

Effect of diets containing different nutrient density on performance and faecal egg count of West African Dwarf rams

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Abstract

A study was conducted to determine the effect of different nutrient densities on performance characteristics and faecal egg count of West African Dwarf (WAD) rams semi-intensively managed. Twenty four yearling lambs between 10 – 15kg were used for the experiment. The lambs were allotted to two treatment groups containing 12 animals per group. They were released into the paddock containing sown pasture to graze for 6 hours per day. The animals were randomly assigned to treatments containing two levels of protein-energy density; low energy, low protein (LELP) and high energy, high protein (HEHP) in a completely randomized design. Performance characteristics of WAD rams showed that protein and energy density have significant effect ($P < 0.05$) on weight gain, daily weight gain and protein intake. Metabolic weight gain was influenced ($P < 0.05$) positively by the protein and energy density. Animals fed HEHP diets had significantly ($P < 0.05$) higher protein intake (54.66 g) than those fed LELP diets (22.92 g). The slope observed for animals on HEHP diet was lower compared to that of their counterpart on LELP diet. Hence, HEHP diets improved performance of West African Dwarf sheep as well as reducing the gastrointestinal parasite infection due to lower FEC recorded.

Keywords: Nutrient densities, performance, faecal egg count

Introduction

A serious constraint on small ruminant production in Africa has been the high prevalence of diseases and parasites, particularly in the more humid areas. This causes high mortality amongst kids and lambs, diminishing the benefits of their high reproductive performance. Up till now, these parasitic diseases were mainly controlled by the repeated use of anthelmintic treatments in order to prevent and/or to cure infections.

However, anthelmintic resistances in nematode populations is now a worldwide phenomenon, in constant expansion (Jackson and Coop, 2000) and the presence of resistant worm populations in sheep and goat farms severely limit the efficiency of control based on chemical treatments (Van Wyck *et al.*, 1997). The concern of consumers on the use of chemicals in farm industry is increasing, including in regard of methods for the control of diseases. The interactions between nematode

infections and host nutrition refer to two related aspects. The main pathophysiological consequences of parasites affect the host digestive physiology. The presence of the different nematode species in the various parts of the digestive tract is usually associated with: (i) a decrease in food consumption; (ii) a malabsorption/maldigestion syndrome; and (iii) changes in the host metabolism in order to maintain tissue and blood homeostasis (Hoste *et al.*, 1997). Conversely, more recent studies have brought evidence showing that manipulation of the host nutrition could represent an option to improve the host resistance and or resilience to parasites. Most of the studies have been performed in sheep. In addition, because nematode parasites mainly affect the host protein metabolism and because the protein part of the diet is usually the main limiting factor, the bulk of the studies has been dedicated to investigation on the benefits associated

with manipulation of diet protein components (Van Houtert and Sykes, 1996; Coop and Kyriazakis, 1999, Hoste *et al.*, 2001). A general model framework has even been proposed which allows and explaining most of the results, acquired from the previous studies, according to a scale of priorities expressed by the animal, depending on its reproduction and its immunological status of nematode parasitism (Coop and Kyriazakis, 1999). The few results acquired in goats also fit with this framework (Hoste *et al.*, 2001). In addition, some results suggest that in situation where energy represents the main limiting nutritional factor, manipulation of the energy component of the diet could also lead to major improvement of the host response to infections (Torres-Acosta, 2003).

These reasons explain the growing interest for alternative method to chemotherapy aiming at controlling nematode parasitism of the digestive tract in small ruminants but compatible with the concept of sustainable agriculture.

Materials and Methods

Experimental site

The experiment was carried out at the Small Ruminants Unit of the Teaching and Research Farm, University of Agriculture, Abeokuta, Ogun State. The site is located in the rain forest vegetation zone of South-Western Nigeria on Latitude 7° 13' 49.46" N, longitude 3° 26' 11.98"E and altitude 76m above the sea level. The climate is humid with a mean annual rainfall of 1037mm and mean temperature and humidity of 34.7°C and 83%, respectively.

Preparation of Experimental diets

Cassava peels was purchased from Gari processing industry (some kilometers to the experimental site) and sun dried for three days. Wheat offal, palm kernel cake (PKC),

bone meal, oyster shell, and salt were obtained from UNAAB Leventis Agroservice, Kotopo, Abeokuta, Ogun state. The ingredients were ground and mixed together to form concentrate supplement containing different protein and energy densities (Table 1)

Experimental Animals and Management

Twenty four growing West African Dwarf rams were used for the experiment. The rams were purchased from villages around Abeokuta and Ibadan. The sheep were between 12 - 15 months old. They were housed individually in an experimental pen with aluminum roofing sheet and slatted floor with raised floor. The rams were allotted to two treatment groups containing 12 animals per group. They were released into the paddock containing sown pasture to graze for 6 hours per day. The animals were randomly assigned to treatments containing two levels of

protein-energy density; low energy, low protein (LELP) and high energy, high protein (HEHP) in a completely randomized design.

