tetraptera* were collected from different locations in Akamkpa, Akpabuyo, Bakassi, Boki, Ikom, and Odukpani, Local Government Areas in Cross River State (Table 1), washed manually with distilled water and sun-

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dried. The dried fruits were pulverized into fine powder using a grinder (Binatone: BLG-400), sieved through mesh sieves (1mm) and stored in air tight bottles. These were then used for the various analyses outlined below.

Table 1: Accessions of *Tetrapleura tetraptera* and their collection sites.

Accession	Location	L.G.A.	Latitude	Longitude	Altitude (m)
AKA1	Akor	Akamkpa	05^{0}22/57N	008^{0}16/44E	89
AKA2	Oban	Akamkpa	05^{0}36/45N	008^{0}50/41E	102
AKA3	Aningeje	Akamkpa	05^{0}24/53N	008^{0}13/48E	98
AKP1	Ikot Ekpo	Akpabuyo	04^{0}33/45N	008^{0}23/34E	97
AKP2	Ekpene-Efioeyo	Akpabuyo	04^{0}27/41N	008^{0}21/38E	92
AKP3	Efak Inang	Akpabuyo	04^{0}24/38N	008^{0}18/31E	86
AKP4	Ikot Edem Ndarake	Akpabuyo	04^{0}27/41N	008^{0}21/38E	92
AKP5	Ikot Edem Ita	Akpabuyo	04^{0}39/22N	008^{0}33/44E	97
AKP6	Ikot Ewa	Akpabuyo	04^{0}34/46N	008^{0}26/37E	94
AKP7	Ekpri Ikang	Bakassi	04^{0}12/13N	008^{0}04/59E	63
AKP8	Esighi	Bakassi	04^{0}13/18N	008^{0}09/62E	48
AKP9	Ikot offiong Ambai	Akpabuyo	04^{0}33/48N	008^{0}29/37E	79
AKP10	Ikot Nakanda	Akpabuyo	05^{0}06/32N	008^{0}11/48E	77
AKP11	Etomkpe Inameti	Akpabuyo	04^{0}11/34N	008^{0}14/38E	93
BOK1	Isorbendegekem	Boki	06^{0}26/40N	008^{0}48/41E	118
BOK2	Afi-forest	Boki	06^{0}23/59N	008^{0}45/04E	109
IKM1	Etara community	Ikom	05^{0}46/60N	008^{0}31/60E	121
IKM2	Akparabong	Ikom	06^{0}01/60N	008^{0}45/00E	109
ODU1	Ikot Ukpa	Odukpani	05^{0}07/33N	008^{0}21/19E	60
ODU2	Ikot Eyo-Okon	Odukpani	04^{0}46/00N	007^{0}57/00E	49

Proximate analysis

Moisture, ash, fibre and crude fat were determined using the methods of Udo et al. (2009); crude protein was determined by macro -Kjedahl method (Onwunka 2005, Udo et al. 2009); nitrogen free extract (NFE) referred to as soluble carbohydrate was obtained by subtracting all the other components (except fat and dry matter) from 100%. NFE = 100 – (% ash + % crude fibre + % crude protein + % moisture).

Phytochemical analysis

Alkaloids, flavonoids, saponins, phenols, tannins and sterols were estimated by the methods described by Harborne (1973) and Edeoga et al. (2006); while hydrogen cyanide was estimated using the alkaline extraction method described by Onwunka (2005).

Vitamin and mineral analysis

Vitamins A and E contents were estimated by the methods described by Pearson (1976); vitamin C was estimated as described by Kirk and Sawyer (1998), B-complex vitamins (thiamine, riboflavin and niacin), zinc and iron were estimated as described by James (1995). Phosphorus, Calcium, Potassium, Sodium and Magnesium were estimated by AOAC methods (AOAC 2000).

Data collection and analysis

All the attributes were taken in triplicates and data from all determinations were subjected to analysis of variance using Genstat Discovery Edition 4 (Genstat 2007) software. The least significant difference (LSD) test was used to identify significance among treatment means ($p<0.05$) as outlined by Obi (2002).

