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Effect of energy graded levels on live weight and nutrient digestibility of pregnant Red Sokoto Goat

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Target Audience:

Abstract

The aims of the study were to determine the effect of energy graded levels on live weight and nutrient digestibility of pregnant red Sokoto goat. A total of twenty (20) yearlings red Sokoto does were synchronized for pregnancy using a buck. The animals were divided into four treatment groups of five (5) animals each containing four graded energy levels of 2,400, 2,200, 2,000 and 1800 kcal/kg ME in a completely randomized design (CRD). Feed and were given to the animals ad-libitum. The result revealed that 1800 to 2,400 kcal/kg ME were acceptable to pregnant does, although there were no significant differences (P>0.05) observed between treatment means in terms of final weight, average daily gain (ADG), feed intake, dry matter as percentage body weight and feed conversion ratio (FCR) despite numerical differences exist that are not statistically (P>0.05) significant. The crude fibre, either extract (EE), ash, nitrogen free extract, acid detergent fibre, lignin and energy intake of the pregnant does were significantly (P<0.05) affected by different energy levels. The use of energy graded levels on live weight and nutrient digestibility of pregnant red Sokoto goats has beneficial effect of nutrient digestibility. The present study showed that crude fibre either extract, ash, nitrogen free extract, acid detergent fibre increased significantly as the level of energy increases. This indicates that inclusion of energy graded levels increases nutrient digestibility with increases of energy. Therefore, this study recommends the use of 2400 kcal ME/Kg and 2200 Kcal ME/Kg energy level for pregnant Red Sokoto doe.

Key words:

Description of Problem

Inadequate nutrition particularly during the dry season is a major constraint in pastoral livestock production. Forages during the dry season are fibrous, low in digestible protein, energy, minerals and vitamins which do not meet goat nutrient requirement. Therefore, nutrient supplementation particularly during the dry season is one alternative to rectify energy and protein deficiencies in local feed resources (12). Energy is the major dietary element responsible for nutrient utilization, productivity, and gain (9). Many studies have reported that high dietary energy levels increase the average daily gain (ADG) of small ruminants (10, 21). Productivity of goats is fostered by the efficient utilization of nutrients which possibly with an adequate supply of energy. Energy requirements are affected by age, body size, physiological state, environmental factors, hair growth, muscular activity, and relationships with other nutrients (1). Weather conditions such as temperature, humidity, sunshine, and wind velocity may increase or decreases energy needs depending upon the region. Stress of any kind may increase energy requirement (16).

Deposition of lipids is the main form of energy storage in goats and is important in determining body condition score (BCS). When goat nannies present poor BCS, they often have low conception rates, low twinning rates and kids with low birth and weaning weights (13). Goats lose body condition with the progressive deterioration of pasture in the dry season. This condition can be improved with a sufficient level of concentrate supplementation. It is important to feed high-energy rations at the time of breeding, late gestation and lactation (19). Therefore, the aim of this study was to evaluate the effect of energy graded levels on live weight and nutrient digestibility of pregnant red sokoto goat.

Material and Methods

Experimental location

The experiment was conducted at the Teaching and Research Farm, Federal University, Dutsin-Ma, Katsina State. The State is located between latitudes 11º 02' and 13º 03' E and longitudes 6º 05' and 9º 02' N. The State bordered Kaduna State to the South, Niger Republic to the North, Zamfara State to the West and Kano and Jigawa States to the East. It covers an area of about 23,983 sq kilometers. The weather varies according to the season of the year. Maximum temperature ranges from 29º to 38ºC in the hot and dry season period (March-May). The Harmattan season is November- February with lower temperatures, which range from 18º to 27ºC. The wind is dry from January to April, signalling the arrival of the rainy season, which lasts from May to September. The mean annual rainfall ranges from 400 to 1300 mm (11).

Experimental feed preparation

All the ingredients used in formulating the experimental diets were sourced from Dutsin-Ma and Funtua. Soyabean straw and groundnut hay were chopped and packed in sacks for experimental diets compounding. Whereas cotton seed cake was ground before mixing, other feed ingredients such as wheat offal, cowpea husk, bone meal, rice milling waste and table salt were sourced locally.

