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Genetic Variability in Proximate, Mineral, Vitamin, Carotene and Anti-Nutrients Content of Fluted Pumpkin (*Telfairia Occidentalis* Hook F)

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ABSTRACT

This study aimed to evaluate genotypic variability in twenty fluted pumpkin (*Telfairia occidentalis*) accessions for nutrient composition and anti-nutrient contents. The trials were in Teaching and Research Fields of Michael Okpara University of Agriculture, Umudike, Abia State and Akwa Ibom State University, Obio Akpa Campus, Akwa Ibom State, laid in Randomized Complete Block Design (RCBD) with three replications. Analysis of variance was used to partition the variability into the components due to genetic and non-environmental factors, genetic(GCV), phenotypic (PCV) and environmental (ECV) components of variation, estimates of broad sense heritability(h^2Bs) and Genetic advance(GA). High range of variability and high genetic variance were observed for all the traits in both locations. Close differences between genotypic and phenotypic variances and genotypic, phenotypic and environmental coefficient of variations were observed for all the traits. The lower variances observed indicates that the genotypic component was the major contributor to the total variances for the characters in both locations. In Obio Akpa moderate broad sense heritability and genetic advance was observed which indicated the influence of environmental variance is more than genetic variance. Based on the parameters observed, considerable selection program for the improvement of these traits is possible in *Telfairia occidentalis*.

KEYWORDS: *Nutrients, Anti- nutrients, genotypic variance, heritability, genetic advance, genotypic, phenotypic and environmental coefficient of variation, Telfairia occidentalis*

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INTRODUCTION

Fluted pumpkin (*Telfairia occidentalis* Hook F.) is a leafy vegetable that belongs to the cucurbitacae family. It has two main species in the genus; *Telfairia occidentalis* and *Telfairia pedata.* Although perennial in nature, it is grown as an annual crop (Ogbonna, 2009). It is a climber and there is need for staking so that the tendril curls or it's allowed to sprawl over the ground. It is known to be a long sprawling plant that can grow up to ten (10) metres in length or more, with a ramifying root system in the top surface of the soil. The angular, glabrous stem, becomes fibrous when old (Akoroda, 1990).

Fluted pumpkin is a dicotyledonous plant, originated from Tropical West Africa (Schippers, 2000). It is indigenous to Nigeria and is widely cultivated in the wet coastal areas of Tropical West Africa, particularly in Benin, Cameroon, Ghana, Nigeria and Sierra Leone. This leafy vegetable is commonly cultivated in the Southeastern Nigeria (Odiaka *et al.,* 2008). However, it is gradually gaining acceptance in North Central where there is increase in its cultivation by small farm holders as a source of income (Ndor *et al.,* 2013).

Telfairia occidentalis is a very important leafy vegetable crop which is known for its high nutritional, medicinal and economic value (Akoroda, 1990; Ehiagbonare, 2008). In ranking, it is among the three most widely consumed leafy vegetables at homes and in restaurants across Nigeria (Abiose, 1999). From report, vegetables contains numerous vitamins, such as beta carotene, ascorbic acid, riboflavin, folic acid as well as minerals like calcium, phosphorus, iron etc (Gupta *et al.,* 2008; Lubdha and Anjali, 2014). These vitamins and minerals are essential dietary constituents required for growth, development and reproduction. The minerals in vegetables contribute alkaline substance in the body which enables the body to maintain acid – base balance. The absence of any particular vitamin may result in a nutritional diseases which is characteristic of such vitamin (Funke, 2011). It also act as powerful medicine which can help in reducing the risk of chronic diseases (Gosslau and Chen, 2004; Lee *et al.,* 2008). It has a potential against heart diseases, cancer, blood pressure and high cholesterol (Antonious *et al.,* 2009).

An important crop with this type of profile deserve research attention especially in area of its genetic improvement. Crop improvement is achieved through plant breeding programme. The success of any crop breeding programme largely depends on the availability of vast genetic variability, genetic advance and character association, direct and indirect effects on yield and its associated traits (Nwangburuka, *et al*., 2012).

