



**Influence of varying protein-energy levels on the population of helminths in naturally infected West African Dwarf sheep**

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**Abstract**

*A 10-week trial was carried out to determine the influence of varying levels of protein and energy on the population of helminths on naturally infected West African Dwarf (WAD) sheep raised in a semi-intensive management system. Four diets (D1- D4) were formulated to contain varying levels of protein and energy, such that, D1 contained low protein and low energy; D2 had high protein and low energy; D3 had low protein and high energy while D4 had high protein and high energy. Twenty-four (24) WAD sheep were allotted to four groups, each with six (6) animals balanced for parasite status, and each animal was an experimental unit. Faecal samples were collected from the rectum of each animal to monitor the worm load as a response to the varying diets. The results revealed three major helminths; strongyle, eimeria and moniezia, of which the former was the highest and the latter was the least in population. The diet high in both protein and energy best control the proliferation of strongyle worms whereas the varied diets did not reduce the load of eimeria species, likewise, moniezia species could not thrive well in all the animals fed with different quantity of protein and energy throughout the period of the experiment.*

**Keywords:** *Strongyle, Eimeria, Moniezia, Helminths*

**Introduction**

Adequate nutrition plays an important role in the profitability of sheep farming (Asaolu and Odeyinka, 2006). Sheep production has invaluable contributory value in the economic development of a nation in terms of meat, milk, wool and skin production which can be greatly affected by gastrointestinal parasites (Forbes *et al.*, 2000; Roeber *et al.*, 2013). Sheep production is of immense benefit in optimizing protein intake of rural and peri-urban dwellers of developing countries like Nigeria (FDLPC. 1992; Alli-Balogun *et al.*, 2003). The survivability of sheep is threatened by some challenges ranging from nutrition, management to health challenges (Taiwo *et al.*, 1995). Among these, helminthiasis has been considered to be a major challenge of sheep production (Kaplan and Vidyashankar, 2012; Arsenopoulos *et al.*, 2021). Diverse attempts have been made to mitigate the menace caused by these parasites which include but not limited to chemotherapeutic approach (Prichard, 1994; Waller, 2006),

biological control where another organism is allowed to feed on intermediate host (Kwenti, 2017), rotational grazing (Smith *et al.*, 2009), use of browse plants that are high above the ground level (Butter *et al.*, 2000) and diet modifications (Ayankoso *et al.*, 2012a; Cei *et al.*, 2017).

Diets containing varying levels of protein and energy have been used to provide resistance and / or resilience in animals beyond reasonable doubt, of which helminths are more sensitive to protein than energy, but when diets are high in both protein and energy tends to perform better in terms of weight gain, feed intake and feed conversion ratio (Bown *et al.*, 1991, Ayankoso *et al.*, 2012b). Having established this, there is need to know the response of specific gastrointestinal parasites to varying levels of energy and protein (Bown *et al.*, 1991).

Also, it has been observed that information in literature are scarce on population and response of specific helminths to different

levels of protein and energy. The objective of this study was to investigate the influence of varying protein-energy levels on the population of helminths in naturally infected West African Dwarf sheep raised under semi-intensive management system.

## Materials and Methods

### Experimental Site

This experiment was conducted at the Small Ruminant unit, Directorate of University Farms, Federal University of Agriculture, Abeokuta, Ogun State, Nigeria located on latitude 71°10'N and longitude 3°20' E (Google earth, 2021). The climate is tropical with mean annual rainfall of 1,037 mm. The mean ambient temperature ranges from 28°C in December to 36°C in February with a yearly average of 34°C. The vegetation represents an interphase between the tropical rainforest and the derived savannah with a yearly average humidity of 83% (Accuweather, 2021).

### Experimental animal management and diets

Twenty-four growing West African Dwarf sheep were used for the study. The animals were obtained from the Small Ruminant Experimental Unit of the Directorate of University Farms. The sheep aged between 5 and 6 months with average weight of 11.5 kg. The animals were kept in an individual pen in an open sided type of house with corrugated aluminum roofing sheet and slatted floor. All the animals were treated against external parasite before the commencement of the experiment during the period of acclimatization in the quarantine pens for 14 days. Thereafter, the experiment was carried out for a period of ten (10) weeks in which data were collected fortnightly throughout the trial. The experimental pens were properly cleaned and disinfected with Morigad® disinfectant. The animals were released into the paddock made up of *stylosanthes hamata* and *Pennisetum pediselatatum* on daily basis within

the hour of 08.00 and 13.00 where the animals were naturally infected. Thereafter, in the evening, the animals were fed at 4 % of their body weight with concentrate supplement (Table 1) and water was made available *ad-libitum* on daily basis throughout the experiment. The feed was gradually introduced to the animals for four days for them to acclimatize to the new diets before the commencement of the experiment.

