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VOLUNTARY INTAKE, DIGESTIBILITY AND NITROGEN UTILIZATION OF FATTENING RAMS FED GRADED LEVELS OF SUGAR CANE MOLASSES

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ABSTRACT

An experiment was carried out to determine the effects of feeding graded levels of cane molasses on intake, nutrient digestibility and growth performance of fattening Balami sheep. Sixteen Balami rams aged 15 months years with mean liveweight of 54±0.47Kg were randomly allocated to four treatment groups in a randomize complete block design experiment received 0.7kg of concentrate diets containing 0% Molasses, (Control) 10%, 20% and 30^0% molasses in T_0 T_1, T'_2 and T_3 respectively. All treatment groups were offered a basal diet of cowpea pods ad-libitum and were individually housed in pens with concrete floors. Inclusion of molasses in the concentrate diet tended to increase dry matter intake. The dry matter intake (DMI) and dry matter digestibility (DMD) were 1.27, 1.31, 1.40, andi.34kg and 67.22, 71.22, 72.48, and 73.78% respectively. The crude fibre digestibility was 63, 71, 65 and 51% for T_0, T_l, T_2 and T_3 respectively. Daily liveweight gain were 0.15, 0.12, 0.34 and 0.07kg/day for T_0, T_1. T_2 and T_3 respectively. Only animals fed on concentrate diet containing 20% molasses showed a significantly higher ($p<0.05$) daily live weight gain. Results of Nitrogen intake, nitrogen in faeces, and nitrogen in urine were 27.9, 26.8, 28.6 and 27.6; 13.1, 9.8, 11.1 and 10.9 and 4.7, 8.7, 6.6 and 4.5 for T_0 T_1. T_2 and T_3 respectively. The study suggest an optimum level of inclusion of 20% molasses in the diets of fattening rams in the semi-arid region of Nigeria.

Keywords: Molasses, Voluntary intake, Cowpea pods, Fattening rams and Digestion.

INTRODUCTION

The productivity of Nigerian livestock has been known to be below their genetic potential mainly due to poor nutrition and inadequate good quality feed (Shaiwoya and Mohammed, 1999). Feeding of small ruminant animals during the dry season poses a lot of challenges to the small holders that represent the greater percentage of the livestock producers in Nigeria. Small ruminants (Sheep and goats) still roam about without adequate attention from the owners. Sheep are multi-purpose animals, but they are primarily kept for the production of meat (Mutton) accounting for about 11% of the total meat supply in Nigeria. This contribution is higher if animals slaughtered in the rural areas and not processed in slaughter houses are taken into account. Mutton is widely consumed in all parts of the country as there are no "taboos" on the consumption. The most immediate stimulus to fatten sheep is the pressure to sacrifice a ram during the major Islamic festivals, most notably Id-El-Kabir. As the price for rams can double or "triple" in the weeks leading to the festival (Amole *et al.*, 2016)**,** Prudent households buy stock several months in advance and fatten them for slaughter. Fattening of rams is a highly profitable venture with return of premium to the farmer. Fattening of rams in the semi-arid zone is affected by the short duration of rainfall and long dry season. Poor nutrition especially during the long dry season is one of the major factors militating against livestock production in the sub-sahelian zone of Borno State. Feeds become scarce, most grasses are dried, low in nutrients and not

sustainable sheep production (Ademosun, 1994), with resultant poor-animal performance (Zimmelink, 1973). During the wet season there is plenty of green pasture available for the animals. Thus, fattening of ruminants could be done through grazing natural or cut and carry pasture. Therefore, to boost performance you may need some supplementary feed rich in energy and protein. Sheep or goats could be managed and fattened during the dry season using local feeds such as dry grass of hay, legume hay, crop residues, brans and oil seed cakes Mshel-Bwala, (1996). The major sources of energy for sheep diets include maize offal, wheat offal, cassava, maize cob, brewer's grains, rice bran and molasses. Sansoucy and Emery (1982) has suggested that in order to reduce the competition between man and livestock on feeding stuffs, non-conventional feed ingredients should be exploited and used for livestock feeding. This made it imperative for nutritionists to look more inwardly for more agricultural resources that are yet to be popular in feeding livestock. These carbohydrates ration makes up most, although not all of the energy requirement by the animals. Energy is needed to maintain all the body processes as well as for production. Ideal situation would be for soluble carbohydrate to improve nitrogen utilization and provide glucose precursors without depressing fibre digestion or intake of roughages. Sugar – cane molasses is a potential energy supplement available in many countries in sub – Saharan Africa. Soluble carbohydrates given at moderate levels increase the amount of energy in the diet (Sanchez and Preston, 1980), improve the utilization of nitrogen in the rumen and may increase ruminal outflow rate (Khalili and Huhtanen, 1991). However, information on the optimum level of molasses with low – quality roughage based diets used in Nigeria is limited. The objectives of the research are to determine the effects of graded levels of molasses on intake, digestibility and live weight changes of fattening rams offered a basal diet of cowpea pods.