Genetic diversity is important for selection of parents to recover trangressive segregants. Determination of heritability estimates using various methods (Obilaria and Fakorede, 1981; Wray and Visscher, 2008) will provide information on the proportion of phenotypic variance that is due to genetic factors for different traits but heritability estimate alone is not sufficient measure of the level of possible genetic progress that might arise not even when the most understanding individuals are selected in the breeding programme (Nwangburuka *et al.,*2014). The value of heritability estimated is enhanced when used together with the selection differentia or genetic advance (GA) (Ibrahim and Hussien, 2006).

In this study, therefore, leaves collected from twenty accessions of *Telfairia occidentalis* grown in two locations (Umudike and Obio Akpa) was analysed for proximate, mineral, vitamins and carotene and anti – nutrients contents with the objective of partitioning the observed variability into heritable and non-heritable components and estimating the broad sense heritability and genetic advance expected from the selection as a percent of the mean across the two locations.

MATERIALS AND METHODS

The twenty diverse accessions of fluted pumpkin collected from ten Local Government Areas of Akwa Ibom State, Nigeria was grown in Teaching and Research Farms of Michael Okpara University of Agriculture, Umudike and Akwa Ibom State University, Obio Akpa Campus, Akwa Ibom State during 2017 planting season. The experiment was laid in Randomized Complete Block Design (RCBD) with three replications. Plots of 1.5m x 1.5m with 0.5m inter- plot spacing was used. The seeds were sown directly on flat on each of the plots with one seed per hole at the spacing of 1m x 1m with planting density of 10, 000 plants/hectare. Weeding was done manually at three weekly intervals.

The *Telfairia occidentalis* leaves obtained from the two locations were washed with tap water and rinsed with distilled water to removed soluble impurities. The residual moisture was evaporated at room temperature. It was there after oven dried at 60℃. The dried leaves were then grinded in porcelain mortar, sieved through 2mm mesh sieve and stored on labeled polythene bags. The grinded sample was used for proximate, mineral, vitamins and carotene and anti – nutrients analyses. Moisture content was determined using fresh leaves. Proximate analysis of moisture, ash, crude protein, energy value and crude fat content was determined using standard method of AOAC. Fibre was determined by difference. Nitrogen Free Extract (NFE) referred to as soluble carbohydrate was obtained by subtracting all other components from 100%. NFE = 100 – (%ash + %crude fibre + %crude protein + %moisture) (Uyoh *et al*., 2009).

Mineral analysis was determined by the dry ash extraction method described by James (1995), Kirk and Sawyer (1998). Vitamins and beta carotene analysis was determined using the spectrophotometric method of Okwu (2004) while Anti – nutrients were estimated by the methods described by Harborne (1973) and Edeoga *et al*., (2005). All the determinants were done in triplicates.

Data was subjected to analysis of variance (ANOVA) using Genstat Discovery Edition 4 (Genstat, 2007) software. The analysis of variance was used to partition the gross variability into the components due to genetic and non- genetic environmental factors and to estimate their magnitude (Wricke and Weber (1986) and Prasad *et al.,* (2010).

Genotypic Variance (VG) = $\frac{MSG - MSE}{r}$, Phenotypic Variance (VP) = $\frac{MSG}{r}$

Error Variance (VE) = $\frac{MSE}{r}$

where MSG, MSE and r are the mean squares of genotypes, mean squares of error and number of replications respectively. The Phenotypic (PCV) and Genotypic (GCV), Error (ECV) Coefficients of Variations was estimated by the methods of Burton

(1952), Johnson *et al*.,(1955) and Kumar *et al*., (1985) as follows:

PCV = $\frac{\sqrt{VG}}{x}$ x $\frac{100}{1}$; GCV = $\frac{\sqrt{VG}}{x}$ x $\frac{100}{1}$; ECV = $\frac{\sqrt{VE}}{x}$ x $\frac{100}{1}$; where VP, VG , VE and x are Phenotypic variance, Genotypic variance, Error Variance and Grand mean respectively for each attribute under consideration. Broad Sense Heritability (h^2Bs) expressed as the ratio of VG to the VP was estimated on genotypic mean basis as described by Allard (1991). Genetic Advance (GA) was estimated by the method of Fehr (1987) as GA = K(Sp)h^2Bs, where k is a constant (2.06 at 5% selection pressure), Sp is the phenotypic Standard Deviation ($\sqrt{VP}$), h^2Bs is the Broad Sense Heritability, GA was calculated as a percentage of the mean factor analysis based.

