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Apparent digestibility and performance of West African dwarf sheep fed ensiled maize stover and concentrate supplements

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***Target Audience**: Farmers, Livestock Farmers, Animal Nutritionist.*

Abstract

A feeding trial was conducted on 20 growing West African Dwarf (WAD) sheep to determine the dietary effect of ensiled maize stover (EMS) and concentrate supplements (CS). Individual feed intake and weight changes were determined for 105 days to allow measurement of the effects of the feeds on weight gain, feed intake, apparent digestibility and feed conversion ratio (FCR) of West African dwarf sheep. The animals were randomly allocated to five experimental diets: A (100% EMS), B (75% EMS + 25% CS), C (50% EMS + 50% CS), D (25% EMS + 75% CS) and E (100% CS). Significant differences (P < 0.05) occurred in body weight gain (BWG), dry matter intake (DMI), metabolic weight gain (MBW), metabolic daily dry matter intake (MDDMI) and feed conversion ratio (FCR) among the treatments means. Animals on diet E (100% CS) had the highest weight gain (90.48g/d/head) and FCR (6.55). However, BWG of animals on diet A (silage alone) was negative (-12.70g/d/head), indicating that the animals lost weight. DMI decreased significantly with increased inclusion of maize stover silage. Significant differences occurred among the treatments for organic matter digestibility, cellulose, hemicellulose and metabolisable energy while other parameters like digestible crude protein, digestible crude fibre, nitrogen free extract and fibre fractions were similar across the dietary treatments. The results suggest that maize stover silage could be utilized to supply energy requirements of sheep and improved nutrient digestibility and dry matter intake when fed with concentrate supplements.

Keywords: *Ensiled Maize stover; concentrate supplements; WAD sheep; apparent digestibility; metabolisable energy.*

Description of the problem

The beneficial roles of livestock in production of meat, milk, fibre and skin in alleviation of poverty, malnutrition and conserving natural resources has not been adequately exploited (1). Agricultural production in most of the tropics and subtropics are predominantly mixed farming systems. Part of the solution in Nigeria is an increase in the production of small ruminant animals, mainly sheep and goats which are found in most of the households in Southern and North-East of the country (2).

Traditional ruminant livestock production in Africa is based predominantly on animals grazing natural pastures which are often of low nutritive value especially during the dry season. The nutritive value of the natural pastures varies according to season. Protein content is between 8 and 12% of DM at the start of the rainy season but drops to 2% in the 6 – 7 month dry season (3). The grasses grow rapidly during the wet season, later becoming fibrous, coarse, and highly lignified rendering it indigestible. Their quality declines further during the dry season when they become standing hay. This results in loss of palatability and ineffective utilisation of the pastures by the animals. Performance of animals fed crop residues is limited by poor intake, low nitrogen contents and poor digestibility. However, sheep and goats can play an active role in converting crop residues of no human dietary value to meat and milk of high nutritive value for man (4).

The search for alternative and locally available sources of energy and protein to enhance productivity of sheep and goats during the period of scarcity and dry season has placed attention on the used of post-harvest crop residues. These can be used to improve the nutrition of ruminant livestock during the dry season through the strategic supplementation of animals with crop residues. In Nigeria, very few crop residues are utilised as ruminants feed by small holder farmers. Maize crop residue (stover) can be an inexpensive source of forage, and it may be grazed, stacked or ensiled. Preservation of maize stover as silage makes it possible to preserve plant nutrients that otherwise would be lost by physiological activity or leaching, offering the possibility of using stover in rations for growing animals.

To achieve efficient utilisation of the crop residues especially ensiled maize stover as a potential feed for the ruminants; it has to be supplemented with concentrates. Sustainability of sheep production could come through the feeding of ensiled maize stover and concentrate supplements. This study was therefore, undertaken to assess the dietary effect of ensiled maize stover and concentrate supplements on apparent digestibility and growth performance of West African dwarf sheep.

