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Effect of Supplementing Grazing N'dama Calves with Urea Treated Maize Stover and *Centrosema pubescens*

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ABSTRACT

Maize stover consists of the leaves and stalks of maize plants left in a field after harvest and it makes up about half of the yield and is similar to straw. Ensiling maize stover with urea makes it a urea treated maize stover. Centrosema pubescens is a legume in the family Fabaceae, subfamily Faboideae and tribe Phaseolae. It is native to Central and South America and cultivated in other tropical areas as forage for livestock. An experiment was conducted to investigate the effects of urea treatment on chemical composition; feed intake, blood urea and ammonia of maize stover. The potential of such a stover for growth performance of calves were investigated using 8 N'dama calves of 5 to 8 months of age and an average initial live weight of 92.5 kg. The animals were divided into two groups each of which were individually fed to appetite on basal diets of either untreated maize stover and Centrosema pubescens (Diet T_1) or 5 % urea treated maize stover and Centrosema pubescens (Diet T_2) for 90 days. In addition all the calves were allowed free access to mineral/vitamin blocks and ample drinking water ad libitum. Urea treatment increased the crude protein (CP) content of maize stover in Diet T_2 by 22.12% and also a highly significant difference ($p<0.01$) in the crude fibre (CF) content over the untreated stover in Diet T_1. Besides, compared with the untreated stover, urea treatment brought an improvement of 28% in daily feed intake. These improvements in terms of chemical composition, daily feed intake and dry matter intake led to a highly significant ($p<0.01$) live weight gain of animals fed on the urea treated stover diet compared with those fed on the untreated stover diet. However, there was no significant difference ($p>0.05$) in blood urea levels but significant existed in feed cost/kg gain and linear body measurements between the animals fed on Diet T_1 and those fed on Diet T_2. Generally, with the added advantage of Diet T_2 being more cost effective than Diet T_1, feeding urea treated maize stover may be considered as one of the strategies that bring about an efficient utilization of crop residues for livestock feeding in Eastern part of Nigeria.However, its economic advantage over other alternatives must carefully be examined under the prevailing price conditions before it is implemented in an area.

Introduction

The rapid increase in population and more demand for food is pushing agriculture to marginal lands in West Africa (Singh *et al.*, 2004). This coupled with little or no use of fertilizers has led to continuous decline in soil fertility and low food productivity in the region resulting into widespread malnutrition and hunger (Ajeigbe *et al.*, 2001). Crop and livestock integration helps in maintaining soil fertility by the use of manure and increases farm efficiency by providing traction and transport and also it increase the farm income and human nutrition through milk and meat (Smith *et al.*, 1997). The major constraint to crop-livestock integration in West Africa is the limited availability of livestock feed with high nutrient quality (Latham, 1999). In this region, farmers mostly feed their livestock with sorghum, millet and maize stovers as basal diet, while cowpea and groundnut haulms are fed as protein supplement (Russo, 1990). Other agricultural by-products such as bran, oilcakes, etc., which are generated when crops are processed (de Leeuw, 1997) are also fed to livestock as energy and mineral supplement.

The problem of dry season livestock feeding in particular, has directed research efforts towards harnessing and enhancing the utilization of abundant arable by-products and crop residues which are generally low in nutrients (Orskov, 1998). In other to make crop residues useful to animals, they need to be processed. Cereals crop residues are low in nutritive value because of their relatively low digestibility, low crude protein content and low content of available minerals and vitamins (Owen, 1994). According to Ani, (2012) various strategies have been adopted in improving crop residue nutrients and utilization includes; physical method (brisquetting, pelleting, extrusion, chopping, grinding),

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chemical method (treating with Sodium hydroxide, wood ash, ammonia) and biological method (using fungi to degrade lignin in crop residue and using solid state fermentation system). Efforts to improve the nutritive value of the cereals residues through treatment with urea and other chemicals have not been very popular because technologies are often high for application by small holder subsistence farmers (Owen and Jayasuriya, 1989).

Large quantities of crop residues produced on private and government farms in Nigeria are wasted year after year. Some are left to rot in the field, which may improve soil fertility but most are burned (Onyeonagu and Njoku, 2010). The abundant supply of crop residues and agro-industrial by-products at reasonable prices could enhance production and reduce cost of compounded feeds without adversely affecting the performance of the animals. Therefore, because of increases in human population and consequent high cost and demand for conventional feedstuffs such as groundnut cake and soya bean meal, it has become increasingly necessary that alternative feed ingredients are found to reduce the competition between, man and livestock (Iyeghe-Erakpotobor *et al*., 2002). There is evidence that livestock fed with crop residues and agro-industrial by-products could achieve substantial weight gains (O'Donovah, 1979).