Results and Discussion

Proximate composition

Significant differences ($p<0.001$) were observed for moisture content, ash, crude fiber, fat, protein and carbohydrate, Table 2. Moisture contents were low, ranging from 7.37% in IKM2 to 10.64% in AKP8, in line with reports by Bouba et al. (2012) and Abii and Elegalam (2007) in this plant. Moisture content of any food is an index of its water activity and is used as a measure of stability and susceptibility to microbial contamination (Darey 1989). The low moisture content observed among the accessions of the plant corroborates its seeming resistance in nature to microbial spoilage, leading to improved shelf-life of the fruits (Aruah et al. 2012).

Table 2: Proximate composition of 20 accessions of *T. tetraptera* from Cross River state.

	Attributes					
Accession	**Moisture (%)**	**Ash (%)**	**Fibre (%)**	**Fat (%)**	**Protein (%)**	**CHO (%)**
AKA1	8.82	3.84	3.26	13.57	6.85	63.66
AKA2	8.46	3.76	3.14	11.79	6.67	66.29
AKA3	8.31	3.73	2.85	23.17	6.95	54.99
AKP1	8.61	4.81	3.25	19.26	7.17	56.91
AKP2	9.84	3.73	3.19	13.79	5.95	63.51
AKP3	8.39	4.14	3.19	22.44	6.29	55.56
AKP4	9.39	3.85	2.79	19.22	6.75	58.01
AKP5	9.46	3.17	4.16	20.09	6.79	56.32
AKP6	9.35	4.17	3.09	12.17	7.37	63.86
AKP7	9.27	4.19	2.94	18.67	6.45	58.48
AKP8	10.64	3.95	3.25	21.19	6.85	54.13
AKP9	9.71	4.13	3.26	21.37	6.91	54.61
AKP10	10.55	2.86	3.21	15.24	6.56	61.58
AKP11	8.81	4.25	3.43	13.80	7.27	62.44
BOK1	10.19	3.94	3.15	24.71	6.85	51.17
BOK2	7.93	3.91	2.85	15.79	7.32	62.18
IKM1	7.62	3.94	3.69	21.71	5.48	57.54
IKM2	7.37	3.94	4.81	20.22	5.84	57.82
ODU1	8.73	4.24	2.91	21.08	7.64	55.41
ODU2	10.53	4.09	2.91	17.27	7.84	57.32
$LSD_{0.05}$	0.066	0.030	0.022	0.145	0.042	0.195

Ash content was observed to be lowest in AKP10 (2.86%) and highest in AKP1 (4.81%). These values are lower than those reported by other workers in the same plant and for other spice plants namely: 9% in *T. tetraptera (*Abii and Elegalam 2007); 12.24% in *Ocimum gratissimum*, (Nwofia and Adikibe 2012); 10.5% in *T. tetraptera*, (Bouba et al. 2012). Such differences may arise from variation in soil micronutrients in the different locations (Okwu 2001), it could also be partly attributed to the method used in the analyses. High ash content in plant materials indicates high mineral content. The percentage of crude fiber in the studied accessions ranged from 2.79% in AKP4 to 4.81% in IKM2 which is in line with reports of 4.5% by Abii and Elegalam (2007) but lower than 7.76% by Osagie and Eka (1998), and 8.75% by Dike (2010) in the same plant. Fiber has some physiological effects in the gastrointestinal tract (Effiong et al. 2009) and low fiber in diets is undesirable as it may cause constipation. However, the low fiber reported in this work for *T. tetraptera* may not affect the use of the plant as the fruits are not consumed directly, but used as spice and flavoring agent.

Fat content, which ranged from 11.79 in AKA2 to 21.71 in IKM1 were higher than previous reports by Bouba et al. (2012) (5.6%), Abii and Elegalam (2007) (4%), and Osagie and Eka (1998) (8.50%) in the same plant. Dietary lipids are responsible for carrying nutritionally essential fat-soluble vitamins and excess fat consumption has been implicated in cardiovascular disorders such as artherosclerosis, cancer and aging (Antia et al. 2006).

The values for crude protein ranged from 5.48% in IKM1 to 7.84% in ODU2 and are similar to reports by Bouba et al. (2012) (5.0%) and Osagie and Eka (1998) (8.50%) in the same plant. It is generally known that any plant food that provides less than 12% of their caloric value from protein is not considered to be a good source of protein (Effiong et al. 2009, Ali 2010). Thus, *T. tetraptera* cannot be used as a supplement for protein.

