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INFLUENCE OF POULTRY MANURE APPLICATION ON VITAMIN CONTENT, PROXIMATE AND CHEMICAL PROPERTIES OF MORINGA (*MORINGA OLEIFERA* LAM) LEAVES

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ABSTRACT

The study was carried out in the Department of Crop Science, Faculty of Agriculture, University of Nigeria Nsukka, to determine the influence of poultry manure application on the vitamin content, proximate and chemical properties of leaves of *Moringa oleifera* plants. The levels of poultry manure used were 0 tonne/ha, 5 tonnes/ha and 10 tonnes/ha respectively. The moringa seeds used were collected from three locations of Nigeria i.e Nsukka (Enugu State), Dutse (Jigawa State) and Jos (Plateau State). The experiment was a 3 x 3 factorial trial in a randomized complete block design (RCBD) with three replications. The poultry manure levels did not show any significant differences ($p>0.05$) in the proximate properties (% ash, % crude protein, % fat, % crude fibre and % carbohydrate), chemical properties (nitrogen, potassium, phosphorus, calcium, magnesium, sodium, manganese, iron, zinc, copper) and some vitamin contents (vitamins A, B_1, B_2, B_6, and C). Succulent leaves had higher values of the proximate properties except carbohydrate, vitamins (except vitamin B_2) and chemical properties except copper (Cu) and zinc (Zn). There were no significant effects ($p>0.05$) of the seed sources on the proximate properties of the leaves, vitamin content except vitamin A and chemical compositions except phosphorus (P) and copper (Cu).

INTRODUCTION

Previous research work by Makkar and Becker (1996) had shown that moringa leaves contained up to 25.1 % crude protein, 6.5 % lipid and 12 % ash. Fuglie (2005) obtained values of 27.1 % protein, 2.3 % fat, 38.2 % carbohydrate, 19.2 % fibre, 20.0 % calcium (Ca), 1.37 % magnesium (Mg), 0.20 % phosphorus (P), 1.32 % potassium (K), 0.03 % iron (Fe) and 0.87 % sulphur (S) in *Moringa oleifera* leaves. He also obtained high levels of vitamins A, B, C and E in the dried leaves. Analysis of poultry manure had shown that it was high in N, K and other nutrient elements (Ogbonna and Umar-shaaba, 2011). Awodun (2007) reported that poultry manure and NPK fertilizer increased the leaf N, P, K Ca and Mg contents of *Telfairia occidentalis*. Singh (2010) also reported increase in N, P, K Zn, protein and carbohydrate contents of corn (*Zea mays* L.) with poultry manure application. Moringa plants have been used to combat malnutrition, especially among infants and nursing mothers (Makkar and Becker, 1996). Moringa leaves are rich in B carotene, amino acids and ascorbic acids (Anwar *et al*., 2006, Makkar and Becker, 1997). Moringa plant is a good food source in the tropics because it flushes and flowers all seasons. In Philippines, moringa leaves were used to increase milk production in lactating mothers and as such, the plant was nicknamed "Mother's Best Friend" (Anwar *et al*., 2006). The leaves of *Moringa oleifera* plant can be eaten fresh, cooked or stored as dried powder for many months without loss of nutrients. The objective of this study was to determine the influence of poultry manure application on vitamin content, proximate and chemical properties of M*oringa oleifera* leaves.

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MATERIALS AND METHODS

The study was carried out in the Department of Crop Science, Faculty of Agriculture, University of Nigeria, Nsukka to determine the effect of poultry manure application on the mineral content, proximate and chemical properties of *Moringa oleifera* plant leaves. Three levels of poultry manure (0 tonne/ha, 5 tonnes/ha and 10 tonnes/ha) constituted the first treatment (Factor A) while three sources of moringa seeds (Jos, Nsukka and Jigawa in Nigeria) constituted the second treatment (Factor B). The experiment was a 3 x 3 factorial trial

in a randomized complete block design (RCBD) with three replications. The poultry manure was incorporated into the soil before planting the seeds at stake at planting distance of l m x l m. Succulent leaves (first to the fifth leaf) and older ones (from the base) were sampled monthly for proximate and mineral content analyses which were carried out at the International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria.