The trend has changed from the situation in which maize stovers were considered as waste and are now being converted to animal protein for human consumption (Singh *et al.,* 2004 and Singh *et al.,* 2011). Recently there has been growing policy recognition of the role of non-conventional feed resources in livestock production (FAO, 1999). All ruminants depend on crop residues and agro-industrial by-products which play a significant role in the nutrition of ruminant animals (Agarwal and Verma, 1983).

There is very little information on the actual availability and usage of crop residues and agro-industrial by-products in the eastern part of Nigeria compared to the northern part (Onyeonagu and Njoku, 2010). Therefore, the objectives of this study were to determine the improvement in chemical composition, growth performances, economics of feeding and blood urea and ammonia levels of N'dama calves fed urea treatment of maize stover as compared with the untreated stover and *Centrosema pubescens.*

Materials and Methods

Location and Duration of Study

The study was carried out in the Cattle unit of the Department of Animal Science Teaching and Research Farm, University of Nigeria, Nsukka. Nsukka lies on the geographical coordinates of 6^0 52' 0" N, 7^0 23' 0" E and on the altitude 447m above sea level (Offomata, 1975). The climate of the study area is typically tropical, with relative humidity ranging from 65-80% and mean daily temperature of 26.8^0C (Agbagha, *et al.,* 2000). The rainy season of Nsukka is between April to October and dry season between November to March with annual rainfall range of 1680-1700mm (Breinholt *et al*., 1981). The experiment lasted for 14 days adaptation and 90 days experimental periods.

Feed Preparation

Maize stover of an improved sweet variety (*Zea mays*) was collected from the Department of Crop Science Farm, University of Nigeria, Nsukka after the maize cobs had been harvested. The maize stover was allowed to dry in the sun at constant moisture level. Both the maize stover and the fresh leaves of *Centrosema pubescens* was chopped to 6-8mm, then the maize stover was treated with 5% urea (5kg urea dissolved in 50 litter of water for every 100kg of maize stover) and ensiled in 0.2mm thick polyethylene bags of dimensions 112 x 76cm for three weeks. The maize stover was thoroughly hand mixed so that the urea solution was uniformly mixed with the maize stover. 50% untreated maize stover plus 50% *Centrosema pubescens* served as the control Diet A while 50% treated maize stover plus 50% *Centrosema pubescens* served as the Diet B.

Experimental Animals and Management

Eight N'dama calves of about 8 months old were randomly allocated to two treatments with four calves per treatment. They were housed in individual compartment in the Cattle unit of the Department of Animal Science, University of Nigeria, Nsukka Teaching and Research Farm. Treatment one was fed Diet A while treatment two was fed Diet B in the morning before they are allowed to go about their normal grazing and after grazing they are returned back to their individual compartment to continue feeding on the experimental diets.

All the calves were allowed free access to mineral/vitamin blocks and ample drinking water *ad libitum*. Cleaning of the compartments, removal and weighing of leftovers from previous day were done daily before supplying each day's diet. The animals were weighed monthly.

Parameters

The daily feed intake and monthly body weight gain were measured using weighing balance. The feed conversion ratio and dry matter intake were calculated as follows:

Feed conversion ratio: feed intake (kg)/Weight gain (kg)

Dry matter intake (g/day): %dry matter/100 x feed intake

Blood samples were also collected from the calves before and after the experiment to determine their blood urea and ammonia levels. The blood urea was determined by Randox kit as described by Weatherburn (1967).

The proximate composition of the experimental diets was carried out using A.O.A.C (2000) methods.

Statistical Analysis and Design

The effects of dietary treatments on different parameters and means were analyzed using the Students T-test, for a completely randomized design with two treatments.

Results and Discussion

Results

Table 1. Proximate analysis of the experimental diets

		Treatment groups			
Parameters	T_1	T_2	SEM	T	Prob.
Ash	8.16^b	10.65^a	0.013	-138.952	0.000^{**}
Ether extract	0.71^a	0.60^b	0.130	5.824	0.028^{*}
Crude fibre	43.00^a	27.03^b	0.058	157.983	0.000^{**}
Crude protein	18.90^b	24.27^a	0.015	-240.154	0.000^{**}
Nitrogen free extract	29.00^b	37.47^a	0.058	-83.713	0.000^{**}

The proximate analysis of the experimental diets for the two treatment groups is presented in Table 1.

