# Use of groundnut hay and groundnut cake as supplements to Gambian N'Dama heifers exposed to trypanosomiasis

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## Abstract

Thirty-two N'Dama heifers were offered *ad libitum Andropogon* hay plus 10.2 g/kg LW groundnut hay (GNH) (L) or 10.2 g/kg LW GNH and 3.9 g/kg LW groundnut cake (GNC) (H). After four weeks on diet, half of each group were inoculated intradermally with *Trypanosoma congolense* clone (ITC 50) (LI and HI). Peak parasitaemia occurred 6–8 days after inoculation and started to decrease approximately 56 days later. No differences in parasitaemia levels were observed between LI and HI animals. GNH and GNC intakes were maintained during the trial, however, infected animals decreased ($P<0.05$) intakes of *Andropogon* hay. LI animals lost significantly ($P<0.001$) more weight during the experimental period than their non-infected controls (-71.4 cf -13.7 g/day). Meanwhile, HI animals gained less weight ($P<0.001$) compared to H (52.2 cf 167.6 g/day). Weight losses appeared to be accounted for by decreased intakes of the forage part of the diet. PCV levels fell in all treatments (by 5.4, 13.8, 3.7 and 9.4 units after 49–63 days p.i. for L, LI, H and HI groups, respectively) and significant effects of infection and diet were observed ($P<0.001$). Digestibilities did not differ significantly either between diets or with infection. It is concluded from the results that strategic use of locally available supplements can alleviate the effect of trypanosomiasis, although forage intake may be depressed.

## Introduction

Murray (1987) suggested that one of the most important factors affecting the susceptibility of trypanotolerant animals to infection with trypanosomiasis is the nutritional status of the host. A study with sheep suggested that as plane of nutrition declines, the degree of trypanotolerance may decline (Reynolds and Ekwuruke 1988) and in cases of extreme nutritional stress N'Dama cattle are unable to control the anaemia caused by the disease (J. Bennison. personal communication). Previous studies carried out in the Gambia have shown that the severity of infection in grazing cattle can be reduced by supplementing with small amounts of concentrate feed (Agyemang et al 1990; Little et al 1990). Agyemang et al (1990) found that supplemented cattle recovered more rapidly from anaemia, while Little et al (1990) showed that PCV levels in animals on a lower plane of nutrition declined more rapidly than those on a higher plane. Little et al (1990) also suggested that the efficiency of nutrient utilisation was impaired in infected animals. However, in the former study, intake of the grazed part of the diet was not measured.

Under village husbandry systems in the Gambia, farmers do not normally supplement cattle, except for some saved groundnut hay (GNH) to oxen. However, GNH and oilseed cakes such as groundnut and sesame are available locally (Little et al 1991). In the present study N'Dama heifers were offered *Andropogon* hay supplemented with GNH or GNH plus groundnut cake (GNC) and the effects on intake, digestibility and pathogenesis of the disease determined.

## Materials and methods

Thirty-two N'Dama heifers, aged 1–2 years, ranging in liveweight from 89–146 kg were used. Animals were allocated to four treatments, two groups (L and LI) receiving *ad libitum Andropogon* hay and GNH, while the remaining groups (H and HI) received an additional supplement of GNC. Diets were introduced to the animals over a two week period followed by a four week adaptation period. At the end of the sixth week, animals in groups LI and HI were inoculated intradermally with *Teleria congolense* clone (ITC 50). A standard pour-on, bayticol, was applied on a monthly basis to prevent cross infection from external parasites. Measurements were continued until sixteen weeks post infection (p.i.) when infected animals were treated with diminazine aceturate (Berenil) at 7 mg/kg LW.

Feed composition is presented in Table 1. Hay was fed hand chopped to a length of approximately 20 cm and fed *ad libitum* at 130% of the previous days intake. GNH was offered at 10.2 g/kg LW and GNC at 3.9 g/kg LW according to the mean LW of the animals in each group.