RESULTS

The levels of the poultry manure did not have any significant effects ($p>0.05$) on the proximate qualities of the moringa leaves sampled at three months after planting (Table 1). Five tonnes/ha of poultry manure gave the least values of percentage ash and protein and greatest value of percentage carbohydrate. Ten tonnes/ha gave the least values of percentage ash and crude fibre, and highest protein value. Zero tonne/ha gave the least values of percentage carbohydrate and fat content in the leaves. The poultry manure levels did not show significant differences ($p>0.05$) in the values of vitamins A, B, and C but vitamin E (Table 1). Five tonnes/ha poultry manure gave the greatest values of vitamins A,B_1, B_6, and E and the least value of Vitamin C in the leaves compared to other levels. Zero tonne/ha gave the highest value of vitamin C and least values of vitamins A and E. There were no significant differences ($p>0.05$) in the effects of the poultry manure levels on N, P, K, Ca, Mg, Mn, Zn, iron (Fe) and copper (Cu) contents of the leaves. However, 10 tonnes/ha poultry manure gave the highest values of Mn, Fe, Zn and N (Table 1).

Table 1. Effects of poultry manure on the proximate, vitamin and chemical properties of *Moringa oleifera* leaves

	Manure Rates				
Proximate Values	0 ton/ha	5 tons/ha	10 tons/ha	Mean	$FLSD_{(0.05)}$
Ash	6.64	6.53	6.47	6.54	ns
% Protein	12.37	12.26	12.57	12.40	ns
% M.C	29.57	27.13	28.58	28.43	ns
% Fat	0.17	0.20	0.20	0.19	ns
% Crude Fibre	16.96	16.29	15.99	16.41	ns
% Carbohydrate	40.93	44.13	42.67	42.58	ns
Vitamins					
Vit A (ppm)	0.57	0.60	0.59	0.58	ns
Vit B1 (ppm)	0.27	0.31	0.27	0.29	ns
Vit B2 (ppm)	0.66	0.66	0.66	0.66	ns
Vit B6 (ppm)	1.06	1.11	1.04	1.07	ns
Vit C (ppm)	0.38	0.33	0.35	0.36	ns
Vit E (ppm)	0.87	1.13	1.00	0.99	0.21
	0.77	0.73	0.75	0.75	ns
Chemical Properties					
% Mg					
% K	0.38	0.35	0.37	0.36	ns
P (ppm)	71.20	71.00	71.20	71.10	ns
Na (ppm)	13.86	15.26	13.68	14.27	ns
Mn (ppm)	22.85	21.95	24.00	22.94	ns
Fe (ppm)	61.30	58.00	62.20	60.50	ns
I (ppm)	1.10	1.01	1.05	1.05	ns
Cu (ppm)	1.43	1.26	1.43	1.38	ns
Zn (ppm)	2.58	2.65	2.86	2.70	ns
% N	1.98	1.96	2.01	1.98	ns

ns = non-significant

Data presented in Table 2 showed that the succulent leaves had higher values of ash, crude protein, crude fibre, and vitamins A, B_1, B_6, C and E. The succulent leaves also had higher values of N, P, K, Ca, Mg, Mg, Mn, and Fe. There were no significant differences ($t > 0.05$) between the two leaf types in their proximate and vitamin compositions. Both, also, did not differ significantly ($t>0.05$) in their chemical compositions except in P, Mn and Fe contents (Table 2). The source of seeds did not have any significant ($p>0.05$) effect on the proximate and vitamin contents of the leaves except vitamin A (Table 3). Similarly, there were no significant differences ($p>0.05$) in the chemical compositions of the leaves of plant grown from seeds collected from the different locations except Na and Zn contents (Table 3).

Table 2. Effects of ages of leaves on the proximate, vitamin and chemical properties of *Moringa oleifera* leaves

Proximate Value	Age		Mean	$t_{0.05}$
	Older	Succulent		
Ash	6.35	6.73	6.54	ns
% protein	11.63	13.17	12.40	ns
% M.C	29.03	27.82	28.43	ns
% fat	0.19	0.19	0.19	ns
% crude fibre	14.87	17.94	16.41	ns
% carbohydrate	44.28	40.87	42.58	ns
Vitamin				
Vit A (ppm)	0.53	0.64	0.58	ns
Vit B1 (ppm)	0.16	0.41	0.29	ns
Vit B2 (ppm)	0.66	0.65	0.66	ns
Vit B6 (ppm)	0.97	1.16	1.07	ns
Vit C (ppm)	0.30	0.41	0.36	ns
Vit E (ppm)	0.88	1.12	0.99	ns
	2.03	2.21	2.12	ns
Chemical Properties				
% Ca				
% Mg	0.74	0.76	0.75	ns
% K	0.34	0.39	0.36	ns
P (ppm)	67.40	74.90	71.10	5.59
Na (ppm)	14.02	14.52	14.27	ns
Mn (ppm)	19.87	26.00	22.94	3.18
Fe (ppm)	54.80	66.20	60.50	6.52
I (ppm)	1.05	1.05	1.05	ns
Cu (ppm)	1.48	1.27	1.38	ns
Zn (ppm)	2.98	2.60	2.70	ns
% N	1.86	2.11	1.98	ns

ns = non-significant

Table 3. Effects of seed source on the proximate, vitamin and chemical properties of *Moringa oleifera* leaves

