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Effect of dietary supplementation of ensiled rice straw with molasses on the performance, nutrient digestibility and haematology of Yankasa rams

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Target audience: *Farmers, Agronomists, Researchers*

Abstract

A study was carried out to determine the effect of feeding ensiled rice straw with molasses as supplement on growth performance and nutrient digestibility of Yankasa rams. Fifteen Yankasa rams with average weight of 17k±0.5g and aged between 7-9 months were used for 90days feeding trial. The straw was ensiled with 5% urea and was fed as a basal diet. Five graded levels of molasses; 0, 2.5, 3.5, 4.5 and 5.5% were used as supplement and were designated as treatments 1, 2, 3, 4 and 5, respectively. Fifteen Yankasa rams were then allotted to five treatments in a completely randomized design and were replicated three times with one animal per replicate. Results shows that all parameters evaluated for growth performance were significantly (P<0.05) influenced by dietary treatments. Average Daily feed intake was significantly (P<0.05) in animals on treatment 5(454.42g), while those on the control diets T1 (372.43g) had the lowest average daily feed intake. Similarly, animals on T5 (108.11g) had the highest average daily weight gain when compared to those on T2 (69.11g) and the control T1 (73.33g). Feed conversion ratio was better in animals fed T3 (4.14) and T4 (4.14) and followed by those on T5 (4.20). The result of Nutrient intake though significantly different across the treatment groups, did not followed any particular pattern. The rumen pH and ammonia concentration before and after feeding were similar across the treatments. The haematological measurements were all similar across the treatments, while the serum biochemical indices were significantly different (P<0.05) across the treatments except for glucose.

Keywords: Intake, Weight gain, Haematology, Yankasa rams, Ensiled rice straw.

Description of problem

The low nitrogen content of dry season fodder usually confers severe nutritional stress on ruminants. Dry season results in a rapid decline in the quantity and quality of forages leading to low intake and digestibility with resultant poor performance. The prices of conventional sources of protein in livestock diet have risen exorbitantly and this has necessitated the search for cheap alternative feed materials that can meet nutritional requirements of farm animals. Such alternative feed materials should not be in high demands by humans, should be cheap and available (1).

It has been reported that adequate nutrition is a prerequisite for the development of nature's human resource and it is perhaps the most important considerations in livestock management. Inadequate supply of both quantity and quality of feeds is responsible for the low livestock productivity. The seasonal variability in Nigeria affects the nutritive quality of natural pastures, which in turn, affects live weights of animals (2). Rice is one of the most cultivated crops especially in Nigeria and many other tropical countries of the world which serve a great portion in dry season feeding to ruminants (3). The straw is obtained after the rice has been threshed and seeds separated from the straw. It is low in quality and feeding it alone does not provide enough nutrients to the ruminants to maintain high production levels. The high level of lignifications and limited ruminal degradation of the carbohydrates and the low content of nitrogen are the main deficiencies of the rice straw affecting its value as feed for ruminants (4). Rice straw is poorly fermented and has low rates of disappearance in the rumen and passage through the rumen thereby reducing the feed intake. Rice straw when treated with urea or calcium hydroxide or by supplementing with protein sources, intake, digestibility and the ruminant's performances could be enhanced compared to feeding untreated rice straw alone (5).

Several studies in the recent past have reported the utilization of rice straw supplemented with protein source, physical or chemical treatment as ruminant feed (6,7). The straw could also be improved through the addition of molasses. Molasses is a by-product of sugar extraction from sugarcane. It is a major feed ingredient used as an energy source and a binder in compound feeds. Sugarcane molasses have several important roles in livestock feeding due to its nutritive, appetizing and physical properties (8). It provides readily fermentable energy that promotes lactic acid bacteria development, subsequently reduces pH and improves silage quality. It can also be added to grass silage at about 5% (9)

The study is therefore aimed at assessing the performance of Yankasa rams fed basal diet of urea ensiled rice straw with graded levels of molasses.