Materials and Methods

Experimental Site/Location:

The experiment was carried out at the University of Maiduguri Teaching and research Farm. The area is situated on latitude $11^0$51' North, longitude $30^0$05' East and at altitude of 354 m above sea level. It falls within the sahelian region (semi-arid zone) of West Africa, which is characterized by short duration of rainfall (3-4 months). Rainfall vries from 300-500 mm, ambient temperatures are highest by April and May and is in the range of 35-40^0C while the relative humidity ranges from 45-50% as reported by Waziri *et al.* (2009).

Animals and Design

Sixteen rams aged 15 months and weighing on average 54+0.47kg were used for the study. The animals were divided into four groups of four animals each based on similarity in body weight and were randomly allocated to one of the four treatment groups in a randomized complete block design experiment. The animals received 0.7kg of concentrate diet containing 0% molasses (control), 10%, 20% and 30% molasses in treatments T_0 T_1, T_2 and T_3 respectively (Table 1).

Table 1: Composition of experimental diets (%)

	T_0	T_1	T_2	T_3
Molasses	0	10	20	30
Poultry waste	10	10	10	10
Wheat offal	80	70	60	50
Maize offal	10	10	10	10
ME: MJ /Kg DM	14.80	14.34	14.77	14.90

Feeding and management

All animals were dewormed with banmith F (Pfizer) and housed in individual pens with free access to water and mineral licks. The study comprised of 14 days of feed adaption period and 7 days measurement period. Feed was offered twice daily at 8.00hrs and 16.00hrs. the daily output of faeces and total urine voided were recorded form each animal and sampled for chemical analysis. Sample of feed offered were taken daily during the measurement period for chemical analysis. Body weight of the animals were measured at weekly intervals.

At the end of the feeding trial, one ram from each treatment were randomly selected and placed in metal metabolism cages. Feed, faeces and urine were collected separately. Total urine produced daily was recorded and samples collected in flasks containing 10% sulphuric acid. Faeces was also collected and weighed and sub – samples were taken and kept for chemical analysis.

Statistical Analysis

Data collected were subjected to Analysis of Variance (ANOVA) in a completely randomized design using the SAS (2009) Package.

RESULTS

Chemical analysis

The chemical composition of the experiment diets is shown in Table 2. The crude protein content varied from 11.5% in T_3 to 12.8% in T_0 (control). Crude fibre content was lowest in T_3 (10.0%) and highest in T_0 (15.0%). All diets under study have ether extract less than 4.5% nitrogen free extract content was highest in T_2 followed by T_3 (64.6%) and T_1 (62.2%). T_1 has the highest amount of ash (2.5%). The mineral content of molasses is very variable depending on the species and stage of growth of the sugar cane (Deaville, 1994).

Table 2: Chemical composition of experimental feeds (% dry matter)

	T_0	T_1	T_2	T_3
Dry matter (DM)	94.4	92.5	93.5	89.3
Crude protein (CP)	12.8	11.8	11.9	11.5
Crude fibre (CF)	15.0	13.5	12.5	10.0
Ether extract (EE)	4.5	2.5	2.2	1.7
Ash	2.0	2.5	2.2	1.7
Nitrogen free extract (NFE)	61.1	62.2	65.4	64.6

Feed intake and digestibility

Molasses diet is palatable at moderate levels of inclusion. Voluntary dry matter intake (DMI) of T_2 was 1.40kg per day which is higher than any other treatment groups. There was significant difference ($P<0.05$) daily DM intake among the treatment groups. Sheep fed with 0% molasses diet has the lowest DMI. DM digestibility of T_3 (30% molasses inclusion) was significantly higher ($P<0.05$) than all other diets. The apparent digestibility of Crude protein fibre was highest in 10% molasses diet. The result also shows that the crude fibre digestibility decreases with increase in the level of molasses while ether extract digestibility was highest in molasses diet.

Table 3: Dry matter intake, Dry matter Digestibility, and Live weight change in fattening rams offered concentrate diet with graded Level of molasses.