Ash

The mean ash percentage values for the experimental diets of T_1 and T_2 were 8.16 and 10.65 respectively. The result indicated highly significant ($p<0.01$) differences on the ash percentage values between the experimental diets. Diet T_2 had higher ash percentage value than diet T_1.

Ether extract

The mean values of ether extract for the experimental diets of T_1 and T_2 were 0.71 and 0.60 respectively. The result

showed significant differences between the ether extract values of both experimental diets. Diet T_1 had higher ether extract percentage value than diet T_2.

Crude fibre

The mean crude fibre percentage values for the experimental diets of T_1 and T_2 were 43.00 and 27.03 respectively. The result indicated highly significant ($p<0.01$) differences between the crude fibre contents of the experimental diets.

Crude protein

The mean crude protein percentage values for the experimental diets of T_1 and T_2 were 18.90 and 24.27 respectively. The result indicated highly significant ($p<0.01$) differences between the crude protein percentage values for both experimental diets. Diet T_2 had higher crude protein percentage than diet T_1.

Nitrogen free extract

The mean nitrogen free extract percentage values for the experimental diets of T_1 and T_2 were 29.00 and 37.47 respectively. The result indicated highly significant ($p<0.01$) differences between the two diets. Diet T_2 had higher nitrogen free extract percentage value than diet T_1.

Table 2. Growth performance of N'dama calves fed urea treated maize stover and *Centrosema pubescens*

Units		Treatment groups			
Parameters	T_1	T_2	SEM	T	Prob.
Initial weight (Kg)	89.42	95.58	4.001	-1.041	0.309
Final Weight (Kg)	104.92^b	122.83^a	0.415	-1.099	0.003
Total Weight gain (Kg)	15.50^b	27.25^a	0.269	-30.769	0.000^{**}
Monthly weight gain (Kg)	5.33^b	9.08^a	0.567	-4.552	0.000^{**}
Daily Weight gain (Kg)	0.18^b	0.30^a	0.003	-33.387	0.000^{**}
Daily Feed Intake (Kg)	2.59^b	3.59^a	0.079	-8.815	0.000^{**}
Daily Dry matter intake (Kg)	2.30^b	2.95^a	0.066	-6.988	0.000^{**}
FCR	14.51^a	12.09^b	0.502	3.402	0.003^{**}
Feed cost/Kg gain /N	116.07^a	108.82^b	14.770	1.203	0.242

The growth performance of N'dama calves fed urea treated maize stover and *Centrosema pubescens* is presented in Table 2

Initial weight

The results of the mean initial weight values for the N'dama calves on diets T_1 and T_2 indicated no significant ($p>0.05$) differences among the treatments.

Final weight

The mean final weight values for the N'dama calves on diets T_1 and T_2 were 104.92 and 122.83 respectively. The result showed highly significant ($p<0.01$) difference between the treatment groups. N'dama calves on diet T_2 had higher final weight value than those on diet T_1.

Total weight gain

The mean total weight gain values for the N'dama calves on diets T_1 and T_2 were 15.50 and 27.25 respectively. The result indicated highly significant differences between treatment groups. N'dama calves on diet T_2 had higher final weight value than those on diet T_1.

Monthly weight gain

The results pertaining to the mean monthly weight gain values for the N'dama calves on diets T_1 and T_2 were 5.33 and 9.08 respectively. The result indicated highly significant ($p<0.01$) differences between the treatment groups. N'dama calves on diet T_2 had higher monthly weight gain value than those on diet T_1.

Daily weight gain

The mean daily weight gain values for the N'dama calves on diet T_1 and T_2 were 0.18 and 0.30 respectively. The result indicated highly significant ($p<0.01$) differences between the treatment groups. N'dama calves on diet T_2 had higher daily weight gain value when compared to those on diet T_1.

Daily feed intake

The mean daily feed intake values for the N'dama calves on diet T_1 and T_2 were 2.59 and 3.59 respectively. The result showed highly significant ($p<0.01$) differences between the treatment groups. The results pertaining to daily feed intake value was higher among N'dama calves on diet T_2 than those on diet T_1.

Dry matter intake

The mean dry matter intake values for the N'dama calves on diet T_1 and T_2 were 2.30 and 2.95 respectively. The result indicated significant ($p<0.01$) differences between the treatment groups. N'dama calves on diet T_2 had higher dry matter intake value when compared to those on diet T_1.

Feed conversion ratio

The mean feed conversion ratio values for the N'dama calves on diet T_1 and T_2 were 14.51 and 12.09 respectively. The result showed significant ($p<0.01$) differences between the treatment groups. The value pertaining to the feed conversion ratio was significantly higher among N'dama calves on T_1 while those in T_2 remain the lowest.