Materials and methods

Experimental site

The study was conducted at the Livestock Teaching and Research Farm, Department of Animal Science and Range Management, School of Agriculture and Agricultural Technology, Modibbo Adama University of Technology Yola, Adamawa State. Yola is located in the North Eastern part of Nigeria. It is situated within the Savannah Region and lies between latitude 7^0 14^1 North and longitude 11^o 14^1 East and altitude of about 152m above sea level. Yola has a tropical climate marked by rainy and dry seasons. Maximum temperature can reach 40° C particularly in April, while minimum temperature can be as low as 18° C. Annual rainfall is less than 1000 mm (10).

Experimental animals, management and design

Fifteen (15) Yankasa rams aged between 7 to 9 months with live- weight of 15 to 17 kg were used for the experiment. They were purchased from Girei and Song livestock markets of Adamawa State. The animals were adapted for two weeks prior to the commencement of the study**.** The ensiled rice straw was fed as basal diet and molasses as supplement. Fifteen Yankasa rams were allotted to five treatment diets and replicated three times in a completely block design (CRD). The treatment combinations are:

T1 = 5% Urea Ensiled Rice Straw only (0% Molasses)

T2 = 5% Urea Ensiled Rice Straw with 2.5% Molasses

T3 = 5% Urea Ensiled Rice Straw with 3.5% Molasses

T4 = 5% Urea Ensiled Rice Straw with 4.5% Molasses

T5 = 5% Urea Ensiled Rice Straw with 5.5% Molasses

Data Collection

Growth performance evaluation

Feeds were offered to the animals twice daily in the morning and evening (8.00am and 4.00pm), while salt lick and water were provided *ad- libitum.* The left over feed were weighed every morning before the next feeding. Growth performances of the rams were determined by weighing them with weighing scale (Rocket® balance made in Germany) on weekly basis and it lasted for 90 days.

Digestibility study

The digestibility study was conducted immediately after the feeding trial. The three rams from each treatment making a total of fifteen rams were taken to the metabolic crates and adapted for seven days. They were allocated to the same treatment diets used in the feeding trial. The faecal collection lasted for five days including total faecal output which was measured daily using a weighing scale. 10% sub-sample were dried and stored for dry matter determination before chemical analysis. The rumen pH values were obtained by the extraction of the rumen liquor using drenching gun and a hose for collection of rumen fluid before feeding and 4 hours after feeding and was used to test the rumen pH and rumen ammonia concentration.

Blood profile evaluation

Blood samples were collected via jugular vein using hypothermic needle and the blood collected was quickly put into a test tube bottle treated with Ethylene Diamine Tetra acetic Acid (EDTA) for the hematological test. The blood samples for biochemical analysis were collected into EDTA- free bottles and allowed to clot for serum separation.

Chemical analysis

Chemical analysis of the feeds and faecal samples were determined by the standard method according to A.O.A.C (11). Acid detergent fibre and Neutral detergent fibre were analysed according to Goering and Van Soest (12).

Statistical analysis

The data collected were subjected to analysis of variance (ANOVA) according to Steel andTorrie (13), after which the least significant difference (LSD) test was used to separate significantly different treatment means.

Results

Chemical composition of experimental diets

The chemical composition of the experimental diets is presented in Table 1. The chemical composition ranged from 95.50 to 96.00% for DM, 18.00 to 18.50% for CP, 47.60 to 60.00% for NFE, 0.50 to 3.50% for EE and 9.90 to13.00% for Ash. While the neutral and acid detergent fibre contents ranged from 54.00 to71.20% and 43.40 to 53.10%, respectively.

Table 1: Chemical composition of experimental diets

Nutrient (%)	T1	T2	T3	T4	T5
Dry Matter	96.00	96.00	96.00	95.50	96.00
Crude protein	18.4	18.5	18.0	18.2	18.5
Nitrogen-Free Extract	47.6	55.0	52.1	60.0	54.1
Ether Extract	2.1	3.5	1.0	0.5	0.5
Ash	12.5	13.0	9.9	11.5	9.9
Neutral Detergent Fibre	71.2	69.0	56.0	54.3	54.0
Acid Detergent Fibre	53.1	51.0	50.5	43.4	49.5