Management of experimental animals and design

Twenty (20) yearling Red Sokoto Goat (does) and one Buck were used for the study. The animals were purchased from Dutsin-Ma and Batsari markets and quarantined for three weeks before the commencement of the study. The experimental animals were flushed and group fed with groundnut hay. The Animals were also administered ivermect (1ml/10kg body weight) against endo- and ecto-parasites. They were also covered with oxy-tetra-cycline long acting, broad spectrum antibiotics based on the manufacturer's recommendation (1ml/10kg liveweight). The animals were divided into four treatment groups of five animals each and balanced for body weight during the allotments. Each group of animals was assigned to one of the four experimental dietary treatments in a completely randomized design (CRD). Experimental diets were fed *ad-libitum* as complete diet daily for five months. Water and salt lick were also offered *ad-libitum*.

Experimental diet formulation

Four complete experimental diets containing graded energy levels of 2,400, 2,200, 2, 000 and 1,800 kcal/Kg ME were formulated and designated as treatments 1, 2, 3, and 4 respectively. The formulation was done using Microsoft excel (2007).

Table1: Gross composition of the experimental diets

Ingredient (%)	1(2,400)	2(2,200)	3(2,000)	4 (1,800)
Maize	16.50	5.50	0.00	0.00
W/offal	11.70	17.00	40.00	36.70
RMW	9.00	17.00	3.00	26.10
Cowpea husk	6.80	6.80	15.00	16.50
CSC	28.00	26.70	15.00	0.00
Soya bean straw	25.00	25.00	25.00	6.00
Soya bean meal	0.00	0.00	0.00	9.70
Bone meal	1.00	1.00	1.00	4.00
Salt	1.00	1.00	1.00	1.00
Total	100	100	100	100

W/offal=wheat offal, RMW=rice milling waste, CSC=cotton seed cake, CP=Crude Protein, CF=Crude Fibre

Data collection

The animals were weighed prior to the commencement of the experiment and at two weeks intervals throughout the gestation period. Weighing was carried out between 8:00hr am and 9:00hr after an overnight fasting using top glass 150kg gauge digital scale. Daily feed intake of the animals was determined by difference between the weighed of feed given and the leftover the following morning throughout the period. Feed conversion ratio and average daily intake and weight gain were calculated.

Chemical analysis

Thoroughly mixed representative samples of the four experimental diets and faecal samples were analyzed for proximate composition as outlined by (3). Acid detergent Fibre (ADF) and neutral detergent Fibre (NDF) were determined using Vansoest procedure. Feed and nutrients apparent digestibility co-efficient was calculated as outlined. Samples of the four experimental diets were analyzed for proximate composition as outlined by (3). Acid detergent Fibre (ADF) and neutral detergent Fibre (NDF) were determined using (14) Feed and nutrients digestibility was calculated as outlined by (14).

Statistical analysis

Data obtained from the trials were managed in the Microsoft excel (2007) and analyzed using ANOVA (general linear model of statistical analysis system (20) Honest Significance Difference (HSD) was used to separate the means. Data obtained from the two trials were managed in the Microsoft excel and analyzed using the CRD general linear model in statistical analysis system (20) Honest Significance Difference (HSD) was used to separate the means.

Result

Chemical composition of experimental diets

Results of the proximate composition of the experimental diets are shown in table 2. From the table it could be deduced that diet 2 has the highest dry matter (94.08%) with diet 3 having the lowest (93.11%) value. Crude Protein (CP) content was higher in diet 4 (15.88%) and lower in diets 1 and 3 (15.01%). The highest value of Ether Extract (EE) was obtained in diet 3 (5.03%) and the lowest was recorded in diet 1 (4.02). The Crude Fibre (CF) content was highest in diet 3 (28.68%), followed by 28.48% and 28.37% in treatments 1 and 2 respectively, while the lowest (28.08%) value was in treatment 4. The highest value of Ash content was in treatment 2 (10.17%) and the lowest value was obtained in treatment 1 (8.41%). Nitrogen free-Extract (NFE) was lower in

diet 4 (25.55%) and higher in diet 1 (44.07%).

Fibre fractions of the experimental diets were also indicated in table 2. Treatment 1 had the highest value of Acid Detergent Fibre (ADF) (29.17%) whereas Treatment 2 recorded the lowest value (18.66). The Neutral Detergent Fibre (NDF) recorded the highest value in diet 1(42.87%) followed by 41.94% and 29.77% for treatments 3 and 2 respectively, the lowest value was however recorded in treatment 4 (36.78%). Similarly, diet 1 had the highest lignin value (12.35%) followed by diet 2 (11.67%), the lowest value was recorded in diet 4 (8.59).

