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Bioactive Compounds and Mineral Contents of *Telfairia occidentalis* hooker fil. Grown in Urea Solutions

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ABSTRACT: The study focused on the use of Urea containing hydroponic solutions for growing *Telfairia occidentalis* Hooker fil and evaluated the bioactive compounds and mineral contents of *T. occidentalis*. They solutions varied in the amount of Urea granules (25g, 50g, 75g, 100g, 125g and 150g, respectively) dissolved in water and designated as $M^{25}U$, $M^{50}U$, $M^{75}U$, $M^{100}U$, $M^{125}U$, $M^{150}U$ and Control, respectively. Two-week old seedlings of *T. occidentalis* raised using River-sand were transferred into the growth media; in four replicates. The bioactive compounds (nutritional composition, vitamins, and amino acids contents) and mineral content were determined 5 weeks after planting following standard procedures. *Telfairia occidentalis* grown in Control and $M^{25}U$ media had the highest energy level (1509.76 KJ/100g and 1496.70 KJ/100g, respectively) while the lowest energy content (1351.87 J/100g) was recorded at $M^{75}U$ growth medium. The study showed that *T. occidentalis* contains more of water-soluble vitamins than fat-soluble vitamins. The leaves grown in $M^{100}U$ medium had the highest total vitamins value. Also, 9 essential amino acids (EAA) and 11 non-essential amino acids (NEAA) were detected and quantified in the leaves of *T. occidentalis* grown in varying Urea solutions. The EAA contents were lower than the NEAA contents. Amongst the amino acids and growth media, glycine content (9.10%) of leaves was the most concentrated in $M^{50}U$ medium. The concentrations of N, Ca, Mg and K in the leaves were high compared Na, Mn, Fe, Zn and Cu in the growth media. The leaves grown in the Control medium had the lowest mineral content in most of the growth media.

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The vigour and yield of a plant depends on the availability of nutrients. Plants require 16 mineral elements for adequate growth and development. These mineral elements are nitrogen (N), phosphorus (P), potassium (K), magnesium (Mg), calcium (Ca), sulphur (S), manganese (Mn), molybdenum (Mo), copper (Cu), boron (B), chlorine (Cl), iron (Fe), zinc (Zn), oxygen (O), hydrogen (H) and carbon (C). The mineral elements are classified into primary macro-nutrient (N, P, K), secondary macro-nutrient (Ca, Mg, S) and micro-nutrient (Mn, Mo, Cu, B, Cl, Fe, Zn, O, H, C) depending on their requirement by plants. High concentrations or deficiency in any of these mineral elements in the soil solution can inhibit plant growth and crop yield (Marschner, 1995; Mengel *et al.*, 2001). Mineral elements are supplied through nutrient solution except oxygen, hydrogen and carbon which are supplied from the atmosphere and water. According to Trejo-Tellez *et al.* (2007), other elements such as sodium (Na), silicon (Si), vanadium (V), selenium (Se), cobalt (Co), aluminium (Al) and iodine (I) among others, are considered beneficial because some of them can stimulate the plant growth or compensate the toxic effects of other elements, or may replace essential nutrients in a less specific role. Studies have been carried out for many years on the absorption of minerals from the environment by plant roots and eventual distribution within the plant (Mengel *et al.*, 2001; Karley and White, 2009; Miller *et al.*, 2009; Miwa *et al.*, 2009; Puig and Pen ˜arrubia, 2009; White and Broadley, 2009). The major constraint to crop production on calcareous or alkaline soils is often the low phytoavailability of Fe, Zn, Mn, or Cu (Frossard *et al.*, 2000; He *et al.*, 2005; Broadley