T1 = 5% Urea Ensiled Rice Straw only (0% Molasses)
T2 = 5% Urea Ensiled Rice Straw with 2.5% Molasse
T3 = 5% Urea Ensiled Rice Straw with 3.5% Molasses
T4 = 5% Urea Ensiled Rice Straw with 4.5% Molasses
T5 = 5% Urea Ensiled Rice Straw with 5.5% Molasses

Growth performance of Yankassa Rams fed urea-ensiled rice straw with graded levels of molasses

The growth performance of Yankassa rams fed urea-ensiled rice straw with graded level of molasses is shown in Table 2. There was significant difference in total feed intake among treatments. Animals placed on treatment 5 have significantly higher (P<0.05) values for total feed intake (40.87) and least value was observed in treatment 1(33.50). Average daily feed intake was also significantly different (P<0.05) with higer value in treatment 5(454.42) and least in treatment 1 (372.43). Final weight was higher in T5 (25.87) and least value in T1 (23.07) but the total weight gain was significantly higher (P<0.05) in T4 (9.90) and least in T1 (6.06). The feed conversion ratio was significantly superior in treatments 3 (4.14) and 4 (4.14).

Table 2: Performance of Yankasa ram fed urea-ensiled rice straw with graded levels of molasses

Parameters	T1	T2	T3	T4	T5	SEM
Initial weight (kg)	17.01	16.99	15.89	15.90	15.90	0.031^{NS}
Average daily feed intake (g)	372.43^{c}	381.51^{c}	397.03^{b}	400.46^{b}	454.42^{a}	0.003*
Total feed intake (kg)	33.50^{c}	34.33^{c}	35.73^{b}	36.73^{b}	40.86^{a}	0.003*
Average daily weight gain (g)	73.33^{c}	69.11^{c}	95.89^{b}	96.67^{ab}	108.11^{a}	0.052*
Total weight gain (kg)	6.06^{c}	6.22^{c}	8.63^{b}	9.90^{a}	9.73^{a}	0.022*
Final weight (kg)	23.07^{c}	23.21^{c}	24.52^{b}	25.80^{a}	25.86^{a}	0.187*
Feed conversion ratio	5.07^{ab}	5.51^{a}	4.14^{c}	4.14^{c}	4.20^{b}	0.304*

a, b,c, means without common superscripts differ at P<0.05
SEM- Standard error of means
NS-Not significant

Nutrient intake

Table 3 shows the nutrient intake of rams fed urea ensiled rice straw with graded levels of molasses. The result indicated that there were significant differences (p<0.05) among the treatment groups. Dry matter was significantly higher in T5 (436.24) and lowest value was observed in T1 (357.53). Crude protein intake was also significantly higher in T5 (84.06) with the least value in T1 (68.53). Nitrogen free extract follow the same trend with significantly higher value in T5 (245.84) and least value in T1 (177.27).

The dry matter digestibility was significantly different (P<0.05) with the highest value in T5 (78.67) and lowest in T1 (57.77). Crude protein digestibility was also significantly different having the highest value in T5 (78.67) and least in T1 (55.71), while the ADF and NDF were both significantly different with the highest values in T5 (70.17) and (58.00) and least values were observed in T1 (55.27) and (44.10), respectively.

Rumen pH and rumen ammonia concentration

Table 5 shows the rumen pH of Yankassa rams fed urea ensiled rice straw with graded levels of molasses before and after feeding of the experimental diets. The result showed no significant difference (p>0.05) among the treatment groups before and after feeding of experimental diets, though, the values increase with level of supplementation. The rumen pH before feeding and after feeding increases numerically with level of supplementation and ranges from 6.83 to 7.15% and 5.83 to 6.83%, respectively. The rumen ammonia concentration was also not significantly different (P>0.05) among the treatment groups, though the values increases with supplementation levels and ranges from 17.73 to 18.87% and 19.73 to 19.67%mml/100ml, respectively.