RESULTS AND DISCUSSION

The analysis of variance showed that all the traits were highly significant ($p< 0.001$). This indicates the presence of wide genetic diversity among the genotypes and potential for exploiting the observed genetic diversity for the improvement of the *Telfairia occidentalis*.

The Phenotypic, Genotypic and Error Variances for proximate, minerals, vitamins and carotene and anti-nutrients of the *T. occidentalis* grown in Umudike and Obio Akpa are shown in Tables 1 and 2. The estimates of the variances were close to each other at both locations. The error variance was relatively lower than the genotypic variance for the traits. Similar results of higher genotypic variance than error variance for some characters were observed by Eze and Nwofia (2016) for Taro, Nwofia *et al*., (2013) for egusi melon, Chinatu *et al*.,(2018) for *Tetrapleura tetraptera* fruits. These lower variances indicate that the genotypic component was the major contributor to the total variance for these characters in each of the two locations. It can be concluded that most of the variability observed in the phenotype for the different characters had more of genetic than non – genetic basis. The variability due genetic variance indicated considerable scope for selection. It is difficult to compare the variances among the range of various characters because they are not unit free (Baye, 1996).

Phenotypic Coefficient of Variation (PCV), Genotypic Coefficient of Variation (GCV), Error Coefficient of Variance (ECV), Broad Sense Heritability (h^2Bs) and Genetic Advance (GA) for proximate attributes, minerals, vitamins and carotene and anti- nutrients compositions measured in Umudike and Obio Akpa are shown in Tables 3 and 4.

In Umudike, PCV ranged from 2.60 – 44.46 in proximate attributes, 4.75 – 8.84 in minerals, 5.09 – 22.40 in vitamins and carotene and 7.49 – 26.05 in anti – nutrients. GCV ranged from 2.54 – 36.65 in proximate attributes, 4.74 – 8.84 in minerals, 5.06 – 22.40 in vitamins and carotene and 7.49 – 26.05 in anti – nutrients. ECV ranged from 0.58 – 25.17 in proximate attributes, 0.28 – 1.15 in minerals, 0.55 – 4.48 in vitamins and carotene and 1.36 – 14.93 in anti – nutrients. Broad Sense Heritability ranged from 60 – 100 while Genetic Advance ranged from 0.02 – 23.49 (Table 3).

In Obio Akpa, PCV ranged from 2.84 – 66.79 in proximate attributes, 0.29 – 13.69 in minerals, 12.56 – 28.50 in vitamins and carotene, and 27.92 – 61.43 in anti – nutrients. GCV ranged from 1.62 – 38.16 in proximate attributes, 3.22 – 8.10 in minerals, 7.25 – 16.86 in vitamins and carotene and 13.96 – 28.96 in anti – nutrients. ECV ranged from 0.30 – 6.76 in proximate, 0.29 – 1.36 in minerals, 0.19 – 2.01 in vitamins and carotene and 1.97 – 4.97 in anti-nutrients. Broad Sense Heritability ranged from 20.00 – 50.00 and Genetic Advance from 0.009 – 16.27 (Table 4).

Phenotypic Coefficient of Variability (PCV) was slightly higher than Genotypic Coefficient of Variability (GCV), GCV was far higher than Error Coefficient of Variability (ECV). The same trend was reported by Chinatu and Ukpaka (2016) in *Piper guineense,* Eze *et al.,* (2016) in Taro, Nwofia and Adikibe (2012) in *Occium gratiissium.*

These suggest that environmental effects constitute a portion of the total phenotypic variation in the traits. High GCV together with high heritability and high genetic advance will give valuable information that each parameter alone (Saha *et al.,* 1990).

Heritability in conjunction with genetic advance is more effective and reliable in predicting the results and effectiveness of selection (Johnson *et al*., 1955). High estimate of Broad Sense Heritability (h^2Bs) with relatively high genetic advance obtained for energy value, vitamin C, Potassium, Sodium and alkaloid (Tables 5 and 6), indicate that these attributes are under the control of additive gene effects and therefore the plant can be improved with respect to these attributes through direct selection.

