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Effect of diets with different protein-energy density on the gastrointestinal nematode status of semi- intensively managed West African dwarf sheep

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Target Audience: Animal Scientists, policy makers, Small Ruminant researchers

Abstract

This study was conducted to determine the effect of different protein and energy density diets on the gastrointestinal parasite status of semi-intensively raised West African Dwarf (WAD) sheep. The different densities used were low energy-low protein (LELP); low energy-high protein (LEHP); high energy-low protein (HELP) and high energy-high protein (HEHP). Twenty four WAD sheep with an average weight of 11.5±0.41 kg, aged between 5 and 6 months were used. These were divided into four groups of six animals per group in a completely randomized design. Groups were each fed one of the diets, respectively, as supplement and released into a paddock grown with Stylosanthes hamata and Pennisetum pedicellatum, to graze for 12 weeks at 5 hours per day. The faecal egg count (FEC) ranged from 375 to 3483 eggs per gram (epg). The strongyle eggs had the highest (P<0.05) number whereas moniezia eggs were the least. The effect of the different protein-energy densities on the final FEC and the differences between the final and initial FEC were significant (P<0.05). The FEC obtained in animals fed LELP and LEHP showed 56.30 and 13.30 percentage reduction (P<0.05) in epg, respectively, whereas animals fed HELP showed percentage increase (P<0.05) of 104.30 epg. The highest trend (P<0.05) of infestation was obtained in those fed LELP while the least trend was obtained in those fed HEHP. It could therefore be concluded that diets high in protein and energy levels reduced the gastrointestinal nematodes of WAD sheep compared to other nutrient combinations.

Keywords: Gastrointestinal nematode, Nutrient density, WAD sheep

Description of Problem

Helminths are major cause of mortality and sub-optional productivity of sheep in traditional farming system. Parasitic nematodes of the digestive tract are one of the main constraints to small ruminant production worldwide (1, 2, 3). They render animals more susceptible to other infections. The maintenance of host resistance to helminthiasis is more sensitive to protein supply than to energy supply within a range of nutritional conditions which would be anticipated for well managed sheep in practice (4). Gastrointestinal nematodes are conventionally controlled by repeated use of anthelmintics, which is now strongly questioned because of the increasing development of resistance of the parasites to these compounds (1, 3, 5) and mis-use of chemotherapeutic approach (6). However, occurrence of resistance to anthelmintics is now a worldwide phenomenon (7, 8 and 9). Grazing management and biological control are two non-chemical method of parasite control that have proved to be effective (3). Among the alternative method to anthelmintics currently available, the manipulation of host nutrition to improve the host resistance and/or resilience to parasite infestation seems to represent one of the most promising options (1, 2, 10, 11, 12 and 13). So, sheep that are well nourished will grow and reproduce faster and are better able to withstand the effects of worm infestation than those on low plane of nutrition (2). Also, the relative unimportance of energy and the dominant effect of protein supply have been partly researched on development of resistance to infection (14), which has generated an argument on whether the control of helminthes in livestock is more sensitive to protein than energy. Therefore, the aim of this study is to investigate the effect of protein-energy densities on gastro-intestinal parasite status of semi-intensively raised sheep.

Materials and Method

Study area

The experiment was carried out at the Small Ruminant Experimental Unit of the Teaching and Research Farm of the College of Animal Science and Livestock Production, Federal University of Agriculture, Abeokuta (FUNAAB), Ogun State, Nigeria. The site is located in the rain forest vegetation zone of South-Western Nigeria at latitude 7^0 13″, 49.46″N; longitude 3^0 26″ , 11^o 98″E and altitude of 76m above the sea level. The climate is humid with a mean annual rainfall of 1037mm; and the annual mean temperature and humidity of 34.7°C and 82%, respectively.

Experimental animals and management

Twenty-four growing West African Dwarf sheep aged 5 to 6 months were used for the experiment. The animals were obtained from the Small Ruminant Experimental Unit of the Teaching and Research Farm of the University. The sheep were weighed at the beginning of the experiment. The animals were housed in individual pens in an open- sided house with corrugated aluminum roofing sheet and slatted floor. All the animals were initially treated against external parasite by dipping with Astuntol® powder solution (3g/L of water) during the period of acclimatization which lasted for two weeks (14 days). The experimental pens were properly cleaned and disinfected with Morigad® and Diazintol® solutions. The animals were fed at 3% of their body weight. Water was provided *ad-libitum.* The experimental animals were reared on semi-intensive management. They were released into a paddock grown with *Stylosanthes hamata* and *Pennisetum pedicellatum* to graze for 5 hours daily. Concentrate supplement containing different protein and energy densities were provided (Table 1) in the evening after grazing. Cassava peels were purchased from gari processing factory at Camp (some kilometers to the experimental site) and sun-cured. Wheat offal, palm kernel cake, bone meal, oyster shell, and salt were obtained from FUNAAB Leventis Agro- service, Kotopo, Abeokuta, Ogun state.