Carbohydrate ranged from 51.17% in BOK1 to 66.29% in AKA2. It provides energy to the cells in the body, particularly the brain, which is the only carbohydrate-dependent organ in the body (Effiong et al. 2009). Carbohydrate is necessary for maintenance of the plasma level; it spares the body protein from being easily digested and helps to prevent the using up of protein. The high carbohydrate content observed in this study suggests high caloric energy.

Phytochemical composition

Generally, the fruits of *T. tetraptera* had low values for tannin, sterol, phenol and saponin, but high values were obtained for hydrogen cyanide, alkaloid and flavonoid. Tannins ranged from 0.24% to 0.64%, and are generally regarded as dietary anti-nutrients responsible for the astringent taste and poor palatability of foods and drinks (Chikezie et al. 2008). They usually form insoluble complexes with proteins, thereby interfering with their bioavailability (Enujiugha and Agbede 2000). Tannins are useful in the treatment of intestinal disorders such as diarrhea and dysentery, and urinary tract infections (Fahey 2005, Akimpelu and Onakoya 2006), this explains the use of the plant in the treatment of gastrointestinal disorders.

Concentrations of sterols were relatively low in all the accessions of *T. tetraptera* studied, ranging from 0.04% to 0.14%. The presence of sterols (phytosterols) in a plant is an indication that the plant is a good source of steroidal compounds which are potent precursors for the synthesis of sex hormones (Okwu 2001, Edeoga et al. 2005).

Phenols ranged from 0.05% to 0.12% in the present study. Phenolic compounds are potent water soluble antioxidants and free radical scavengers which prevent oxidative cell damage, and have strong anti-cancer activity (Salah et al. 1995, Del-Rio et al. 1997, Okwu 2004).

Saponins ranged from 0.44% to 0.80% in this study, the values being relatively lower than the report by Abii and Elegalam (2007) in the same plant. Saponins are produced by plants as a deterrence mechanism to stop attacks by foreign pathogens, making them natural antimicrobials. They have the following properties: ability to bind with cholesterol, bitterness, and haemolytic activity in aqueous solutions (Sodipo et al. 2000). Like phenol, the presence of saponin in *T. tetraptera* might contribute to some reported medicinal properties of the plant.

Alkaloid was highest in AKP10 and BOK1 (2.76%) but lowest in AKA1 (1.73%). They are the most therapeutically significant plant substances. Pure isolates of alkaloids and their synthetic derivatives are used as basic medicinal agents because of their analgesic, anti-spasmodic and anti-bacterial properties (Stay 1998, Harisaranraj et al. 2009). The presence of appreciable concentration of alkaloids in the different accessions of *T. tetraptera* explains their use in traditional medicine.

Flavonoid was highest in AKP7 (3.84%) and lowest in ODU1 (1.63%). These values are similar to reports by Abii and Elegalam (2007) in the same plant. Flavonoids enhance the effects of vitamin C and function as antioxidants. They are also known to be biologically active against liver toxins, tumours, viruses and other microbes, allergies and inflammation. They protect blood vessels especially the tiny capillaries that carry oxygen and nutrients to cells and are believed to slow down the development of cataracts in persons who have diabetes (Okwu 2004, Harisaranraj et al. 2009).

The hydrogen cyanide content was highest in AKP1 (5.25mg/kg) and lowest in IKM2 (3.64mg/kg), Table 3. Hydrogen cyanide was observed to be higher than other phytochemicals in all the accessions studied. This may be one of the reasons why the fruits are not consumed raw. The daily dietary requirement of hydrogen cyanide ranges from 25-50mg/100g and the consumption of food containing high hydrogen cyanide could result in acute or chronic cyanic toxicity. The hydrogen cyanide in plants could, however, be reduced by cooking (Osagie and Eka 1998).

Vitamin composition

Highly significant differences ($p<0.001$) were observed among the 20 accessions in vitamin A, riboflavin, niacin, vitamins C and E, but thiamin was not significantly different ($p>0.05$). Vitamin A varied from 2.64% in AKP1 to 4.72% in AKP10, while Vitamin E varied from 2.42mg/100g in IKM1 to 3.74mg/g in AKA1. Vitamin C was highest in AKP8 and BOK2 (1.25mg/100g) and lowest in AKP4 (0.79mg/g). Niacin ranged from 0.03% in ODU1 to 0.13% in AKP8 while riboflavin ranged from 0.02% to 0.03%, Table 4. The result obtained showed that the plant contains moderate quantity of thiamin, riboflavin, niacin, and vitamin C. Vitamins A and E were slightly higher in all the accessions compared to others.