Table 3. Blood parameters of N'dama calves fed urea treated maize stover and *Centrosema pubescens*

		Treatment groups			
Parameters	T_1	T_2	SEM	T	Prob.
Urea	38.98	39.75	1.481	-0.320	0.760
Ammonia	0.50^b	0.63^a	0.033	-2.611	0.040^{*}

The result of blood parameters of N'dama calves fed urea treated maize stover and *Centrosema pubescen* is presented in Table 3

Urea

The mean blood urea levels for the N'dama calves fed diets T_1 and T_2 were 38.98 and 39.75 respectively. The result showed no significant differences between the two groups.

Ammonia

The mean blood ammonia levels for the N'dama calves fed diets T_1 and T_2 were 0.50 and 0.63 respectively. The result indicated significant ($p<0.05$) difference between the groups. N'dama calves on diet T_2 had higher blood ammonia levels.

Discussion

Proximate analysis

The proximate analysis of the experimental diets is shown in Table 1; the most obvious change in maize stover treated with urea was the colour of the stover. During the ammoniation procedure, browning of the maize stover occurred and this supports the earlier work of (Saenger *et al.*, 1982). The observations made by Buettner (1978) reported that the browning of ammoniated wheat straw occurred at room temperature and was more severe with increasing rate of ammonia, time of exposure and temperature. The urea treated

maize stover was less coarse and more pliable than the untreated maize stover, this agrees with the work of Saenger *et al.,* (1982) and Ali *et al.,* (2012). The reports by Wang *et al.,* (1964) illustrated that ammonia breaks bonds that cements cell wall constituents together and breaks cross links in cell walls resulting in swelling and increased flexibility of the fibre.

The observations made in the present study pertaining to the values of ash, crude fibre, crude protein and NFE were higher than those reported by Wang *et al*., 1964; Saengert *et al*., 1982 and Ali *et al*., 2012. The increased crude protein content of diet T_2 was due to ammoniation of the maize stover in the diet and this supported the findings of Saenger *et al.,* (1982); Tesfaye *et al.,* (2005) and Ali *et al.,* (2012) who all reported increased crude protein of various crop residues when ammoniated. The reduced crude fiber in diet T_2 was due to the urea treatment of the maize stover which is in agreement with the earlier work of Saenger *et al.,* (1982) which suggested that the crude fibre becomes more digestible after treatment with urea. The import of this study is that urea ammoniation of maize stover increased the dry matter digestibility and is a readily available nutrients in the rumen of the N'dama calves. This supports the observations made by Oji *et al.,* (1977) who reported improved dry matter digestibility of maize treatment with aqueous NH_3 at 3% of dry matter. This is in disagreement with Kunkel *et al.,* (1980) who found that soybean meal supplement had no effect on dry matter digestibility of corn stover silage.

Growth Performance

Growth performance of N'dama calves fed the experimental diets are presented in Table 2. N'dama calves on diets containing urea treated maize stover and *Centrosema pubescens* had higher values in final body weight, total weight gain, monthly weight gain and daily weight gain than those N'dama calves on the diet containing untreated maize stover and *Centrosema pubescen.* This is in agreement with the findings of Bui and Le (2001) who reported considerably higher growth rates for cattle fed ammoniated rice straw than those fed untreated straw plus molasses-urea block. These authors recorded such improvements in growth rate, which was 25% to 50% increase in dry matter intake of the ammoniated straw. Furthermore, their study on the effects of urea treatment of maize stover on performance of growing steers and heifers is comparable to Munthali *et al.,* (1992) who reported increased intake of energy is associated with improvement in the utilization of non protein nitrogen in the treated straw resulted in improvement of live weight gain of the animals.

In this study, the highly significant weight gain of N'dama calves on the urea treated maize stover and *Centrosema* pubescens than those on untreated maize stover and *Centrosema* pubescens could be attributed to higher crude protein content of the urea treated maize stover which is in turn resulted in higher crude protein intake of the animals. This is in agreement with the findings of Tesfaye, (2006) and Ali *et al.,* (2012). Though the daily dry matter intake of N'dama calves fed the diet containing untreated stover and *Centrosema* pubescens was above the recommended value of Kearl, (1982) that enabled group of animals to attain a daily weight gain of about 180g, which was not in agreement with the report of (Tesfaye *et al.,* 2005). These authors reported a daily weight gain of 400g when crossbred (50% Borana X 50% Friesian) calves of nine to twelve months of age with an average initial live weight of 138.9 kg fed untreated maize stover and natural pasture hay on a recommended value (Kearl, 1982). This could be due to the lower crude protein content of the diet, lower crude protein intake and breed differences of the animals.

