

## Performance of West African dwarf sheep fed cassava peel-based diets

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### Abstract

*Chemical compositions of ensiled cassava peels, dried cassava peels and gliricidia on the performance of West African Dwarf sheep were evaluated. Twelve grower rams and ewes between 5-7 months of age were allotted to three treatment diets: D1 (control) diet was 100 % gliricidia (GLI) (leaves with bark and soft stem), D2 consisted of 80 % ensiled cassava peels plus 20 % gliricidia (ENP/GLI) while D3 consisted of 80 % dried cassava peels plus 20 % gliricidia (DP/GLI). The three test feeds were observed to have comparable crude fibre contents ranging from 16.07 % for ensiled cassava peels to 18.20 % for gliricidia. The gross energy values were also comparable ranging from 3.93kcal/g DM for ensiled cassava peels to 4.64kcal/gDM for gliricidia. Gliricidia was however observed to be richer in crude protein and minerals compared to ensiled cassava peels and dried cassava peels. Dry matter intakes, dry matter digestibility and growth rates showed significant ( $P < 0.05$ ) differences with the tilt being in favour of the animals fed on the sole gliricidia diet. The energy digestibility of 79.83 % for the animals fed on ensiled cassava peels and gliricidia diet was not significantly ( $P > 0.05$ ) different from the corresponding value of 82.67 % observed for animals fed on the sole gliricidia diet. Both values were however significantly ( $P < 0.05$ ) higher than the values of 74.17 % obtained for animals on the dried cassava peel plus gliricidia diet. Feed conversion values showed no significant ( $P > 0.05$ ) differences for the three groups with values ranging from 8.8 (ENP/GLI) to 10.80 (DP/GLI). Cassava peels supplemented with gliricidia can be used in practical production diets for West African Dwarf sheep with better prospects of utilization through ensiling of the peels.*

**Keywords:** Cassava-peel based diets, Performance, West African Dwarf Sheep

### Introduction

The intake of animal protein in Nigeria at present is 4.82 g/day (Tewe, 1999). This is rather low when it is compared with the minimum intake of 35 g recommended by FAO (1992). This observed low level of animal protein intake has its root cause in the high cost of feeding farm animals for optimum growth and production. Although it is almost impossible to quantify feed costs accurately (Van Dijk *et al.*, 1982), the

feeding costs of farm animals are estimated to constitute between 60 and 80 % of total cost of production (Dettmers *et al.* 1976; Fajinmi *et al.*, 1993; and Tewe, 1997). To reduce this trend, there has been a world - wide interest in the use of unconventional feed ingredients, which are usually less expensive, for the feeding of livestock (Adegbola, 1977; Sonaiya and Omole, 1977; Osuji, 1982; Omole, 1983; Smith, 1984; Akinfala and Tewe, 2002).

Jakonda (1975) suggested that cassava or its peels can be used in feeding various classes of livestock as a way of increasing animal protein supply. Other parts of cassava plant already being evaluated for livestock feeding include the leaves and tender stems (Wardhani and Ahmed, 1985; Torre and De La 1982; Akinfala and Tewe, 2002; Akinfala and Tewe, 2004). Some works have been reported in the literature on the feeding value of cassava peels for non-ruminants (Sonaiya and Omole, 1977; Adeyanju and Pido, 1978; Sonaiya and Omole, 1981; Obioha and Anikwe, 1982; Obioha *et al.*, 1983; Okeke *et al.*, 1986; Akinfala *et al.*, 2001). Most of these works recorded significant economic benefits in reduced feed cost and increased revenue derived from increased levels of cassava peels in the diets. Ruminants can be fed on cassava tubers, roots, foliage, peel and residue obtained after processing cassava (Iyayi and Tewe, 2003). Adebowale (1981) fed sheep fermented cassava peels at 0, 20, 40 or 60 % in the diet over a six month period, and found that feeding cassava peels at a level of 20 % in the diet gave comparable growth rates as the feeding of concentrates based on maize. Fomunyan and Meffeja (1987) fed sheep sun-dried cassava peels at levels of 0, 35 or 75 % in the diet over a three month period. They combined cassava peels with varying levels of elephant grass with cotton seed cake for protein sources. They found out that the live weight gains of the animals increased with increasing levels of cassava peels in the diets. Hence, they concluded that cassava peel based diets showed promise as dry season feedstuffs for sheep.

