Health and nutritional potential of Okra (*Abelmoschus* spp L.) for reducing malnutrition in rural Ghana.

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Introduction

Five (5) essential mineral elements and four (4) micro elements were determined in ten varieties of okra. Phytochemical constituents of the fresh fruits were also determined. The objectives were to assess essential mineral contents & total flavonoid content (TFC), phenolic content (TPC), antioxidant activity (TAA) in the fresh fruits of the varieties.

Materials & Methods

Experimental Site: Ghana Research Reactor 1 & Applied Radiation Biology Centre, GAEC.

Methods:

- Instrumental Neutron Activation Analysis (INAA) for elemental analysis
- 1,1-Diphenyl 1-2-PicrylHydrazl (DPPH) for total antioxidant analysis
- Aluminium chloride colourimetric method for total flavonoids
- Folin-Ciocalteau method for total phenolics

Experimental Design: Randomised complete block design, RCBD with four replicates.

Data Collection: Mineral elements, Flavonoid, Phenolic & Antioxidants

Results & Discussion

There were;

- statistically significant differences ($p \leq 0.05$) in TFCs, TPCs and TAAs (Tab.1&2) among the varieties
- concentrations of essential minerals also varied significantly ($P \leq 0.05$) (Tab.3)
- degree of associations among the elements was variable (Tab.4)

Conclusion

- Significant variability was recorded among the ten okra varieties for mineral element composition as well as phyto-chemical constituents.
- Okra is a good source of some essential elements as well as antioxidants.
- Fresh fruits of the variety, Mamolega have the highest contents of Al, Br, Cl and Na. Mamolega and Wune mana have the highest contents of total flavonoids and phenolics.

Table 1: Total Flavonoids and Phenolics in mature fruits of 10 Varieties of okra

	Flavonoids		Phenolics	
Variety	**Concentration (ethanolic extract)**	**Concentration (aqueous extract)**	**Concentration (ethanolic extract)**	**Concentration (aqueous extract)**
Wune Mana	4980.50±1.23^{b}	1449.24±1.28^{c}	18.19±2.25^{b}	8.58±0.84^{ijk}
Labadi	1958.80±0.00^{ijk}	379.29±0.96^{m}	9.02±0.28^{hij}	19.74±0.11^{d}
Clemson Spineless	1288.06±92.91^{n}	532.77±2.11^{j}	9.69±1.17^{hi}	27.08±2.00^{b}
Volta	3204.58±2.34^{c}	400.22±2.16^{m}	14.59±2.54^{cd}	**6.82±0.09^{jkl}**
Agric Short Fruit	**5159.21±12.90^{a}**	487.67±14.92^{k}	24.12±4.64^{a}	39.46±0.15^{a}
Kortebortor	1515.50±3.88^{m}	279.72±33.92^{p}	15.76±1.71^{cd}	23.62±1.33^{c}
Legon Fingers	3601.42±0.65^{c}	693.07±3.84^{f}	9.89±0.61^{hi}	16.92±0.61^{ef}
Indiana	1609.01±1.45^{mn}	750.83±28.82^{e}	10.51±0.63^{hi}	19.97±0.00^{d}
Mamolega	1181.91±0.45^{n}	517.91±2.51^{j}	12.23±1.26^{efg}	14.25±1.17^{gh}
Asontem	2338.87±8.31^{gh}	493.08±14.74^{k}	13.18±2.30^{def}	22.46±0.64^{c}
MEAN	2683.78±12.41	598.38±10.53	13.718±1.74	19.89±0.69

±sd=standard deviation, mean with same letters in a column are not statistically different ($p \geq 0.05$) from each other according to Duncan's multiple range test. Values bolded and underlined refers to variety with the highest concentration; Bolded values represents variety with the lowest concentration. All concentrations were measured in µg/g.

Table 3: Concentration of Nine Mineral Elements in the varieties of Okra in mg/kg*