Vitamin A exists in plants as the precursor of carotenoid family. It functions in the immune system in the modulation of diverse pathways: in the expression of mucins and keratins, lymphopoession, cytokine production, neutrophil maturation and function, the functional expression of natural killer cells, monocytes and macrophages, T and B lymphocytes and immunoglobin production. Vitamin C is vital for body performance (Okwu and Josiah 2006), it is also an antioxidant which acts as an electron donor for 8 human enzymes. The antioxidant properties of vitamin C stabilize folate in food and in blood plasma. A common feature of vitamin C deficiency is anaemia. Its deficiency also impairs the normal formation of intercellular substances throughout the body, including collagen, bone matrix and tooth dentine. Thiamin plays a central role in cerebral metabolism. Its deficiency results in dry and wet beriberi, lactic acidosis and Wernicke-Korsakoff syndrome (Fattal-Valevski 2011). Vitamin E has potential in providing protection from free radicals and products of oxygenation. It works in conjunction with other antioxidants and nutrients to quench free radicals. It also inhibits lipoxygenation, an enzyme responsible for the formation of proinflammatory leukotrienes (Anon. 2002).

Table 3: Phytochemical composition of 20 accessions of *T. tetraptera* from Cross River state.

	Attributes						
Accessions	**Tannin (%)**	**Sterol (%)**	**Alkaloid (%)**	**Phenol (%)**	**Flavonoid (%)**	**Saponin (%)**	**HCN (mg/kg)**
AKA1	0.56	0.07	1.73	0.07	2.19	0.58	3.95
AKA2	0.44	0.09	1.86	0.07	2.83	0.64	4.18
AKA3	0.32	0.11	2.59	0.05	2.64	0.61	4.13
AKP1	0.39	0.08	1.94	0.07	2.35	0.77	5.25
AKP2	0.24	0.07	1.84	0.07	1.65	0.69	4.18
AKP3	0.31	0.14	1.86	0.09	3.77	0.80	5.14
AKP4	0.26	0.07	1.81	0.12	2.06	0.70	5.07
AKP5	0.61	0.09	2.58	0.08	1.84	0.72	4.63
AKP6	0.28	0.11	2.18	0.06	1.95	0.53	5.18
AKP7	0.45	0.09	2.73	0.06	3.84	0.75	4.29
AKP8	0.64	0.04	2.32	0.08	1.96	0.70	4.28
AKP9	0.29	0.08	1.95	0.06	3.08	0.55	4.85
AKP10	0.25	0.09	2.76	0.05	2.44	0.44	4.75
AKP11	0.56	0.12	1.75	0.08	2.85	0.73	3.69
BOK1	0.41	0.09	2.76	0.08	2.95	0.64	3.84
BOK2	0.47	0.06	2.43	0.09	1.92	0.64	4.54
IKM1	0.26	0.10	2.31	0.08	3.15	0.75	3.73
IKM2	0.39	0.08	1.83	0.09	2.84	0.60	3.64
ODU1	0.50	0.12	1.91	0.07	1.63	0.73	3.93
ODU2	0.52	0.10	1.89	0.06	1.69	0.50	5.07
$LSD_{0.05}$	0.016	0.011	0.031	0.012	0.022	0.024	0.024

Mineral composition

Highly significant differences ($p<0.001$) were observed among the 20 accessions in calcium, iron, potassium, magnesium, phosphorus and zinc, while sodium was not significantly different ($p>0.05$). Calcium ranged from 10.83mg/100g in AKP5 to 183.70mg/100g in IKM1. Potassium ranged from 270.18mg/100g in IKM2 to 241.64mg/100g in AKP1, AKP3 and AKP7. Magnesium were highest in ODU1 (96.31mg/100g) and lowest IK M1 (76.79mg/100g), Table 5.