Table 2: Proximate composition of the experimental diets containing graded energy levels fed to Red sokoto goats

Nutrients (%)	Treatments (Energy levels, kcal ME/ Kg)			
	1 (2,400)	2 (2,200)	3 (2,000)	4 (1,800)
DM	94.04	94.08	93.11	93.67
CP	15.01	15.46	15.01	15.88
CF	28.48	28.37	28.67	28.08
EE	4.02	4.15	5.03	4.28
NFE	44.07	37.90	30.82	25.55
Ash	8.41	10.17	8.57	9.21
ADF	29.17	18.66	22.10	20.03
(NDF	42.87	39.77	41.94	36.78
Lignin	12.35	11.67	9.87	8.59
Energy (ME Kcal/Kg)	2434	2241	2042	1828

DM=Dry matter, CP=Crude Protein, CF=Crude Fibre, EE=Ether Extract, NFE=Nitrogen Free Extract, ADF=Acid Detergent Fibre, NDF=Nitrogen Detergent Fibre

Performance of pregnant does fed diet containing different energy levels

Results from Table 3 indicated the performance of pregnant Sokoto red does fed diets containing different energy levels. It could be observed from the table that no significant differences (P>0.05) were observed between treatments means in terms of final weight, Average daily gain (ADG), feed intake, dry matter as % body weight and feed conversion ratio (FCR). The average daily gain (ADG) was numerically higher in treatment 2200kcal/kg ME (75.50g/day) and lowers in diet 1800kcal/kg ME (70.83g/day). Mean feed intake (FI) numerically decreased from 952g/day in treatment 2000kcal/kg ME to 883g/day in diet 2200kcal/kg ME. Though feed to gain ratio did not differ significantly (P>0.05) between all the treatments, but highest mean was obtained in diet 1800kcal/kg ME (13.70) and the least is in treatment 2200kcal/kg ME (11.99). Similarly, diet 2400kcal/kg ME had the highest value (666.27N/Kg) for the cost of feed per kilogram live weight whereas diet 1800kcal/kg ME recorded the least value of 553.86N/Kg. Treatment 2000kcal/kg ME had the highest value (3.13%) of dry matter intake as percentage body weight followed by diet 1800kcal/kg ME (3.06%) while diet 2200kcal/kg ME recorded the lowest value (2.92).

Table 3: Performance of pregnant does fed diets containing different energy levels.

Parameters	Treatments (Energy levels, kcal ME/ kg)				
	1 (2400)	2 (2200)	3(2000)	4 (1800)	SEM
Initial weight (kg)	21.60	21.40	21.36	21.36	1.15
Final weight (kg)	30.50	30.30	30.38	29.88	1.32
Average daily gain (g/day)	74.17	75.50	75.17	70.83	6.83
Average feed intake (g/d)	894.00	883.00	952.00	912.00	46.89
DM Intake (g/d)	840.75	830.76	886.41	854.27	44.02
DM intake as % body weight	2.93	2.92	3.13	3.06	0.08
Feed conversion ratio	12.12	11.99	12.90	13.70	1.15
Cost of feed consumed (N/d)	49.14	40.78	43.27	42.46	-
Cost of Feed per Kg live gain	666.27	638.06	579.96	553.86	-

DM= Dry matter

However, cost of feed consumed (CFI) indicated numerically higher value in diet 2400kcal/kg ME (49.14 N/day), followed by treatments 1800kcal/kg ME and 2000kcal/kg ME with 42.46 N/day and 43.27 N/day, respectively. Treatments 2200kcal/kg ME recorded the lowest value (40.78N/day). The cost of feed per kilogram live weight gain increased as the energy level increased with the highest values (666.27N/kg) in diet containing 2,400Kcal/kg ME and the least is in the containing 1,800Kcal/Kg ME.