Highly significant ($p<0.01$) variations were reported between the two treatment groups in the present study for every kg live weight gain of N'dama calves on urea treated maize stover and *Centrosema pubescens* diet consumed than those N'dama calves on untreated maize stover and *Centrosema pubescens* diet. The observations made in this study are not in accordance with the findings of Tesfaye *et al.,* (2005) who observed (1.8 kg for every kg weight gain). He also reported no significant ($p>0.05$) difference in the feed conversion ratio of crossbred calves fed urea treated maize stover and natural pasture hay. The result pertaining to weight gain in this study was also higher than those recorded by Lee *et al.,* (2008) in crossbred cattle fed ammonia treated maize stover. Similarly, Zou *et al*., (1995) found no improvement of 1.6 kg in feed conversion efficiency of young Holstein cows fed wheat straw ammoniated with urea compared with the efficiency of those cows fed the untreated straw. The discrepancies in the findings of those studies and that of the present study could be attributed to the differences in non-genetic factors, breed types and crop residues used in different studies.

Feed intake

Table 2 shows the feed intake and dry matter intake (DMI) of N'dama calves fed diets T_1 and T_2. Highly significant differences were recorded between the two treatment groups for feed intake and dry matter intake. Daily feed intake of the urea treated maize stover and *Centrosema* pubescens was higher than that of the untreated stover and *Centrosema pubescens*. FAO (1986) stated that urea treatment may increase voluntary intake of the treated straw by 25 to 30% over that of the untreated straw. According to Smith *et al.,* (1989) also reported a significant increase in DMI of the urea-treated maize stover compared with that of the dry fresh maize stover while Tesfaye *et al.,* (2005) reported that dry matter intake of treated maize stover was 22% higher than that of untreated stover. On the other hand, Saadullah *et al.,* (1982) observed no trend of intake increment for urea treated rice straw fed to calves. Furthermore, Munthali *et al.,* (1992) observed no increase of dry matter intake in urea treatment stover when compared to water treatment of maize stover.

Generally, the daily feed intakes of N'dama calves in both treatments were above the levels recommended by Kearl (1982) for animals of comparable live weight to produce a daily weight gain of 250 to 500 g, though only the daily weight gain of calves fed diet T_2 falls within that range (303g). With regard to crude protein intake, the daily intake of calves fed the diet containing urea treated maize stover was significantly ($p<0.01$) higher than the intake of those fed diet T_1.

Blood parameters

No significant differences ($p>0.05$) was recorded between the two treatment groups for blood urea. This is in accordance with the observations made by (Lee *et al*., 2008). Similarly to the present results, the reports of Kumar and D'Mello, (1995) also recorded increasing concentration of both ruminal ammonia and blood urea nitrogen in calves advancing with age. Blood urea concentration was higher in calves on diet T_2 than those fed diet T_1 which could be attributed to higher concentration of protein in the former.

Furthermore, N'dama calves fed diet T_2 recorded higher significant ($p<0.01$) difference in the blood ammonia level but

the blood ammonia values for T_1 and T_2 falls between the normal range as previously recorded by Lee *et al.,* (2008) and Rauprich *et al*., (2000).

Summary and Conclusion

The results of this work have confirmed other reports that urea-ammoniation improved the effective degradability and potential degradability of DM and fiber in maize stovers. The benefit associated with urea treatment of maize stover increased with increasing crude protein content. Furthermore, urea-treated stover diets tended to reduce the negative effect associated with feeding high concentrate diets. Therefore, the approach of using ammoniated stover diets can be one method of reducing the nutritional disorders that result from feeding high concentrate diets.

Also increments of 28% feed intake of maize stover by N'dama calves fed, have been achieved as a result of urea treatment. These improvements in terms of chemical composition, intake and digestibility have led to higher live weight gain of animals fed the diet containing the urea-treated maize stover compared with that of the animals fed the diet containing the untreated stover.

Analyses of feeding costs indicated that each kg live weight gained by animals fed the urea treated maize stover diet was achieved at lesser expense than the weight gained by animals fed the untreated maize stover. Therefore, urea ammoniation in general may be considered as one of the strategies that bring about an efficient utilization of crop residues for livestock feeding especially in Eastern Nigeria where crop residues constitute the major ruminant feeds. However, its economic advantage over other alternatives must carefully be examined under the prevailing price conditions before it is implemented in an area.

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