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INFLUENCE OF POULTRY MANURE APPLICATION ON ANTI-NUTRIENT COMPOSITIONS OF MORINGA (*MORINGA OLEIFERA* LAM) LEAVES

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ABSTRACT

The study was carried out to determine the influence of poultry manure application on anti-nutrient compositions of old and succulent leaves of *Moringa oleifera* plants. Three levels of poultry manure i.e. O tonne/ha, 5 tonnes/ha and 10 tonnes/ha were used for treatment. 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 carried out on the field in the Department of Crop Science, University of Nigeria, Nsukka. It was a 3 x 3 factorial experiment laid out in a randomized complete block design (RCBD) with three replications. Old and succulent leaves of the moringa plants were sampled monthly for three months after planting and taken to the laboratory of International Institute for Tropical Agriculture, (IITA) at Ibadan (Western Nigeria) for anti-nutrient determination. Poultry manure application insignificantly ($p>0.05$) increased oxalate, phytate and saponin compositions of the leaves. The older leaves had higher values of tannin, oxalate, phytate and saponin than the succulent ones. Seed source did not have any significant ($p>0.05$) effect on the quantities of the anti-nutrients in the leaves.

INTRODUCTION

Anti-nutrients are substances which interfere with the metabolism and utilization of body nutrients, examples are phytates, oxalates, tannins and saponins. Moringa leaves have been found to contain little quantities of the anti-nutrients (Makkar and Becker, 1996 and 1997). Phytates decrease the availability of minerals and reduce protein digestion by the formation of phytic acid protein complex (Gupta *et al*., 1988, Richter *et al*., 2003). Tannins have beneficial effects on health. They curb haemorrhage (haemostatic) and bare swelling. They are used for mouth and eye washes, vaginal douches and treatment of rectal disorders (Elvin-Lewis *et al*., 1977, Bamshaiye *et al*., 2011). At low and moderate quantities, tannins can improve protein digestion in the lumen of ruminants (Frutos *et al*., 2004). Moringa leaves have been found to contain small quantities of saponins at levels that are relatively harmless to human health. Thus, moringa leaves are consumed with no side effects. Low dietary levels of saponins in soyabeans had been shown to increase growth in tilapia while high quantities tended to retard it (Liener, 1994, Richter *et al*., 2003). Oxalic acid combines with divalent metallic cations such as calcium (Ca^{2+}) and iron (ii) (Fe^{2+}) to form calcium and iron oxalate crystals which are excreted in urine. An estimate of 80% of kidney stones is formed from calcium oxalate. Consumption of crops with high concentrations of oxalate may lead to kidney problems. Fresh and dried moringa leaves have been found to contain negligible quantities of oxalate which are not harmful to the body if the leaves are consumed in moderate quantities. However, fresh moringa leaves contain more oxalate than the dry ones (Fuglie, 1999, Fahey, 2005 and Johnson *et al*., 2005). Poultry manure and other organic fertilizers increase the nutrient status of most soils and boost crop productivity (Awodun, 2007 and Singh, 2010), but there is little information on the influence of poultry manure application on anti-nutrient compositions of most plant leaves especially moringa. The objective of the study is to determine the influence of poultry manure application on the anti-nutrient compositions of old and succulent leaves of moringa plants.

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MATERIALS AND METHODS

The study was carried out at the Department of Crop Science, Faculty of Agriculture, University of Nigeria, Nsukka. The moringa seeds used were collected from three locations of Nigeria; Nsukka (Enugu State), Dutse (Jigawa State) and Jos

(Plateau State). The seeds were planted directly (at stake) on the field. Prior to seed planting, soil samples were collected from different locations of the field, bulked to form a composite sample and analyzed in the laboratory for physical and chemical properties. The poultry manure was analyzed for N, P, K, Ca, Mg, sodium (Na), pH, organic matter (OM) and organic carbon (C). Tables 1 and 2 represent the physical and chemical properties of the soil of the experimental site and the poultry manure used for the experiment. The treatments consisted of three levels of poultry manure (0 tonne/ha, 5 tonnes/ha and 10 tonnes/ha) and moringa seeds collected from the three locations of Nigeria. The experiment was a 3 x 3 factorial trial laid out in a randomized complete block design (RCBD) with three replications. The moringa seeds were planted two/hole on the seed beds, in the field, at the planting distance of 1m x lm. The seedlings were thinned down to one/hole two weeks after emergence. The poultry manure was incorporated into the soil at the different rates before planting.

Sampling and laboratory analysis of moringa leaves

Sampling of the leaves was done monthly for three months after planting (at 50% flowering; anthesis). First to fifth leaf from the shoot-tip and older leaves from the base were used for laboratory analyses. The leaves were dried and ground into powder for analyses. Analyses of the leaf samples were done at the International Institute for Tropical Agriculture (IITA), Ibadan, Nigeria. The samples were analyzed for tannins, phytates, oxalates and saponins.

RESULTS

Anti-Nutrient Composition of the Moringa Leaves

The older leaves of the moringa plants had higher concentrations of tannin, oxalate, phytate and saponin than the succulent leaves. There were no significant differences ($t>0.05$) in the anti-nutrient contents of both leaf ages (Table 3). The effect of poultry manure rates on the anti-nutrient contents of moringa leaves is presented in Table 4. The different poultry manure levels showed no significant differences ($p>0.05$) in the anti-nutrient composition of the leaves. However, the highest value (6.48g/100g) of tannin in the leaves was obtained at 0 tonne/ha while the least value (6.19/100g) was obtained at 5 tonnes/ha treatment.