However, relatively high estimates of broad sense heritability with low genetic advance were obtained for other attributes in this study, indicating the presence of non – additive gene action. Thus, direct selection for such attributes may not be effective. In such situation recombination breeding may give better response for improvement (Subi and Idris, 2013).

This study have shown that there are genetic variability for the traits under consideration and selection among these nutritional traits can lead to an increase in their availability to the vast populace in the third world Countries of which is a major source of vegetable.

Table 1: Mean squares and variance ratio obtained in analysis of variance of proximate, minerals vitamins, and Anti - nutrients composition of twenty genotypes of T. *occidentalis* leaves grown in Umudike.

	Mean squares		
Parameters	**Genotype**	**Error**	**Variance ratio**
Proximate			
Ash	0.4810	0.003697	130.12***
Carbohydrate	12.945	1.761	7.35***
Moisture content	11.1251	0.1977	56.28***
Energy value	194.67	29.13	6.68***
Fat	0.0628	0.00048	130.78***
Fibre	0.8283	0.002321	356.94***
Protein	0.66506	0.01013	65.66***
Minerals			
Calcium	77.7161	0.5575	139.40***
Magnesium	33.4857	0.3015	111.06***
Sodium	206.38	0.4025	512.71***
Potassium	392.0223	0.4577	856.46***
Iron	0.05563	0.000305	182.42***
Zinc	0.0166	0.0004	41.56***
Vitamins			
Carotene	0.362555	0.003838	94.46***
Thiamine	0.024149	0.00044	54.08***
Riboflavin	0.01524	0.000237	64.08***
Niacin	0.0211	0.00024	84.85***
Vitamin C	86.183	0.3425	251.65***
Vitamin E	0.02943	0.00038	77.15***
Anti - nutrients			
Alkaloid	0.01056	0.000213	49.61***
HCN	0.019378	0.000142	136.45***
Oxalate	0.0024	0.0000345	69.57***
Phenol	0.00039	0.0000086	45.77***
Phytate	0.11268	0.0174	6.48***
Tannin	0.000891	0.000025	35.29***

Table 2: Mean squares and variance ratio obtained in analysis of variance of proximate, vitamins, minerals and Anti - nutrients composition of twenty genotypes of *Telfairia occidentalis leaves* grown in Obio Akpa.

Parameters	Mean squares		
	Genotype	**Error**	**Variance ratio**
Proximate			
Ash	1.024	0.0019	537.08***
Carbohydrate	5.30778	0.05523	96.10***
Moisture content	5.10553	0.06171	82.74***
Energy value	75.1170	0.9062	82.89***
Fat	0.06798	0.00027	247.33***
Fibre	1.25172	0.0007843	1595.01***
Protein	0.0737582	0.001794	411.05***
Minerals			
Calcium	14.9827	0.2304	65.03***

Magnesium	40.2345	0.6193	237.67***
Sodium	57.9351	0.3895	148.73***
Potassium	563.5457	0.6787	830.35***
Iron	0.03335	0.0001849	180.36***
Zinc	0.022611	0.000267	84.77***
Vitamins			
Carotene	0.909456	0.001725	527.33***
Thiamine	0.01324	0.000089	148.42***
Riboflavin	0.02252	0.0001462	154.06***
Niacin	0.03751	0.000298	125.51***
Vitamin C	231.52	0.04519	5123.11***
Vitamin E	0.0430	0.0001911	225.24***
Anti - nutrients			
Alkaloid	0.04	0.00026	155.46***
HCN	0.04975	0.00020	245.01***
Oxalate	0.00178	0.000025	70.70***
Phenol	0.000576	0.0000218	263.39***
Phytate	0.093184	0.002248	41.00***
Tannin	0.00041	0.000002	207.26***

Table 3: Phenotypic, genotypic and error of variances for Proximate, Minerals Vitamins and Carotene, and Anti- nutrients composition of twenty genotypes of *Telfairia occidentalis leaves* grown in Umudike.