Data Collection and Analysis

Chemical Analysis

The chemical composition of feed sample was carried out to determine the moisture, ash, fat, crude fibre, protein, carbohydrate and mineral content. The moisture content was determined by drying in an oven at 100°C until constant weigh was obtained, ash by incineration in a muffle furnace at 550°C for 48 h, Proteins by nitrogen determination using the Kjeldahl method and conversion of nitrogen to proteins by the factor 6.25. Fat was by Bligh dyer technique, crude fibers by successive digestion of the defatted sample with 0.26 N sulphuric acid and 0.23 N potassium hydroxide solutions. Nitrogen free extract

Table 1: Ingredient composition (%).

Ingredient	LELP	HEHP
Cassava peel	65.00	14.00
Wheat offal	33.00	36.00
PKC	00.00	48.00
Bone meal	1.00	1.00
Oyster meal	0.50	0.50
Salt	0.50	0.50
Total	100.00	100.00
Calculated Analysis		
Crude Protein (%)	8.40	12.02
Metabolizable energy (MJ/kg)	7.23	15.34

LELP – Low energy, low protein

HEHP – High energy, high protein

was calculated using the formula: 100 - percentage of ash + percentage of moisture + percentage of fat + percentage of protein) AOAC, (2000)

Weight changes and feed intake

Weight changes were measured by weighing the sheep at the beginning of the experiment and at 7-day interval throughout the experimental period. Daily feed intake was measured by subtracting the feed refusal from the feed supplied.

Feed Conversion Ratio:- Calculated thus:

FCR = Average feed intake/Average body weight gain

Parasite egg count

Sample of faeces were collected directly from the rectum of all experimental animals at the commencement of the experiment to

determine the faecal egg count (FEC) as a measure of initial parasite infestation. Thereafter, the faecal samples were collected seven days interval (within each month) throughout the 3 months of the experiment to determine the level of their gastrointestinal parasite burden. The faecal samples were taken to the Veterinary Microbiology and Parasitology Laboratory, University of Agriculture, Abeokuta, for the determination of FEC: eggs per gram of faeces. The faecal samples collected were treated according to a modified Wisconsin salt floatation techniques as described by Jordan *et al.* (1988).

Results

The results of performance characteristics of West African dwarf sheep are presented in Table 2. Protein and energy densities had

Nutrient density on performance and faecal egg count of rams

significant effects ($p < 0.05$) on weight gain, daily weight gain and protein intake. Animals on HEHP diet had higher values for weight gain (4.02kg) and daily weight gain (46.21g) than their counterparts on LELP diet. When the weight gain and daily weight gain were expressed in terms of metabolic weight, the daily weight gain was influenced ($P < 0.05$) by the protein and energy densities while the weight gain (kg) was not influenced by the nutrient densities.

The initial weight, final weight, feed conversion ratio, dry matter intake and feed intake were not influenced ($P < 0.05$) by protein and energy densities. The nutrient densities also had a significant effect ($P < 0.05$) on the protein intake with the animals on HEHP having higher protein intake (54.66g) when compared with animals on LELP diets.

The effect of the nutrient density on faecal egg count is presented in Fig 1. The range of

Table 2: Effect of protein and energy densities on the performance characteristics of West African Dwarf sheep

PARAMETERS	HEHP	LELP	SEM	P
Initial Weight (kg)	10.53	10.47	1.54	0.97
Final Weight (kg)	14.55	12.82	2.39	0.54
Weight gain (kg)	4.02 ^a	2.35 ^b	0.96	0.03
Weight gain (kgBW ^{0.75})	2.84	1.90	0.59	0.07
Weight gain (gday ⁻¹)	46.21 ^a	27.01 ^b	10.70	0.03
Weight gain(gday ⁻¹ BW ^{0.75})	17.72 ^a	11.85 ^b	3.60	0.07
Feed Conversion Ratio	6.71	10.17	5.03	0.94
Dry Matter Intake (g)	310.04	274.78	46.40	0.52
Dry Matter Intake (gBW ^{0.75})	71.53	65.78	9.84	0.62
Protein Intake(g)	54.66 ^a	22.92 ^b	6.92	0.00

^{a,b} means in the same row with different superscripts differ significantly ($p < 0.05$).

