

## **Growth performance and nutrient digestibility of growing sheep fed a concentrate diet supplemented with some plant oils**

**Kolo.\* U. M.,<sup>1</sup> Maigandi, S. A.,<sup>2</sup> Malami, B. S.,<sup>2</sup> Shuaibu, A. Y.,<sup>1</sup> Girgiri, A. Y.,<sup>1</sup> Bislava, M. B.,<sup>1</sup> Amin, A. B.,<sup>3</sup> Asheikh, L. G.<sup>1</sup> and Shettima, S. M.<sup>1</sup>**

<sup>1</sup>Department of Animal Science, University of Maiduguri, Maiduguri, Nigeria.

<sup>2</sup>Department of Animal Science, Usmanu Danfodiyo University, Sokoto, Nigeria.

<sup>3</sup>Department of Animal Science, Federal University Dutse, Dutse, Nigeria.

**\*Author for correspondence; uskolo220@gmail.com**

**\*Corresponding Author Phone number: +2348038329041**

**Target audience: Livestock farmers, meat scientists and researchers.**

**Department of Animal Science, University of Maiduguri, P.M.B. 1069, Maiduguri, Nigeria**

### **Abstract**

The study was conducted using locally available plant oils (garlic oil, Soybean oil and groundnut oil) to determine growth performance and nutrient digestibility of lambs. Sixteen (16) Uda lambs were used for this study. Dietary treatments formulated comprised Treatment 1 (T1) is the control diet with no oil additive. Treatment 2 (T2) contained 30 ml/kg garlic oil, Treatment 3 (T3) had 30 ml/kg Soybean oil while 30 ml/kg groundnut oil was added in Treatment 4 (T4). The results of growth performance showed that there was significant difference ( $P < 0.05$ ) between treatment means in final weight, basal feed intake and dry matter intake as % body weight and feed conversion ratio while average daily gain, dry matter intake, supplement feed intake and methane were not significantly ( $P > 0.05$ ) different between the treatments groups. Nutrient digestibility results showed that there was no significant ( $P > 0.05$ ) difference in Dry matter, Ash and Acid detergent lignin digestibilities between treatment means, while crude protein, crude fibre, ether extract, acid detergent fibre, neutral detergent fibre, hemicellulose and cellulose digestibilities were significantly influenced ( $P < 0.05$ ) by treatments (garlic, soybean and groundnut oils). It is concluded that, the inclusion of different plant oils in the diets of Uda lambs led to a significant increase in their daily live weight gain. Groundnut oil supplementation resulted in the highest growth performance among the oils used.

**Key words:** Growth performance, Nutrient digestibility Plants oil, Uda Lamb.

### **Introduction**

Small ruminants, including goats and sheep; are a crucial component of the Nigerian agricultural economy as well as the country's food supply. With an estimated

population of 34.5 million goats and 22.1 million sheep in Nigeria, small ruminants are a significant source of animal protein for human consumption and play an essential role in bridging the gap between demand and

supply. Sheep provide meat, milk, skin fibre and manure to large number of low income, marginal farmers and landless labourers (1).

Livestock feed accounts for a significant percentage (60-70%) of the total cost of production in Nigeria, which contributes to the high cost of animal products (2). To increase the production of this livestock, it is important to consider the use of feed additives. Feed additives are supplements added to animal feed to enhance its nutritive value. Garlic has been widely studied as a feed additive in poultry diets, and has been reported to improve the productive performance of broiler chickens (3). Another promising natural alternative to antibiotics for manipulating ruminal fermentation is plant oils. These oils have the ability to modify cell permeability in microbes and are toxic to some strains of rumen microorganisms. The study was conducted using locally available dietary oils (garlic oil, Soybean oil and groundnut oil) to determine growth performance and nutrient digestibility of lambs.

## **Materials and Methods**

### **Experimental site**

The experiment was conducted at the Livestock Teaching and Research Farm, Department of Animal Science, Main Campus, Usmanu Danfodiyo University, Sokoto.. Sokoto State is situated in the North-Western region of Nigeria, between latitudes 11030' and 14000'N and longitudes 4000' and 6040'E. The state has a total land area of 32,000 km<sup>2</sup> and is located at an altitude of 350m above sea level. The region falls under the Sahel savannah vegetation zone, with a hot dry season from March to May and sometimes extending to June in the extreme northern part. The area experiences a short, cool, dry period (harmattan) between October and February, with an annual rainfall of approximately 700 mm (4).

