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Asian Journal of Agriculture and Rural Development

journal homepage: http://aessweb.com/journal-detail.php?id=5005

Effects of Concentrate Supplementation on Performance Characteristics of Goats Challenged with *Trypanosoma brucei*

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Abstract

The influence of concentrate-feed supplementation on dry matter and nutrient intake and digestibility, nitrogen retention and body weight gain in goats challenged with trypanosomiasis was studied. Sixteen male West African Dwarf (WAD) goats (7.32 ± 0.70 kg) inoculated with 1.5×10^6 *Trypanosoma brucei* were divided into four treatment groups each of four replicates in a 56-day, completely randomized design experiment. Treatments consisted of varying intake levels (0, 50, 100 and 150 g/head/day) of a maize-based concentrate supplement (19.72 %; CP) to basal *Panicum maximum* hay (10.81 %; CP). Dry matter intake (g/head/day) of 211.77 ± 2.66, 215.14 ± 7.25, 253.28 ± 5.23, and 275.96 ± 3.65 obtained for goats fed supplement at 0, 50, 100 and 150 g/head/day respectively were different. Coefficient of crude protein or crude fibre digestibility was higher ($p < 0.05$) for goats fed the concentrate supplement at 100 or 150 g/head/day level than for those fed at 50 g/head/day or the control. Differences in feed nutrient intake and digestibility caused gradual improvement ($p < 0.05$) in body weight gain (g/head/day) from 8.39 ± 0.21 in the un-supplemented group to 18.21 ± 0.42 in goats fed concentrate supplement at 150 g/head/day. The results indicated a positive influence of concentrate supplementation on ability of the goats infected with trypanosomiasis to consume and digest feed nutrients for body weight gain. The 100 g /head/day level of supplementation was considered adequate.

Keywords: Concentrate supplement, *panicum maximum hay*, *trypanosomiasis*, WAD goat

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Introduction

Indigenous breeds of sheep and goats are often characterized by slow rate of body weight gain, culminating in small body size at maturity. Poor nutrition, unfavourable climate and high prevalence of infectious diseases were identified as the major non-genetic causes of poor growth performance of ruminants in a developing tropical country (Lamg *et al*., 1988). Nutrition and Health management not only utilize a significant percentage of human and material resources available for both ruminant and non-ruminant production, it is also a major determinant of productivity in the livestock industry.

African trypanosomiasis was described as the commonest and most threatening disease of ruminant livestock in regions where tse-tse fly, the vector organism is prevalent (Nantulya, 1990). In Nigeria, over one-fifth of the 228.3 Km^2 total land area is within tse-tse fly infested belt (Iwwala and Ajezie, 1980). The West African Dwarf sheep or goat being trypanotolerant, is the predominant breed found in the tse-tse fly region. Trypanotolerance however, only signifies resilience to trypanosomiasis. Osho and Ogunsusi (2001) noted that trypanotolerant breeds of livestock are all susceptible to both acute and chronic forms of the disease but with low mortality rate and an ability to maintain positive body weight gain following infection. Hence trypanosomiasis in the WAD sheep and goat is often presented in its mild chronic form resulting in depressed productive and reproductive performance. Interactions exist between plane of nutrition and trypanosomiasis as exemplified by the observed increase in the incidence and severity of the disease during the dry season of the year when feed supply becomes limiting both in quantity and quality (Omotonishe, 2000).

The objective of this study was to further investigate such interactions under intensive production system in the West African Dwarf goats, experimentally infected with trypanosomiasis. Specifically, the study seeks to determine the optimum level of supplementation of low quality *Panicum maximum* hay with concentrate feed in goats challenged with *Trypanosoma bruceibrucei*. Concentrate supplementation could be utilized to improve health and productive performance in the livestock. Previous reports on interaction between host nutrition and trypanosomiasis in domestic animals had concentrated on patho-physiological effects of the disease (Holmes *et al*., 2000). Zubair *et al.* (2012) observed positive effect of feed supplementation on goat milk yield

Materials and methods

Infecting goats with Trypanosomes

Samples of *Trypanosoma bruceibrucei* (strain, BIIT-VE) obtained from National Institute for Trypanosomiasis Research (NITR), Vom Nigeria were inoculated intravenously into two albino rats. The rats were later bled during the first wave of parasitaemia into a container containing ethylene diamine tetra acetic acid (EDTA). The phase contrast buffy coat technique (Paris *et al.*, 1982) was used to detect and quantify trypanosomes in the blood samples. Sixteen apparently healthy weanling (7.32 ± 0.70 kg, initially) WAD goats selected from a herd of twenty goats previously screened for trypanosomes were inoculated by jugular route with 3 ml PBS containing 1.5×10^6 trypanosomes . The species of trypanosomes was confirmed in the infected goats following laboratory blood test (Murray *et al*. 1983) on the 6^{th} day post-infection.

