

Performance and Nutrient Digestibility of Uda rams fattened with diets containing graded levels of Groundnut oil



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Abstract

Plant oil, reduce methane emissions by reducing the number of rumen protozoa which can affect the methane producing bacteria and slow down protein turnover in the rumen as well as increasing transport of microbial nitrogen to the duodenum. The study was conducted to determine the effect of groundnut oil on the performance of growing and fattened Uda rams. Four dietary treatments; Treatment 1 was the control. Treatments 2, 3 and 4 each contained graded levels at 0, 15, 30 and 45ml/kg of groundnut oil. Data were collected on body weight, feed and nutrient intake and nutrient digestibility, the data collected were subjected to One-way analysis of variance. The results of fattened characteristics of rams showed significant differences ($P < 0.05$) in the final body weight and body weight gain. Higher mean daily live weight gain (77.38) and the estimate percentage of CH_4 reduction (66.11) in lambs fed diets containing groundnut oil. The higher mean daily live weight gain (101.19) and estimate percentage of CH_4 reduction (79.74) in fattened rams fed diets with higher groundnut oil were better compared to control. The increase inclusion of groundnut oil decreases the cost of feed per Kg. Conclusively the study showed that groundnut oil at 45 mL/kg gave better performance of fattened ram. Therefore, this study recommended the use of oils inclusion in the diet of growing and fattened rams.

Keywords: Performance, Nutrient digestibility, groundnut oil, Uda rams, Fattening



Performance et digestibilité des nutriments des béliers Uda engraisés avec des régimes contenant des niveaux progressifs d'huile d'arachide

Résumé

L'huile végétale réduit les émissions de méthane en réduisant le nombre de protozoaires du rumen qui peuvent affecter les bactéries productrices de méthane et ralentir le renouvellement des protéines dans le rumen ainsi qu'en augmentant le transport de l'azote microbien vers le duodénum. L'étude a été menée pour déterminer l'effet de l'huile d'arachide sur les performances des béliers Uda en croissance et engraisés. Quatre soins diététiques ; Le traitement 1 était le contrôle. Les traitements 2, 3 et 4 contenaient chacun des niveaux gradués de 0, 15, 30 et 45 ml/kg d'huile d'arachide. Des données ont été collectées sur le poids corporel, l'apport alimentaire et nutritif et la digestibilité des nutriments. Les données collectées ont été soumises à une analyse de variance unidirectionnelle. Les résultats des caractéristiques à l'engraissement des béliers ont montré des différences significatives ($P < 0,05$) dans le poids corporel final et le gain de poids corporel. Gain de

poids vif quotidien moyen plus élevé (77,38) et pourcentage estimé de réduction du CH₄ (66,11) chez les agneaux nourris avec des régimes contenant de l'huile d'arachide. Le gain de poids vif quotidien moyen plus élevé (101,19) et le pourcentage estimé de réduction du CH₄ (79,74) chez les béliers engraisés nourris avec un régime riche en huile d'arachide étaient meilleurs que ceux du contrôle. L'augmentation de l'inclusion d'huile d'arachide diminue le coût de l'aliment par kg. En conclusion, l'étude a montré que l'huile d'arachide à 45 mL/kg donnait de meilleures performances aux béliers engraisés. Par conséquent, cette étude a recommandé l'utilisation d'huiles dans l'alimentation des béliers en croissance et engraisés.

Mots-clés: Performance, Digestibilité des nutriments, huile d'arachide, Béliers Uda, Engraissement

Introduction

Sheep is an important source of animal protein and contributes immensely to the diversification of livestock production, thus making it an integral part of the tropical agricultural system. In Nigeria, sheep are found in all agro-ecological zones of the country. They are used for meat, milk, hair (wool), skin and as a financial reverse for the rural and peri-urban population as well as playing sociocultural roles in customs and traditions of many Nigerian societies especially in a region dominated by Muslims. Nigeria is known to have the largest sheep population in Africa (33.9 million), which constitutes about 3.1% of the 1078.2 million sheep in the world (FAOSTAT 2008), and this population may be higher today thus making sheep a major contributor to animal protein. There are four main indigenous breeds of sheep in Nigeria; West African Dwarf (WAD), Balami, Ouda (Uda as the case may be) and Yankasa sheep.