Materials and Method

Experimental Site

The study was carried out at the Sheep and goat unit of the Teaching and Research Farm, University of Ibadan, Ibadan, Oyo State, Nigeria. It is situated in derived savannah vegetation zone (Latitude $7^0$27'N and$3^0$45E) at an altitude between 200m and 300m above sea level. The mean temperature is 25-29^0c with an average annual rainfall of about 1250mm. The soils are much drained and belong to the afisol (Rhodic Kandiustalf) (5).

Preparation of ensiled maize stover

Freshly harvested green maize stovers were collected from University of Ibadan farm in the month of July and the samples were collected in batches. Harvested maize stovers were chopped into 3–5cm pieces size with cutlass (for easy compaction). Thereafter, the chopped materials were wilted under shade for 24 hours on concrete floor to reduce the moisture content for good fermentation. The chopped maize stover was weighed and ensiled in polythene bags, each has holding capacity of 30kg wilted maize stover used as silos. Each polythene bag was placed inside a 65 litres capacity plastic basing for reinforcement and ease of fermentation. Ensiling was done by rapid compaction of the material (to eliminate air) into the silos. Sealing of the silos were done by placing a 25kg sandbag on top of each polythene bag tied carefully and firmly. Fermentation period was 30 days.

Preparation of Pens

The animal pens were made of low walls of 1.90m (Height) and 7.10m by 13.94m in size and each pen was about 1.83m long and 1.54 m wide. The floor of the pen was made of concrete and the roof of the sheep unit, which housed the pens was made of corrugated iron sheets. The pens were dusted and washed thoroughly with detergent and were further disinfected with broad spectrum insecticide, acaricides and larvicides (Diazintol). The feeding and drinking troughs were washed and disinfected and the whole house was left to rest for two weeks before usage. Wood shavings were spread on the floor of the pens up to a depth of 5cm as bedding materials to enhance prompt removal of urine and faeces which were replaced fortnightly.

Composition of Experimental Diets

The composition of experimental diets and the concentrate supplement fed to WAD sheep are shown in Table 1.

Table 1: Ingredient composition (%) of experimental diets fed to WAD sheep

Diets					
Ingredients	**A**	**B**	**C**	**D**	**E**
EMS (%)	100	75	50	25	-
CS (%)	-	25	50	75	100
Total	100	100	100	100	100

EMS =Ensiled Maize Stover, CS = Concentrate supplements

Experimental Diets

Diet A = 100% Ensiled Maize stover (Silage only), B = 75% Ensiled Maize stover + 25% Concentrate supplements, C = 50% Ensiled Maize stover + 50% Concentrate supplements
D = 25% Ensiled Maize stover+75% Concentrate supplements, E = 100% Concentrate supplements

Experimental Animals and Management

Twenty (20) post weaned male West African dwarf sheep with average initial body weight of 14.0 – 16.0kg and 9 – 12 months old were used for the experiment. They were purchased from Iwo in Osun State of Nigeria. On arrival, animals were given a prophylactic treatment which consisted of oxytetracycline long acting antibiotic (1ml/10kg body weight of the animal) and vitamin B complex. They were also drenched with albendazole to control endoparasites and treated for mange and other ectoparasites using Ivomec(R). They were later vaccinated against *Pestes des petits ruminante* (PPR) using a tissue culture Rinderpest Vaccine. During the adaptation of six weeks, sheep were offered diets they were eaten from where they were purchased, but were introduced to the experimental diets two weeks before the end of adaptation period.

At commencement of the feeding trial, animals were weighed and randomly allotted to the five dietary treatments on weight equalisation basis such that the average initial weights per treatment were not statistically different. Silage and concentrate supplements were fed to the animals in a mixture. Feed was offered at 0800h and 1500h at 5% body weight. Ration offered was frequently adjusted to ensure that each animal received 10% of feed above its previous week's consumption. For the determination of daily feed intake, the orts were weighed daily before feeding and amounts deducted from total amounts served the previous day. Sample from orts were taken for proximate composition. Fresh water and feed were served *ad libitum* each day for the one hundred and five days (105) duration of the experiment. Salt licks were placed permanently in each pen. Weights of sheep were taken on a weekly basis using weighing scale before the morning feeding.