Table 4: Vitamin composition of 20 accessions of *T. tetraptera*

Accessions	Attributes					
	Vit.A (µg/g)	Thiamin (%)	Riboflavin (%)	Niacin (%)	Vit.C (mg/100g)	Vit.E (mg/100g)
AKA1	4.18	0.05	0.03	0.10	0.94	3.74
AKA2	3.93	0.05	0.03	0.09	0.81	3.24
AKA3	2.79	0.04	0.03	0.09	0.92	2.45
AKP1	2.64	0.04	0.02	0.11	1.25	2.79
AKP2	3.16	0.04	0.03	0.09	1.05	2.81
AKP3	3.16	0.05	0.03	0.08	1.05	2.81
AKP4	4.31	0.04	0.02	0.09	0.79	3.18
AKP5	3.17	0.05	0.03	0.11	1.09	2.94
AKP6	3.17	0.04	0.02	0.96	1.16	2.85
AKP7	3.16	0.04	0.02	0.12	0.96	2.85
AKP8	3.16	0.05	0.03	0.13	0.96	2.84
AKP9	3.81	0.04	0.03	0.01	0.97	3.17
AKP10	4.72	0.18	0.02	0.09	0.92	3.24
AKP11	3.07	0.04	0.03	0.12	0.81	2.74
BOK1	2.73	0.11	0.02	0.05	1.06	2.68
BOK2	2.94	0.03	0.02	0.05	1.25	3.17
IKM1	3.42	0.03	0.02	0.08	1.03	2.34
IKM2	3.62	0.04	0.02	0.08	0.96	2.42
ODU1	2.95	0.02	0.02	0.03	1.06	2.61
ODU2	2.71	0.03	0.02	0.04	1.06	2.45
$LSD_{0.05}$	0.015	ns	0.001	0.006	0.014	0.026

Mineral elements are very important in human nutrition. The need for calcium in the body increases with increase in skeletal mass (Osagie and Eka 1998). Potassium functions to maintain the normal balance of and distribution of fluids throughout the body. The electrolytes, including potassium, are involved in the maintenance of normal pH balance, and work in conjunction with calcium and magnesium in the maintenance of normal muscle contraction and relaxation, and nerve transmission (Akpabio and Akpakpan 2012). Calcium and potassium were very high, magnesium and phosphorus were moderate, while zinc and sodium were minimal in the studied accessions. Similar results were reported by Bouba et al. (2012) in the same plant. The high concentrations of potassium and calcium present in *Tetrapleura tetraptera* could be exploited in the treatment of persons suffering from deficiency of such minerals. This may explain why *T. tetraptera* is often given to nursing mothers after delivery. Iron, magnesium and zinc strengthen the immune system as antioxidants. Zinc provides natural protective mechanism against viruses, especially those causing respiratory tract infections (Sadler 2004). Iron is important in regeneration of lost blood. Interestingly, iron and zinc were low in our findings, but Abii and Elegalam (2007) reported high values for these minerals. Again, this may be as a result of variation in micronutrients in the soil in the different locations (Okwu 2001). From their findings, they explained that the high concentration of iron in fruits of *T. tetraptera* is probably the reason for their use by lactating mothers, to regenerate lost blood. Potassium and calcium are essential for prevention, control and management of bones and muscle related disorders.

Table 5: Mineral composition of 20 accessions of *T. tetraptera*

Accessions	Attributes						
	Calcium (mg/100g)	Iron (mg/100g)	Potassium (mg/100g)	Magnesium (mg/100g)	Sodium (mg/100g)	Phosphorus (mg/100g)	Zinc (mg/100g)
AKA1	175.69	1.93	240.96	94.71	11.81	40.17	0.81
AKA2	176.84	1.89	253.25	95.16	11.37	42.32	0.89
AKA3	175.81	1.81	245.83	85.32	9.79	35.68	0.85
AKP1	174.31	1.79	241.64	94.13	10.52	38.73	0.84
AKP2	169.41	1.65	246.78	85.29	10.62	35.85	0.79
AKP3	174.31	1.79	241.64	94.13	10.52	38.73	0.84
AKP4	173.61	1.65	249.76	89.51	9.49	34.75	0.79
AKP5	10.83	1.68	248.31	86.41	10.83	39.36	0.82
AKP6	172.75	1.64	243.74	89.56	9.50	35.84	0.84
AKP7	174.31	1.79	241.64	94.13	10.52	38.73	0.84
AKP8	11.51	1.72	248.81	86.74	11.51	36.28	0.84
AKP9	180.50	1.82	249.61	92.75	13.17	39.44	0.79
AKP10	175.59	1.70	251.62	90.07	10.73	35.80	0.83
AKP11	176.69	1.73	249.19	79.41	9.64	34.77	0.82
BOK1	176.40	1.81	248.77	80.18	10.17	34.91	0.69
BOK2	174.17	1.83	250.17	81.38	10.44	36.36	0.74
IKM1	183.70	1.55	268.56	76.79	12.34	39.48	0.72
IKM2	182.55	1.51	270.18	78.33	11.59	39.38	0.64
ODU1	13.08	1.92	260.78	96.31	13.08	41.36	0.85
ODU2	182.37	1.92	263.43	95.17	12.79	41.52	0.84
$LSD_{0.05}$	0.179	0.022	0.107	0.067	Ns	0.060	0.015