High content of Saturated Fatty Acid (SFA) in sheep products is caused by hydrolysis of lipids and the consequent biohydrogenation of the constituent Poly Unsaturated Fatty Acid (PUFA) by rumen microbes (Kim *et al.*, 2009). Plant oils have the potential to manipulate carbohydrate breakdown to reduce methane production and potentially improve performance. Methane (CH₄) is a by-product of

carbohydrate breakdown in the reticulo-rumen. Methane production is energy inefficient, wasting 2-15% of digested energy (McCrabb and Hunter, 1999). However, methane can be produced from volatile fatty acids (VFAs) and alternative sinks for hydrogen to remove hydrogen from the rumen for healthy rumen functioning. The present studies evaluate graded levels of groundnut oil in the diet of Uda sheep.

Materials and Methods

Experimental Site

The studies were carried out at the Livestock Teaching and Research Farm, Department of Animal Science, Main Campus, Usmanu Danfodiyo University, Sokoto. Sokoto State is located in North-western Nigeria between latitudes 11°30' and 14°00'N and longitudes 4°00' and 6°40'E. The state covers a total land area of 32,000 km² (Mamman *et al.*, 2000) and at an altitude of 350m above sea level (Mamman *et al.*, 2000). The State falls within the Sahel savannah vegetation zone. The hot dry spell extends from March to May and sometime to June in the extreme northern part. A short, cool, dry period (harmattan) occurs between October and February (Malami *et al.*, 2001). The annual rainfall is about 700 mm. The rainy season starts from June to early October with a peak in August, potential evapotranspiration has been

reported to be 162mm. maximum temperature of 41°C has been reported in April and minimum of 13.2°C in January (SEPP, 1996). The State is one of the largest livestock producing area in Nigeria. Among the livestock produced in the area are cattle, sheep, goats, donkey, poultry and camels.

Sources of the oils:

Soybean and groundnut oils used in this experiment were bought from Gerewa oil mills while garlic oil was extracted locally in Kano State.

Experimental animal and their management

Sixteen (16) Uda rams were used for this study. The experimental rams were from the

previous experiment. The rams were allowed to rest for 3-4 weeks before the commencement of the trial. The rams received prophylactic treatment against internal and external parasites.

Experimental diets

The gross composition of experimental diet (presented in Table 1). Graded levels of the best plant oil identified from experiment II were used at 0, 15, 30 and 45mL/kg for T1, T2, T3, and T4 respectively. The experimental rams were fed at the rate of 2% body weight while sorghum husk were used as basal diet which was fed *ad libitum*.

Table 1. Composition of Experimental Diet supplemented with graded level of groundnut oil

Ingredients (%)	T1 (Control) 0	T2 (oil) 15mL/kg	T3 (oil) 30mL/kg	T4 (oil) 45mL/kg
Maize	20	20	20	20
Soybean	10	10	10	10
Cowpea husk	28	28	28	28
Wheat offal	25	25	25	25
Rice milling waste	16	16	16	16
Common salt	1.0	1.0	1.0	1.0
Calculated ME Mcal/kg	100	100	100	100
Calculated Crude Protein %	2234	2234	2234	2234
Calculated crude Fibre %	14.2	14.2	14.2	14.2
Calculated Ether extract (%)	20	20	20	20
Calculated Ether extract (%)	4.1	4.1	4.1	4.1

ME== Metabolizable Energy

Experimental design and feeding

The animals were allotted to 4 treatments; four (4) animals were randomly allocated to each treatment. The animals were housed in individual pens with adequate ventilation. The animals were balanced for weight before commencement of the experiment and weighed weekly thereafter throughout the experimental period. An experimental diet was offered at 2% of body weight while sorghum straws were fed *ad libitum* as basal diet for a period of 84 days (12 weeks). Feed intake were determined as the difference of

the amounts of feed offered and the refusals. Water was given *ad libitum*.

Measurements of productive parameters **Productive parameters**

The performance parameters measured are; feed intake, body weight, body weight gain, feed conversion ratio and cost of feed consumed. Mortality was recorded throughout the experimental period, and post mortem examination was carried to ascertain the cause of death.

Feed consumption/intake

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 calculated by dividing the amount consumed by the number of animals in each replicate group.

Body weight

Rams 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 rams 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.

Body weight gain/week

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.

Feed Conversion Ratio

This was obtained on a weekly basis. It was measured by dividing the mean feed intake per ram in grams by the mean live weight gain in grams per ram for each replicate.

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

Methane determination

Kirchgessner *et al.* (1994) methane (g/d) = $63 + 79 \times \text{CF} + 10 \times \text{NFE} + 26 \times \text{CP} - 212 \times \text{Cfat}$ (kg/d)

Digestibility Trial

At the end of each feeding trial, digestibility trial was conducted using three rams from each treatment. The rams 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 sample were sampled and oven dried at 60°C for dry matter determination and proximate analysis (Coles *et al.*, 2005; Rubianti *et al.*, 2007).