Growth performance	T_0	T_1	T_2	T_3	SED
DMI (kg/day)	1.27^b	1.31^a	1.40^a	1.34^a	0.07
Faecal Output (g/kg)	0.27^b	0.68^b	0.75^a	0.73^a	0.03
Initial weight (kg)	54	56	54	55	
Final weight (kg)	66.7^b	68.2^b	70.5^a	65.7^c	1.03
Daily live weight Gain (kg/day)	0.15^b	0.12^b	0.34^a	0.07^b	0.05
DMD (%)	67.22^b	71.22^a	61^b	53.78^a	2.36
Crude Protein (%)	84^a	89^a	86^a	86^a	2.0
Crude Fibre (%)	63^b	71^a	65^b	51^c	3.0
Ether Extract (%)	69^a	68^a	71	62^b	1.0

a, b, c =Mean in the same row with different superscripts differ significantly ($P<0.05$); SED= standard error of difference

The DMD of the supplemented group is significantly ($P<0.05$) higher than the control group. The crude fibre digestibility for T_1 is significantly higher ($P<0.05$) than the other treatment group. There was a significant ($P<0.05$) difference between the supplemented group and the control group (T_0) between the extract digestibility result shows that there is a

statistical significant (P<0.05) in terms of nitrogen in faces and urine. There was no significant different (P<0.05) treatments in terms of nitrogen intake and nitrogen retention. The result of the nitrogen balance trial showed significant differences (P<0.05) between diets in terms of nitrogen intake, nitrogen in faces and nitrogen in urine. There is no significant difference (P<0.05) in nitrogen retention and nitrogen intake.

Table 4: Nitrogen absorption and retention (g/day) in sheep fed molasses

	T_0	T_1	T_2	T_3	SED
Nitrogen intake (g/day)	27.9	26.8	28.6	27.6	1.13
Nitrogen in faces (g/day)	13.1^{c}	26.8^{ab}	28.6^{a}	27.6^{a}	1.13
Nitrogen in urine (g/day)	4.7b	8.7^{a}	6.6^{b}	4.5^{b}	1.82
Nitrogen absorbed (g/day)	14.8^{c}	17^{b}	17.5^{b}	23.1^{a}	0.05
Nitrogen absorbed As % of intake (g/day)	53.0^{c}	63.43^{b}	61.18^{b}	83.69^{a}	2.65
Nitrogen retained (g/day)	10.1	8.3	10.9	12.2	2.3
Nitrogen retained as% of nitrogen intake	38.35^{b}	30.97^{c}	38.11^{b}	44.2^{a}	1.25

a, b, c =Mean in the same row with different superscripts differ significantly (P<0.05); SED= standard error of difference

Growth rate

The sheep fed on 20% molasses inclusion gain on average of 0.34kg per day while the sheep fed with 30% molasses diet gain 0.07kg per day and there was statistical significant difference (P<0.05) between the treatments as shown in Table 2.

DISCUSSION

Chemical composition

The crude fibre content decreases with increasing levels of molasses in the diets. Ether Extracts and Ash contents of the diets ranged from 1.7% to 4.5% and 1.5% to 2.5% respectively The mineral content of molasses is very variable depending on the species and stage of growth of the sugar cane Deaville (1994).

The crude protein content ranges from 11.5% to 12.8% dry matter respectively. The crude protein declines with increase in the level of molasses. Nitrogen free extracts content was slightly higher in 20% molasses inclusion.

Intake and digestibility

The DMI were 1.27, I .31, 1.40, and I .34kg/day for To, T_1 , T_2, and T_3 respectively. Rams fed on concentrate diet containing 20% molasses consumed more feed when compared to other treatment groups. Molasses enhances palatability of the feed at moderate levels of inclusion and hence increases intake Gohl, (1981). The total dry matter intake (DMI) were significantly higher for the supplemented groups receiving molasses, compared to the control group. Thus, the result of the DMI showed that the animals on To consumed less dry matter compared to animals on T_1, T_2 and T_3.The differences observed in intake of the supplemented groups may be due to the different levels of wheat offals in the diet supplemented with molasses. The present result indicates that feeding molasses at higher levels alleviate the negative effect of molasses on voluntary intake. This may be due to a diminished carbohydrate effect of soluble carbohydrates (Mould *et al*; 1983) which affects the activity of cellulotic microbes (Russell and Baldwin, 1978). Increase in DMI