Experimental design

The twenty-four (24) experimental animals were grouped into four containing six (6) animals per group balanced for weight and parasite status in which each animal was an experimental unit. The sheep were assigned in a completely randomized design. The animals were solely kept under semi-intensive management system and alloted to diets containing varied levels of protein-energy densities (Tables 1). The amount of feeds offered was calculated on individual basis. There was an adjustment weekly after weighing the animals, just to ensure 3% of the body weight of the animal as feed offered. The initial faecal egg counts of the animals were determined and distribution of the animals into treatment groups was based on this.

Parasite egg count

Individual samples of faeces were taken from the rectum of the animals at the commencement of the experiment to determine the pre-trial parasite load. The faecal samples were collected fortnightly throughout the period of the experiment to determine the level of gastrointestinal parasite burden. The faecal samples were taken to the Veterinary Microbiology and Parasitology Laboratory of the Federal University of Agriculture, Abeokuta for determination of Faecal Egg Counts (FECs) in eggs per gram (epg) of faeces. The faecal samples collected were treated according to a modified McMaster techniques using saturated solution of Sodium chloride at a sensitivity of 50 epg of faeces.

Statistical analysis

All the data obtained were subjected to one way analysis of variance using statistical software (15) in a completely randomized design. Significant means were separated using Duncan's Multiple Range Test within the same package.

Results

Table 1 shows the results obtained for the chemical analysis of the experimental diets. Diet LELP gave lower value for protein than the calculated analysis. The values obtained for energy were higher. Diets LEHP, HELP and HEHP followed similar trends for the determined and calculated analyses for both protein and energy.

The faecal egg counts (egg per gram, epg) of animals fed the different protein-energy density diet in are presented in Figure 1. The initial faecal count ranged from 375 - 400 epg while values obtained at the end of the study ranged from 175 -

766.67 epg. The animals with the least mean initial faecal egg count were allocated to LEHP, HELP and HEHP while those with slightly higher mean values were allotted to LELP. The results obtained for mean final faecal egg count, difference and percentage variation were significantly influenced (P<0.05) by the diets. The highest mean faecal egg count was obtained in those fed HELP, followed by those fed HEHP, and LEHP while the least was obtained in animals fed LELP. The difference between the initial and final faecal egg count for LELP, LEHP, HEHP and HELP were -225, -50, 75 and 391.67epg, respectively. The least mean difference was obtained from the group of animals fed LELP while the highest mean difference was obtained in those fed HELP. The percentage variation for fecal egg count for LELP, LEHP, HELP and HEHP were -56.30, -13.30, 104.30 and 20.00 respectively. The gastrointestinal nematodes identified during the counting were strongyles and moniezia.

Table 1: Chemical composition of the experimental diets (g/kg DM)

Parameters	LELP	LEHP	HELP	HEHP
Dry matter	876.1	899.2	868.4	907.9
Crude protein	75.8	143.0	61.8	148.1
Ether extract	40.5	32.4	61.1	69.2
Ash	45.6	46.1	41.2	52.2
Neural Detergent fiber	892.4	767.9	824.5	807.9
Acid Detergent Fiber	382.1	297.2	337.9	410.6
Acid Detergent Lignin	253.2	249.1	183.3	312.2
ME (MJ/Kg)	7.7	7.5	12.5	13.2

LELP – Low energy, low protein LEHP – Low energy, high protein HELP – High energy, low protein HEHP – High energy, high protein ME – Metabolizable Energy

Table 3: Effect of Protein-energy densities on number of *Moniezia* oocyst (egg per gram) of West African Dwarf Sheep

	Weeks				
Feed Type	0	2	4	6	8
LELP	-	-	-	-	-
LEHP	++++	++++	-	-	-
HELP	-	-	-	-	-
HEHP	-	-	-	-	-

LELP – Low energy, low protein LEHP – Low energy, high protein HELP – High energy, low protein HEHP – High energy, high protein

Absent

+ Low (≤ 200) ++ Medium (> 200) +++High (> 500) ++++Very high (> 1000)