### Experimental design

Twenty-four (24) experimental animals were divided into four groups of six (6) animals balanced for parasite status in which each animal was an experimental unit. The experimental design was completely randomized (CRD). The animals were solely kept under semi-intensive management system and allocated to diets containing varied levels of protein and energy as shown in Tables 1 and 2.

### Parasite egg counts

Samples of faeces were collected directly from the rectum of all the animals at the commencement of the experiment to determine their faecal egg count (FEC) as a measure of the level of parasite infestation. Faecal samples were then collected fortnightly throughout the period of the experiment to determine FEC as level of their gastrointestinal parasite burden. The faecal samples collected were taken to the Veterinary Microbiology and Parasitology Laboratory, University of Agriculture, Abeokuta for the determination of FEC in eggs per gram of faeces.

The faecal sample collected was treated according to a modified Wisconsin salt floatation techniques as described by Jordan and colleagues (1988).

### Statistical Analysis

Data collected were analysed using descriptive statistics of SPSS version 23 (2003) to estimate

the means of parasite burden between the treatment group.

### Results and Discussion

Table 1 showed the gross composition of the experimental diets while the results of proximate analysis is presented in Table 2. D1 gave lower value for protein than what was obtained for calculated analysis whereas values for energy were higher which might be due to the quality of the feed ingredients. D2, D3 and D4 followed similar trend for both calculated and determined analysis for both protein and energy.

Table 3 presented the mean population of *strongyle* eggs during the faecal egg count. The *strongyle* eggs had the highest infestation during the period of the study. The four groups of animals used for the study showed the presence of *strongyle* parasite. Animals fed D1 and D3 had the highest values which were similar, followed by those fed D4, and the least value was obtained from those fed D2. Although, it was observed that the group of animals fed D4 had better control even with further re-infection and multiplication of *Strongyle* eggs. By implication, *Strongyle* worms were the most numerous in the study area which is similar to a study conducted by Francisco *et al.* (2012). There was complete absence of *strongyle* eggs in week 6, except for those fed D4 which showed the infectivity of *strongyle* eggs. This might be due to the age and sex of strongyles that was pre-dominant, and their capability to produce large number of eggs within a short period of time. This is in consonance with the report of Hepaworth *et al.* (2006) which observed that adult male and female worms reproduce sexually in the host abomasum with an astonishing production per female worm estimated from 5,000 to 15,000 eggs/day. Rapid re-infection occurred in all the treatments except for D4 at week 8 which might be due to nutrient availability in the diet which assisted the animals to build resistance

and/or resilience against the proliferation of the parasite. A level of reduction was observed at 10th week of the study across the treatments which was more obvious in treatments D2 and D4, meanwhile D4 better reduces infestation level. This implies that, diets high in protein are capable of reducing infectivity of *strongyle* worms while diets high in both protein and energy control it better, which might have possibly improved the coping system of the animals towards hindering the proliferation of the worms. This agrees with the reports of Ayankoso *et al.* (2012a) and Sonibare *et al.* (2016) where diets high in protein and energy were used to control parasites.

Table 4 shows the mean population of the oocyst of *eimeria* observed during the period of the study. The mean of the oocyst of *eimeria* was observed to be next to *strongyle* eggs in terms of the population in the study area. *Eimeria* species were observed right from the second week of the study. D3 and D1 gave the least mean population of oocyst of *eimeria*. The values obtained for those fed D2 and D4 were similar but were higher than those obtained from animals fed D3 and D1. It could be deduced that high protein and energy does not importantly influence the control of oocystes of *eimeria* species of worms. It could also be construed that ruminants can successfully live in a highly infected area with *eimeria* worms without any deleterious impact on them. This is in agreement with the report of Metzger (2017) which stated that *coccidia* which caused disease condition known as coccidiosis are always present in the herd perpetually without any conspicuous damage to the performance of ruminant animals.