Table 3: Nutrient intake of Yankassa rams fed urea-ensiled rice straw with graded levels of molasses

Parameters	T1	T2	T3	T4	T5	SEM
Dry matter	357.53^c	366.25^c	381.15^b	382.43^b	436.24^a	2.55*
Crude protein	68.53^c	70.58^b	71.47^b	72.08^b	84.06^a	3.84*
Crude fibre	121.03^{ab}	80.49^c	125.06^{ab}	102.11^b	138.60^a	3.00*
Nitrogen free extract	177.27^c	209.83^{ab}	206.83^{ab}	240.27^a	245.84^a	4.71*
Ether extract	7.82^{ab}	13.35^a	3.97^b	2.06^c	2.27c	1.34*
Ash	46.55^b	49.59^a	39.31^c	46.05^b	44.98^b	1.29*

A, b, c, means without common superscripts differ at P<0.05

Table 4: Nutrient digestibility of Yankassa rams fed urea-ensiled rice straw with graded levels of molasses

Parameters (%)	T1	T2	T3	T4	T5	SEM
Dry matter	57.76^b	61.53^{ab}	67.53^{ab}	68.00^{ab}	78.67^a	3.55*
Crude protein	55.70^b	67.72^{ab}	67.72^{ab}	67.91^{ab}	78.67^a	4.84*
Nitrogen free extract	57.77^{ab}	63.00^a	51.53^{ab}	39.97^c	40.00^c	4.61*
Ether extract	13.13^a	17.67^a	16.00^a	15.67^a	10.83^a	1.45*
Neutral detergent fibre	44.10^c	51.70^{ab}	49.93^{bc}	45.10^{bc}	58.00^a	1.39*
Acid detergent fibre	55.27^b	70.37^a	68.77^a	54.03^b	70.17^a	1.69*
Ash	44.70^a	30.43^b	32.84^b	28.32^b	14.43^c	1.13*

A, b, c, means without common superscripts differ at P<0.05

Table 5: Rumen pH and ammonia concentration of Yankassa rams fed urea-ensiled rice straw with gaded levels of molasses

Feeding time	T1	T2	T3	T4	T5	SEM
pH before feeding	6.83	7.16	6.90	7.33	7.15	2.38^{NS}
pH after feeding	5.83	6.60	6.80	6.50	6.83	0.38^{NS}
Ammonia before feeding	17.73	17.63	18.56	18.18	18.86	0.86^{NS}
Ammonia after feeding	19.73	18.88	20.83	17.66	19.66	0.812^{NS}

A, b, c, means without common superscripts differ at P<0.05

Blood profile

Table 7 showed the blood profile of Yankasa rams fed urea ensiled rice straw with graded levels of molasses. There was no significant difference (p>0.05) for all the parameters evaluated for haematology WBC, RBC, HBC, PCV, MCH, MCV and MCHC. The values ranges from 7.11 to 8.00% (WB), 10.46 to 11.87% (RBC), 12.16 to12.75% (HBC), 25.00 to 30.88% (PCV), 22.05 to

24.36% (MCH), 72.51 to 76.25% (MCV) and 32.16 to 34.81% (MCHC). There was a significant variation in all the parameters measured for biochemical indices except for glucose which were similar across the treatments.

Table 6: Blood profile of Yankasa rams fed urea ensiled rice sraw with graded levels of molasses

Parameters	T1	T2	T3	T4	T5	SEM
WBC ($X10^6$/mm)	7.26	7.11	7.38	7.70	8.00	0.30^{NS}
RBC ($x10^6/mm^3$)	10.46	11.53	11.64	11.74	11.87	0.09^{NS}
Hbc (g/dl)	12.16	12.40	12.44	12.60	12.75	0.61^{NS}
PCV (%)	25.00	25.10	26.10	29.16	30.88	0.02^{NS}
MCH (pg)	22.05	22.45	22.80	22.83	24.36	0.07^{NS}
MCV (fi)	76.25	74.60	74.51	74.43	72.51	0.38^{NS}
MCHC (%)	32.16	32.70	30.75	33.85	34.81	0.06^{NS}
Biochemical indices						
Albumin (g/l)	39.43^{a}	38.66^{b}	37.53^{b}	41.33^{a}	42.13^{a}	0.04*
Globulin (g/l)	33.37^{a}	31.14^{a}	29.78^{b}	33.63^{a}	34.13^{a}	0.02*
Glucose (mmol/l)	18.85	18.83	19.15	19.85	20.03	0.68^{NS}
Total protein (g/dl)	6.06^{b}	7.52^{a}	7.75^{a}	7.65^{a}	7.51^{a}	0.02*
Blood urea (mmol/l)	6.40^{b}	7.93^{ab}	7.66^{a}	6.26^{b}	7.56^{a}	0.05*
Sodium (mmol/l)	118.88^{c}	128.00^{b}	130.50^{a}	130.50^{a}	130.20^{a}	0.14*