and palatability due to molasses supplementation had been reported by Gohl (1981) Iwuanyanwu *et al*; (1990) also reported that inclusion of molasses in diet of sheep increases DMI. The dry matter digestibility (DMD) for animals supplemented with concentrate containing various levels of molasses decreases with increasing level of molasses. This is similar to the report of Alhassan *et al*, (1986) and Chaudry *et al*. (1996). The decrease in fibre digestion caused partly by the carbohydrate effect in wheat - bran - molasses mixture affect dry matter digestibility, Khalili and Osuji (1993). Iwuanyanwu *et al*; (1990) reported that lower levels of molasses supplements (100, 200 or 300g/day) have been found to have little effect on DM digestibility. The present study also shows that inclusion of higher levels (30%) of soluble carbohydrate (molasses) in the diets reduces fibre digestion (England and Gill, 1985). Crude fibre digestibility decreased linearly (in the supplemented groups receiving molasses) when the level of molasses in the diets increased (Khalili and Osuji, 1993). This depression in digestibility can be partly caused by a decrease in the amount of highly digestible fibre since by substitution of wheat bran by molasses the proportion of highly digestible fibre of wheat bran origin in the diets was decreased. The result also shows no negative effect of molasses on crude protein digestibility. This is similar the report of Khalili *et al*. (1992) that molasses supplement were additives and increase dry matter and crude protein digestibility. The highest ether extract digestibility is observed in T_2 (20% molasses inclusion). Nitrogen in faeces was higher in the control group and lower in the supplemented group. Soluble carbohydrate supplements have been shown to decrease rumen ammonia concentration indicating increased uptake of ammonia for microbial synthesis Khalili, (1992). Nitrogen in urine ranges between 4.5 to 8.7g/day respectively.

Growth rate

The higher liveweight gain in T_2 may be due to high dry matter intake and dry matter digestibility. This is similar to the report of Minson (1983) that animal intake is related directly to dry matter digestibility. Pagot (1993) also reported liveweight gain of 8.1kg for fattening sheep fed molasses supplemented within 63 days with a calculated daily liveweight gain of 129 g/day. The liveweight change of animals in treatment 3 is lower compared to other groups. This may be due to high level of molasses inclusion which produces low levels of propionic acid (the chief glucose precursor) and more butyric acid (Clark *et al*., 1972; Chenost and Mayer, 1977). An increase in the molar proportion of butyrate is a typical finding when the level of molasses in the diet is high (Karalazos and Swan, 1976) and this is frequently accompanied by a decrease in the molar proportion of acetate and propionate (Fegeros *et al.*, 1989). The Interaction between the nature of the end-products of rumen fermentation and animal growth is complicated by metabolism of volatile fatty acids (VFA) within the gut wall of the rumen or small intestine. Thus, Bergman (1990) showed that approximately 30% of the acetate produced in the rumen is metabolized in the rumen wall and that the proportions of propionate and butyrate metabolized are higher if the level of molasses in the diet is high. Butyrate from rumen fermentation is largely converted to beta - hydroxybutyrate by rumen epithelia (Bergman, 1990) and also increases with increase in level of molasses inclusion in diet (Yan *et al*. 1997). There was no symptoms of ketosis exhibited by any of the animals. There is also evidence that butyrate inhibits both propionate uptake by the liver *in vivo* (Krehbiel *et al*., 1992). This suggest that excessive butyrate production resulting in inefficient energy utilization at tissue level. This could be overcome by decreasing the level of molasses as reported by

Sutton (1968) that inclusion of moderate levels of soluble carbohydrates in diet will increase molar proportion of propionate at the expense of acetate and balance the availability of Nitrogen and digestible carbohydrates in the rumen, the moderate level of inclusion in the present study is 20%. The decrease in growth rate as a result of high level of molasses inclusion in the present study is in contrast to the report of Ørskov and Ryle (1990) who reported that even at high growth rates, performance is unlikely to be restricted by the supply of glucose precursors. The present study shows that performance is greatly affected by the supply of glucose at high growth rates.

CONCLUSION

By products such as wheat bran and molasses are important supplements for ruminants fed low quality basal diets. Molasses and wheat bran supplement provide additional nitrogen and energy for microbes in the rumen. The level of inclusion of molasses should be reduced from 30% to lower levels so as to avoid depression in crude fibre digestibility and will also increase DM digestibility and DM intake and higher live weight gain of the animals. The results also showed that molasses - wheat bran mixture could serve as both maintenance and production ration for sheep.

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