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et al., 2007; Cakmak, 2008; Fageria, 2009; White and Greenwood, 2012). The nutrient composition of an edible plants has direct effect on human health in addressing its nutritional requirements. Its importance in the food chain and food web cannot be over-emphasized. Studies have shown that humans are likely to require at least 25 mineral elements for their well-being (Graham *et al*., 2007; Stein, 2010). The dietary source of most of these elements is plants. Unfortunately, mineral malnutrition is prevalent in both developed and developing countries and it is estimated that up to two-thirds of the world's population might be at risk of deficiency in one or more essential mineral element, with deficiencies of Fe and Zn being most common (White and Broadley, 2009; Stein, 2010). They also reported that the mineral elements most commonly lacking in human diets are Fe, Zn, I, Se, Ca, Mg and Cu. The essential mineral elements required by humans and other animals enter the food chain primarily through plants. The concentrations of mineral elements in edible plant tissues are therefore of fundamental importance to human nutrition. Edible plants can contain low concentrations of mineral elements when grown in areas with low mineral phytoavailability, strongly acidic or alkaline soils (Wilkinson *et al.*, 1990; Frossard *et al.*, 2000; Rengel, 2001; Cakmak, 2004; Broadley *et al.*, 2007; Cakmak, 2008). The study evaluated the bioactive compounds and mineral contents of *T. occidentalis* under varying urea growth media.

MATERIALS AND METHODS

Source of materials and planting: The seeds of *T. occidentalis* were obtained from a farm in Choba, Port Harcourt, and authenticated by a Taxonomist in the University of Port Harcourt Herbarium. The seeds were planted in white sand from the Choba River Port Harcourt, as a medium for germination. The two-week-old seedlings were transferred into a non-circulating hydroponic nutrient system.

Formulation of hydroponic solutions: The method of Kratky (2002) was used with modification in nutrient formulation and container used. Urea granular fertilizer was weighed (25g, 50g, 75g, 100g, 125g and 150g, respectively) and transferred into black plastic bowls with the dimensions: 29 cm width, 41 cm length, and 23 cm depth. The same was dissolved with 20 litres of tap water in the plastic bowls leaving a space for aeration with the addition of 20 ml micronutrients stock solution (0.6 g H_3BO_3; 0.4 g $MnCl_2.4H_2O$; 0.05 g $ZnSO_4$; 0.5 g $CuSO_4.5H_2O$; 0.02 g $Na_2MoO_4.2H_2O$) and Epsom salt (9.8 g MgSO4). The Control medium (water) was setup without the addition of Urea, micronutrients and Epsom salt. These formulations were replicated four times and designated as $M^{25}U$, $M^{50}U$, $M^{75}U$, $M^{100}U$, $M^{125}U$, $M^{150}U$ and Control.

The fluted pumpkin seedlings grown in the different solutions were allowed to stand for five (5) weeks before harvest and analyses. The following bioactive compounds were assessed:

Proximate Analysis: Proximate analysis (moisture, ash, protein, carbohydrate, lipid content and crude fibre) was determined using the standard method of Association of Analytical Chemists (AOAC, 1990). Energy value was determined according to the calculation of methods of Okwu and Ukanwa (2007); NIS (2004); Osborne and Voogt (1978) using the equation.

Energy (KJ/100g) = 4.186 {(% crude protein x 4) + (% crude fat x 9) + (% carbohydrate x 4)}.
Total fatty acid = Crude fat x 0.83 (Greenfield and Southgate, 2003)

Amino Acids: The amino acids preparation and determination using Waters 616/626 LC (HPLC) were carried out according to the method described by Okonwu *et al.* (2018a, 2018b).

Vitamins: The extraction and determination of vitamin A**,** B_2, B_6, $B_{12,}$ and E were according to the method described by Okonwu *et al.* (2018a, 2018b) while **v**itamin C was determined using titrimetric method (Okwu, 2004).

Pigment content: The pigments (Chlorophyll and carotenoid) of fluted pumpkin were extracted using acetone according to the methods described by Kukric *et al*. (2012), Chang *et al*. (2013) and Duma *et al*. (2014).