A, b, c, means without common superscripts differ at P<0.05

Discussion

The dry matter content of the experimental diets were higher than 92.40% reported by (14), but similar value (96.87%) was reported by (15). Also, a lower range value of 86 to 92% was reported by (16) in separate studies with similar diets. The differences in dry matter content could be attributed to the stage of harvest, soil or rainfall or mode of processing. Crude protein content is higher than 5.10% reported by (17) with similar diet involving Guinea grass, while (18) reported 12.60% and 6.67% crude protein content. The differences could be due to the stage of harvest, soil or process of the treatment and formulation. Ether extracts content is lower than the range values of 8.34 – 9.0% reported by (19) while (20) reported 3.07% which is within the range values of 0.50-3.50% with Guinea grass. Nitrogen –Free extract range values of 47.60-60.00% is higher than 25.18% reported by (20) with *Panicum maximum*. Same aurthor in separate study with *panicum maximum* reported lower ADF (36.95%) and higher NDF (73.39%) than in this study.

The intake in this study increases with supplementation level and similar to the earlier reports by (20, 21, 22) fed similar diets with straws and stovers to ruminant animals and reported increase in intake with increase in supplementation levels. They all attributed the increase in intake to the palatability brought about by ensiling and molasses inclusion. Similarly, (23) reported that the level of molasses inclusion in feed reduces pH and improves rumen environment which agrees wth the earlier report by (24) who observed that 5% molasses supplementation improves feed intake and ruminal activities. Increasing the level of molasses in the diet markedly increased the weight gain with rams to the maximum value of inclusion and this agrees with the earlier report of (25) who observed that energy–Protein balance of a ration enhances live weight gain (26) also in separate study reported increase in weight gain and final weight gain with rams fed urea-treated straw supplemented with molasses in ruminant animals. The increased in weight could be attributed to the increase in feed consumption which might have contributed to the observed weight gain. However, the Weight increase could also be attributable to the ability of the microorganisms in the rumen to combine with ammonia with products of carbohydrate metabolism to form amino acids to produce protein hence increased weight gain.

There is corresponding increase in feed conversion ratio with supplementation level and it agrees with the report of (21) who recorded improvement with feed conversion ratio with supplementation level of molasses (27) reported a similar feed conversion efficiency when urea treated straw was supplemented with molasses in the diet of rams. Similar results were also reported by (28,20,17) also observed a similar result when they fed different grasses and supplements to ruminant animals and recorded increased weight gain with increasing level of supplements of different sources. Nutrient intake in this study increase with supplementation level and superior over unsupplemented groups. Nutrient intake was similar to the report by (29) who fed cows with urea treated maize cobs ensiled with enzose enzyme and attributed higher nutrient intake to improved digestibility of the fibre fractions. (30) also reported increase in nutrient intake as result of starch in supplementation and nitrogen in treated stover which resulted into better utilization of non-protein nitrogen than any other carbohydrate sources.

Nutrient digestibility of Yankasa rams increased with molasses supplementation for all the nutrients. This is similar to the report by (31) who observed increased digestibility of fibrous feed with molasses supplementation. (32) also reported that digestibility of fibrous residues was increased due to treatment with alkali and that the crude fibre in the straw was broken down after being softened by the water in the urea solution. This also agrees with earlier report of (33) who reported that feeding ensiled-urea treated fibrous material with fermentable carbohydrates could increase digestibility of the feed.