Animals and experimental treatments

The sixteen selected goats were divided into four dietary groups of four animals per treatment in completely randomized-design experiment that lasted 56 days. Treatments consisted of a level (0, 50, 100 or 150 g /head/day) of maize-based concentrate that was used to supplement *ad libitum* intake of low quality (10.81 % CP) *Panicum*

maximum hay. Goats were housed individually in fly-proof concrete-floor compartments during the first 42 days of the 56-day feeding trial. Goats were adapted to cage condition for seven days in fly-proof wooden metabolism cages that allowed for separate but total collection of faeces during a subsequent 7-day collection period.

Collection of samples and analyses

Goats were weighed on the first day and subsequently at two weeks intervals during the 56-day feeding trial. Average daily hay consumption was estimated from the differences between the amounts of hay offered and the amounts refused. Average daily dry matter or nutrient intake was the sum of values of hay and the amounts of concentrate supplement consumed. Representative samples (10 %) of feeds, faeces and feed refused were collected daily during a 7-day collection period and preserved for laboratory analyses. Feeds and faecal samples were separately oven-dried at 60^{o}C for 48 hours, ground in a Willy mill to pass through 2 mm sieve and divided into two sub samples. A sub-sample was oven dried to constant weight at 105^{o} C for determination of dry matter while another sub sample was used for estimation of proximate composition using the AOAC (1980) procedures. Presence of trypanosomes in the blood of goats or rats was confirmed using the dark ground buffy coat method (Paris *et al.,* 1982). Data collected were subjected to analysis of variance (Steel and Torrie, 1980) with treatment means separated (Duncan, 1955).

Results and discussion

Compositions of the concentrate supplement and the *Panicum maximum* hay used in the present study were as shown in Table 1. The concentrate had higher levels (%) of crude protein (19.72) and nitrogen free extracts (62.61) than the *Panicum maximum* hay (10.81; 34.83). A relatively high crude fibre (41.55 %) but low crude protein (10.81 %, dry matter basis) content of *Panicum maximum* hay is suggestive of low nutritional quality.

Table 1: Composition of concentrate and panicum maximum hay fed to the goats

Component	Concentrate	Panicum maximum Hay
	Proximate (% Dry matter)	
Dry matter	87.26	90.66
Crude protein	19.72	10.81
Crude fibre	7.25	41.55
Ether extract	3.68	3.35
Ash	4.42	7.54
Nitrogen free extract	62.61	34.83
Ingredient (Concentrate), %		
Maize	55	
Groundnut cake	24	
Maize offal	15	
Rice husk	5	
Sodium chloride + Bone meal (1:1)	1	
Total	100	

Table 2 showed data on the effects of varying intake levels of a concentrate supplement on dry matter and nutrients intake and digestibility, nitrogen retention and body weight gain by goats infected with trypanosomiasis. Average total intake of dry matter (g/head/day) was influenced ($p < 0.05$) by the amounts of concentrate

supplement offered with the goats receiving 150 g concentrate /head/day having the highest value (275.96 ± 3.65) and those offered un-supplemented *Panicum maximum* hay ration the lowest (211.77 ± 2.66) dry matter intake. Similar positive effects of concentrate supplementation had been reported (Tewe *et al*., 1982) for apparently healthy lambs fed a basal diet of *Cynodon nlemfuensis* that was supplemented with one of maize, cassava flour and sweet potato concentrates. Mba *et al.* (1982) however, observed a reduction in total dry matter intake when non-infected WAD goats received increased amounts of a cassava based concentrate as supplement to *Gliricidia sepium* suggesting that differences in composition of diets could also influence dry matter intake. Daily dry matter intake (g/head/day) from *Panicum maximum* hay averaged; 211.77 ± 2.66, 171.51 ± 5.12, 166.02 ±4.55 and 101.44 ± 3.01 decreasing with an increase in the level of concentrate offered. The hay dry matter intakes represent 100, 79.72, 65.55 and 44.94 % of the total dry matter intakes by goats offered the concentrate supplement at 0, 50, 100 and 150 g/head/day respectively and is in line with the finding (Adegbola, 2002) of a reduction in dry matter intake from rice straw by bulls offered supplemental cotton seed cake.

Increasing levels of concentrate intake had significant ($p < 0.05$) effects on the digestibility of dry matter, crude protein, crude fibre and nitrogen free extract in the trypanosome–infected WAD goats (Table 2).