Apparent Digestibility study

Fifteen animals were used for apparent digestibility study. These were carried out immediately after the 12 weeks of performance trial by transferring the animals into wooden metabolic crates fitted with facilities for separate collection of urine and faeces. The quantity of feed offered, feed residue, faeces and urine determined for seven days, after seven days adjustment to the cages. Ten percent (10%) of the faeces and urine collected daily were kept and pooled over the seven days period. Nitrogen loss from the urine by volatilisation was prevented by introducing 20ml of 10% H_2SO_4 into the well-labelled urine collection container and stored in a refrigerator. All samples were frozen until subsequent laboratory analysis.

Chemical Analysis

The dry matter, crude protein, crude fibre, ash, ether extract and nitrogen free extract of feed and feacal samples were determined according to (6). Neutral detergent fibre, acid detergent fibre and acid detergent lignin were determined according to (7). Hemicellulose was calculated as the difference between NDF and ADF and cellulose as the difference between ADL and ADF.

Statistical Analysis

The experimental design was completely randomized design (CRD). The feed intake, growth rate and feed conversion ratio were computed and subjected to a one-way analysis of variance using the procedure of (8). Significant treatment means were compared using (9) option of the same software.

Results

Table 2: Ingredients composition and crude protein content (%) of concentrate supplement fed to WAD sheep

Ingredient	Percentage
Wheat bran	60.00
Palm kernel cake	25.00
Corn bran	10.00
Oyster shell	3.00
Salt	1.00
Premix (Ruminants)	1.00
Total	100.00
Crude Protein	15.30

Table 3: Determined chemical composition (%) of diets

Diet Composition (%)					
Parameters	A	B	C	D	E
Dry matter	31.62	46.08	60.54	74.99	89.45
Organic matter	91.20	92.11	91.03	89.21	86.06
Crude protein	8.40	12.60	14.35	16.45	15.05
Ether extract	6.77	8.86	7.84	8.50	7.88
Ash	8.80	7.89	8.97	10.79	13.94
Nitrogen free extract	46.25	45.76	46.09	43.39	43.30
Crude fibre	29.78	24.89	22.75	20.87	19.83
Neutral detergent fibre	46.83	54.60	49.69	52.80	44.74
Acid detergent fibre	26.86	32.76	28.82	27.84	29.69
Acid detergent lignin	12.81	11.92	10.91	10.81	9.50
Hemicellulose	19.97	21.84	20.87	24.96	15.05
Cellulose	14.05	20.84	17.91	17.03	20.19

Diet A = 100% Ensiled Maize stover (Silage only), B = 75% Ensiled Maize stover +25% Concentrate supplements, C = 50% Ensiled Maize stover + 50% Concentrate supplements, D = 25% Ensiled Maize stover + 75% Concentrate supplements, E = 100% Concentrate supplements.

Apparent digestibility of WAD Sheep fed ensiled maize stover and concentrate supplements

Apparent digestibility (%) of dry matter (DDM), organic matter (DOM), crude protein (DCP), crude fibre (DCF), ether extract (DEE), nitrogen free extract (DNFE), ash (DA), neutral detergent fibre (DNDF), acid detergent fibre (DADF), acid detergent lignin (DADL), hemicellulose (DHEM), cellulose (DCEL) and metabolisable energy (ME) in WAD sheep are presented in Table 4. The DDM, DCF, DA, DNFE, DEE, DNDF, DADF and DADL values ranged from 62.18 – 67.44, 35.09 – 58.56, 19.29 – 32.77, 74.51 – 84.26, 52.39 – 69.99, 46.47 – 59.67, 30.27 – 45.65 and 31.08 – 48.48% and were similar across the treatments. However, DOM, DCP, hemicellulose, cellulose and ME varied significantly ($P<0.05$) across the treatments. The DOM varied from 73.0% in dietary treatment E to 84.50% in dietary treatment A, while DCP varied from 47.82% in diet A to 74.04% in diet D. Digestible Hemicellulose of animals fed diet E varied from 67.23% to 79.04% in animals fed diet C. The digestible cellulose ranged from 58.27 to 74.47. The dietary treatment C was significantly ($P < 0.05$) higher than A but similar to B, D and E. Metabolisable energy (ME) values ranged from 10.95 to 12.68 MJ/KgDM and differed significantly ($P < 0.05$) across the dietary treatments.