Attributes	Means	Range	VP	VG	VE
Proximate					
Ash	5.81	4.86 – 6.34	0.16	0.16	0.004
Carbohydrate	5.27	0.00 – 12.37	5.49	3.73	1.76
Moisture content	75.24	71.28 – 79.80	3.83	3.64	0.19
Energy value	60.91	38.73 – 85.53	84.31	55.18	29.13
Fat	1.76	1.52 – 2.09	0.02	0.02	0.0004
Fibre	5.93	4.86 – 7.60	0.28	0.28	0.002
Protein	6.00	4.70 – 6.80	0.23	0.22	0.01
Minerals					
Calcium	64.99	57.84 – 74.60	26.28	25.72	0.56
Magnesium	65.78	60.64 – 74.84	11.36	11.06	0.30
Sodium	136.60	124.7 – 155.7	69.06	68.66	0.40
Potassium	240.8	224.4 – 261.8	130.98	130.53	0.46
Iron	1.59	1.36 – 1.84	0.02	0.02	0.0003
Zinc	1.17	1.04 – 1.30	0.005	0.005	0.0004
Vitamins					
Carotene	3.24	2.65 – 4.18	0.12	0.12	0.003
Thiamine	0.74	0.59 – 1.02	0.008	0.0079	0.0004
Riboflavin	0.32	0.20 – 0.45	0.005	0.005	0.0002
Niacin	1.29	1.89 – 1.46	0.006	0.006	0.0002
Vitamin C	105.7	95.48 – 117.5	28.95	28.61	0.34
Vitamin E	0.83	0.60 – 1.06	0.009	0.009	0.0003
Anti - nutrients					
Alkaloid	0.73	0.63 – 0.85	0.003	0.003	0.0002
HCN	0.74	0.53 – 0.89	0.006	0.006	0.0001
Oxalate	0.10	0.07 – 0.20	0.0007	0.0007	0.00003
Phenol	0.08	0.06 – 0.12	0.0001	0.0001	0.000008
Phytate	0.94	0.72 – 1.93	0.05	0.03	0.02
Tannin	0.09	0.06 – 0.14	0.0003	0.00028	0.00002

VP = Phenotypic variation, VG = Genotypic variation, VE = Error variation

Table 4: Phenotypic, Genotypic and Error of Variances for Proximate, Minerals, Vitamins and carotene and Anti - nutrients composition of twenty genotypes of *Telfairia occidentalis* leaves grown in Obio Akpa.

Attributes	Means	Range	VP	VG	VE
Proximate					
Ash	5.41	4.28 –6.43	1.02	0.34	0.0019
Carbohydrate	3.46	0.88 – 5.87	5.36	1.75	0.055
Moisture content	79.97	78.20 – 83.70	5.16	1.68	0.06
Energy value	49.07	38.96 – 58.35	76.02	24.73	0.90
Fat	1.57	1.32 – 1.83	0.06	0.02	0.0002
Fibre	4.31	3.06 – 5.30	1.25	0.41	0.0007
Protein	5.24	4.30 – 6.15	0.73	0.24	0.0017
Minerals					
Calcium	68.64	63.28 -72.80	15.21	4.91	0.23
Magnesium	62.52	56.24 – 68.74	40.40	13.35	0.16
Sodium	136.3	124.8 – 143.8	58.32	19.18	0.38
Potassium	273.6	245.3 -292.4	564.22	187.62	0.67
Iron	1.56	1.42 -1.85	0.03	0.01	0.0001
Zinc	1.03	0.79 – 1.16	0.02	0.007	0.0002
Vitamins					
Carotene	3.47	2.74 -4.27	0.91	0.30	0.0017
Thiamine	0.73	0.02 – 0.85	0.01	0.004	0.00008
Riboflavin	0.49	0.34 –0.65	0.02	0.007	0.0001
Niacin	1.37	1.20 – 1.62	0.03	0.01	0.00029
Vitamin C	111.2	95.7 – 125.8	231.56	77.15	0.045
Vitamin E	0.96	0.75 – 1.16	0.04	0.01	0.0001
Anti - nutrients					
Alkaloid	0.68	0.45 – 0.94	0.04	0.01	0.0002
HCN	0.67	0.43 – 0.94	0.04	0.01	0.0002
Oxalate	0.08	0.04 – 0.15	0.001	0.0005	0.0002
Phenol	0.05	0.03 – 0.08	0.0005	0.0001	0.000002
Phytate	0.48	0.24 - 0.82	0.09	0.02	0.0022
Tannin	0.07	0.04 – 0.09	0.0004	0.0001	0.000002

VP = Phenotypic variation, VG = Genotypic variation, VE = Error variation

Table 5: Phenotypic Coefficient, Genotypic Coefficient and Environmental Coefficient of Variations, Broad Sense Heritability and Genetic Advance of Proximate, Vitamins, and Anti- nutrients composition of twenty genotypes of *Tefairia occidentalis* leaves from Umudike.