Mineral elements: The mineral contents (Mg, Cu, Mn, K, Zn, Ca, Na and Fe) of fluted pumpkin were determined using Atomic Absorption Spectrophotometer (AAS).

Statistical analyses: The data obtained from the performance of fluted pumpkin in the different growth media were subjected to statistical analyses. The treatment means and standard deviations of the data were calculated on the variables assessed using Microsoft Excel 2013 version. Also, Statistical Analysis System (SAS) version 9.0 was used to carry out the two-way analysis of variance (ANOVA) of the data to ascertain significant difference at $P = 0.05$.

RESULTS AND DISCUSSION

Nutritional composition of T. occidentalis leaves grown in Urea solutions: The nutritional composition of *T. occidentalis* leaves grown in medium with varying concentrations of Urea at 5 WAP is presented in Table 1. Among the growth media, *T. occidentalis* grown in Control and $M^{25}U$ media had the highest energy level (1509.76 KJ/100g and 1496.70 KJ/100g, respectively) while the lowest energy content (1351.87 J/100g) was recorded at $M^{75}U$ growth medium. In the proximate composition, high fat content was recorded, ranging from 7.86 – 12.95%. The highest fat content and total fatty acids of the leaves were recorded at Control and $M^{25}U$growth media while the lowest was at $M^{50}U$ medium. *T. occidentalis* leaves in the medium with the lowest quantity of Urea ($M^{25}U$) had the highest percentage crude fibre and fat contents with the lowest ash content when compared with other urea growth media. However, increase in the quantity of Urea did not give rise to a corresponding percentage crude fibre and fat content in that sequence. The ash content of the leaves was appreciably high, ranging from 5.99 – 9.46% with the Control medium being the highest and the second is $M^{100}U$ medium while the percentage moisture contents was low (9.89 – 15.33% range).

Table 1: Nutritional composition of *T. occidentalis* leaves grown in different Urea growth media at 5 WAP

Growth medium	Crude fibre (%)	Moisture content (%)	Ash content (%)	Crude protein (%)	Fat (%)	CHO (%)	Total fatty acids	Energy (KJ/100g)
Control	3.61	12.97	9.46	25.13	12.95	35.90	10.75	1509.76
$M^{25}U$	8.80	11.66	5.99	16.49	12.67	44.39	10.51	1496.70
$M^{50}U$	6.21	9.89	7.54	24.94	7.86	43.56	6.52	1443.08
$M^{75}U$	8.35	14.43	7.33	18.66	8.67	42.57	7.19	1351.87
$M^{100}U$	7.49	13.84	9.34	15.45	10.53	43.35	8.74	1381.25
$M^{125}U$	4.05	15.33	7.54	17.37	8.77	46.95	7.28	1407.38
$M^{150}U$	6.91	12.54	9.28	20.64	12.54	38.10	10.41	1455.97
Mean	6.488	12.951	8.069	19.811	10.570	42.117	8.771	1435.146
Std. dev.	2.012	1.819	1.319	3.929	2.166	3.811	1.799	58.402
%CV	31.01	14.04	16.35	19.83	20.49	9.05	20.51	4.069

CHO = Carbohydrate; Std. dev. = Standard deviation; CV = Coefficient of variation; WAP = weeks after planting