Table 1. Physical and chemical properties of the soil of the experimental site

Parameter	Value
Clay (%)	22
Silt (%)	13
Fine Sand (%)	24
Coarse Sand (%)	42
pH (H_2O)	5
pH (KCl)	4.7
Carbon (%)	1.65
Organic matter (%)	1.02
Nitrogen (%)	0.06
Sodium (meq/100g)	0.34
Calcium (meq/100g)	0.6
Magnesium (meq/100g)	1.8
CEC (meq/100g)	14.9
Base salt (%)	21
H^+ (meq/100g)	2.7
Phosphorus (ppm)	14.99

Table 2. Chemical properties of the poultry manure

Chemical Properties	Value
pH (H_2O)	7.3
pH (KCl)	6.7
Organic C (%)	19.89
Organic matter (%)	51
N (%)	1.73
Sodium (%)	0.08
Potassium (%)	0.08
Calcium (%)	4.65
Magnesium (%)	1.35
Phosphorus (%)	1.39

Table 3. Anti-Nutrient contents of succulent and older leaves of *Moringa oleifera* plants

Anti-nutrient	Succulent leaves	Older leaves	Mean	$t_{(0.05)}$
Tannin (g/100g)	6.11	6.48	6.30	ns
Oxalate (g/100g)	2.51	3.24	2.87	ns
Phytate (g/100g)	8	9.75	8.88	ns
Saponin (g/100g)	3.77	4.32	4.04	ns

ns = non-significant

Table 4. Effect of poultry manure on anti-nutrient contents of *Moringa oleifera* leaves

	Manure Rate				
	0 ton/ha	5 tons/ha	10 tons/ha	Mean	$FLSD_{(0.05)}$
Tanin (g/100g)	6.48	6.19	6.23	6.30	ns
Oxalate (g/100g)	2.84	2.87	2.91	2.87	ns
Phytate (g/100g)	8.47	9.41	8.74	8.89	ns
Saponin (g/100g)	3.65	4.63	3.86	4.04	ns

ns = non-significant

Table 5. Effect of seed source on the anti-nutrient contents of *Moringa oleifera* leaves

	Seed Source				
Anti-nutrient	JOS	NSK	DTS	Mean	$FLSD_{(0.05)}$
Tannin (g/100g)	6.01	6.75	6.12	6.300	ns
Oxalate (g/100g)	2.716	3.321	2.585	2.874	0.48
Phytate (g/100g)	8.8	8.96	8.87	8.880	ns
Saponin (g/100g)	3.9	4.16	4.07	4.040	ns

ns = non-significant, JOS= Jos, NSK= Nsukka and DTS= Dutse

The highest value (2.91g/100g) of oxalate was obtained at 10 tonnes/ha followed by 5 tonnes/ha (2.87g/100g) and 0 tonne/ha (2.84g/100g) in that order. The highest values of phytate and saponin (9.41g/100g and 4.63g/100g) were obtained when the poultry manure was applies at 5 tonnes/ha while the least values (8.47g/100g and 3.65g/100g) were obtained at the 0 tonne/ha (control). The different poultry manure levels showed no significant differences ($p>0.05$) in the anti-nutrient compositions of the leaves (Table 4). The seed source did not have significant effects ($p>0.05$) on the anti-nutrient contents of the leaves as presented in Table 5. Moringa leaves from Nsukka accession had statistically higher oxalate content than those from Jos and Dutse.

DISCUSSION

The higher values of the anti-nutrients (oxalates, phytates and saponins) obtained in the manure-treated moringa leaves suggested positive influence of poultry manure on the composition of the anti-nutrients in the plants. Poultry manure

probably had substances which could have contributed to the anti-nutrient compositions of the leaves. Gupta *et al*. (1988) reported values of 2.73%, 3.1% and 4.1% respectively for tannins, phytates and oxalates in untreated moringa leaves as against 6.23%, 9.41% and 2.91% which were the highest values of these anti-nutrients obtained in the present study for the leaves of poultry manure-treated plants. Oxalates had been found to be negligible or relatively absent in dried leaves of moringa plants according to Fahey (2005) and Fuglie (2005). The higher concentration of the anti-nutrients in the older leaves is an indication of the fact that older leaves are better accumulators of these anti-nutrients. The cells of the older leaves are usually tougher, larger and broader than those of the succulent ones. There was likely to be little or no mobility of the anti-nutrients from the older leaves to the succulent ones as the leaves were aging. Thus, leaf senescence can be said to be synonymous with and directly proportional to leaf anti-nutrient accumulation. This fact gives a good direction to the consumers to take small quantities of older leaves or concentrate more on the young succulent leaves which contain lesser quantities of anti-nutrients.

Conclusion

Moringa oleifera is a hardy plant which can adapt to various soils, climatic and other environmental conditions. It is an all-season crop, not easily retarded by soil nutrient deficiencies. Thus, moringa plants can be grown with little or no fertilizer or manure application to avoid increasing the anti-nutrient composition of the leaves and other edible portions of the plants. It is advisable to harvest the younger and succulent leaves for consumption as the older ones have higher anti-nutrient compositions.

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