Attributes	PCV	GCV	ECV	H_2B(%)	GA(%)
Proximate					
Ash	6.87	6.87	1.08	100	0.82
Carbohydrate	44.46	36.65	25.17	67.94	3.28
Moisture content	2.60	2.54	0.58	95.04	3.83
Energy value	15.07	12.20	8.86	65.45	12.38
Fat	8.04	8.04	1.14	100	0.29
Fibre	8.92	8.92	0.75	100	1.09
Protein	7.98	7.81	1.67	95.65	0.94
Minerals					
Calcium	7.89	7.80	1.15	97.87	10.34
Magnesium	5.12	5.06	0.83	97.36	6.76
Sodium	6.08	6.07	0.46	99.42	17.02
Potassium	4.75	4.74	0.28	99.65	23.49
Iron	8.84	8.84	1.08	100	0.29
Zinc	6.02	6.02	1.70	100	0.15

Vitamins					
Carotene	10.70	10.70	1.69	100	0.71
Thiamine	12.04	11.97	2.69	98.75	0.18
Riboflavin	22.40	22.40	4.48	100	0.15
Niacin	5.97	5.97	1.09	100	0.16
Vitamin C	5.09	5.06	0.55	98.82	10.95
Vitamin E	11.46	11.47	2.09	100	0.19
Anti –nutrients					
Alkaloid	7.49	7.49	1.93	100	0.11
HCN	10.52	10.52	1.36	100	0.16
Oxalate	26.05	26.05	5.39	100	0.05
Phenol	12.39	12.39	3.51	100	0.02
Phytate	23.61	18.29	14.93	60	0.28
Tannin	18.79	18.16	4.85	93.33	0.03

Table 6: Phenotypic Coefficient, Genotypic Coefficient and Environmental Coefficient of Variations, Broad Sense Heritability and Genetic Advance of Proximate, Minerals, Vitamins, and Anti - nutrients composition of twenty genotypes of *T. occidentalis* leaves from Obio Akpa.

Attributes	PCV	GCV	ECV	H_2B(%)	GA(%)
Proximate					
Ash	18.64	10.76	0.80	33.33	0.69
Carbohydrate	66.79	38.16	6.76	32.64	1.55
Moisture content	2.84	1.62	0.30	32.55	1.52
Energy value	17.76	10.13	1.93	22.53	5.84
Fat	15.51	8.95	1.04	33.33	0.16
Fibre	25.89	14.82	0.64	32.80	0.75
Protein	16.27	9.33	0.78	32.87	0.57
Minerals					
Calcium	0.29	3.22	0.69	32.28	2.59
Magnesium	10.16	5.84	0.63	33.04	4.32
Sodium	5.60	3.21	0.45	32.88	5.17
Potassium	8.68	5.00	0.29	33.25	16.27
Iron	11.03	6.33	0.85	33.33	0.11
Zinc	13.69	8.10	1.36	35.00	0.10
Vitamins					
Carotene	27.41	15.74	1.18	32.97	0.64
Thiamine	13.60	8.60	1.21	40.00	0.08
Riboflavin	28.50	16.86	2.01	35.00	0.10
Niacin	12.56	7.25	1.23	33.33	0.11
Vitamin C	13.68	7.89	0.19	33.32	10.44
Vitamin E	20.74	10.37	1.03	25.00	0.10
Anti -nutrients					
Alkaloid	29.33	14.66	2.36	25.00	0.10
HCN	29.55	14.77	2.08	25.00	0.10
Oxalate	35.33	24.98	4.99	50.00	0.03
Phenol	38.10	17.04	2.41	20.00	0.009
Phytate	61.43	28.96	9.45	22.22	1.13
Tannin	27.92	13.96	1.97	25.00	0.01

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