Vitamins composition: The composition of vitamins in *T. occidentalis* leaves grown in varying concentrations of Urea at 5 WAP is as shown in Table 2. The water-soluble vitamins (39.20%, 48.88%, 33.77%, 27.45%, 58.26%, 27.64%, and 35.61%) of the leaves were higher than the fat-soluble vitamins (17.49%, 11.96%, 9.65%, 15.53%, 11.23%, 10.14%, and 12.93%) for Control, $M^{25}U$, $M^{50}U$, $M^{75}U$, $M^{100}U$, $M^{125}U$ and $M^{150}U$ growth media, respectively. Vitamin B_2 and B_3 of the leaves were the least concentrated vitamins (0.01%) among the vitamins and within each growth medium while the most concentrated vitamins were vitamins B_9 and C, respectively. The $M^{100}U$ medium had the highest value (69.49) for total vitamins (water-soluble and fat-soluble) compared to others. The percentage ratios of water-soluble vitamins to fat-soluble vitamins for the treatments were: water (69.15: 30.85), $M^{25}U$ (80.34: 19.66), $M^{50}U$ (77.78: 22.22), $M^{75}U$ (63.87: 36.13), $M^{100}U$ (83.84: 16.16), $M^{125}U$ (73.16: 26.84) and $M^{150}U$ (73.36: 26.64), in that order. Individual vitamins (B_1, B_2, B_3, B_6, B_9, B_{12}, C, A, E and K) values vary across and within different growth media. The fat-soluble and the water-soluble vitamins of the leaves grown in varying concentrations of Urea range from 0.02 – 17.27% and 0.01 – 23.69%, respectively.

Table 2: Vitamins content (%) of *T. occidentalis* leaves grown in Urea growth media at 5 WAP

Growth medium	Water-soluble vitamins							Fat-soluble vitamins		
	B_1	B_2	B_3	B_6	B_9	B_{12}	C	A	E	K
Control	0.08	0.01	0.01	2.12	7.82	8.58	20.58	17.27	0.19	0.03
$M^{25}U$	0.07	0.01	0.01	4.17	11.06	9.87	23.69	11.75	0.18	0.03
$M^{50}U$	0.07	0.01	0.01	2.16	14.79	4.92	11.81	9.44	0.18	0.03
$M^{75}U$	0.05	0.01	0.01	5.25	7.33	4.35	10.45	15.38	0.13	0.02
$M^{100}U$	0.06	0.01	0.01	4.13	30.38	6.96	16.71	11.05	0.16	0.02
$M^{125}U$	0.07	0.01	0.01	2.74	15.57	2.72	6.52	9.93	0.18	0.03
$M^{150}U$	0.05	0.01	0.01	5.93	16.78	3.77	9.06	12.77	0.14	0.02
Mean	0.064	0.010	0.010	3.786	14.819	5.881	14.117	12.513	0.166	0.026
Std. dev.	0.011	0.000	0.000	1.501	7.808	2.648	6.353	2.880	0.023	0.005
%CV	17.64	0.00	0.00	39.65	52.69	45.026	45.00	23.01	13.87	20.79

Std. dev. = Standard deviation; CV = Coefficient of variation; WAP = weeks after planting

Amino acids content: A total of twenty amino acids were detected and quantified in the leaves of *T. occidentalis* grown in varying Urea solutions (Table 3). These AA were nine EAA and eleven NEAA. The TAA content of the leaves was: 41.327, 50.026, 51.396, 41.600, 50.247, 41.890, and 48.318 for the

Control, $M^{25}U$, $M^{50}U$, $M^{75}U$, $M^{100}U$, $M^{125}U$ and $M^{150}U$ growth media, respectively. The percentage ratio of EAA to NEAA for the growth media was: Control (42.33: 57.67), $M^{25}U$ (48.83: 51.17), $M^{50}U$ (38.746: 61.25), $M^{75}U$ (40.23: 59.77), $M^{100}U$ (43.65: 56.35), $M^{125}U$ (45.10: 54.90) and $M^{150}U$ (40.66: 59.34). Amongst the AA and growth media, glycine was the most concentrated with $M^{50}U$ medium having the highest AA value of 9.098, followed by valine content (9.004) at $M^{25}U$ growth medium while tryptophan was the lowest (0.157) at Control growth medium. However, the EAA for each of the growth media was lower than NEAA when compared. For EAA, valine content of the leaves had the highest value for the Control, $M^{25}U$, $M^{50}U$, $M^{75}U$, and $M^{100}U$ growth media, while the phenylalamine content was the highest at $M^{125}U$ and $M^{150}U$ growth media, respectively. The AA values recorded in the leaves vary amongst AA and growth media. The AA range for EAA and NEAA were 0.157 – 9.004 and 0.407 – 9.098, respectively. The lowest AA values were recorded in the Control medium for EAA (17.492) and NEAA (23.835), which resulted in TAA of 41.327.