Nutrient intake of pregnant does fed diets containing different energy levels

The results in table 4 showed that the dry matter and crude protein intake of the pregnant does fed different energy levels were similar (P>0.05) amongst the treatment means. The crude fibre, ether extract, ash, nitrogen free extract, acid detergent fibre, lignin and energy intake of the does were significantly (P<0.05) affected by the different energy levels. Pregnant does fed lower energy (1,800 and 2,000 ME kcal/kg) had higher (P<0.05) crude Fibre intake compared to those fed 2,200 and 2,400 ME kcal/kg. Contrary, ether extract intake was statistically higher (P<0.05) for pregnant does fed 2,200 and 2,400 ME kcal/kg compared to those fed 1,800 and 2000 ME kcal/kg. Ash intake of does fed 2,400 and 2,000 ME kcal/kg were statistically similar (P>0.05) but higher (P<0.05) than the intake of does fed 1,800 ME kcal/kg. Pregnant does fed 2,200 ME kcal/kg had similar (P>0.05) ash intake with those fed 1,800, 2000and 2,400 ME kcal/kg. NFE intake of pregnant does fed 2400 ME kcal/kg was significantly higher than that of does fed 2,200 ME kcal/kg.

Does fed 1,800 ME kcal/kg and 2,000 ME kcal/kg had similar (P>0.05) NFE intake which were similar to those of does fed 2,200 and 2,400 ME kcal/kg. ADF intake of pregnant does fed 1,800ME kcal/kg was higher (P<0.05) than those fed 2,000, 2,200and 2,400 ME kcal/kg, while the ADF intake of does fed 2,000ME kcal/kg was higher (P<0.05) than those fed 2,200 ME kcal/kg. Pregnant does fed 1,800 ME kcal/kg had lower (P<0.05) lignin intake than those fed 2,200 and 2,400 kcal/kg ME, while those fed 2,000ME kcal/kg had similar (P>0.05). Energy intake of pregnant does fed 2,400 ME kcal/kg was statistically higher (P<0.05) than those fed 2,200 and 2,000 and 1,800 Kcal/kg ME. However, Pregnant does fed 2,000 and 2,200ME kcal/kg had similar (P>0.05) energy intake.

Table 4: Nutrient intake of pregnant does fed diets containing different energy levels

Nutrient intake (g/d)	Treatments (Energy levels, kcal ME/ kg)				
	1 (2400)	2 (2200)	3(2000)	4 (1800)	SEM
DM intake	840.75	830.76	886.41	854.27	44.02
Crude protein	158	136	143	145	12.49
Crude fiber	254.55^{a}	285.33^{a}	387.18^{b}	411.13^{b}	16.46
Ether extract	35.99^{b}	36.66^{b}	47.87^{a}	39.04^{b}	1.99
Ash	75.15^{b}	89.83^{a}	81.59^{ab}	83.99^{a}	4.44
Nitrogen free extract	383.32^{ab}	351.18^{ab}	399.27^{a}	331.43^{b}	18.93
Acid detergent fiber	260.79^{a}	164.77^{c}	210.39^{b}	182.67^{bc}	10.32
Neutral detergent fiber	383.32	357.18	399.27	331.47	18.93
Lignin	110.43^{a}	103.06^{ab}	93.96^{b}	78.34^{b}	5.22
Energy (kcal/kg ME)	22678^{a}	19794^{b}	19443^{bc}	16679^{c}	949.61

a, b, c Means in the same row with different superscripts are significantly different ($P<0.05$)

Discussion

Chemical composition of the experimental diets containing graded energy levels fed to Red sokoto goats

Results of the proximate composition indicated no significant variation amongst all the treatment groups for all the parameters investigated. However, diet 2 was found to have the highest dry matter (94.08%) content with diet 3 recorded the lowest (93.11%) value. Crude Protein (CP) content was higher in diet 4 (15.88%) and lower in diets 1 and 3 (15.01%). The CP contents were within the range (15-18%) recommended by ARC (5) for growing sheep and goats. Similarly, Aduku (2) recommended similar values for the same animals. The CP values recorded were slightly lower than the (16.15-16.23%) values reported by Garba et al (8) when a complete diet containing combination of rice milling waste and soya bean meal residue was fed to Yankasa ram lambs in the semi-arid Nigeria. However, the experimental diets used in this study met the protein requirement of both lactating and growing Red sokoto goats (2). The highest value of ether extract (EE) was obtained in diet 3 (5.03%) and the lowest was recorded in diet 1 (4.02). These values met the minimum EE requirements of lactating and growing red sokoto goats and can be favourably compared with the values (5.92-7.63%) reported by (17) when rice milling waste replaced wheat offal in the diets of Kano Brown goat. The crude fibre content was higher in diet 3 (28.68%) and the lowest (28.08%) value was obtained in treatment 4. The range of values recorded in the present study met the minimum requirement recommended for ruminant animals by (6). Similarly, the values of 28.08-28.67% were lower than the values of 32-37% reported by (17), this can be associated to the choice of ingredients used in formulating the diets. The NFE values reported in this study increased with increasing energy levels. This agreed with the report of (15) when different energy levels were used to evaluate the performance of growing Uda lambs. The fibre fractions (NDF and lignin) values were numerically lower in treatment 4, this could be associated to the inclusion of soyabean meal which is known to have a very low fibre content.