Table 2: **Performance characteristics of trypanosome-infected goats**

Level of Concentrate Supplementation, g/head/day				
Item/Treatment	0	50	100	150
Live Weight				
Initial live weight, kg	7.25 ± 0.12	7.30 ± 0.18	7.53 ± 0.16	7.23 ± 0.29
Final live weight, kg	7.72 ± 0.16	7.81 ± 0.11	8.46 ± 0.09	8.25 ± 0.14
Live weight gain, g/day	8.39 ± 0.21^{c}	9.11 ± 0.34^{c}	16.61 ± 0.26^{b}	18.21± 0.42^{a}
Dry MatterIntake				
Concentrate	Nil	43.63 ± 1.60^{c}	87.26 ± 4.23^{b}	174.52 ±1.82^{a}
P. max. hay	211.77± 2.66^{a}	171.51± 5.12^{b}	166.02±4.55^{b}	101.44±3.01 ^{c}
Total	211.77±2.66^{c}	215.14±7.25^{c}	253.28±5.23^{b}	275.96±3.65^{a}
DM Digestibility,%	4.62 ± 2.82^{c}	61.04 ± 2.79^{b}	63.96 ± 4.43^{b}	68.11 ± 6.09^{a}
Crude Protein				
Intake, g/head/day	22.89 ± 1.19^{c}	29.14 ± 2.57^{c}	35.16 ± 1.08^{b}	45.19 ± 1.91^{a}
Digestibility, %	50.11 ± 3.70^{c}	61.32 ± 4.29^{b}	68.43 ± 3.43^{a}	67.95 ± 3.18^{a}
Crude Fibre				
Intake, g/head/day	87.99 ± 3.71^{a}	74.42 ± 5.95^{b}	75.31± 2.41^{b}	54.80 ± 2.75^{c}
Digestibility, %	42.78 ± 1.96^{b}	43.62 ± 2.73^{b}	56.91 ± 5.17^{a}	52.39 ± 2.07^{a}
Ether Extract				
Intake, g/head/day	7. 09± 0.78^{c}	7.35 ± 0.98^{b}	8.77 ± 0.76^{b}	9.82 ± 0.91^{a}
Digestibility, %	57.52 ± 2.80	57.78 ± 0.85	58.60 ± 2.92	59.77 ±2.47
Nitrogen Free Extract				
Intake, g/head/day	73.76 ± 3.58^{d}	87.06 ± 3.72^{c}	112.45±5.88^{b}	144.60 ±4.51^{a}
Digestibility, %	69.53 ± 2.07^{b}	70.18 ± 3.31^{b}	70.25 ± 3.28^{b}	78.13 ± 2.86^{a}

* - mean of four goats ± Standard error a, b, c, d – Values with different superscripts in a row differ ($p < 0.05$)

Digestibility of dry matter was highest (68.11 %) for goats receiving concentrate supplement at 150 g/head/day and lowest (44.62 %) for those fed *Panicum maximum* hay alone. The values of crude protein and crude fibre digestibilities obtained for goats fed concentrate supplement at 100g/head /day and 150 g/head/day were higher ($p< 0.05$) than for those that received un-supplemented *Panicum maximum* hay. Effect of treatment on digestibility of nitrogen free extract was significant ($p < 0.05$) only at the 150 g/head/day level of concentrate intake. Low intake of nutrients other than crude fibre and low digestibility values recorded for goats on un-supplemented *Panicum maximum* hay reflect the nature of feeds with high crude fibre contents (Adegbola and Okonkwo, 2002). However the condition could have also been aggravated by loss of resilience to trypanosome infection (Tolera *et al.*, 2000). Differences in dry matter and nutrient intake, and digestibility resulted in improved ($p < 0.05$) body weight gain in goats that were fed concentrate supplements at 100 or 150 g/head/day level. Rates of body weight gains (g/day) were 8.39 ± 0.21, 9.11 ± 0.34, 16.61 ± 0.26 and 18.21 ± 0.42 for the trypanosome infected goats fed concentrate supplement at 0, 50, 100 and 150 g/head/day respectively. However, higher rates of body weight gain were recorded (Yousuf *et al.*, 2013) for uninfected, West African Dwarf goats that were fed whole plant cassava-poultry manure based concentrate. Holmes *et al.*, (2000) reported that body weight changes in trypanosomiasis infected cattle were markedly influenced by the levels of protein and energy intake. The grass hay of low crude protein and higher crude fiber contents used in the present study require supplementation to support production in healthy goats and improve resilience in condition of trypanosomiasis. Murray and Whitelaw (1982) had suggested the application of nutritional management in solving the problem of trypanosomiasis as the severity of the disease is known to be affected both by genotype and nutritional status of an infected animal.