Sources of the oils:

The soybean and groundnut oils used in the study were procured from Gerewa oil mills, while the garlic oil was extracted locally in Kano State (In an open market).

### **Experimental diets**

Dietary treatments were formulated with Treatment 1 (T1) as the control diet with no oil additive. Treatment 2 (T2) contained 30 ml/kg garlic oil, Treatment 3 (T3) had 30 ml/kg Soybean oil while 30 ml/kg groundnut oil was added in treatment 4. The gross composition of the experimental diets were Maize 14%, Soybean Meal 15%, Cowpea husk 30%, Wheat offal 25%, Rice Milling Waste 15% and salt 1%. Containing 2181 kcal/kg ME give energy of 16 % CP, 19.4% CF and 4.2% Ether Extract (Table 1).

### **Experimental animals and their management**

The study utilized sixteen (16) Uda ram lambs, which were purchased from Achida Livestock Market in Sokoto. Prior to the experiment, the lambs were dewormed with Ivermectin 5% to protect against internal and external parasites at 1ml/50kg body weight. Additionally, the lambs were given Oxytetracycline, a broad-spectrum antibiotic, at 1m/10kg body weight, and multivitamin injections at 1ml/10kg body weight for three days to reduce stress. The lambs were quarantined for two weeks before the start of the experiment, during which they were provided with groundnut haulms ad libitum. The lambs were housed in pens with wide windows to ensure proper ventilation.

### **Experimental design and feeding**

The lambs were allotted to 4 treatments; four (4) lambs were randomly allocated to each treatment in a Complete

**Table 1:** Composition of Experimental Diet Supplemented with Different types of Plant Oils

Ingredients	Treatments			
	T1 (Control)	T2 (GLO)	T3 (SBO)	T4 (GNO)
Maize	14	14	14	14
Soybean Meal	15	15	15	15
Cowpea husk	30	30	30	30
Wheat offal	25	25	25	25
Rice Milling Waste	15	15	15	15
Salt	1.0	1.0	1.0	1.0
Total	100	100	100	100
Calculated analysis				
ME Mcal/kg	2181	2181	2181	2181
Crude Protein %	16.00	16.00	16.00	16.00
Crude Fibre %	19.40	19.40	19.40	19.40
Ether extract (%)	4.20	4.20	4.20	4.20

GLO=garlic oil, SBO=Soybean oil, GNO=Groundnut oil, ME= Metabolizable Energy

Randomized Design. The lambs were housed in individual pens with adequate ventilation and balanced for weight before commencement of the experiment and weighed weekly thereafter throughout the experimental period. The experimental diets were offered at 2% of body weight while sorghum husk were fed ad libitum as basal diet. Feed intake were determined as the difference of the amounts of feed offered and the refusals. Water was offered ad libitum and the experiment lasted for 84 days (12 weeks).

#### Data Collection

##### Measurement of growth performance

The performance parameters measured are; feed intake, body weight, body weight gain and feed conversion ratio. Feed consumption from each treatment was measured on daily basis by subtracting left-over from feed served the previous day per group. Adequate

measures were taken to guard against spillage and related wastage. The mean daily feed intake per animal was taken. Lambs were weighed on weekly basis using a weighing balance to determine the body weight gain. The mean live weight of each treatment group was determined by total weight of animals divided by the total number of animals in each replicate group. The animals were fasted for 6 hours before weighing to avoid errors due to gut fill. The body weight gain of each of the treatment group was obtained by calculating the difference between the mean live weights of the current week from the mean live weight of the preceding week. Body weight gain was determined on weekly basis. This was obtained on a weekly basis. It was measured by dividing the mean feed intake per animals in grams by the mean live weight gain in grams per animal for each replicate.

$$\text{Feed conversion ratio} = \frac{\text{Mean feed intake (g)}}{\text{Mean body weight gain (g)}}$$

### Methane determination (5)

$$\text{Methane (g/d)} = 63 + 79 \times \text{CF} + 10 \times \text{NFE} + 26 \times \text{CP} - 212 \times \text{C fat (kg/d)}$$

CF= Crude fibre NFE=Nitrogen free extract  
Crude Protein C fat= Crude fat

### Digestibility trial

At the end of the feeding trial, digestibility trial was conducted using three (3) animals from each treatment. The animals were fed the same experimental diets used in the feeding trial. The digestibility trials lasted for two weeks (one week for the adaptation and one week for total faecal sample collection). Faecal collection bags were used in the sample collection. These were fitted on the first day of adaptation. During the collection period, daily feed intake and total faecal output from each animal were recorded. After thorough mixing, 5% of the faecal samples were sampled and oven dried at 60°C for dry matter determination and proximate analysis (6).