Table 3: Amino acid content (%) of *T. occidentalis* leaves grown in different Urea growth media at 5 WAP

Types of AA	AA	Growth medium							Mean	%CV
		Control	$M^{25}U$	$M^{50}U$	$M^{75}U$	$M^{100}U$	$M^{125}U$	$M^{150}U$		
EAA	Thr	3.555	4.848	2.815	2.327	2.816	2.431	2.768	3.080	28.36
	Leu	1.260	0.804	0.674	0.999	2.822	2.561	1.585	1.529	55.68
	Iso	0.667	0.8	0.338	0.257	0.592	0.338	0.704	0.528	40.47
	Lys	1.387	1.063	1.715	1.305	1.005	0.715	1.577	1.252	27.78
	Meth	0.692	1.341	0.779	0.644	0.779	0.672	0.766	0.810	29.65
	Phe	2.500	4.641	2.576	2.032	5.138	6.091	5.707	4.098	41.17
	Try	0.157	0.601	0.819	0.794	0.532	0.571	0.597	0.582	37.47
	Val	4.648	9.004	5.228	4.321	5.230	4.514	5.140	5.441	29.65
	Hist	2.626	1.325	4.970	4.058	3.017	0.999	0.804	2.543	62.82
NEAA	Ala	0.718	0.408	0.809	0.597	0.526	0.407	0.177	0.520	40.90
	Aspa	0.646	1.07	1.106	1.032	0.983	1.066	0.9	0.972	16.35
	Asp	0.778	0.683	1.355	1.001	0.882	0.682	0.829	0.887	26.47
	Gluta	5.045	5.6	4.368	3.542	5.452	3.108	5.293	4.630	21.23
	Tyr	1.413	2.623	1.456	1.149	2.904	3.443	3.226	2.316	41.17
	Glu	2.851	3.165	2.469	2.002	3.081	1.757	2.992	2.617	21.22
	Gly	5.222	4.587	9.098	6.719	5.923	4.579	5.565	5.956	26.47
	Pro	2.877	2.487	2.656	2.884	3.221	3.461	3.618	3.029	13.79
	Ser	0.674	1.455	2.106	1.39	1.455	1.129	2.041	1.464	34.00
	Arg	2.812	2.47	4.899	3.618	3.189	2.465	2.997	3.207	26.48
	Cys	0.799	1.051	1.16	0.929	0.7	0.901	1.032	0.939	16.75
	TAA	41.327	50.026	51.396	41.600	50.247	41.890	48.318	46.401	9.86

WAP = weeks after planting; AA = Amino acid; EAA = Essential Amino acid; NEAA = Non-Essential Amino acid; Thr = Threonine; Leu = Leucine; Iso = Isoleucine; Lys = Lysine; Meth = Methionine; Phe = Phenylalamine; Try = Tryptophan; Val = Valine; Hist = Histidine; Alanine = Ala; Aspa = Aspartic acid; Asp = Asparagine; Glua = Glutamic acid; Tyr = Tyrosine; Glu = Glutamine; Gly = Glycine; Pro = Proline; Ser = Serine; Arg = Argine; Cys = Cystine; TAA = Total amino acid; Std. dev. = Standard deviation; CV = Coefficient of variation