The nutritive value of gliricidia has been studied extensively. It has been fed experimentally to all types and classes of livestock including poultry (Mishra *et al.*, 1977). Studies with ruminants such as those conducted by Carew (1983); Mba *et al.*, (1982), Sumberg (1984), Onwuka (1980 and 1986), Odeyinka and Ademosun (1993 and 1995), Odeyinka (2000 and 2001) and Odeyinka *et al.*, (2003) show that

gliricidia is a suitable feed for ruminants as it can be consumed in large amounts without deleterious effects on animal performance. It has been shown to have a great potential for ruminant feeding, especially during the dry season in sub-Saharan Africa when the natural vegetation is of poor nutritive value (Onwuka, 1986). The objective of this study therefore, was to evaluate the performance of West African dwarf sheep fed a combination of dried cassava peels and ensiled cassava peels with gliricidia.

### Materials and methods

Cassava peels were obtained from some "garri" processing points located in Oyo town, Oyo State, Nigeria and were derived from the bitter variety of *Manihot esculenta* (Crantz). The processed cassava tubers were harvested at 12 - 16 months after planting. The processing was done on the day of harvesting. The peeling and processing were carried out immediately after harvesting, as peeling of tubers was done manually with knives. The peels were about 6 cm long, and on the average had about 3 cm thickness of the pulp along with them. Gliricidia was harvested (before podding) daily from the Obafemi Awolowo University Teaching and Research Farm, Ile-Ile, Nigeria.

The silage was made from cassava peels wilted to about 60 % DM. The wilted peels were ensiled in 200-litre drums which had earlier been perforated at the bottom to permit adequate drainage. The internal sides of the drums were lined with black polythene sheets, and the silage mass weighted down with heavy stones to ensure a good compaction. Cassava peel silage with the most desirable colour and lowest pH are produced from peels with about 60 % dry matter content produced from air-drying the peels for about two days and ensiling the resultant peels for 14 days as described by (Adegbola and Asaolu, 1987). Dried cassava peels were obtained after sun-drying fresh cassava peels for between 6 and 10 days depending on weather conditions. In a twelve week feeding trial,

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twelve 5-7 months old grower rams and ewes were allotted to three treatments of four animals each. The animals were individually housed in a concrete floored pen with watering and feeding facilities. They were then dewormed and sprayed against ecto-parasites before being allotted to the treatments.

The first (control) diet was 100 % gliricidia (GLI) (leaves with bark and soft stems), the second diet was 80 % ensiled cassava peels plus 20 % gliricidia (ENP/GLI), while the third diet was 80 % dried cassava peels plus 20 % gliricidia (DP/GLI). The animals were offered these diets at 6 % of their live weights twice daily at 09.00 hours and 16.00 hours throughout the duration of the study. The animals were adapted to the experimental diets for 14 days prior to the commencement of the feeding trial. Dry matter intake, DM digestibility, gross energy digestibility, growth rate and feed conversion ratio were determined. The DM and GE digestibilities were determined during the 4<sup>th</sup>, 8<sup>th</sup> and 12<sup>th</sup> weeks of the feeding trial.

Samples of feed for chemical analyses were collected at the commencement of the study, mid-way through, and at the end of the study. These were then pooled and ground prior to analyses. Samples of the ensiled peels were kept in the deep freezer while samples of dried peels and gliricidia were dried to constant moisture levels. Faecal samples were collected daily with the aid of separators designed for complete separation of faeces from urine. The droppings collected were wrapped in polythene bags, and stored in a deep freezer until required for analysis.

The dry matter contents of the feed and faecal samples (with the exception of cassava peel silage), nitrogen, ether extract, crude fibre and nitrogen free extract were determined (AOAC 1995). The crude protein was obtained by multiplying the nitrogen content by a factor of 6.25. The phosphorus (P) content of the test feeds was determined using a Gallenkamp

Colorimeter, while the sodium (Na) and potassium (K) were determined using flame photometer. Gross energy determination was done using the Gallenkamp Ballistic Bomb Calorimeter while the free and bound hydrocyanide contents were determined using the method of Grace (1977). pH determination was carried out using the EIL pH meter model 38B.

The dry matter content of the silage sample was determined by placing 100 g of each sample in the oven for 6 hours. The oven was set at 80°C for 2 hours stirring after 1 hour. The temperature was then lowered to 70°C for the remaining 4 hours. The result from this method of dry matter determination has been shown to agree with the toluene distillation method, which compensates for the loss of organic compounds by not removing hygroscopic water which in most cases amount to 2.5% of the dry matter (Perch and Tracey, 1956).

The data from the feeding trial were tested for significant differences using the method of analysis of variance. Significant differences were further subjected to Duncan's New Multiple Range Test. Correlations were found between hydrocyanic acid consumption and average daily gains, and between hydrocyanic acid consumption and feed: gain ratios (Steel and Torrie, 1980).