### Proximate analysis

Experimental diets and faecal samples from all the experiment were analyzed using Standard analytical methods as outlined by (7). Sample of each diets were analysed for neutral detergent fibre (NDF) with a heat stable  $\alpha$ -amylase and sodium sulphite and for acid detergent fibre (ADF) using method (7). Lignins were computed on ADF residues by solubilisation with sulphuric acid (8). Ash was determined after 2 hours of oxidation at 600°C in a muffle furnace using method (7).

### Data analysis

All data collected were subjected to Analysis of Variance (ANOVA) and where significant difference exist Duncan's

Multiple Range Tests (DMRT) was used for mean separation.

### Results

Growth performance of Uda lamb supplemented with diet containing different plant oils

Result of the growth performance of Uda lamb supplemented with different plant oils is shown in Table 2. There was significant difference ( $P < 0.05$ ) between treatment means in final weight, basal feed intake and dry matter intake as % body weight and feed conversion ratio while average weight daily gain, dry matter intake, supplement feed intake and methane were not significantly ( $P > 0.05$ ) different between the treatments groups.

Final body weight of lambs supplemented with different plant oils was significantly different ( $P < 0.05$ ) among the treatments groups. The final body weight of the animals (24.37, 25.37 and 27.50 kg) for treatment 2 diet with garlic oil 9(T2), treatment 3 diet with soybean oil (T3) and treatment 4 diet with groundnut (T4) were statistically similar ( $P > 0.05$ ), respectively. However, T4 differed significantly ( $P < 0.05$ ) from T1 control diet.

Basal feed intake (kg DM/week) of lambs fed the control diet (2.30 kg) and T3 and T4 diets were similar ( $P > 0.05$ ) but T1 significantly differed ( $P < 0.05$ ) compared to T2 (2.77 kg). Basal feed intake of lambs on T2 diet was not significantly different from T3 diet and T4 diet.

Dry matter intake as % body weight of ram-lambs supplemented with different plant oils significantly differed ( $P < 0.05$ ) among the treatments groups. Treatment 2 diets (3.33%) was higher for dry matter intake as % body weight compared to those in T1 (3.18 %) and then T3 diets (3.12 %) while the lowest intake as % body weight value was recorded in T4 diets.

Feed conversion ratio of lambs ram-lambs supplemented with different plant oils. Treatment 2 diets (30.29%) and then T3 and T4 diets (55.95 and 66.11 %), respectively. However, percentage of methane (CH<sub>4</sub>) reduction of

**Table 2:** Effects of supplementing with different plant oils on growth performance of growing lambs.

Parameters	T1 (Control)	T2 (GLO)	T3 (SBO)	T4 (GNO)	SEM
Initial weight (kg)	18.75	18.75	19.12	18.50	0.44
Final weight (kg)	23.75 <sup>b</sup>	24.37 <sup>ab</sup>	25.37 <sup>ab</sup>	27.50 <sup>a</sup>	0.61
Average daily weight gain (g/day)	59.52	66.96	66.96	77.38	7.36
Basal intake (g/day)	328.86 <sup>b</sup>	396.42 <sup>a</sup>	358.33 <sup>ab</sup>	355.05 <sup>ab</sup>	10.62
Supplement intake (g/day)	426.45	415.40	430.42	464.50	13.19
Total Dry matter intake (g/day)	755.31	811.82	788.75	819.55	18.48
Dry matter intake as %	3.18 <sup>ab</sup>	3.33 <sup>a</sup>	3.12 <sup>ab</sup>	2.97 <sup>b</sup>	0.06
Body weight					
Feed convention ratio	12.88 <sup>a</sup>	12.35 <sup>b</sup>	10.62 <sup>c</sup>	6.95 <sup>d</sup>	0.69
CH <sub>4</sub> (KJ/day)	535.50 <sup>a</sup>	373.28 <sup>b</sup>	236.16 <sup>c</sup>	181.49 <sup>d</sup>	41.27
Percentage of CH <sub>4</sub> reduction	0.00	30.29	55.95	66.11	-