Statistical Analysis

Data obtained from the three (3) experiments were subjected to Analysis of Variance using Completely Randomized Design and significant difference between treatment means were separated using the Duncan's Multiple Range Test at 5% level. Data on *In-vitro* Gas Production at different periods of time were in line graph chart and data on methane expressed in percentage.

$$Y_{ij} = \mu + T_i + \square_{ij}$$

Where;

Y_{ij} = observation on the i^{th} treatment of the j^{th} random error,

μ = overall mean,

T_i = fixed effect of dietary treatment,

\square_{ij} = random error

Results

Performance characteristics of fattened Uda rams on diets containing graded levels of groundnut oil

The result of the **performance characteristics** of fattened Uda ram supplemented with diet containing different level of groundnut oil are shown in Table 2. The results **showed there was significant difference** ($P < 0.05$) between treatment means in the final body weight, average daily gain and dry matter intake as % of body weight, **while total** dry matter intake, basal feed intake Supplement feed intake

and methane were not significantly (P>0.05) different among the treatments group.

The final body weight of the fattened Uda rams ranged from 29.30 to 33.00 for treatments 1 control diet and 4 diet with 45mL/kg of groundnut oil respectively. Treatment T2 diet with 15mL/kg, three diet with 30ml/kg and 4 diet with 30ml/kg of groundnut oil were similar but treatment 4 diet with 45ml/kg of groundnut oil differed significantly (P<0.05) from treatment 1 (diet without oil supplementation), however treatment 1 (diet without oil supplementation) was also similar (P>0.05) to treatments 2 diet with 15mL/kg and 3 diet with 30ml/kg. The Average daily gain of the

Uda rams for treatments 4 diet with 45mL/kg (101.19 g/day) recorded significantly (P<0.05) the highest, while lowest average daily gain was observed on treatment 1 control diet (58.82g/day). The Dry matter intake as % Body weight of Uda rams ranged from 3.19 to 3.41 % for treatment T4 diet with 45ml/kg and T1 control diet respectively. Feed conversion ratio values were 16.11, 14.94, 12.96 and 10.51 for treatment 1 control diet, 2 diet with 15ml/kg, 3 diet with 30ml/kg and 4 diet with 45ml/kg respectively. The Percentage of CH₄ reduction of Uda rams were 49.77, 67.24 and 79.74 % for treatment T2, 3 and 4 diet with 15, 30 and 45mL/kg respectively

Table 2: Effect of supplementing graded levels of groundnut oil on fattened performance Uda rams.

Parameters	T1 (Control)	T2 (15mL)	T3 (30mL)	T4 (45mL)	SEM
Initial weight (kg)	24.37	24.62	24.50	24.50	0.37
Final weight (kg)	29.30 ^b	30.50 ^{ab}	31.25 ^{ab}	33.00 ^a	0.71
Average daily gain (g/day)	58.82 ^c	69.94 ^b	80.35 ^{ab}	101.19 ^a	7.14
Basal intake (g/day)	522.50	552.50	565.00	582.50	11.93
Supplement intake (g/day)	447.50	472.5	472.50	470.00	13.32
Total Dry matter intake (g/day)	998.12	1025.00	1037.50	1052.5	20.79
Dry matter intake as % Body weight	3.41 ^{ab}	3.36 ^a	3.32 ^{ab}	3.19 ^b	0.06
Feed convention ratio (feed:gain)	16.11	14.94	12.96	10.51	0.64
CH ₄ (KJ/day)	718.16 ^a	360.76 ^b	235.29 ^c	145.49 ^d	65.67
Percentage of CH ₄ reduction	0.00	49.77	67.24	79.74	--

SEM = Standard error of means, a, b = Means in the same row bearing different superscripts differ significantly (P<0.05); CH₄= methane

Economic production of fattened rams fed diet containing graded groundnut oils

Economic production of growing lambs fed diet containing different plant oils is presented in Table 3. Cost of feed consumed were 38.66, 42.98, 45.55 and 48.51 N/day for lambs fed diets 1, 2, 3 and 4,

respectively. Cost of feed per body weight gain The increase in inclusion of groundnut oil decrease the cost of feed per Kg. it was more expensive to compound diet control diet (644.33 N/Kg) followed by diet 2 (614.00 N/Kg), diet 3 (569.38 N/Kg), and diet 4 (485.10N/Kg).