Performance of pregnant Red sokoto does fed diet containing graded energy levels

Results from the present study indicated the performance of pregnant red Sokoto doe fed diets containing different energy levels. The energy levels evaluated were comparable, this implied that the use of

1,800kca/kg ME to 2,400Kcal/kg ME were acceptable to pregnant does. Furthermore, it perhaps confirmed that animals consumed to satisfy their energy requirements as earlier reported by (14). Moreover, when animals could not meet their energy needs from any giving diet, there is the tendency to fall back to protein consumed or body reserved protein in a process referred to as gluconeogenesis to satisfy their energy needs. In the present study the energy and protein requirements of the animals were met.

The animals, therefore did not have any challenges of reproductive failure, high mortality or susceptibility to diseases which according to (6, 18) that inadequate energy in the diet of pregnant goats lead to the reduced production, reproductive failure, high mortality, and susceptibility to diseases and parasites. However, findings from this study revealed that pregnant Red Sokoto doe gained weight during experimental period which could be partly associated to the weight of foetuses in their womb and the quality of diets fed to the does throughout the gestation period. The DMI expressed as per cent body weight values generally indicated that the animals on various diets showed consumption of more than 2.5% of their body weight. It was recommended (7) daily DM requirement for meat type goats in the tropics as 3%. The performance variables of pregnant does due to energy levels were all comparable amongst all the treatments even though no definite trend was established. There was however an increasing trend from 1,800kcal/kg ME to 2,000kcal/kg ME declined thereafter and increased.

The average daily gain (ADG) was numerically higher in the group of Red Sokoto goats fed with 2,200 Kcal/kg ME (75.50g/day) and was lower in treatment group fed 1,800 Kcal/kg ME (70.83g/day); these values were favourably compared with the findings of (4) on performance of Red Sokoto Goats and (6) on the general performance of pregnant goats. Mean feed intake (FI) numerically decreased from 952g/day in the treatment group fed 2,000 Kcal/ ME to 883g/day in the treatment group fed 2,200kcal/kg. The fluctuations on feed intake obtained in this study might be associated to the variation in the diurnal temperature during the experimental period as the experiment was conducted in April to September. The results indicated that as the level of energy decreases in the diet from 2400 to 1800kcal/kg ME the cost of feed per Kg live weight gain also decreases from N666.27k to N553.86k. When ADG is considered in combination with cost of feed/KgLWG as determinants of production, it reveals clearly that increased energy level from 1800kcal to 2000kcal was beneficial with resultant increment of 6.1% (4.34g/h/d) with corresponding increase in cost of feed/kgLWG of 4% (N26.1/kg LWG). Increasing the energy levels to 2200kcal/kl resulted an increase the live weight gain by 0.4% (0.33gk/d) with correspond increase in cost/kg gain by 10% (N58.1/kg LWG). This led to recommending 2000kcalME/kg to pregnant does, since their performance was superior and more economical.

Nutrient intake of pregnant does fed graded levels of energy diet revealed that as the energy level increased from 1800 ME (kcal/kg) to 2400 ME (kcal/kg), intake of lignin and energy increased while that of CF declines steadily. Intake of EE was higher at 2000 ME (kcal/ME) of energy offered. Intake of ash NFE ADF and NDF all increased with increase in energy level up to 200 ME (kcal/kg) declined and tended to increase but not beyond treatment 2000kcalME/kg diet.

Conclusion and Applications

1. The present study showed that crude fibre either extract, ash, nitrogen free extract, acid detergent fibre increased significantly as the level of energy increases.
2. This indicates that inclusion of energy graded levels increases nutrient digestibility with increases of energy.
3. The use of 2400 kcal ME/Kg and 2200 ME (Kcal/Kg) energy level is recommended for pregnant Red Sokoto does.

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