SEM = Standard error of means, a,b,c,d = Means in the same row bearing different superscripts differ significantly (P<0.05); GLO=garlic oil SBO= Soybean oil GNO= Groundnut oil; CH<sub>4</sub>= methane

#### Nutrient digestibility of lambs fed different plant oils

The results of nutrient digestibility of lambs supplemented with diet containing different plant oils is presented in Table 3. There was no significant (P>0.05) difference in Dry matter (DM), Ash and Acid detergent lignin digestibilities between treatment means, while Crude protein (CP), Crude fibre (CF), Ether extract (EE), Acid detergent fibre (ADF), Neutral detergent fibre (NDF), Hemicellulose and Cellulose digestibilities were significantly influenced (P<0.05) by

treatments (garlic, soybean and groundnut oils).

The CP digestibility in T4 diet recorded the highest value of 82.80%, while T1 had the lowest value of 76.40%. The CP digestibility tended to increase in sequential order from T1 to T4 diet reflecting an increase in the level of DM in the diets. The CP digestibility values obtained in this study followed the same trend with DM digestibility. The CF digestibility increased progressively across treatment groups which ranged from 36.36 to 54.38 % for T1 to T4 respectively. The CF digestibilities of diets with oils supplementation were higher than

the control group. The EE digestibility ranged from 97.21 % to 98.21 % with T2 having the highest value and is comparable to T1 and T3 but significantly ( $P < 0.05$ ) different from T4. Treatment 4 was similar ( $P < 0.05$ ) to T1 and T3.

The ADF digestibility showed significant differences ( $P < 0.05$ ) among treatments. Lambs fed on the T1 control diet recorded the lowest value of 29.41. The NDF digestibility ranged from 42.81 % to 60.92 % for T1 control diet and T4 diet with groundnut oil respectively. Treatment T4 diet with groundnut oil recorded the highest value. It was observed that NDF digestibility was higher with oils supplementation in the diet. The Hemicellulose digestibility T4 diet with groundnut oil recorded the highest value of 71.87 % which contained groundnut oil supplementation, while T1 control diet had the lowest value of 57.06 %. The Cellulose digestibility in T4 diet with groundnut oil recorded the highest value of 63.23 % which contained groundnut oil supplementation, while T1 control diet had the lowest value of 40.32b %. The oil supplementation treatments were higher and comparably the same ( $P > 0.05$ ) among treatment groups than control treatment groups. The Cellulose digestibility values obtained in this study followed the same pattern with Hemicellulose digestibility. However, the diet supplemented with groundnut oil resulted in a lower mean total feed intake compared to other treatment groups. The nutrient digestibility is high in all treatment groups, with dry matter digestibility tending to increase with higher levels of crude protein in the diets. The study results were consistent with some previous research, but also demonstrated some differences in results that could be attributed to the types of oils used in the study. Overall, plant oils hold promise as

feed additives in ruminant nutrition to improve feed efficiency and control the spread of pathogens in livestock.

## **Discussion**

Growth performance of Uda rams fed diets containing different plant oils

The study observed that the inclusion of different oils in the diets of Uda rams led to a increase in their daily live weight gain. Among the oils used, groundnut oil supplementation resulted in the highest growth performance in comparison to all other treatments. These results are consistent with previous research conducted by (9), which showed that essential oils improve nitrogen and energy utilization in ruminant nutrition. However, (10) reported that garlic oil may lead to an increase in  $\text{NH}_3\text{-N}$  concentration in the rumen of ruminant animals. The final live weight of the lambs fed with the groundnut oil diet was the highest, which could be attributed to the higher metabolizable energy in the diet. Plant oils have the potential to serve as feed additives in ruminant nutrition, enhancing feed efficiency and controlling the spread of pathogens in livestock, as suggested by (9).

