ISSN 2349-0837
Volume 5 Number3
Journal of Advances in Agriculture

NUTRITIONAL POTENTIAL OF CASSAVA PEELS ENSILED WITH MORINGA, GLIRICIDIA AND LEUCAENA LEAVES

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ABSTRACT

The experiment was conducted to assess the proximate composition, mineral content, gross energy and antinutrients of cassava peels ensiled with *Moringa, Gliricidia* and *Leucaena* leaves. The crude protein for cassava peels ensiled with *Moringa oleifera* (CMO) was 20.32g100g^{-1}, cassava peels ensiled with *Leucaena leucocepphala*(CLL) was 23.17g100g^{-1} and cassava peels ensiled with *Gliricidia sepium* (CGS) was 22.23g100g^{-1}. Ether extract values were 4.02g100g^{-1}, 3.56g100g^{-1} and 3.20g100g^{-1} for CMO, CLL and CGS respectively. Ash content for cassava peels ensiled with *Moringa, Leucaena* and *Gliricidia* were 4.26g100g^{-1}, 3.80g100g^{-1} and 4.20g100g^{-1} respectively. The crude fibre ranged from 12.03g100g^{-1} in CLL to 12.56g100g^{-1} in CGS. In cassava peels ensiled with *Moringa, Leucaena* and *Gliricidia* leaves Na, K, Ca, Zn were the most abundant minerals in all the treatments. The tannin content varied from 0.20g100g^{-1} in CMO to 0.45g100g^{-1} in CGS. The phytic acid ranged from 10.12g100g^{-1} in CMO to 14.76g100g^{-1} in CGS. The phytic-phosphorus ranged from 2.85g100g^{-1} in CMO to 4.16gg100g-1 in CGS. The oxalate contents were 2.85g100g^{-1}, 3.52g100g^{-1} and 4.16g100g^{-1} in CMO, CLL and CGS respectively. It is evident that cassava peels ensiled with *Moringa, Leucaena* and *Gliricidia* have great potentials for livestock animals and could be utilized as a source of supplementary feed for ruminant animals.

Key words: Nutrition; Ensiling; Supplements; Molasses; Polythene sheets; tropical feedstuffs.

INTRODUCTION

Forages play an important role in ruminant nutrition by providing energy, protein and minerals as well as fibre for chewing and ruminating (Ahmad, 2000). However, the major constraint to ruminants production in Nigeria is the scarcity and fluctuating quality of all year round forage supply (Ajayi *et al.*,2005). Available forages and crop residues fed to small ruminants especially during the extended dry season are fibrous resulting in poor utilization and poor performance of animals. In Nigeria, where livestock production is mainly based on grass-dominated pastures, herbage mass during the extended dry season is generally not sufficient to satisfy the nutritional requirements of livestock. Browse plants have been implicated to enhance intake of poor quality roughages, improved growth rates and increased reproduction efficiency in small ruminants (Asaolu *et al.*, 2011). The dry matter degradability values of leaf meals from browse plants make them appropriate as supplement to basal diets of poor quality grass.

The processing of cassava tubers yields cassava peels which is a by-product that is valuable ruminant feeds when properly processed (Aro *et al.*,2010). Cassava peels should not be fed alone, as the protein and mineral content cannot support optimum rumen function and productivity in ruminants and their optimal utilization require sources of readily fermentable protein and by-pass protein as well as micronutrients including sulphur, phosphorus and vitamin B-complex (Smith, 1988).

In Nigeria, supplementation of ruminant feeds with browses such as *Gliricidia sepium* and *Leucaena leucocephala* which are higher in crude protein compared to tropical grass, crop residues and agro-industrial by-products have been reported (Odeyinka *et al.*, 2003). *Moringa oleifera*, an under exploited browse plant is gradually gaining research attention within the West African sub-region as ruminant feed supplement with the view to address the observed crude protein shortages of forages and crop residues (Ayssiwede *et al.*,2011). To mitigate these problems, ensiling materials using molasses is one of the alternative feeds as it is relatively simple to produce and utilizes the sulphur in herbage production from the rainy season (Mendieta-Araica *et al.*,2009). Molasses contains a wide range of trace minerals, vitamins, sugar and particularly rich in potassium and sulphur (Gohl,1981). Ensiling is a process of conserving herbage through acidification process by epiphytic bacteria. Ensiling ensures readily available feeds during seasons of high production for conservation and storage for later use in period of scarcity (Koon, 1993). This study is undertaken to ascertain the nutritional potential of ensiled cassava peels with *Moringa oleifera, Gliricidia sepium* and *Leucaena leucocephala* leaf meals.