Conclusion

The results indicate that feed nutrients intake and digestibility can be enhanced in trypanosome-infected WAD goats fed low quality diets through concentrate supplementation. This could be an important nutritional management option to improve the goats' immune system, enhance resilience and promote performance while infected with trypanosomiasis. The 100 g/head/day level of concentrate supplementation was adequate in the present study.

Acknowledgment

The research team gratefully acknowledges financial support it received from University of Ilorin Senate Research Grant Committee in carrying out this study.

References

Association of Official Analytical Chemists, AOAC (1980). *Official methods of analysis, 4th edition*, PP. 152-157. AOAC, Washington DC.

Adegbola, T. A. (2002). Nutrient intake, digestibility and rumen metabolites in bulls fed rice straw with or without supplements. *Nigerian journal of animal production*, 29(1), 40-46.

Adebola, T. A., & Okonkwo, J. C. (2002). Nutrient intake, digestibility and growth rate of rabbits fed varying levels of cassava leaf meal. *Nig. J. anim. Prod*, 29(1), 21-26.

Duncan, D. B. (1955). Multiple range and multiple F- tests. *Biometrics*, 11, 1-42.

Holmes, P. H., Katunguka-Rwakishaya, E., Bennison, J. J., Wassink, G. J., & Parkins, J. J. (2000). Impact of nutrition on the pathophysiology of bovine trypanosomiasis. *Parasitology*, 120 (Suppl.), 73-85.

Iwwala, O. F. M., & Ajezie, C. J. (1980). Control of arthropod vectors of

diseases in Nigeria. *A review*. *Bulletin of animal health and production in Africa*, 28, 197-213.

Lamg, J. A., Brinley-Morgan, W. J., & Wangner, W. C. (1988). *Fertility and infertility in veterinary practice. (Saunder, W. B. Ed.).* Ballience Trindall, London 4th edition, PP. 81-90.

Mba, A. U., Manigui, S. A., & Awah, A. A. (1982). Influence of concentrate supplementation with browse plant (*Gliricidiasepium*) on nutrient utilization and growth rate of the West African Dwarf kids. *Nigerian journal of animal production*, 9(2), 63-73.

Muhammad Z. A., Akhter A., M. Azeem K., Nisar A. S., & Ikram S. (2012). Assessment of feed supplementation to dairy goat: Results of research and technology dissemination trials. *Asian journal of agriculture and rural development*, 2(4), 609 – 620.

Murray, M. and Whitelaw, D. D. (1983). Host susceptibility to African Trypanosomiasis: *Trypanotolerant. Advances Parasitology*, 21, 1-68.

Nantulya, V. M. (1990). Trypanosomiasis in domestic animals–The problem of diagnosis. *Rev. Sci. c Technol. Int'l Epiz*, 9(2), 357-367.

Osho, J. B., & Ogunusi, R. A. (2001). Prevalence of trypanosomiasis of small ruminants under traditional husbandry system. *In: Proceedings of the Nigerian society of animal production annual conference*. 17-21, 80-83.

Omotonise, S. O. (2000). The prevalence of animal Trypanosomiasis in Benue state, Nigeria. *Israel veterinary medical association journal*, 55(4), 36-39.

Paris, J., Murray, M., & MacOdimba, F. (1982). A comparative evaluation of the parasitological techniques currently available for African trypanosomiasis in cattle. *Acta Tropica (Basel)*, 39, 307-316.

Steel, R. G. D., & Torrie, J. H. (1980). *Principles and Procedures of Statistics – A biometric approach*, 2nd Ed. McGraw-Hill, New York.

Tewe, O. O., Akinsoyinu, A. O., & Ogisi, E. M. (1982). Grain replacement value of cassava and sweet potato in rations for growing lambs – 2. Energy and protein utilization. *Nigerian journal of animal production*, 9(2), 94-101.

Tolera, A., Merkel, R. C., Goetsch, A. L., Sahlu, T., & Negesse, T. (2000). Nutritional constraints and prospects of goats production in east Africa, *Institute of Goat research Langston University;* Langston UK. PP. 43-57.

Yousuf, M. B., Adeloye A. A., Okukpe K. M., Adeyemi, K. D., A. H. A. Badmus., Daramola, J. O., & Ogundun, N. J. (2013). Growth performance characteristics of goats fed varied levels of poultry manure in whole cassava plant based concentrate diet. *Asian journal of agriculture and rural development*, 3(11), 823-828.