	Macro Elements			Micro Elements					
Varieties	**Mg**	**K**	**Ca**	**Cl**	**Na**	**Br**	**Al**	**Mn**	**Cu**
Wune Mana	50.96±7.64	23.33±3.49	88.38±13.26	72.54±10.88	223.4±33.51	34.75±5.21	70.11±11.15	17.27±3.51	<0.01
Labadi	55.76±8.36	23.14±3.47	10.63±1.59	85.52±12.83	316.78±47.52	27.43±4.11	41.39±6.62	20.48±3.63	276.4±41.46
Clemson Spineless	43.96±6.59	76.43±11.46*	73.09±10.96	51.37±7.71	221.41±33.21	41.62±6.24	51.39±8.17*	17.07±3.12	<0.01
Volta	45.94±6.89	18.45±2.77	68.63±10.29	61.10±9.17	415.26±62.29	28.65±4.30	38.11±6.10	11.63±2.61	<0.01
Agric Short Fruit	48.57±7.29	92.14±13.82	10.34±1.55	69.17±10.37	205.26±30.79	21.56±2.23	42.72±6.88	15.53±2.92	<0.01
Kortebortor	51.47±7.72	20.09±3.01	89.49±13.42	58.06±8.71	171.1±25.67	22.67±3.40	37.89±6.06	13.88±2.58	<0.01
Legon Fingers	48.95±7.34	15.32±2.30	90.62±13.59	65.08±9.76	570.7±85.61	34.67±5.20	43.57±6.93	15.50±2.88	<0.01
Indiana	44.57±6.69	13.42±2.01	68.39±10.26	46.27±6.94	521.32±78.20	18.45±2.77	31.16±4.67	36.35±5.45*	<0.01
Mamolega	50.91±7.64	40.79±6.12	90.9±13.63	95.48±14.32*	778.5±11.60*	104.6±15.69*	77.41±12.31*	18.03±3.55	<0.01
Asontem	54.75±8.21	23.80±3.57	89.26±13.39	61.53±9.23	16.32±2.45	15.54±2.33	33.80±5.41	15.56±2.93	<0.01
Mean	49.62±7.44	34.45±5.20	67.64±10.19	66.44±9.99	341.73±41.09	34.94±5.15	46.36±7.43	18.10±3.32	30.93±41.46
CV (%)	7.28	72.02	42.34	20.36	60.11	66.68	30.11	34.14	257.81
RDI	320-420	2000	500-1200	100-500	2400-5175	2-5	2	2-5	0.4-1.2

*Values bolded and asterisked refers to the highest concentration for a particular element; Bolded values represents the lowest concentration for a particular element. ± refers to standard error of the mineral element concentration in the variety. CV = Coefficient of Variation; RDI = recommended daily intake: (Source = Dietary Reference, 1991).

Table 2: Antioxidant Potential of 10 Varieties of Okra

Variety	Ethanolic %Inhibition	Extract Conc. (µg/g)	Aqueous %Inhibition	Extract Conc. (µg/g)
Wune Mana	54.060	3030.38±69.31^{a}	48.47	2660.70±0.00^{a}
Labadi	31.97	941.63±1.05^{fg}	17.94	514.14±0.00^{kl}
Clemson Spineless	45.27	1885.32±732.38^{c}	21.65	877.83±0.00^{fg}
Volta	32.14	1440.87±1.59^{de}	23.95	1060.73±1.59^{de}
Agric Short Fruit	46.24	3705.81±0.00^{a}	25.94	2039.89±0.00^{b}
Kortebortor	46.12	2001.22±12.19^{c}	20.96	883.92±0.00^{fg}
Legon Fingers	34.89	1001.85±1.02^{fg}	21.51	605.54±2.03^{ij}
Indiana	**55.97**	1829.58±483.00^{c}	24.90	795.55±0.00^{fgh}
Mamolega	51.15	1483.52±0.00^{d}	**15.09**	**415.51±11.18^{m}**
Asontem	18.53	665.02±0.13^{ij}	27.13	992.43±2.22^{ef}
MEAN	41.63	1798.52±130.07	24.75	1084.62±1.702

±sd=standard deviation, mean with same letters in a column are not statistically different ($p \geq 0.05$) from each other according to Duncan's multiple range test. Values bolded and underlined refers to variety with the highest concentration or inhibition percentage; Bolded values represents variety with the lowest concentration or inhibition percentage. Conc = concentration.

Table 4: Correlations among Nine Mineral Elements in 10 Varieties of *Abelmoschus* spp. (L.).

Mineral	Mg	K	Ca	Cl	Na	Br	Al	Mn	Cu
K	-0.282								
Ca	-0.119	-0.451							
Cl	0.607	0.037	-0.202						
Na	-0.275	-0.213	0.171	0.382					
Br	0.004	0.137	0.291	0.665	0.695				
Al	0.080	0.199	0.274	0.655	0.394	0.819			
Mn	-0.267	-0.209	-0.109	-0.255	0.304	-0.097	-0.187		
Cu	0.543	-0.151	-0.636	0.435	-0.046	-0.103	-0.133	0.118	

P (≤ 0.05) is considered significant.

Note.

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