Conclusion

This study has confirmed that *T. tetraptera* contains appreciable concentrations of nutrients and phytochemicals. Greater variability is captured here than in previous reports as more accessions from different locations were screened. The plant holds tremendous promise in providing the variable secondary metabolites and nutrient supply that could promote good health.

The following accessions showed high therapeutic potentials as demonstrated by their enriched contents and could be further exploited in this regard:

a) AKA1: phenol (0.07%), flavonoid (2.19%), vitamin A (4.18μg/g), niacin (0.10%), vitamin E n (3.74mg/100g), iron (1.93mg/100g), magnesium (94.71mg/100g), phosphorus (40.17mg/100g).

b) AKA2: alkaloid (1.86%), phenol (0.07%), flavanoid (2.83%), vitamine E (3.24mg/100g), iron (1.89mg/100g), magnesium (95.16mg/100g), phosphorus (42.32mg/100g), zinc (0.89mg/100g).

c) AKP3: phenol (0.09%), flavonoid (3.77%), saponin (0.80%), calcium (147.31mg/100g), magnesium (94.13mg/100g), phosphorus (83.73mg/100g) and zinc (0.84mg/100g).

d) AKP7: alkaloid (2.37%), flavonoid (3.84%), niacin (0.12%), calcium (174.31mg/100g), magnesium (94.13mg/100g), phosphorus (83.73mg/100g), and zinc (0.84mg/100g).

e) AKP10: alkaloid (2.76%), vitamin A (4.72μg/g), vitamin E (3.24mg/100g), calcium (175.59mg/100g), potassium (251.62mg/100g) and zinc (0.83mg/100g).

f) ODU1: alkaloid (1.91%), phenol (0.07%), saponin (0.73%), vitamin C (1.06 mg/100g), iron (1.92mg/100g), potassium (260.78mg/100g), magnesium (96.31mg/100g), phosphorus (41.36mg/100g) and zinc (0.84mg/100g).

g) ODU2: alkaloid (1.89%), vitamin C (1.06mg/100g), calcium (182.37mg/100g), iron (1.92mg/100g), potassium (263.43mg/100g) and phosphorus (41.52mg/100g).

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References

Abii, T.A. and Elegalam, A.J. 2007. Investigation into chemical composition of the dry fruit of *Tetrapleura tetraptera*. *Journal of Food Technology*, **3**: 229-232.

Adewunmi, C.O., Andersson, H.C., Busk, L. 1991. A potential molluscicide, aridan (*Tetrapleura tetraptera*), neither induces chromosomal alterrations in Chinese Hamster avary cells, nor mutations in *Salmonella typhimurium*. *Environmental Toxicology and Chemistry*, **30**:69–74.

Akah, P.A. and Nwabie, O.K. 1993. Antibacterial activity of *Tetrapleura tetraptera. Journal of Fitoterapia*, **1(5)**: 42-44.

Akinpelu, D.A. and Onakoya, T.M. 2006. Antimicrobial activities of medicinal plants used in folklore remedies in south-western. *African Journal of Biotechnology*, **5**:1078-1081.

Akpabio, U.D. and Akpakpan, A.E. 2012. Evaluation of nutritive and anti-nutritive composition of the seeds of *Mondora myristica* (*African nutmeg*). *World Journal of Applied Science and Technology*, **4**: 49-55.

Aladesanmi, A.J. 2007. *Tetraplura tetraptera* : molluscicidal activity and chemical constituents. *African Journal of Traditional Complementary Alternative Medicines*, **4**: 23-36.

Ali, A. 2010. A comparative study of nutrients and mineral molar ratio of some plant foods with recommended dietary allowances. *Journal of Food Science and Technology*, **2**: 104-108.