Feed Intake and performance characteristics of WAD Sheep fed ensiled maize stover and concentrate supplements

Table 5 showed the daily body weight gain (BWG), daily dry matter intake (DMI) and feed conversion ratio (FCR) of WAD sheep fed ensiled maize stover and concentrate supplements. Significant differences ($P < 0.05$) occurred in BWG, DMI, metabolic weight gain, metabolic feed intake and FCR among the treatment means except for initial body weight (IBW). The BWG of animals on diet E (concentrate supplements only) was significantly highest (90.48g/d) among other dietary treatments and similar to animals on diet C (73.81g/d). However, BWG of animals on diet A (silage alone) was significantly ($P < 0.05$) negative (- 2.00g/d) compared to other dietary treatments. DMI decreased significantly with increased inclusion of maize stover silage whereas the FCR of diet E (100% CS) was not significantly ($P > 0.05$) different from diet C (75% CS and 25C). Similarly, there was no significant ($P > 0.05$) difference between FCR mean of diet B (75% EMS + 25 CS) and C (50% EMS + 50% CS). However, FCR of diet A (silage alone) was significantly ($P < 0.05$) negative. The metabolic body weight gain and metabolic daily dry matter intake followed similar trend as BWG and DMI.

Discussion

Apparent digestibility was high for all the nutrients except the medium and low values obtained for CF, ADF, ADL and ash. The apparent dry matter digestibility (DMD) of diets (the four silages and concentrate supplements) were similar statistically. Non-significant values obtained in current study for DMD indicates that silage digestibility in the current study reacts similarly to the concentrate supplements as did the forage in the study of (10). The ranged values (62.18 – 67.44%) were in consonance with the work of (11) who obtained 68.02 – 70.55% but greater than 53% and 57% obtained by (12) when treated and untreated maize stover and sorghum stover silages were fed to goat, sheep and cattle. Values of DMD obtained in the present study suggest that dry matter digestibility is not a limiting factor and that when maize stover silage is used in ruminants with concentrate supplements; it could be of benefit to the ruminants. This further supports the need for the inclusion of maize stover silage as a potential feed resource in Nigeria and could form an important feed base for smallholder farmers. Farmers can improve their annual revenue generation by convertng waste maize stover crop residues to silage and sell them to livestock farmers. Furthermore, convertion of maize stover and other cereal stovers to silages can alleviate the perenial problem of scarcity of quantity and quality of green forages faced by ruminant farmers during dry season period. This will reduce incessant clash between crop farmers and Fulani herdsmen.

The OMD ranged values of 73.00 – 83.50% is consistent with the literature values of 72.86 to 78.41% by (13). The observed difference in values obtained in this study and in literature was due to variation in levels of concentrate supplements used. More over the DCP was significantly higher for maize stover silage diets containing 25, 50, 75 and 100% concentrate supplements than maize stover silage without supplements. The high intake resulting in higher protein digestibility is connected to the nature of the silage and the levels of concentrarte supplements. High crude protein in the diet has been considered an important factor that enable high intake of the silage. Crude protein digestibility was higher than 47.20 % reported by (14). Digestibility of CP often increases as CP intake decreases because metabolic faecal N usually makes up a larger part of faecal N at low intake than at high intake. This indicates that concentrate supplements had significant effect on DCP of the maize stover silage.