The rumen pH of yankassa rams fed urea ensiled rice straw with graded levels of molasses were similar (P>0.05), but improves with supplementation level. The trend of the result obtained could be attributable to the fact that fibre digesting bacteria growth is favoured in pH from 6.0 – 6.8 and this is slightly higher than 5.5 – 6 reported by (34) who stated that type of diet could shift pH values when high forage/grasses rations were used because forage normally stimulates higher rate of saliva secretion and it contains bicarbonate which buffers the rumen and increases acetate production. The result of rumen ammonia concentration of rams agreed with that of (35), who reported that levels of ammonia in the rumen of sheep fed with hay increased to peak level three hours after feeding and then gradually decreases. Similar result was reported by (36) who stated that for microbial growth, ammonia is required in the level of 0.35 to 29mg/100ml of the rumen fluid. Also, (36) reported that ammonia in non protein nitrogen and feed protein degradation, microbial protein degradation and urea hydrolysis entering the rumen along with saliva is diffused through the rumen wall.

The haematological and serum biochemical indices of Yankassa rams shows that WBC,RBC HbC, PCV, MCV, MCHC and MCH were similar to the range values reported earlier with *Saukin* lambs by (37). Packed Cell Volume (PCV) were within the physiological range of 27.0 – 45.0% reported by (38), and also within the range of 15 – 30% as reported by (39). In contrast to this, (40) reported higher values of 36.9 and 35.5% for clinically healthy West African Dwarf Sheep and the differences recorded could be be due to quantity of urea and molasses used. The hemoglobin (Hb) range in this study fell within the range of 9 – 15g/dl reported by (41), but higher than the values of 5.6g/dl obtained by (42) for goats fed treated *Jatropha curcas* kernel cake rations. No significant p>0.05) differences were observed in urea ensiled rice straw with molasses supplementation on WBC, PCV, RBC, Hb, MCHC, and MCV in this study. The RBC counts reported in this study were close to the range values of 9.2 – 13.5g/dl reported by (43) and values of 9.9 g/dl reported by (40) which is within the range of 10.25 – 12.85×10^{12}g/dl obtained by (44) WBC counts were similar among the treatment groups and fell within the normal range (5 – 11 g/dl) reported by (45) for sheep. The similar WBC count obtained implies the immune status of the rams were at the same level across the treatment diets. PCV is a blood toxicity reduction index and its abnormal level point to the presence of a toxic factor which has a drastic effect on blood formation (46). Therefore, the non significant (p> 0.05) difference among the treatment for PCV suggest good detoxification of urea. The haematological parameters especially PCV and haemoglobin were positively correlated with the nutritional status of the animal (47). The normal haemoglobin values of all the rams in the current study indicated that, the diets contained good quality proteins that met rams' nutritional requirements. In addition, the normal WBC in all treatments indicated that all rams were healthy throughout the experimental period, being an indication of non-allergic condition, free parasitism and any foreign body in circulation (48).

The serum protein concentration at any given time in turn is a function of hormonal balance, nutritional status, water balance and other factors affecting health. The serum concentration of total protein in healthy animals normally varies between 6.0 – 7.9g/dl and is altered during any liver and kidney diseases (41). The concentration of total serum protein in this study was within the normal range and this implied that the test diets were able to supply adequate amount of nutrients needed to maintain normal serum protein levels. However, the serum protein concentrations in this study tended to increases significantly with increasing levels of supplementation; similar trend was reported by (49) that total protein levels increase gradually with age. A similar observation with serum urea concentration was reported by (50, 51)that rapid hydrolysis of urea to ammonia was as a result of hyper ammonia in the rumen. Serum albumin is similar to the report of (52) who reported 7.40-7.66 g/l. The serum sodium level was within the range of 118.80 – 130.50 mmol/l, but lower than the report of (53) who obtained 147.5 – 167.83 mmol/l) and (71) who also obtained 154 mmol/l in Red Sokoto Goats during wet season and the Glucose obtained in this study also agrees with the earlier report of (54)who stated that blood glucose decrease with age.

Conclusion and Applications

From the study, it can be concluded that:

1. Ensiled rice straws with 50% urea will help to increase the digestibility.
2. Inclusion of molasses in the diet of Yankasa rams also inproved intake, weight gain and feed conversion ratio
3. The urea and molasses are readily available anytime of the year and can be used to improve the quality of feed especially during the dry season.

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