Animals were individually tethered, 3 m apart in a fenced area. GNH and GNC were offered at 0900 h and

Table 1. *Composition of the feeds offered.*

| Feed | Feed composition (% DM) | | | | | |
|---|---|---|---|---|---|---|
| | DM | OM | CP | ADF | NDF | ME[1] (Mj/kgDM) |
| *Andropogon* hay | 95.8 | 95.2 | 2.3 | 50.1 | 78.5 | 7 |
| Groundnut hay | 94.6 | 94.0 | 7.8 | 45.4 | 50.9 | 10 |
| Groundnut cake | 94.3 | 94.9 | 46.4 | 18.0 | 12.7 | 14 |

1. Values are estimates from feed tables.

*Andropogon* hay at 1000 h. Water was offered at 1200 h and 1500 h daily. Each animal had access to a mineral block *ad libitum*. Intakes of feed and water were measured daily and weekly sub-samples of feeds and refusals taken for analysis of crude protein (CP) and ash. Animals were weighed once weekly. Blood samples were taken three times weekly for determination of PCV using the standard micro-haematocrit method and parasitaemia using the dark ground buffy coat method (Murray et al 1977).

On three occasions during the trial, 24–20 days pre-infection and 20–24 and 62–66 days p.i., faecal grab samples and refusals for individual animals were collected over a 5-day period. Samples were analysed for DM and ash and apparent digestibility estimated. On days 10, 25 and 68 p.i., activity (eating, ruminating, idling) was recorded over a 24-hour period.

### Statistical analysis

In order to compare the effect of diet and infection on intakes, liveweight and PCV, treatment means over two 14-day periods were calculated (14–0 days pre-infection and 49–63 days p.i.). Mean values within each period as well as liveweight changes over the whole of the p.i. period were compared using analysis of variance, separating effects due to diet and infection. In each of the digestibility periods, organic matter digestibilities (OMD) were examined in the same way. Mean parasitaemia levels in each week were compared using the standard error of difference.

## Results

Animals in all treatments consumed all GNH and GNC offered throughout the trial. Changes in intake of *Andropogon* hay during the course of the experiment are shown in Figure 1, while Table 2 presents mean values for intakes in the two periods: -14–0 days pre infection and 49–63 days p.i. Intakes of hay before infection were not significantly different between groups, but were lower ($P<0.05$) in infected animals during the p.i. period. Mean reduction in intake after 49–63 days was greater for the HI compared to the LI group (36 cf 17% of pre-infection intakes), although the difference was not significant. Furthermore, HI animals began to recover intakes after 10 weeks p.i., whereas depressed intakes were observed in LI animals until three weeks later.

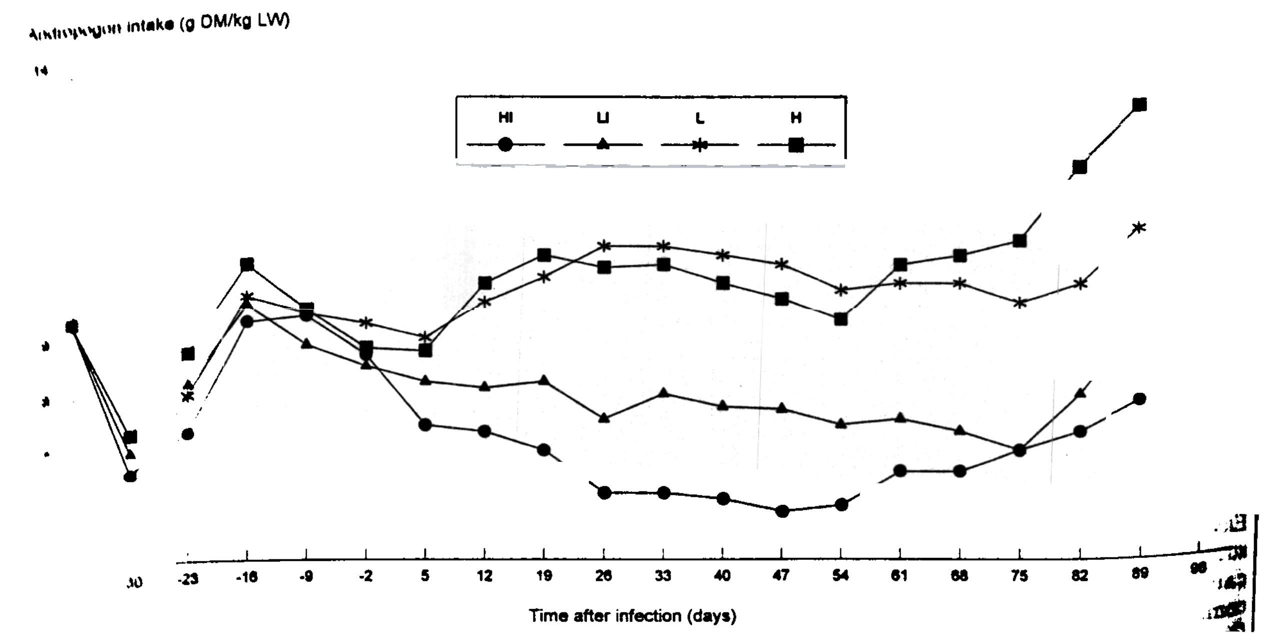


Figure 1 *Mean intakes of* Andropogon *hay before and after infection with* T. congolense.