The study found that the diet supplemented with groundnut oil resulted in a lower mean total feed intake, which is contrary to the findings of (11) and (12), who reported that high crude protein levels increase feed intake. However, the results align with the research conducted by (13), who observed a negative impact on feed intake with higher doses of cinnamaldehyde and a mixture of eugenol. Similar findings were reported by (14) and (15), who observed no difference in DMI in sheep due to oil supplementation in the diet. Studies conducted by (16) and (17) reported a decrease in voluntary feed intake, even with

**Table 3:** Influence of plant oils supplementation on the nutrient digestibility in growing lambs

Parameters	T1 (Control)	T2 (GLO)	T3 (SBO)	T4 (GNO)	SEM
DM	63.49	70.94	70.39	71.00	1.49
CP	76.40 <sup>b</sup>	82.31 <sup>a</sup>	80.61 <sup>ab</sup>	82.80 <sup>a</sup>	1.04
CF	36.36 <sup>b</sup>	44.74 <sup>ab</sup>	48.05 <sup>ab</sup>	54.35 <sup>a</sup>	2.71
EE	97.86 <sup>ab</sup>	98.19 <sup>a</sup>	97.66 <sup>ab</sup>	97.21 <sup>b</sup>	0.13
ASH	79.87	82.41	82.41	81.12	0.85
ADF	29.41 <sup>b</sup>	44.73 <sup>ab</sup>	44.99 <sup>ab</sup>	52.71 <sup>a</sup>	3.28
NDF	42.81 <sup>b</sup>	53.56 <sup>ab</sup>	54.61 <sup>ab</sup>	60.92 <sup>a</sup>	2.60
ADL	49.98	61.66	61.84	61.44	2.17
HCL	57.06 <sup>b</sup>	68.68 <sup>a</sup>	70.44 <sup>a</sup>	71.87 <sup>a</sup>	2.17
Cellulose	40.32 <sup>b</sup>	55.89 <sup>a</sup>	57.00 <sup>a</sup>	63.23 <sup>a</sup>	3.10

SEM = Standard error of means, a, b = Means in the same row bearing different superscripts differ significantly ( $P < 0.05$ ); DM= Dry matter, CP= Crude protein, CF= Crude fibre, EE= Ether extract, ADF = Acid detergent fibre and NDF = Neutral detergent fibre, ADL= Acid detergent lignin, HCL=Hemicellulose, CELL= Cellulose. GLO=garlic oil SBO= Soybean oil GNO= Groundnut oil

the use of protected fats. (18) found no effect on dry matter intake with the addition of different sources and levels of lipids in Total Mixed Ratio systems. However, these findings are not consistent with the research conducted by (19), who reported that CH<sub>4</sub> production is reduced with the addition of lipids to the diet.

Nutrient digestibility of Uda rams fed diets containing plant oils

Overall, the nutrient digestibilities were found to be high in all treatment groups. As the level of crude protein in the diets increased, dry matter digestibility tended to increase as well. Improved fermentation can also have a direct impact on dry matter intake in goats, as reported by (20). These findings contradict the results of (21), who found that oil supplementation significantly reduced dry matter digestibility. Similarly, (22) reported no significant difference in the digestibility of DM, CP, CF, NDF, and ADF,

except for EE. (23) observed similar nutrient digestibilities, except for EE, which was higher in bypass fat (300 g/d) supplemented lactating cows. (24) found higher ( $P < 0.05$ ) digestibility of EE with bypass fat supplementation in calves, with no adverse effect on the digestibility of other nutrients. (25) observed that dry matter digestibility increases significantly with increasing levels of palm kernel meal in the diets of West African dwarf sheep.

In general, high nutrient digestibilities were observed across all treatment groups. Dry matter digestibility tended to increase with higher levels of crude protein in the diets. Improved fermentation also had a direct positive effect on dry matter intake by goats, as reported by (20). These findings are in contrast to the study by (21), which found that oil supplementation led to a significant reduction in dry matter digestibility. Similarly, (22) reported no

significant difference ( $P>0.05$ ) in the digestibility of DM, CP, CF, NDF, and ADF, except for EE. (23) observed similar nutrient digestibilities, except for EE, which was higher in bypass fat (300 g/d) supplemented lactating cows. (24) found that bypass fat supplementation in calves led to a higher ( $P<0.05$ ) digestibility of EE, with no adverse effect on the digestibility of other nutrients. The rumen digestibility measurements obtained in this study were consistent with DM and ADF, but not with other parameters measured (26) and (27). The differences in results may be attributed to the techniques and types of oils used in the study.

### Conclusion

In conclusion, the study found that the inclusion of different plant oils in the diets of Uda ram lambs led to a significant increase in their daily live weight gain. It is concluded from the study that, farmers should include groundnut oil at 30 ml/kg in the diets of Uda ram lambs for higher growth performance.

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