	Accession				
Proximate Value	JOS	NSK	JGW	Mean	$FLSD_{(0.05)}$
Ash	6.43	7.04	6.17	6.54	ns
% Protein	11.79	12.71	12.69	12.40	ns
% M.C	28.83	27.97	28.47	28.43	ns
% Fat	0.18	0.20	0.18	0.19	ns
% Crude Fibre	15.27	16.96	17.00	16.41	ns
% Carbohydrate	43.92	42.16	41.66	42.58	ns
Vitamin					
Vit A (ppm)	0.50	0.66	0.59	0.58	0.12*
Vit B1 (ppm)	0.28	0.30	0.28	0.29	ns
Vit B2 (ppm)	0.70	0.62	0.66	0.66	ns
Vit B6 (ppm)	1.11	1.14	0.96	1.07	ns
Vit C (ppm)	0.33	0.38	0.36	0.36	ns
Vit E (ppm)	0.93	1.00	1.07	0.99	ns
	2.12	2.22	2.02	2.12	ns
Chemical Properties					
% Ca					
% Mg	0.75	0.79	0.71	0.75	ns
% K	0.37	0.38	0.34	0.36	ns
P (ppm)	72.70	71.80	69.00	71.10	ns
Na (ppm)	17.77	12.86	12.17	14.27	3.20*
Mn (ppm)	22.92	23.01	22.89	22.94	ns
Fe (ppm)	59.00	62.50	60.00	60.50	ns
I (ppm)	1.06	1.05	1.06	1.05	ns
Cu (ppm)	1.46	1.38	1.28	1.38	ns
Zn (ppm)	2.46	3.02	2.62	2.70	0.42*
% N	1.89	2.03	2.03	1.98	ns

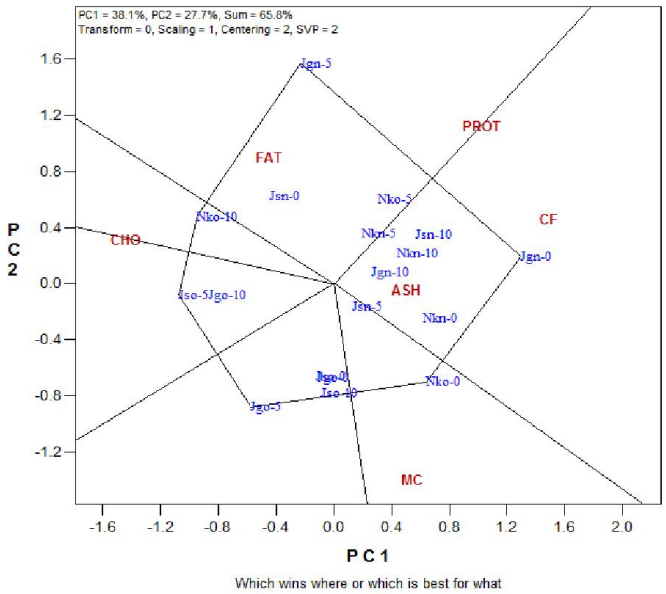

Fig. 1. GGE Biplot Analysis on Effects of Poultry Manure, Accession and Age on the Proximate Compositions of Leaves of *M. oleifera*

CHO = carbohydrate, MC = moisture content, CF = crude fibre, PROT = protein, Jso-0, Jso-5 and Jso-10 = Jos older leaves with 0, 5 and 10t/ha PM respectively; Jsn-0, Jsn-5 and Jsn-10 = Jos succulent leaves with 0, 5 and 10t/ha PM respectively; Nko-o, Nko-5 and Nko-10 = Nsukka older leaves with 0, 5 and 10t/ha PM respectively; Nkn-0, Nkn-5 and Nkn-10 = Nsukka succulent leaves with 0, 5 and 10t/ha PM respectively; Jgo-0, Jgo-5 and Jgo-10 = Jigawa older leaves with 0, 5 and 10t/ha PM respectively; Jgn-0, Jgn-5 and Jgn-10 = Jigawa succulent leaves with 0, 5 and 10t/ha PM. PM = poultry manure.