Mineral composition of T. occidentalis leaves grown in Urea solutions: The proportion of mineral elements in *T. occidentalis* leaves grown under different concentrations of Urea media at 5 WAP varies in their concentrations (Table 4). The concentrations (%) of N, Ca, Mg and K in the leaves were high compared Na, Mn, Fe, Zn and Cu in all the growth media. Among the growth media, the mineral elements range thus: N (0.55 – 1.35%), Ca (0.15 – 0.47%), Mg (0.10 – 0.27%), K (0.05 – 0.13%), Mn (0.00183 – 0.00760%), Fe (0.00163 – 0.00592%), Cu (0.00030 – 0.00073%), Zn (0.00058 – 0.00740%) and Na (0.00006 – 0.00092%). The leaves grown in the Control medium had the lowest mineral content in most of the growth media. Control medium had the highest energy content (1509.76 KJ/100g) in relation to Urea growth media, which had the highest energy content (1496.70 KJ/100g) at $M^{25}U$ medium. The high level of iron in the leaves of *T. occidentalis* seems to provide the basis for its use as a blood bank to convalescent persons (Lubdha and Anjali, 2014). Bishop's vegetable and cashew shoot leaves samples have high crude fibre content (6.20, 7.40%) (Okunade and Adesina, 2014). Non-starchy vegetables are the richest sources of dietary fibre and are employed in the treatment of such diseases as obesity and diabetes (Agostoni *et al.*, 1995; Saldanha, 1995).

The mineral composition of *T. occidentalis* varied across growth media. The highest Fe content of the leaves was recorded at $M^{25}U$ growth media. Fluted pumpkin leaf contains crucial minerals (such as Fe, K, Na, P, Ca and Mg), vitamins and antioxidants (Kayode and Kayode, 2011). The mineral composition of *T. occidentalis* grown in different NPK and Urea solutions were higher compared to the work of Idris (2011). According to Idris (2011), the mineral composition of *T. occidentalis* leaf extract was given as: Ca (0.67 mg/100g), P (0.40 mg/100g), K (0.15 mg/100g), N (3.41 mg/100g), Mg (0.43 mg/100g), Na (0.02 mg/100g), Zn (7.50 mg/100g), Fe (18.5 mg/100g), Mn (1.18 mg/100g). Copper (Cu) Recommended Dietary Allowance (RDA) required acceptable range is 2 to 5 mg intake per day set by the World Health Organization (WHO, 1998). Manganese (Mn) RDA for infants, children, pregnant and lactating mothers (Food and Nutrition Board, 1989). An average human being contains 10 - 20 mg Mn, a quarter of which is found in the bone and a greater percentage present in tissues (Barker, 1996; Garrow *et al.*, 2000). The mineral elements most commonly lacking in human diets are Fe, Zn, I, Se, Ca, Mg and Cu (White and Broadley, 2009; Stein, 2010). The joint WHO/FAO food standards programme Codex Committee on Contaminants in food (1991) has the limit for Mn, Fe and Zn as follows: 6.0 mg/kg, 4.8 mg/kg and 6.0 mg/kg.

The vitamins content of *T. occidentalis* grown in varying proportion of Urea solutions differed.

Table 4: Mineral composition of *T. occidentalis* leaves grown in different Urea growth media at 5 WAP

Growth medium	Mineral N (%)	Ca (%)	Mg (%)	K (%)	Mn (%)	Fe (%)	Cu (%)	Zn (%)	Na (%)
Control	0.55000	0.22000	0.10000	0.09000	0.00196	0.00515	0.00062	0.00163	0.00074
$M^{25}U$	1.35000	0.45000	0.12000	0.10000	0.00277	0.00592	0.00049	0.00672	0.00017
$M^{50}U$	0.96000	0.20000	0.11000	0.13000	0.00370	0.00295	0.00039	0.00740	0.00039
$M^{75}U$	1.28000	0.15000	0.10000	0.07000	0.00183	0.00261	0.00030	0.00598	0.00015
$M^{100}U$	1.15000	0.23000	0.10000	0.05000	0.00760	0.00418	0.00063	0.00716	0.00073
$M^{125}U$	0.62000	0.47000	0.27000	0.10000	0.00389	0.00163	0.00043	0.00605	0.00092
$M^{150}U$	1.06000	0.41000	0.20000	0.09000	0.00420	0.00226	0.00073	0.00058	0.00006
Mean	0.99571	0.30429	0.14286	0.09000	0.003705	0.003529	0.000512	0.005073	0.000450
Std. dev.	0.30967	0.13365	0.06651	0.02517	0.001952	0.001588	0.000154	0.002777	0.000342
%CV	31.1002	43.9220	46.5582	27.9623	52.68542	45.00069	30.1019	54.74319	76.0231