SEM:- Standard error of means

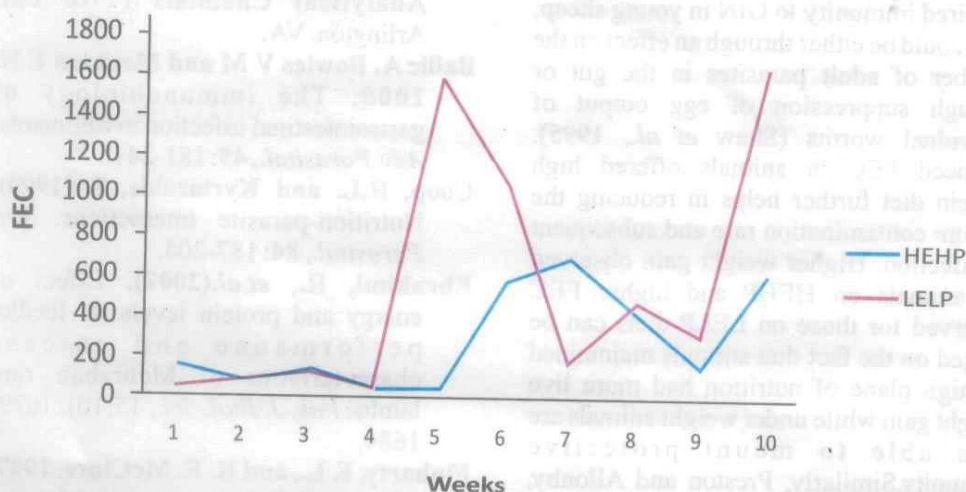
the FEC of animals on HEHP diet was between 176 – 700 throughout the experiment while that of animals on LELP diet range from 44 – 1633. The slope of the FEC of animal receiving HEHP diet was slightly higher from week 1 – 4 than those receiving LELP diet. From week 4 the slope of FEC of animal fed LELP started increasing till the 5th week then later dropped by week 7. The slope later rose gradually from week 8 – 10. At this point the slope observed for animals on HEHP

diet was lower compared to that of their counterpart on LELP diet.

Discussion

The results of the performance characteristics of the experimental animals revealed that HEHP diet enhanced better performance of West African Dwarf sheep through increased weight gain and daily weight gain. This result agrees with those of Fluharty and McClure (1997), Hinds *et al.* (1965), and Hudson *et al.* (1967) who found increase in ADG and final

Fig 1: Trends in faecal egg count reduction as affected by the nutrient density



weight in growing lambs fed above the recommended NRC protein requirement. Similarly, Norberto (2007) reported greater performance of ewes fed grain ration of about 17%CP. Abdel-Baset (2009) in a similar study on effect of dietary energy levels on the performance and nutrient digestibility of lambs reported higher weight gain in lambs fed high-energy diet. It also agreed

with those reported by Hossain *et al.* (2003) and Yagoub and Babiker (2008).

Increasing the energy level may allow the production of more fermentable Metabolizable Energy for rumen microorganisms resulting in a rise in the synthesis of microbial protein and in the amount of protein available to the animal. By balancing the availability of protein and energy, rumen function is improved and availability of microbial protein for intestinal digestion is increased (Leng, 1991). Related studies (McDonald, 1996 and Ebrahimi *et al.*, 2007) showed that

concentrates with high protein promoted rapid growth. Lower protein intake as observed for animals on LELP diet can be related to the poor quality of the diet. In ruminants resistance to both infective larvae and adult nematodes has been associated with the development of acquired immunity (Balic *et al.*, 2000) and expressed by increasing host ability to reject incoming larvae through reduced FEC, to depress worm fecundity and to expel adult worms. The results obtained corroborate the work of Knox, 2000 who revealed that increased dietary intake of metabolizable protein and energy and high quality pasture can directly promote the host resistance and host resilience to worm infection. Also, a number of studies indicated that protein supplementation appears to be most effective in enhancing particular immune response associated with latter stages in the acquisition of host resistance (van Houtert *et al.*, 1995). Supplementation with a protein rich

concentrate like cotton seed meal, urea etc. has a major impact on the development of acquired immunity to GIN in young sheep. This could be either through an effect on the number of adult parasites in the gut or through suppression of egg output of individual worms (Shaw *et al.*, 1995). Reduced FEC in animals offered high protein diet further helps in reducing the pasture contamination rate and subsequent re-infection. Higher weight gain observed for animals on HEHP and higher FEC observed for those on LELP diets can be hinged on the fact that animals maintained on high plane of nutrition had more live weight gain while under weight animals are less able to mount protective immunity. Similarly, Preston and Allonby, 1978 observed higher FEC and greater clinical severity of *Haemonchosis* in sheep on low protein diet compared to high protein diet.

Conclusion

HEHP diets improved the performance of West African Dwarf sheep, their resistance and resilience to gastrointestinal nematode infection.

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