MATERIALS AND METHODS

Site Location -: The experiment was conducted at the Small Ruminant Unit of the Teaching and Research Farm, Ekiti State University, Ado-Ekiti. Ado-Ekiti is in the Humid Zone of West Africa(HZWA), with a tropical climate and bimodal rainfall distribution between April and October accompanied by a break in August and the peak during June and September(Adegun, 2014). The site is located on latitude 07^0 37^1 15^{11} N and longitude 05^0 13^1 17^{11} E, with a temperature range of 21^0 C to 28^0 C and high humidity.

Feed Preparation-: Leaves of *Moringa*, *Gliricidia* and *Leucaena* were harvested from the plantations at the Teaching and Research Farm of Ekiti State University Ado-Ekiti. The harvested leaves were air dried and allowed to wilt for five hours. Fresh cassava peels were collected from Iworoko- Ekiti. The ensiled materials include: black plastic container, black polythene sheets, cassava peels, *Moringa oleifera* leaves, G*liricidia sepium* leaves, *Leucaena leucocephala* leaves, molasses and weighing scale.

Ensiling process-: Fresh leaves of *Moringa oleifera*, G*liriciidia sepium* and *Leucaena leucocephala* were chopped together with the cassava peels into pieces of about 3-4cm long and were packed in layers into a black plastic container lined with polythene sheets, molasses were spread on each layer of the materials and were thoroughly compressed before another layer was added. This was done until the plastic container was full. A black polythene sheet was used to cover the materials ensiled to create air tight condition for the ensiled materials. There were three treatments:

Treatment A : Cassava peels +poultry manure + *Moringa oleifera leaves* + molasses

Treatment B: Cassava peels +poultry manure + *Gliricidia sepium leaves* + molasses

Treatment C : Cassava peels +poultry manure + *Leucaena leucocephala* leaves + molasses

The fermentation lasted for a period of 21 days. At 21st day, the samples of the different ensilage were collected for laboratory analysis.

Proximate analysis-: The proximate constituents of the ensiled materials such as dry matter, crude fibre, ether extract were determined by the method of the Association of Official Analytical Chemist (AOAC, 2005). Nitrogen was determined by the micro-Kjeldahl method and crude protein was taken as N% x 6.25(Pearson, 1976). The total carbohydrate was determined by difference. The gross energy of the ensiled materials was determined against thermocouple grade benzoic acid using a Gallenkamp ballistic bomb calorimeter (model CBB-330-0104L).

Mineral analysis: The minerals were analysed from solution obtained by first dry ashing the sample at 550^{0}C. The Na and K contents were determined by Flame photometry (Jenway Ltd, Dunmow, Essex, UK) while P was obtained by the vanadomolybdate method (AOAC,2005). The other mineral elements were determined after wet digestion with a mixture of nitric, sulphuric and hydrochloric acid using Atomic Absorption Spectrophotometer(AAS Model SP9). All chemicals were BDH grade. All determinations were in duplicate for the three treatments.

Determination of Tannin, Phytate and Oxalate-: Finely milled samples (250mg in 10cm^3 of 70% aqueous acetone) were extracted for 2 hours at 30^{0}C in water-bath using Gallenkamp orbital Shaker (Surrey UK) at 120 revolutions per minute (rpm). Pigments and fat were first removed from the samples by extracting with diethyl ether containin 1% acetic acid. Thereafter, the total polyphenols (as tannic acid equivalent) was determined in 0.05, 0.2 or 0.5cm^3 aliquot using Folin ciocalteau reagent (Sigma) and then 2.5ml of the Sodium carbonate solution. The tubes were vortexed and the absorbance recorded at 725nm after 40 mins as described by Makkar and Good-child(1996).

Determination of oxalate

Oxalate content was determined by the titrimetric method of Moir (1953) as modified by Ranjhan and Krishna (1980). Where extract were intensely coloured, they were decolourised with activated charcoal (Balogun and Fetuga, 1980).