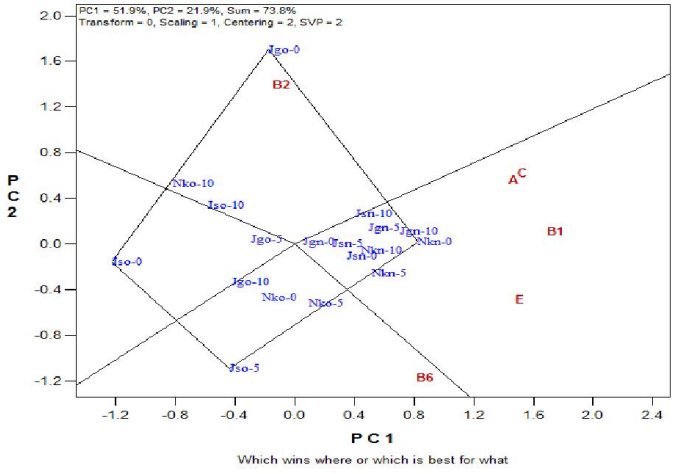

Fig. 2. GGE Biplot Analysis of the Effects of Poultry Manure, Accession and Age on the Vitamin Content of Leaves of *Moringa oleifera*

Jso-o, Jso-5 and Jso-10 = older leaves from Jos without PM, with 5 tons/ha and 10 tons/ha PM respectively; Nko-0, Nko-5 and Nko-10 = older leaves from Nsukka without PM, with 5 tons/ha and 10 tons/ha PM, respectively; Jgo-0, Jgo-5 and Jgo-10 = older leaves from Jigawa without PM, with 5 tons/ha and 10 tons/ha PM respectively; Jsn-0 = succulent leaves from Jos without PM, with 5 tons/ha and 10 tons/ha PM respectively; Nkn-0, Nkn-5 and Nkn-10 = succulent leaves from Nsukka without PM, with 5 tons/ha and 10 tons/ha respectively, while Jgn-0, Jgn-5 and Jgn-10 = succulent leaves from Jigawa without PM, with 5 tons/ha and 10 tons/ha PM respectively.

Nsukka accession had the highest contents of vitamin A and Zn, while Jos accession had the highest leaf Na content. Figures 1 and 2 show the interactions in the effects of poultry manure levels, seed sources and ages of the leaves on proximate and vitamin contents of moringa leaves. Figure 1 showed clearly that crude fibre, protein and ash contents were higher in the young succulent leaves. Young leaves from Dutse (Jigawa State) which received no manure treatment had the highest fibre content. Carbohydrate was higher in the older leaves. Fat was high in the succulent leaves of the plants grown from the seeds collected from from Dutse and Jos accessions. Figure 2 depicts a preponderance of vitamins A, C, B_1 and E in the young succulent leaves mainly from the plants that received some doses of poultry manure. In contrast, B_3 was highest in older leaves from Dutse grown without manure.

DISCUSSION

The insignificant effect of the poultry manure on the proximate qualities, chemical properties and vitamin contents of the moringa leaves within the three months of study could be attributed to the slow nutrient release nature of the manure into the soil for plant use, some other environmental factors such as soil factor as well as the physiological conditions of the plants. This agreed with the work of Demir *et al*. (2010) who also obtained insignificant effects of poultry manure on N, Mg and Mo concentrations of tomato leaves and fruits. It suggests that short-duration crops may not benefit much from poultry manure application because of its long-term residual effects. However, the values of the proximate properties obtained in this study did not differ significantly from the levels reported by previous workers. Makkar and Becker (1996) obtained 25.1 % crude protein in moringa leaves and Richter *et al*. (2003) 25.0 % compared with the average crude protein of 24.5 % obtained in this study. The average levels of other proximate properties like ash, fat and carbohydrate contents of the leaves obtained in this study did not also vary significantly from the results of the previous workers. Richter *et al*. (2003) and Moyo *et al*. (2011) reported 8.4 % and 7.64 % ash contents for untreated moringa leaves against 6.54 % obtained in the present study. Richter *et al*. (2003) reported higher level of crude fibre, 7.9 % against 3.2 % obtained in the current study. Fuglie (2005) in Philippines reported higher values of vitamins A (16.3ppm versus 0.29ppm).

The variations in the levels of the nutrients obtained by the various workers could be due to the differences in the study locations and the environmental conditions. The higher values of vitamins, proximate and chemical properties in the succulent leaves compared to the older ones could be as a result of higher metabolic activities in the succulent leaves. There is usually translocation of nutrients elements like N from the lower (older) leaves to the younger (succulent) leaves during senescence. This can also account for the higher compositions of the nutrient elements, like N, in the succulent leaves than the older ones. This is a good direction for moringa leaf consumers, to harvest the young succulent leaves instead of the older ones for consumption. Plants of moringa seeds collected from different locations of Nigeria gave no significant differences in the compositions of vitamins, proximate and chemical properties of their leaves indicating non-phenotypic influences on the genetic constitutions of the seeds. The performances of the plants were determined by the environmental factors prevalent in the study area (Nsukka) which would have also determined the physiological conditions of the plants. The environmental conditions usually vary from one geographical location to another.

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