Anon. 2002. Mixed Tocophenols. *Alternative Medicine Review*, **7**: 421-427.

Antia, B.S., Akpan, E.J., Okon, P.A. and Umoren, I.U. 2006. Nutritive and anti-nutritive evaluation of sweet potatoes

(*Ipomea batatas*) leaves. *Pakistan Journal of Nutrition*, **5**:166-168.

AOAC 2000. *Official Methods of Analysis International*. 17th edn. Association of Analytical Chemists, Washington DC.

Aruah, B.C., Uguru, M.I., Oyiga, B.C. 2012. Genetic variability and inter-relationshipnamong some Nigerian pumpkin accessions (*Cucurbita spp.*). *International Journal of Plant Breeding*, **6**: 34-41.

Burkill, H.M. 1997. *The Useful Plants of Tropical West Africa*, 2nd ed. Royal Botanic Garden, kew, Richmond, United Kingdom.

Bouba, A.A., Njintang, N.Y., Foyet, H.S., Scher, J., Montet, D. and Mbofung, M.F. 2012. Proximate composition, mineral and vitamin contents of some wild plants used as spices in Cameroon. *Food and Nutrition Sciences*, **3**: 423-432.

Chikezie, P.C., Agomuo, E.N. and Amadi, B.A. 2008. *Biochemistry, Practical/Research Method, A Fundamental Approach*. Vol 2. Mega soft publishers, Owerri.

Darey, K.R. 1989. A predictive model for combined temperature and water activity on microbial growth during the growth phase. *Journal of Applied Microbiology*, **65**: 483-488.

Del-Rio, A., Obdululio, B.G., Castillo, J., Marin, F.G. and Ortono, A. 1997. Uses and properties of Citrus flavonoids. *Journal of Agriculture, Food and Chemistry*, **45**: 4505-4515.

Dike, M.C. 2010. Proximate, photochemical and nutrient compositions of some fruits, seeds and leaves of some plant species in Umudike, Nigeria. *Journal of Agricultural and Biological Sciences*, **5**: 7-16.

Edeoga, H.O. and Eriata, D.O. 2001. Alkaloid, tannin and saponin contents of some Nigerian Medicinal plants. *Journal of Medicinal and Aromatic Plant Science*, **23**: 244-249.

Edeoga, H.O., Okwu, D.E. and Mbaebie, B.O. 2003. Minerals and nutritive value of some Nigerian Medicinal plants. *Journal of Medicinal and Aromatic Plant Science*, **25**: 689-694.

Edeoga, H.O., Okwu, D.E., Mbabie, B.O. 2005. Phytochemical constituents of some Nigerian Medicinal plant. *Journal of Agricultural Biotechnology*, **4(7)**:685-688.

Edeoga, H.O., Omosun, G. and Uche, L.C. 2006. Chemical composition of *Lyptis suaveolens* and *Ocimum gratissimum* hybrids from Nigeria. *African Journal of Biotechnology*, **5(10)**: 892-895.

Effiong, G.S., Ibia, I.O. And Udofia, U.S. 2009. Nutritive and energy values of some wild fruit spices in Southeastern Nigeria. *Electronic Journal of Environment, Agriculture and Food Chemistry*, **8(10)**: 917-923.

Enujugha, V.N. and Agbede, J.O. 2000. Nutritional and anti-nutritional characteristics of African oil bean (*Pentaclethra macrophylla* Benth.) seeds. *Applied Tropical Agriculture*, **5**: 11-14.

Enwere, N.J. 1998. Foods of Plant Origin. *International Journal of Microbiology*, **9 (94)**:329-334.

Essien, E.U., Izunwane, B.C., Aremu, C.Y., Eka, O.U. 1994. Significance for Humans of the Nutrient contents of the Dry Fruit of *Tetrapleura tetraptera. Plant Food and Animal Nutrition*, **45(1)**:47-51.

Fahey, J.W. 2005. Moringa oleifera: A review of the medicinal evidence for its nutritional, therapeutic and prophylactic properties. *Trees of life Journal*, **15**: 1-15.

Fattal-Valevski, A. 2001. Thiamine (vitamin B1). *Journal of Evidence-Based Complementary Alternative Medicine*, **16**: 12-20.

Genstat. 2007. Genstat for windows, Discovery (3rd edn.), Lawes Agricultural trust, Rothamsted Experimental station, UK.