Statistical analysis

The analysis used for determining difference between chemical composition of the feed materials were mean, standard deviation (SD) and coefficient of variation (CV) (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Proximate composition Table 1 shows the proximate composition of cassava peels ensiled with *Moringa, Gliricidia* and *Leucaena* leaf meals. Cassava peels ensiled with *Moringa* leaves contained 4.26g100g^{-1} dry matter (DM), 20.32g 100g^{-1} crude protein (CP), 4.02g 100g^{-1} ether extract (EE), 12.50g 100g^{-1}crudefibre (CF), 34.56g 100g^{-1} nitrogen free extract (NFE) and 15.66 MJKg^{-1} gross energy. Cassava peels ensiled with *Gliricidia* leaves had 32.26g 100g^{-1} dry matter (DM) 22.23g 100g^{-1} crude protein (CP), 3.20g 100g ether extract, 12.56g 100g^s crude fibre (CF), 36.50g 100g^{-1} nitrogen free extract (NFE) and 16.47 MJKg^{-1} gross energy. Cassava peels ensiled with *Leucaena* leaves had 3.80g 100g^{-1} ash, 34.56g 100g^{-1} dry matter (DM), 23.17g 100g^{-1} crude protein (CP) 3.56g 100g^{-1} ether extract (EE), 12.03g 100g^{-1} crude fibre (CF), 33.80g 100g^{-1} nitrogen free extract (NFE) and 16.03 MJKg^{-1} gross energy.

Table 1: Proximate composition (g 100g^{-1}) of cassava peels ensiled with *Moringa, Gliciridia* and *Leucaena* leaves.

Diet	DM	ASH	CP	EE	CF	NFE	GE(MJ Kg^{-1})
CMO	32.65	4.26	20.32	4.04	12.50	34.56	15.66
CLL	34.56	3.80	23.17	3.56	12.03	33.80	16.03
CGS	32.26	4.20	22.23	3.20	12.56	36.50	16.47
X̄	33.16	4.09	21.91	3.59	12.36	34.95	
SD	1.23	0.25	1.45	0.58	0.29	1.39	
CV	3.71	6.11	6.62	16.16	2.36	3.98	

CMO= Cassava peels ensiled with *Moringa oleifera*, CGS= Cassava peels ensiled with G*liricidia sepium,* CLL= Cassava peels ensiled with *Leucaena leucocephala*

— X = mean, SD = standard deviation, CV = coefficient of variance

Mineral content

Table 2 shows the mineral content of cassava peels ensiled with *Moringa, Gliricidia* and *Leucaena* leaf meals. The sodium (Na) varied from 7.67mg $100g^{-1}$ in CCL to 8.49mg $100g^{-1}$ in CGS. The potassium (K) ranged from 6.45mg $100g^{-1}$ in CLL to 7.23mg $100g^{-1}$ in CGS. The calcium (Ca) varied from 7.56mg $100g^{-1}$ in CLL to 9.41mg $100g^{-1}$ in CGS. The magnesium (Mg) varied from 3.30mg $100g^{-1}$ in CLL to 3.56mg $100g^{-1}$ in CGS. The iron (Fe) varied from 1.02mg $100g^{-1}$ in CLL TO 2.01mg $100g^{-1}$ in CGS. The Manganese (Mn) varied from 0.31mg $100g^{-1}$ in CLL to 0.35mg $100g^{-1}$ in CGS. The copper (Cu) varied from 0.003mg $100g^{-1}$ in CGS to 0.005mg $100g^{-1}$ in CLL. The phosphorus (P) varied from 2.12mg $100g^{-1}$ in CGS to 2.32mg $100g^{-1}$ in CLL and Lead (Pb) was not detected.

Table 2: mineral composition of cassava peels ensiled with *Moringa, Gliricidia* and *Leuceana* leaf meals (mg$100g^{-1}$)

Parameters	CMO	CGS	CLL	Mean	SD	CV
Na	8.08	8.49	7.67	8.08	0.41	5.10
K	6.84	7.23	6.45	6.84	0.39	5.68
Ca	8.48	9.41	7.56	8.48	0.93	10.91
Mg	3.43	3.56	3.30	3.43	0.13	3.79
Zn	7.18	7.53	6.83	7.18	0.35	4.87
Fe	1.52	2.01	1.02	1.52	0.50	32.89
Mn	0.34	0.35	0.31	0.33	0.02	6.43
Cu	0.004	0.003	0.005	0.004	0.001	25.00
Pb	ND	ND	ND	ND	ND	ND
P	2.22	2.12	2.32	2.22	0.10	4.50

ND = Not detected

Antinutrients

Table 3 shows the level of antinutrients in cassava peels ensiled with moringa, gliricidia and leucaena leaf meals. The tannin content ranged from 0.20% in CMO to 0.45% in CGS. Phytic-phosphorus varied from 4.16mg g^{-1} in CGS to 3.52mg g^{-1} in CLL. Oxalate ranged from 9.68mg g^{-1} in CGS to 8.25mg g^{-1} in CLL.