### Results

Gliricidia was observed to be rich in crude protein (28.60 %) and crude fibre (18.20 %). Dried cassava peels and ensiled cassava peels were similarly observed to be rich in crude fibre with values of 17.18 % and 16.07 % respectively. They were however poorer in crude protein with value of 3.28 % and 4.12 % respectively. Nitrogen Free Extract values of 70.78 % for ensiled cassava peels are high when compared with a value of 31.32 % for gliricidia. The three test feeds had comparable gross energy value ranging from 3.93 to 4.64 Kcal/gDM. Gliricidia was observed to be the richest in sodium, potassium and

phosphorus contents although total ash contents were similar for gliricidia and ensiled cassava peels. The ensiled cassava peels had the least pH value of 4.35 while gliricidia had the highest value of 5.80. The HCN concentration in gliricidia was found to be 46.76 mg/kgDM, while

it showed a decline from 965 mg/kgDM in the fresh cassava peel to 378 mg/kgDM in the sun-dried sample, and to 162 mg/kgDM in the ensiled sample. These represent losses of 60.83 % and 83.21 % of HCN from the feedstuffs after processing (Table 1).

**Table 1.** Proximate and mineral composition (%) of gliricidia and processed cassava peels

Feed composition	Gliricidia (leaves with soft stem and bark)	Dried cassava peels	Ensiled cassava peels
Dry matter	27.16	85.70	53.0
Crude protein	28.60	3.28	4.12
Ether extract	9.21	1.72	1.41
Crude fibre	18.20	17.18	16.07
Nitrogen free extract	31.32	70.78	66.12
Ash	10.00	4.89	9.98
Na	1.18	0.65	0.63
P	0.54	0.28	0.31
K	3.35	1.58	1.57
Gross Energy (Kcal/g)	4.64	4.14	3.93
Hydro cyanide (mg/kg DM)	46.76	378	162
pH	5.80	5.87	4.35

Table 2 shows that the animals fed on the sole gliricidia diet had an average daily feed intakes (1.544 kg/DM/animal) which was significantly ( $P<0.05$ ) higher than a value of 0.642 kg/DM/animal observed for animals on the DP/GLI diet as well as a value of 0.714 kg/DM/animal observed for animals fed on the ENP/GLI diet. The latter two values, showed no significant ( $P>0.05$ ) difference from each other. The same trend was observed when the average daily feed intakes were expressed as g/kgBW<sup>0.75</sup>. It was observed that the animals fed on the DP/GLI diet consumed the feedstuffs in the ratio of 64:36, and those fed on the ENP/GLI diet consumed the feedstuffs in the ratio of 73:27 while the feedstuffs were actually offered in the ratio of 80:20. The average daily gains showed significant ( $P<0.05$ ) differences with values ranging from 59 g/animal/day for animals on

the DP/GLI diet to 106 g/animal for those on the sole gliricidia diet. The feed: gain ratios showed no significant ( $P>0.05$ ) differences. The dry matter digestibility value of 81.53 % observed for the sole gliricidia diet showed statistical differences from the values obtained for the other two diets. The observed values for the other two diets however showed no statistical difference. There was no significant ( $P>0.05$ ) difference in the digestible energy intakes of the animals fed on the sole gliricidia diet (82.67 %) and the animals fed on the ENPGLI diet (79.83). Both values were however significantly ( $P<0.05$ ) higher than the value of 74.17 % observed for the animals fed on the DP/GLI diet. Hydrogen cyanide consumption was negatively and significantly ( $P<0.05$ ) correlated with average daily gains ( $r=-0.897$ ) while it was not correlated with feed: gain ratios.

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**Table 2.** Performance of sheep fed cassava peel-based diets

Performance characteristics	100% Gliricidia	Dried peels/Gliricidia	Ensiled peels/Gliricidia	SE
HCN	48.82	166.12	93.33	-
Ave. daily feed intake (kg/animal)	1.044 <sup>a</sup>	0.642 <sup>b</sup>	0.714 <sup>b</sup>	0.06
Ave. daily feed intake (g/kgBW <sup>0.75</sup> )	131.84 <sup>a</sup>	75.80 <sup>b</sup>	88.94 <sup>b</sup>	0.10
Ave. daily gain (g)	106.00 <sup>a</sup>	59.00 <sup>c</sup>	81.00 <sup>b</sup>	0.006
Kg feed per kg gain	9.85 <sup>a</sup>	10.80 <sup>a</sup>	8.81 <sup>a</sup>	0.75
DM digestibility (%)	81.53 <sup>a</sup>	72.30 <sup>b</sup>	75.97 <sup>b</sup>	1.38
GE digestibility (%)	82.67 <sup>a</sup>	74.17 <sup>b</sup>	79.83 <sup>b</sup>	1.29