Table 3: Economic production of fattened rams fed diet containing graded levels of groundnut oil

Parameters	1	Treatments/ Diets 2	3	4
Initial body weight (kg)	24.37	24.62	24.50	24.50
Final body weight (kg)	29.30	30.50	31.25	33.00
Supplement intake (kg/day)	0.45	0.47	0.47	0.47
Basal intake (kg/day)	0.52	0.55	0.57	0.58
Cost of supplement diet (₦/kg)	62.80	68.05	73.30	78.55
Cost of basal diet (₦/kg)	20.00	20.00	20.00	20.00
Total weight gain (kg)	4.93	5.88	6.25	8.50
Total weight gain (kg/day)	0.06	0.07	0.08	0.10
supplement diet cost (₦/kg/day)	28.26	31.98	34.45	36.91
basal diet cost (₦/kg/day)	10.4	11.00	11.40	11.60
Total Feed cost (₦/kg/day)	38.66	42.98	45.55	48.51
Cost per Kg gain (₦/kg)	644.33	614.00	569.38	485.10

Key: T1= control, T2=15ml, T3= 30ml and T4= 45ml of Groundnut meal oil

* Cost per kilogram of the various ingredients used in compounding the experimental diets: Soghum husk ₦20.00, Maize ₦84.00; soya bean, ₦180.00; Wheat offal ₦60.00; Cowpea husk, ₦40.00; Rice milling waste, ₦10.00; salt, ₦20.00; Groundnut oil, ₦ 0.35 per ml,

Nutrient digestibility of fattened uda rams fed diet containing graded levels of groundnut oil

The result fattened Uda rams supplemented with diet containing graded levels of groundnut oil is presented in Table 4. **Result showed that there was no significant ($P>0.05$) difference in dry matter (DM), crude protein (CP), crude fibre (CF), acid detergent fibre (ADF), neutral detergent fibre (NDF), acid detergent lignin (ADL), hemicellulose (HCL) and cellulose (CELL) digestibility while ether extract and ash digestibility were influenced significantly ($P<0.05$) by diet with 0, 15, 30 and 45ml/kg graded levels of groundnut oil.**

The DM digestibility value were ranged from 58.03 to 70.13 %. The DM digestibility tended to increase in sequential order from T1 diet with 0ml/kg to T4 diet

with 45ml/kg reflecting an increase with oil supplementation. The highest value DM digestibility was record in diet with highest level groundnut oil inclusion. The CP digestibility of T4 diet with 45ml/kg recorded the highest value of 74.68 %, while T1 diet with 0ml/kg had the lowest value of 65.06 %. The CP digestibility values obtained in this study followed the same pattern with DM digestibility. The CF digestibility increased progressively from T1 diet with 0ml/kg to T4 diet with 45ml/kg which ranged from 43.78 to 62.80 %. The CF digestibility of diets with oils supplementation were comparably the same ($P>0.05$) among treatment groups.

The ADF digestibility, NDF digestibility and ADL digestibility ranged from 43.7 to 66.82%, 49.76 to 69.39 % and 44.40 to 71.85 % respectively. Treatment T4 diet with 45ml/kg had the highest values were

observed in ADF digestibility, NDF digestibility and ADL digestibility which increased with increasing levels of the oil supplemented in the diet. The hemicellulose digestibility in T4 diet with 45ml/kg recorded the highest value of 76.55% with 45 ml/kg of oil supplementation, while T1 diet with 0ml/kg

had the lowest value of 52.81%. The hemicellulose digestibility increase with increasing level oil supplementation. The cellulose digestibility in T4 diet with 45ml/kg recorded the highest value of 72.73% with groundnut oil supplementation, while T1 diet with 0ml/kg had the lowest value of 55.78%.

Table 4: Nutrient Digestibility of fattened Uda rams supplemented with diet containing different levels of groundnut oil

Parameters	T1 (Control)	T2 (15ml)	T3 (30ml)	T4 (45ml)	SEM
DM	58.03 ^b	65.06 ^{ab}	67.94 ^{ab}	70.13 ^a	1.87
CP	65.06 ^b	70.18 ^{ab}	74.39 ^a	74.68 ^a	1.53
CF	43.78 ^b	54.61 ^{ab}	62.43 ^a	62.80 ^a	2.83
EE	97.16	97.52	97.30	97.18	0.09
ASH	78.65	81.31	83.06	81.21	0.78
ADF	43.74 ^b	59.01 ^a	64.24 ^a	66.82 ^a	3.12
NDF	49.76 ^b	62.54 ^a	67.84 ^a	69.39 ^a	2.71
ADL	44.40 ^b	59.46 ^a	62.99 ^a	71.85 ^a	3.37
Hemicellulose	52.81 ^c	63.13 ^b	68.62 ^{ab}	76.55 ^a	2.92
Cellulose	55.78 ^d	61.15 ^c	68.02 ^b	72.73 ^a	1.99

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.