The crude fibre and fibre fractions were relatively digested by WAD sheep. This is expected since sheep is a ruminant. Decreasing fibre digestibility is generally associated with decreased forage intake. Several factors are known to affect fibre digestion including level of intake and interractions with supplementation strategy (13). However, the higher DCF of diet A (100% MSS) was due to nature of the feed, adaptation and proliferation of fibrolytic bacteria and increase in activities of fibre digesting fungi in the rumen of sheep placed on diet A. The hemicellulose and cellulose in the diet were well digested by sheep. The DEE ranged values (52.39 – 69.99%) obtained in this study is higher than ranged value (44.79 – 59.61%) obtained by (11) but lower than ranged value (81.83 – 85.63%) for maize stover silage treated with yeast and urea, fed to lamb in the work of (11). The digestibility coefficient values of NFE did not show any significant differences for maize stover silages with varied levels of concentrates compared to silage without concentrate supplements. However, the results obtained of this study agreed with (14) and (12) who reported that the digestibility (%) of cross bred Rahmany male lambs fed on rations containing corn stover silage with 5g yeast/head/day increased (80.34) for NFE.

For metabolisable energy (ME) values ranged from 10.95 to 12.68 MJ/Kg DM. The values of ME obtained for ensiled maize stover and concentrare supplements is in line with the value of 12MJ/KgDM reported for good-quality grass by (15). According to (16), the energy value of silage and the efficiency of its utilisation, are largely determined by the relative balances of glucogenic energy, long chain fatty acids and essential amino acids absorbed by the animal. It then mean that this diet contained a balance of nutrients, which efficiently interacted to give the highest average daily gain.

Table 4: Apparent digestibility (%) of WAD Sheep fed ensiled maize stover and concentrate supplements

Experiemental Diets						
Parameters	A	B	C	D	E	SEM
Dry Matter	62.18	62.32	66.32	67.44	62.18	3.29
Organic Matter	84.50^{a}	83.50^{a}	78.50^{b}	78.50^{b}	73.00^{c}	0.52
Crude Protein	47.82^{b}	66.40^{a}	73.32^{a}	74.15^{a}	66.62^{a}	2.82
Crude Fibre	58.56	46.43	36.48	35.09	43.50	5.67
Ether Extract	52.39^{a}	69.99^{a}	66.07^{ab}	68.67^{a}	65.64^{ab}	2.62
Ash	32.77	22.05	19.29	23.93	29.90	6.72
Nitrogen Free Extract	74.51	76.95	84.26	76.87	80.97	1.87
Neutral Detergent Fibre	48.71^{ab}	56.73^{a}	59.67^{a}	57.47^{a}	46.47^{ab}	3.60
Acid Detergent Fibre	30.27	44.97	45.65	34.09	35.94	5.58
Acid Detergent Lignin	38.11	43.96	48.48	31.08	44.66	5.62
Hemicellulose	73.40^{ab}	74.33^{ab}	79.04^{ab}	87.95^{a}	67.23^{b}	1.76
Cellulose	58.27^{b}	69.79^{ab}	74.47^{a}	68.61^{ab}	67.64^{ab}	5.85
Metabolizable Energy	12.68^{a}	12.53^{a}	11.78^{b}	11.78^{b}	10.95^{c}	0.08

abc –Means on the same row differently superscripted are significantly ($P<0.05$) different
Diet A = 100% Ensiled Maize stover (Silage only), B = 75% Ensiled Maize stover +25% Concentrate supplements, C = 50% Ensiled Maize stover + 50% Concentrate supplements, D = 25% Ensiled Maize stover + 75% Concentrate supplements, E s= 100% Concentrate supplements
SEM = Standard Error of Means.

Dry matter intake and growth performance

The DMI of the diets C (473.29g) and D (530.90g) increased proportionately as the rate/level of inclusion of concentrate supplements (CS) with silage increased and compared favourably with DMI E (100% CS). However, the DMI (245.8g) of diet A (100% EMS) decreased significantly compared to other silages with concentrate supplements. The metabolic dry matter intake (MDMI) followed a similar trend. For diets A, B, C, D and E translated to – 3.3, 3.5, 4.2, 6.7 and 7.9%, respectively dry matter intake per body weight approximately. As such, apart from the diet A (silage alone), the other four diets met the 3 – 5% DMI per body weight recommended by (18). The values of DMI obtained in this study are lower than the values of 617.2 – 759.1g obtained by (16) while working with a group of WAD sheep fed *Panicum maximum* silage. The DMI is known to be a basic limiting factor in feed utilisation since this determines or controls the quantity of intake of every other nutrient in the feed and invariably the overall performance of the farm animals. The variation observe in the DMI of test diets was expected. (7) reported that plant physical structure and chemical composition are some of the most vital factors governing intake. However, forage quality is best defined in terms of animal output when fed alone (17). It has been shown that the feed value of a forage depends on the biomass produced, voluntary intake, digestibility, and growth rate by an animal; which is the best assessed through sole feeding (17). The artificial flavor impose on the diets during fermentation may have caused a shift in palatability.