The mean population of *Moniezia* eggs is showed in Table 5. *Moniezia* was observed to be the least of all the gastrointestinal parasites observed during the study. Only animals fed with D2 were observed to be infested with the oocyst of the *Moniezia* within the first two

faecal egg count (2-4 weeks). There was no further re-infestation of *Moniezia* during the last 6 weeks of the study. This implies that *Moniezia* were not predominant in the study area unlike *strongyle* worms. All the diets were able to prevent the survivability of the strain of worm.

### Conclusion

In conclusion, *Strongyle* eggs happens to be the most populous amongst the worms identified in the study area, followed by *eimeria* and the least was *Moniezia*. In addition, diets rich in both protein and energy better controlled the proliferation of *strongyle* worms than *eimeria* and *Moniezia*.

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**Table 1: Ingredient composition (%) and calculated analysis of experimental concentrate diet.**

Ingredient	D1	D2	D3	D4
Cassava peel	65.00	6.00	82.00	14.00
Wheat offal	33.00	78.00	8.00	36.00
Palm Kernel Cake	0.00	14.00	8.00	48.00
Bone meal	1.00	1.00	1.00	1.00
Oyster meal	0.50	0.50	0.50	0.50
Salt	0.50	0.50	0.50	0.50
<b>Calculated analysis</b>				
Crude protein	8.40	15.11	6.85	15.34
Metabolizable energy (Mj/Kg)	7.23	6.19	11.84	12.02

D1 – Low energy and low protein

D2 – Low energy and high protein

D3 – High energy and low protein

D4 – High energy and high protein

**Table 2. Proximate analysis (% DM) of the experimental diet**

Parameters	D1	D2	D3	D4
Dry matter	87.61	89.92	86.84	90.79
Crude protein	7.58	14.30	6.18	14.81
Crude fibre	9.04	5.83	5.36	5.12
Fat	4.05	3.24	6.11	6.92
Ash	4.56	4.61	4.12	5.22
Neutral detergent fibre	89.24	76.79	82.45	90.79
Acid detergent fibre	38.21	29.27	33.79	41.06
Acid detergent lignin	38.21	29.72	33.79	41.06
Metabolizable energy (MJ/Kg)	25.32	24.91	18.33	31.22

D1 – Low energy and low protein

D2 – Low energy and high protein

D3 – High energy and low protein

D4 – High energy and high protein

**Table 3: Effect of varying levels of energy and protein on number of *Strongyle* eggs (egg per gram) of West African Dwarf sheep**

Diet Type	Weeks				
	2	4	6	8	10
D1	++++	++++	-	++++	+++
D2	+	++	-	++++	++
D3	+++	++++	-	++++	+++
D4	+++	++++	+++	++	+

D1: Low energy and low protein

D2: Low energy and high protein

D3: High energy and low protein

D4: High energy and high protein

+ = Low ( $\leq 200$ )

++ = Medium ( $> 200$ )

+++ = High ( $> 500$ )

++++ = Very high ( $> 1000$ )

- = Absent

**Table 4: Effect of varying levels of energy and protein on number of oocyst of *Eimeria* eggs (egg per gram) of West African Dwarf sheep**

Diet Type	Weeks				
	2	4	6	8	10
D1	++++	-	-	++++	++
D2	++	++++	-	++++	++++
D3	++++	-	-	++	++++
D4	++++	++++	+	-	++++

D1: Low energy and low protein  
D2: Low energy and high protein  
D3: High energy and low protein  
D4: High energy and high protein  
+ = Low ( $\leq 200$ )  
++ = Medium ( $> 200$ )  
+++ = High ( $> 500$ )  
++++ = Very high ( $> 1000$ )  
- = Absent

**Table 5: Effect of varying levels of energy and protein on number of oocyst of *Moniezia* (egg per gram) of West African Dwarf sheep**

Diet Type	Weeks				
	2	4	6	8	10
D1	-	-	-	-	-
D2	++++	++++	-	-	-
D3	-	-	-	-	-
D4	-	-	-	-	-

D1: Low energy and low protein  
D2: Low energy and high protein  
D3: High energy and low protein  
D4: High energy and high protein  
+ = Low ( $\leq 200$ )  
++ = Medium ( $> 200$ )  
+++ = High ( $> 500$ )  
++++ = Very high ( $> 1000$ )  
- = Absent