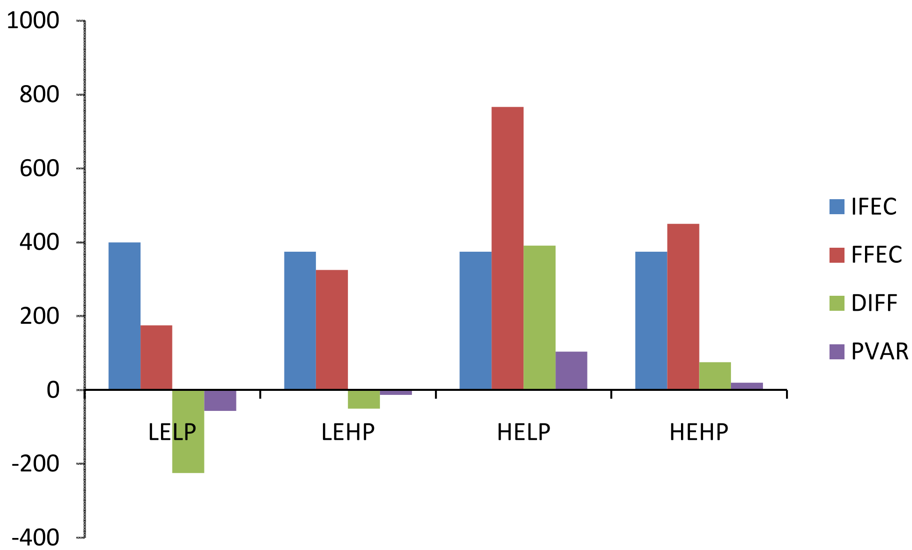

Figure 1: Effect of Protein-energy densities on faecal egg counts (epg) of West African Dwarf sheep

IFEC: initial faecal egg count; FFEC: final faecal egg count; DIFF: difference between initial and final egg count; PVAR: percent variation between initial and final egg count; LELP: low energy low protein; LEHP: low energy high protein; HELP: high energy low protein and HEHP: high energy high protein

The trends of faecal egg counts of gastrointestinal parasite from West African Dwarf sheep fed the different diets is shown in Figure 2. The initial faecal egg counts obtained were not significantly affected (P>0.05) but were subsequently significantly influenced (P<0.05) by the diets. The highest level of infestation was obtained in animals fed LELP in the second week counting while the least was obtained from those fed HEHP. Observation at the 4th week indicated reduction in all the treatments in which animals fed both LELP and HEHP gave values that were similar but higher than values obtained from those fed LEHP and HELP. The 6th week observation showed the highest faecal egg count in animals fed LELP, followed by those fed HELP, whereas the least was obtained in animals fed LEHP. The faecal sample collected at week 8 showed the highest count in those fed HELP, followed by those fed HEHP and the least value was obtained from those fed LELP.

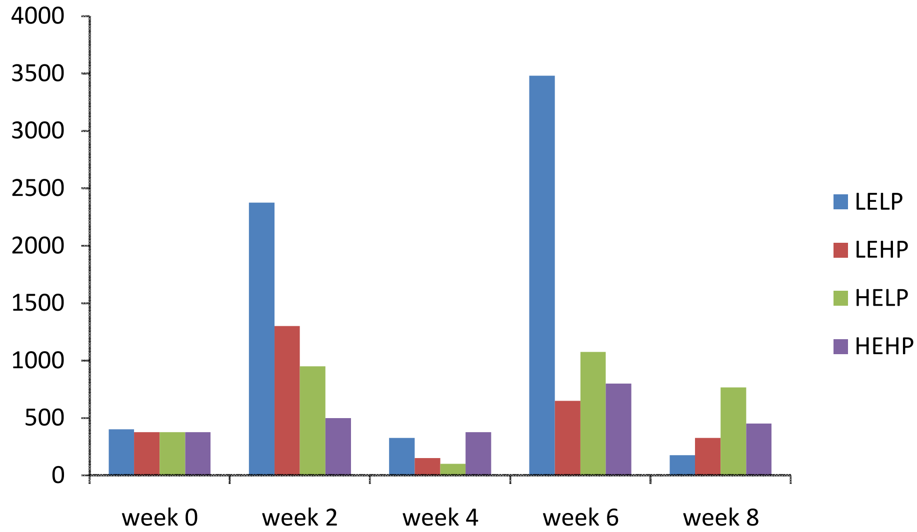

Figure 2: Effect of Protein-energy densities on faecal egg counts (epg) of West African Dwarf sheep from 0 – 8 weeks of experiment. LELP: low energy low protein; LEHP: low energy high protein; HELP: high energy low protein and HEHP: high energy high protein