Furthermore, feed intake is known to be controlled by crude protein level of diet, gut fill, body fat, palatability and changes in body chemical constituents (18). It thus appeared that diets B, C and D silage supplemented with concentrate at varied level that were combined like the diet E (100% CS) had not much physical and chemical characteristics to preclude its consumption. The converse is true for diet A (silage alone) which is ensiled maize stover only. The nutrive value of crop residues depends not only on their digestibility but also on the amount of voluntary intake by an animal. Crop residues, such as maize stover and most cereal stovers, are nutritionally deficient in nitrogen, and when fed to ruminants as silage require supplementing with a protein supplement. Maize stover, as a true of other fibre crop residues, is generally deficient in nutrient content and low in digestibility. The extent and rate of digestion of fibrous feeds are increased by a nitrogen supplement resulting in a greater dry matter intake. It is well documented that the utilisation of the energy components of such materials by ruminant animals is highly dependent on the efficiency of the fermentative activity of the microbes. For optimum or maximum fermentation on a given diet, a certain level of ammonia (NH_3) concentration in the rumen is required. Otherwise feed intake will be reduced if NH_3 concentration is limiting the rate of fermentation (19). Animal fed on such materials (i.e ensiled maize stover only) as their sole diet will show low dry-matter intakes and decline in liveweight. This was reflected in the extent of live-weight change. The daily body weight gains (BWG) of animals (sheep) on test diets B, C, D, E (33.34 g/h/d, 40.48 g/h/d, 66.55g/h/d, 81.94 g/dl) were significantly improved while animals on dietary treatment A (-2.00 g/d) showed decline in liveweight compared to other dietary treatments. However, at the termination of the study (105 days) the final weights of sheep fed diets B (75%C + 25%C), 18.50kg, C (50%C + 50CS) 20.75kg and D (25%C + 75%CS) 20.20kg were statistically similar to diet E (100%CS) except diet A (100%EMS) 14.00kg was significantly lower than the others and the initial body weight. Variation in daily body weight gains of the sheep was due to variation in nutrient supply in the silage and concentrate supplements. The negative value of BWG obtained for the animals on diet A indicated that sheep on ensiled maize stover only lost weight. This implied that nutrient contents of maize stover silage is inadequate to maintain the initial body weight and to support the growth, thus there is need for concentrate supplementations. Furthermore, feed type is an important factor that affects sheep growth and performance. It was reported that average daily body weight gain (ADBWG) of growing lambs improved as dietary protein level increased in the diets. The observation on the of CP content on ADBWG in the present study indicates that the level of protein in the diets improved DMI, digestibility and maximizes efficiency of microbial cell synthesis in the rumen for live-weight gain.The result indicated that utilisation of ensiled maize stover using 25% concentrate supplements by growing sheep at 75% dietary level of inclusions of maize stover silage was beneficial and economical. This observation was similar to previous report of (19), that utilisation of corn stover (maize stover) by sheep was greatly improved by adding 30% concentrates at 70% dietary level of inclusion of maize stover was beneficial and economical. The feed conversion ratio (FCR) differed across the treatment means, meaning that inclusion of ensiled maize stover in each dietary treatment had effect on the efficient utilisation of the feed by the animals. The higher the feed conversion ratio, the less desirable or efficient is a treatment or diet. Feed conversion ratio (FRC) is a measure of an animal's efficiency in converting feed mass into increased body mass. Animals that have low FCR are considered efficient users of feed. The highest FCR was recorded in diet B (75%EMS + 25%CS) 13.63 which implies that the animals utilised the supplied feed with least efficiency. However, the best efficiency was obtained in diet E (100%CS) 6.55 and D (25%EMS + 75%CS) 7.19 in that order. The diet A (100% EMS) as a reference with FCR value of – 12.70 was statistically differed from other treatments with negative value. The negative values obtained for BWG and FCR was inclined to – 53g/day live weight change obtained by (19) when they fed lambs wheat straw without concentrate supplements. The BWG and FCR for the sheep on the 100 % ensiled maize stover (diet A) was negative due to the low level of crude protein (CP). Some data for sheep illusrate variation of FCR. Sheep on a diet of straw, which has a low metabolisable energy concentration, FCR of lambs may be as high as 40 (20). A feed conversion ratio (FCR) (kg feed dry matter intake per kg live mass gain) for lambs is often in the range of about 4 to 5 on high-concentrate rations, 5 to 6 on some forages of good quality, and more than 6 on feeds of lesser quality (20). Other things being equal, FCR value tends to be higher for older lambs (e.g 8 months) than younger lambs (e.g 4 months) (20). Common FCR values for cattle and sheep grazing pasture are around seven to ten whereas pigs and poultry on complete grain-based rations can be two or lower. This reflects the digestion systems of pigs and poultry, which are monogastric (one stomach) omnivores compared to ruminants which are herbivores with four stomachs designed to digest fibrous plant material. Faster growing cattle, sheep and goats typically have a better feed conversion ratio than those growing slower. This is because feed used for maintenance is lower overall than for a slow growing animal.