Discussion

Fattened performance of Uda rams fed diets graded levels of groundnut oil

The groundnut oils improve fattening performance since can stimulate the secretion of digestive enzymes most important to improved nutrient digestion and feed intake as reported by Salam *et al.* (2002); Lee *et al.* (2003); Jamroz *et al.* (2005). The highest live weight gain was recorded in sheep fed on the diets containing 45mL/kg groundnut oil which is the highest level of inclusion. Benchaar *et al.* (2008) reported that essential oil improved energy consumption in the animal. In this study it can be seen that increasing level oils in diet with improved growth performance of fattening rams. The final live weight of sheep fed diet with

45m/kg DM groundnut oil was highest and could probably be due to the increasing levels of energy content in the diet. Groundnut oils hold promise as feed additives in ruminant nutrition to improve feed efficiency and control the spread of pathogens in livestock (Benchaar *et al.*, 2008). The Supplementation of oils to animal diet has also resulted in increased feed efficiency (Kung *et al.*, 2008, Tassoul and Shaver, 2009).

This study showed no effect on dry matter intake with increasing levels of groundnut oil in the diet, which is in line with the finding of Benchaar *et al.* (2012) who found no effect on dry matter intake with the addition of lipids in TMR systems. Kumar *et al.* (2017) reported that the dry matter intake in Buffalo steers was not affected by

gradual increase in dietary supplementation of bypass fat in diet. Reddy *et al.* (2003) and Kumar *et al.* (2006) found no difference in DMI in sheep due to supplementation of protected fat. Purushothaman *et al.* (2008) also noted no difference in DMI of cows with gradual increase in bypass fat supplementation in the diet. Our results were in contrast with the finding of Kumar and Thakur (2007) who observed higher DMI in ruminant by addition of 2.5% bypass fat to the basal diet. Similarly, Shelke *et al.* (2012) reported that, DMI ($P < 0.05$) was improved in Buffaloes with the inclusion of bypass protein and bypass fat (2.5%) to the basal diet. The observed difference in feed intake between the present study and some previous study could be due to the different type of oils or diet ingredient used.

Nutrient digestibility of Uda rams fed diets containing plant oils

The nutrient digestibility of fattening rams fed graded levels of groundnut oil. Feed Intake is usually related to the digestibility; Faichney (1993) report that the increase in feed intake normally increases the rate of passage of the digesta through the gastrointestinal tract and reduces its digestibility. The highest average value of Dry matter digestibility, crude protein digestibility, crude fibre digestibility, Acid detergent fibre digestibility, Neutral detergent fibre digestibility, Acid detergent lignin digestibility, hemicellulose digestibility and cellulose digestibility was recorded in T₄, that is treatment with highest groundnut oil supplementation, which not in line with what Sirohi *et al.* (2010) reported that increasing levels of palm oil residue did not significantly alter the digestibility coefficients of DM, OM and CP. However, EE, NDF digestibility showed linear effect. Comparable result were reported by Thakur and Shelke (2010), who stated that no difference

($P > 0.05$) in digestibility of DM, CP, CF, NDF and ADF with exclusion of EE. Similarly, Sirohi *et al.* (2010) observed similar digestibility of nutrients except that of EE which was higher in bypass fat (300 g/d) supplemented lactating animal. This finding is in line with reports of Fraser *et al.* (2007) who observed that dry matter digestibility increases significantly as nitrogen content was increased in the diet of sheep. It has been suggested that a lower ruminal digestibility as a result of the use of oils in ruminant diets can be compensated by a higher digestibility in the lower tract (Sutton *et al.*, 1983; Faichney *et al.*, 2002). Tyagi *et al.* (2009) noted better utilization of DM and CP in lactating crossbred cows with addition of 2.5% bypass fat to the basal diet. Bateman and Jenkins, 1998; Ueda *et al.*, (2003) reported DM and ADF digestibility measured were not different significant. The differences among results can be attributed to the techniques and type of oils used in study. Fraser *et al.* (2007) stated that differences in techniques used in different trials may result in inconsistencies among studies.

Conclusion

The study on the effect on the performance of fattened Uda rams fed graded levels of the groundnut oil showed that a better was recorded in diets supplemented 45mL/kg groundnut oils. The increase in inclusion of groundnut oil decrease the cost of feed per Kg.

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