Strongyle egg population as affected by different energy-protein densities is depicted in Table 2. The *strongyle* eggs had the highest infestation during the period of the study. Animals fed LELP and HELP had the highest mean values, which were similar, followed by those fed HEHP, and the least mean value was obtained from those fed LEHP. There was complete absence of *strongyle* eggs in week 4 except in those fed HEHP. Re-infestation was observed in week 6 and on week 8, only animals on HEHP were devoid of *strongyle* eggs. *Moniezia* oocysts (Table 3) observed in the faeces was low. Only animals fed with LEHP diet were observed to carry the oocyst of *Moniezia* within the first two weeks of observation. Further re-infestation of *Moniezia* was absent during the remaining period of the study in all the treatments.

Table 2: Effect of Protein-energy densities on number of *strongyle* eggs (eggs per gram) in faeces of West African Dwarf sheep

	Weeks				
Feed Type	0	2	4	6	8
LELP	+++	++++	-	++++	+++
LEHP	+	++	-	++++	++
HELP	+++	++++	-	++++	+++
HEHP	+++	++++	++++	++++	-

LELP – Low energy, low protein LEHP – Low energy, high protein HELP – High energy, low protein HEHP – High energy, high protein

[-]Absent [+]Low (≤ 200) [++]Medium (> 200) [+++]High (> 500) [++++]Very high (> 1000)

Table 3: Effect of Protein-energy densities on number of *Moniezia* oocyst (egg per gram) of West African Dwarf Sheep

	Weeks				
Feed Type	0	2	4	6	8
LELP	-	-	-	-	-
LEHP	++++	++++	-	-	-
HELP	-	-	-	-	-
HEHP	-	-	-	-	-

LELP – Low energy, low protein LEHP – Low energy, high protein
HELP – High energy, low protein HEHP – High energy, high protein
$^{-}$Absent $^{+}$ Low (≤ 200) $^{++}$ Medium (> 200) $^{+++}$High (> 500) $^{++++}$Very high (> 1000)

Discussion

This study indicated that nutrition could affect parasitism not only through quantitative variations of different diet components but also by the presence of qualitative diets consumed as similarly observed by (16). The final faecal egg count was highest for those fed HELP, hence, the low performance of animals fed HELP could have been partly due to the animals requiring extra nutrients to repair or replace damage tissue and express immunity against the gastrointestinal parasites because there is always a diversion of nutrients from production sites towards the repair of tissue-damage provoked by the parasites (17, 18, 19). Probably, the energy present was used up in body metabolism to generate immunity against the presence of the gastrointestinal parasite present. The animals will always feed to first take care of their body (maintenance) and to cope with high level of infestation. Animals fed LELP had the least faecal egg count at 8th week of the count, this agreed with (20), which concluded that the expression of acquired immunity is independent of protein nutrition. The highest faecal egg counts recorded in animals fed LELP had the least weight gain among others. This supported (21) who reported that helminthes cause reduced live-weight gain in animals.

Animals fed LEHP had lower faecal egg count with 50% reduction. This was in agreement with previous reports (4, 22, 23, 24) that resistance to gastrointestinal parasites in sheep could be based on manipulation of host nutrition (mainly protein) and that increasing the protein supply for intestinal absorption can alleviate the detrimental effects of nematode parasite on production and enhances the expression of protective immunological responses to infection through increased numbers of globule leukocytes (25, 26). This is also in agreement with experimental observations that immune animals usually have small worm burdens, without any apparent detrimental effect on their well-being or production (27).

Although, protein supplementation is not expected to contribute towards the acquisition of resistance to parasites, but it contributes towards the building up of resilience (27, 28).

HEHP diet brought about better performance in terms of resistance and resilience of the animals to gastrointestinal parasite. Earlier reports (29) indicated that increased dietary intake of metabolisable protein and energy and high quality pasture can directly promote host resistance and host resilience to worm infection. Furthermore, nutritional supplementation reliably increased host productivity irrespective of infection status and that strategic nutrition have complementary roles in the integrated control of gastrointestinal nematodes (30). It also agreed with (31) which reported that energy balance and supply is increasingly being recognized as an important factor in the immune response. This study tends to disagree with (4) who reported that the maintenance of host resistance is more sensitive to protein supply than energy supply within a range of nutritional conditions.

Conclusion and Application

From the results of this study it could be concluded that

1 *Strongyle* eggs were predominant in the faeces of WAD sheep in the study area.

2 Supplementation of diets of grazing WAD sheep with high protein and high energy concentrates reduced their gastrointestinal parasites compared to other nutrient combination.

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