<sup>a,b,c</sup>Means along horizontal rows without a common superscript are significantly different at ( $P < 0.05$ )

### Discussion

Gliricidia appeared superior to dried and ensiled cassava peels in terms of proximate composition, while the proximate compositions of dried and ensiled cassava peel showed some closeness. While DM, CP and CF obtained for gliricidia used in the study fell within the range reported by some workers, slight variations were observed with regards to EE, NFE, Na, K and gross energy contents (Alconero et al., 1973; Adejumo, 1984; Akpegi, 1984; Onwuka, 1986). The factors responsible for the variability in the composition of gliricidia may include age of plant, plant part, harvesting interval, season and location (Reveron et al., 1967; Devendra and Gohl, 1970; Chadhokar, 1982; Falvey, 1982; Adejumo, 1984; Kabaija, 1985; Odeyinka and Ademosun, 1993).

The proximate contents of the dried and ensiled cassava peels, with the exception of CP agree with the reported values (Sonaiya and Omole, 1977; Akinfala et al., 2001). This variability might be due to the amount of pulp peeled along with the peel during processing. The pulp has been reported to have lower crude protein values than the peel (Oyenuga and Fetuga, 1975; Rajuguru et al., 1978; Akinfala, et al. 2001). The HCN contents of the fresh peels in the present study fall within the reported range (Tewe et al., 1976; Obioha and Anikwe, 1982).

Conflicting results exist in the literature on the rate of decline of HCN for processed cassava products (Tewe et al., 1976; Obioha and Anikwe, 1982; Akinfala and Tewe, 2002). The observed variations have been attributed by these researchers to differences in storage media, duration of storage, and whether or not the processes are properly carried out.

The significant ( $P < 0.05$ ) variation between the intakes of the sole gliricidia diet and the other two diets (Table 4) could have resulted from the fact that sheep consume gliricidia with relish (Vearasilp, 1981; Odeyinka, 2000; Odeyinka, 2001). High intakes of gliricidia have earlier been reported by these researchers. The variations in the proportions in which the animals consumed the feedstuffs in the ENP/GLI and DP/GLI diets may be attributable to the advantages of the ensiling process over sun-drying (Marrison, 1959; Obioha and Anikwe, 1982).

The high average daily gain (106 g/animal) associated with the sole gliricidia diet might have been due to its higher daily intake, its high dry matter digestibility as well as its superior nutritive value (Odeyinka and Ademosun, 1993; 1995). Higher weight gains of animals on ensiled cassava peel based diet over sun-dried cassava peel based diet was also observed with growing

swine by Obioha and Anikwe (1982) and those were attributed to the advantages of ensiling over sun-drying. The non-significant ( $P>0.05$ ) difference observed in the feed:gain ratios could have been due to the adequacy of the crude protein and metabolizable energy both in quality and quantity in the diets as suggested by Akinfala and Tewe (2002) in the study with growing pigs on cassava-based diets. Available data (Falvey, 1982; Carew, 1983; Adejumo, 1984; Odeyinka and Ademosun, 1993, 1995; Odeyinka, 2001), showed that gliricidia was fairly well digested – this supports the high dry matter digestibility of 81.53% for sole gliricidia diet.

Obioha and Anikwe (1982), using swine also obtained a high negative correlation between HCN consumption and average daily gains. Such result was attributed to the levels of intake of HCN, and thereafter recommended analyzed levels or actual intakes of HCN for assessing animal performance. HCN levels as stated in the literature (Tewe et. al., 1976; Obioha and Anikwe, 1982) may not give clear indications of HCN intake by animals and could be misleading from the point of view of assessing animal performance or lethal doses.

## Conclusion

The results presented in this paper showed the superiority of ensiling over sun-drying in preparing cassava peels for West African dwarf sheep. Ensiling led to a higher hydro cyanide detoxification of cassava peels by more than 20 %. The animals in D2 (ensiled cassava peels plus gliricidia) had a higher digestible energy intake and recorded a significantly ( $P<0.05$ ) higher average daily weight gain. Overall results suggest that ensiled cassava peels combined with gliricidia such that gliricidia makes up between 20 and 25 % of the diet could be used as a production diet for West African dwarf sheep. In addition, a possible way of optimally utilizing the available gliricidia during the dry season has been demonstrated.

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