Harborne, J.B. 1973. *Phytochemical Methods*. Chapman and Hall limited, London.

Harisaranraj, R., Suresh, K. and Saravanababu. S. 2009. Evaluation of the chemical composition in *Rauwolfia serpentina* and *Ephedra vulgaris. Advances in Biological Research*, **3**:174-178.

James, C. S. 1995. *The Analytical Chemistry of Foods*. Chapman and Hall, New York.

Kirk, R.S. and Sawyer, R. 1998. *Pearson's composition and composition analysisof foods*. 9th ed. Churchhill Livingstone, Edinburgh.

Noamesi, B.K., Mensah, J.F., Dagne, E. and Bogale,M. 1992. *Seventh symposium on medicinal plants, spices and other natural products*. Abstract No.Wp-20, Manila.

Nwofia, G.E. and Adikibe, C. 2012. Chemical composition and variability among some *Ocimum gratissimum* accessions. *International Journal of Medicinal and Aromatic Plants,* **2**: 460-467.

Nwofia, G.E., Nwogu, N.V. and Nwofia. B.K. 2012. Nutritional variation in fruits and seeds of Pumpkins (*Cucurbita spp.*) Accessions from Nigeria. *Pakistan Journal of Nutrition,* **11**: 946-956.

Obi, I.U. 2002. *Statistical methods of detecting differences between treatment means and research methodology issues in laboratory and field experiments,* AP Express publishers, Nsukka.

Ojewole, J.A. and Adewunmi, C.O. 2004. Anti-inflamatory and hypoglycaemic effects of *Tetrapleura tetraptera* (*Fabaceae)* fruit aqueous extract in Rats. *Journal of Ethnopharmacology,* **95**:177-182.

Okwu, D.O. 2001. Evaluation of the chemical composition of indigenous spices and flavouring agents. *Global Journal of Pure and Applied Science,* **7**: 445-459.

Okwu, D. E. 2003. The potentials of Ocimum gratissimum, Penrgularia extensa and *Tetrapleura tetraptera* as spice and flavouring agents. *Nigerian Agriculture Journal,* **35**:143–148.

Okwu, D.E. 2004. Phytochemicals and vitamins content of indigenous species of South Eastern Nigeria. *Journal of sustainable Agriculture and Environment,* **6**:30-37.

Okwu, D.E. and C. Josiah, 2006. Evaluation of the chemical composition of two Nigerian medicinal plants. *African Journal of Biotechnology*, **5**: 357-361.

Osagie, A.U. and Eka, O.U. 1998. *Nutritional quality of plant foods*. Post Harvest Research Unit, University of Benin, Nigeria.

Osuagwu, G G. E. 2008. Proximate and vitamin contents of four Nigerian *Pterocarpus species. Nigerian Food Journal,* **26(1)**: 21-26.

Omukhua, G.E. and Ukohimah, H.N. 2008.Fruiting Pattern of *Tetrapleura tetraptera* (Schum and Thonn) in Benin and Ekpoma areas. *Pantsuk Journal,* **4**: 80-84.

Onwuka, G.I. 2005. F*ood analysis and instrumentation (Theory and Practice).* Naphthali prints, Lagos.

Pearson, D. 1976. *Chemical analysis of foods*. Churchill Livingstone, Edinburgh.

Sadler, K. F. 2004. Neuropsychopharmacology. *Biopsychiatry*, 28: 181-190.

Salah, N., Miller, N. J., Pagange, G., Tijburg, L., Bolwell, G. I., Rice, E. and Evans, C. 1995. Polyphenolic flavonols as scavengers of aqueous phase radicals as chain breaking antioxidant. *Archives of Biochemistry and Biophysics*, 2: 339-346.

Sodikpo, O.A.; Akiniyi, J.A. and Ogunbamosun, J.A. 2000. Studies on certain characteristics of extracts of bark of *Pansinystalia macruceras* (K schemp) Pierre Exbeille. *Global Journal of Pure and Applied Science*, **6**:83-87.

Stay, F. 1998. *The natural guide to medicinal herbs and plants*. Tiger Books International, London.

Udo, E.J., Ibia, T.O., Ogunwale, J.A., Ano, A.O. and Esu, I.E. 2009. *Manual of Soil, Plant and Water analysis*. Sibon books limited, Lagos.