Std. dev. = Standard deviation; CV = Coefficient of variation; WAP = weeks after planting

The highest total vitamin was recorded at $M^{100}U$ growth media. The water-soluble vitamins content of *T. occidentalis* was higher than the fat-soluble vitamins. Singh *et al.* (2012) reported that vitamin C is a crucial antioxidant present in the human system and have a range of functions such as: possess the ability to partake in enzymatic and hydroxylation reactions, involved in the oxidation-reduction reactions, it aids the absorption of micronutrients like Fe and Cu, available in trace element metabolism and protects cells from damage occasioned by the presence of free radical and environmental pollution. Vitamins serve as biological catalysts in many chemical reactions as well as precursors to various body factors. Sami *et al.* (2014) documented daily requirement of vitamins as follows: 15 – 20 mg for B_3, 2 – 3 mg for B_6, 2.4 mg for B_{12}, 60 mg C, 8 – 10 mg for E, 0.08 mg for D_3, 0.8 – 1 mg for A, 2 – 7 mg for β-carotene and 80 µg for K_3. Vitamin B complexes can be used or maintaining health in humans and animals (Ball, 2006). Dietary intake with low water-soluble vitamins such as B and C has the capacity to affect mitochondrial functions (Institute of Medicine, 1997, 1998; 2000; 2001; Depeint *et al.*, 2006). The value obtained for vitamin B_3 was within the range of daily dietary intake of vegetables. The vitamin E content of *T. occidentalis* grown in Urea solutions were lower compared to the work of Okonwu *et al.* (2018a), who assessed the vitamin E content of *T. occidentalis* grown in solid media. This observation is in line with the report of Kornsteiner *et al.* (2006), who reported that vitamin E increased with temperature during seed maturation and also during drought. Douthit *et al.* (2017) reported the significance of vitamin K consumption on cardiovascular health of an adult. Previous works on the consumption of vitamin K have been inconsistent (Jie *et al.,* 1995; Braam *et al.,* 2004; Geleijnse *et al.,* 2004; Villines *et al.,* 2005; Erkkila *et al.,* 2005; Maas *et al.,* 2007; Erkkila *et al.,* 2007; Gast *et al.,* 2009; Pan and Jackson, 2009; Beulens *et al.*, 2009). *T. occidentalis* is rich in vitamins (water-soluble and fat-soluble). The non-essential amino acids content of *T. occidentalis* was higher than the essential amino acids. The highest total amino acids (TAA) of *T. occidentalis* was recorded at $M^{50}U$ growth media. The results of the amino acids profile obtained in *T. occidentalis* using HPLC were comparable with the reports of others (Tindall, 1968; Fasuyi, 2006), who reported only seventeen (17) acids with the exception of proline, aspartic acid and glutamic acid. However, this study revealed the presence of twenty amino acids in *T. occidentalis.* Arowora *et al.* (2017) reported the amino acid composition range of 1.26 – 8.745 % in pumpkin leaf with EAA ranging from 2.11 – 5.95% and NEAA from 1.34 – 8.75%, respectively. Amino acids such as Glycine, Lysine, Threonine and Glutamine help to sustain abdominal integrity and health (Rhoads and Wu, 2009; Wang *et al*., 2009).

Conclusion: The concentration and presence of amino acids vary from one plant to another in different growth media. The medium of propagation of plant is also a key factor to the concentration of amino acids. Among the Urea treatments, lower concentration of

Urea in solution resulted in higher EAA, NEAA, TAA, and vitamin content of *T. occidentalis* leaves.

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