**Table 2.** *Mean liveweights, intakes and CP content of the diet, before (-14-0 days) and after infection (49–63 days).*

| | Diet composition | | | | |
|---|---|---|---|---|---|
| | L | LI | H | HI | Pooled SE |
| **Pre-infection (14–0 days)** | | | | | |
| Mean LW (kg) | 112 | 111 | 115 | 116 | 1.72 |
| Hay intake (g DM/kg LW) | 9.7 | 9.2 | 9.9 | 9.4 | 0.36 |
| Total DM intake (g/kg LW) | 19.2[a] | 18.9[a] | 22.3[b] | 52.3[b] | 0.35 |
| CP content of diet (% DM) | 5.1[a] | 5.2a | 11.7[b] | 11.7[b] | |
| **Post-infection (49–63 days)** | | | | | |
| Mean LW (lg) | 110[a] | 107[a] | 118[b] | 118[b] | |
| *Andropogon* intake (g DM/kg LW) | 10.1[a] | 7.6[b] | 6.0[b] | 6.0[b] | 0.53 |
| Total DM intake (g/kg LW) | 20.0[a] | 17.8[b] | 18.7[b] | 18.7[b] | 0.51 |
| CP content of diet (% DM) | 5.0[a] | 5.5[b] | 13.7[d] | 132.7[d] | 0.23 |

Means within the same row with different superscripts are significantly different (P<0.05).

Liveweight changes are presented in Figure 2. Animals on low levels of supplementation lost weight while those receiving the additional supplement of GNC gained weight. LI animals lost significantly (P<0.001) more weight following infection p.i. than their non-infected controls (-71 cf -14 g/day).

Meanwhile, HI animals gained less weight (P<0.001) than H group controls (52 cf 168 g/day). However, actual liveweights at 46–63 days p.i. were not greatly affected by infection, though they were significantly increased (P<0.01) by supplementation (see Table 2).

PCV (Figure 3) levels fell in all treatments by 5.4, 13.8, 3.7 and 9.4 units after 49–63 days p.i. for L, LI, H and HI groups, respectively, and significant effects of both infection and diet were observed (P<0.001) The most severe drop in PCV level was observed in the LI group, though there was no significant interaction between diet and infection. Changes in mean parasitaemia are shown in Figure 4. No significant differences were observed between treatments. Animals in both groups were able to tolerate the disease and began to recover spontaneously, parasite numbers starting to fall, around 56 days p.i.

Digestibilities are presented in Table 3. No significant differences were observed in OM digestibility due to either infection or diet in any of the three measurement periods.

Means for intake during these periods were calculated, but are not presented here, since the trends were similar to those in the pre- and post-infection periods shown in Table 2.