Table 5: Feed intake and performance of WAD sheep fed ensiled maize stover and concentrate supplements

	Experimental Diets					
Parameters	A	B	C	D	E	SEM
Initial body weight (Kg/h)	15.75^{a}	15.00^{a}	16.50^{a}	13.75^{a}	15.00^{a}	0.91
Final body weight (Kg/h)	14.00^{c}	18.50^{bc}	20.75^{ab}	21.50^{ab}	24.50^{a}	0.86
Body weight gain (Kg/h)	-2.00^{d}	3.50^{c}	4.25^{bc}	7.75^{ab}	9.50^{a}	0.64
Daily body weight gain (g/h/d)	-19.05^{d}	33.34^{c}	40.48^{bc}	73.81^{ab}	90.48^{a}	6.13
Metabolic body weight gain (g/h/dW$^{0.75}$)	-7.39^{c}	13.63^{b}	15.28^{b}	25.11^{ab}	29.14^{a}	1.92
Total daily dry matter intake (g/h/d)	242.26^{c}	454.49^{b}	473.29^{b}	530.93^{ab}	592.41^{a}	18.21
Metabolic daily dry matter intake (g/h/dW$^{0.75}$)	31.67^{b}	54.96^{a}	52.74^{a}	58.83^{a}	64.13^{a}	0.68
Dry matter intake (%) body weight (%/h/BW)	1.62	2.71	2.54	3.01	3.00	-
Feed conversion ratio	-12.70^{c}	13.63^{a}	11.69^{a}	7.19^{b}	6.55^{b}	3.34

a,b,c = Means on the same row with different superscripts are signinficantly ($P < 0.05$) different
SEM = Standard Error of Means, g/h/d = gramme per head per day
Diet A = 100% Ensiled Maize stover (Silage only), B = 75% Ensiled Maize stover +25% Concentrate supplements, C = 50% Ensiled Maize stover + 50% Concentrate supplements, D = 25% Ensiled Maize stover + 75% Concentrate supplements, E = 100% Concentrate supplements

Conclusion and Applications

1. The result of this study showed that maize stover silage alone can neither maintain nor support the growth of WAD sheep since animals on silage only lost weight. However ensiled maize stover can meet energy requirement of WAD sheep as indicated in the study.

2. Supplementation of ensiled maize stover with concentrates improved dry matter intake, apparent digestibility and growth performance of WAD sheep
3. Livestock producers can incorporate maize stover silage into ruminants feed with little concentrate supplements in order to reduce the cost of production especially during the dry season.

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