Table 3: Anti-nutritional factors of cassava peels ensiled with *Moringa, Gliricidia* and *Leucaena*

Parameters	CMO	CGS	CLL	MEAN	SD	CV
Tannic acid (g $100g^{-1}$)	0.20	0.45	0.311	0.32	0.13	39.16
Phytic acid (mg g^{-1})	10.12	14.76	12.48	12.45	2.32	18.64
Phytic - P (mg g^{-1})	2.85	4.16	3.52	3.52	0.66	18.80
Oxalate (mg g^{-1})	6.75	9.68	8.25	8.23	1.47	17.80

DISCUSSION

Cassava peels ensiled with Moringa, Gliricidia and Leucaena contain high nutrient compared with cassava peels alone and fresh leaves of Moringa, Gliricidia and Leucaena alone based on the proximate composition. The CP content of cassava peels ensiled with *Gliricidia* and *Leucaena* leaf meals used in this study were within the range of 20.32-23.17. This range compares favourably with those reported by Ayodeji (2005). In this study (23.17) was higher than 22.50% CP content reported by Limcango-Lopez (1997) for fresh *Leucaena* leaf. There was a decrease in % CP, %ash, and increase %CF, %EE, content (17.01, 7.93; 7.09 and 2.11) respectively in a sole *Moringa* leaf reported by Ogbe and Affiku (2011) compared to the %CP %ash, %CF, %EE, %ash (20.32,12.50,4.02 and 4.26) in the silage of cassava peels + *Moringa* leaf obtained in this study. These differences may not be unconnected with variations in the geographical locations of the growth and development or stages of maturity of the plants.

Generally, elements are acknowledged to be important to proper nutrition. Many minerals, particularly Ca, P, Na are essential for small ruminants for optimum productivity (Ghazanfar *et al*., 2011). The mineral content of the silage of mineral leaf with cassava peels is higher than the mineral content of *Moringa* alone and cassava peels alone. The mineral contents of *Moringa* and *Gliricidia* leaves are higher than the content in *Leucaena* leaves (Aletor and Adeogun 1995).

This is also the same for the silage of cassava with *Moringa*, cassava with *Gliricidia* and cassava peels with *Leucaena* leaf meals except for the value of copper and phosphorus.

Tannins interfere with digestion by displaying anti-trypsin and anti amylase activities, form complexes with vitamin E12 and interfere with bioavailability of protein (Liener,1980). Tannins generally contribute to poor palatability of ration and can bind to the digestive enzymes or directly with the dietary protein. The tannin reported present in *Moringa oleifera* leaves is 21.19% according to Ogbe and Affiku(2011) compared to the reduced tannin content in ensiled cassava peels with *Moringa* leaf meal. There is also reduction in tannin of ensiled cassava peels with *Gliricidia* and cassava peels ensiled with *Leucaena*.

Phytic acid acts as a strong chelator to form insoluble complexes that are not readily absorbed from the gastro intestinal tract (Leiner,1980). It also reduced protein and mineral bioavailability. The value of tannin, phytate and phytic phosphorus present in silage of cassava peels and *Moringa*, cassava peels and *Leucaena*, cassava peels and *Gliricidia* reduced drastically compared with the tannin, phytate and phytic phosphorus in fresh leaves of *Moringa, Gliricidia* and *Leucaena*. The oxalate in the silage increases compared to the content present in fresh leaves.

CONCLUSION

The ensiling of cassava peels with Moringa, Gliricidia and Leucaena leaves have sufficient amount of crude protein required by ruminant animals. The process of ensiling enhances the nutritional value of the browse plants as well as the cassava peels. The ensiled product is rich in all essential nutrients needed for growth and development of ruminant animals. The reduction in the antinutrients as a result of ensiling increases palatability and digestion by ruminant animals and thus better growth performance thereby making meat from ruminant animal readily available at a cheaper rate for consumers.

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