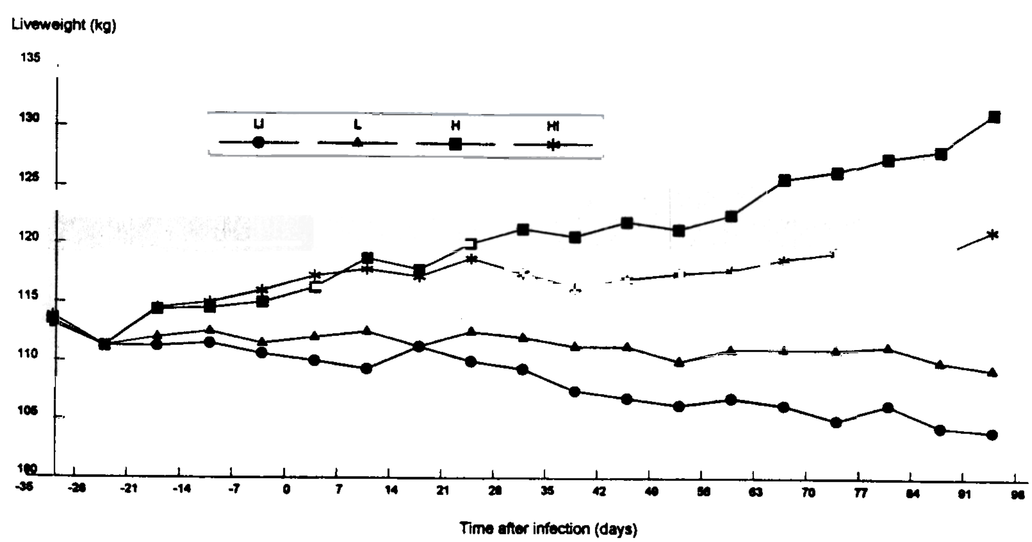


**Figure 2.** *Mean liveweights before and after infection with* T. congolense.

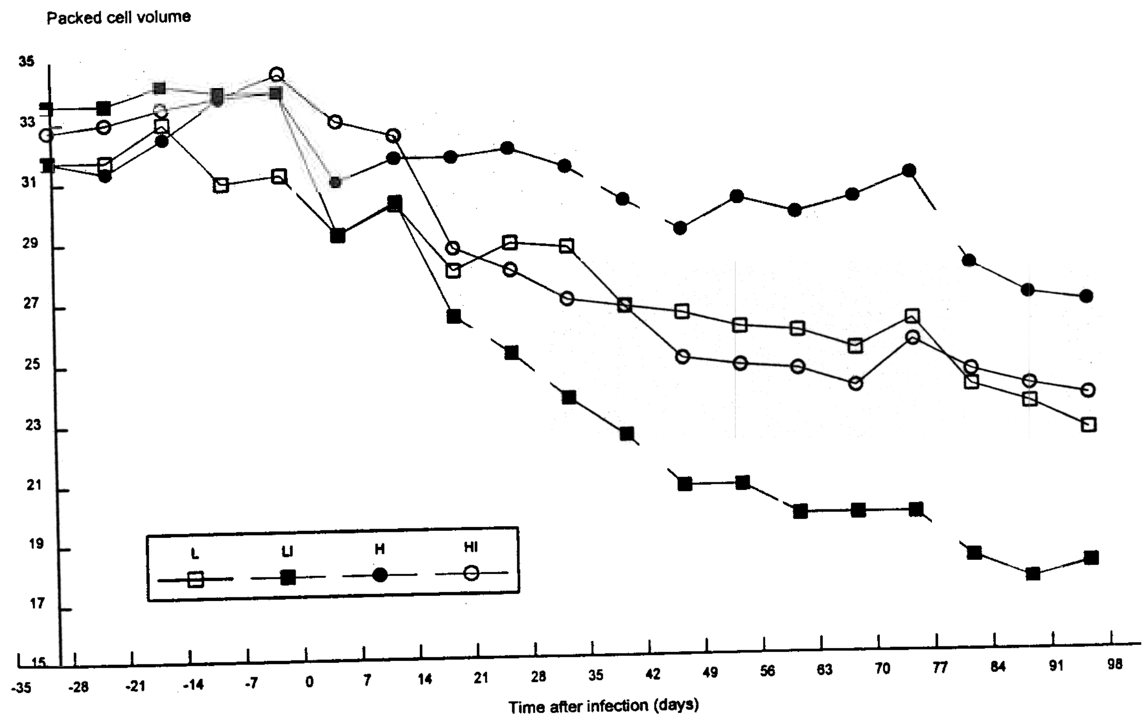


**Figure 3.** *Mean PCV levels in the blood before and after infection with* T. congolense..

**Table 3.** *Organic matter digestibility in animals on a high (H) or low (L) plane of nutrition, and infected animals on the same diets (HI, LI) measured 24–20 days pre infection, 20–24 and 62–66 days p.i.*

| | Diet composition | | | | | |
|---|---|---|---|---|---|---|
| | L | LI | H | HI | Pooled SE | Significance |
| Pre-infection: 24–20 days | 0.51 | 0.54 | 0.57 | 0.53 | 0.010 | 10 |
| Post-infection: 20–24 days | 0.52 | 0.52 | 0.59 | 0.53 | 0.010 | ns |
| Post-infection: 62–66 days | 0.58 | 0.59 | 0.59 | 0.60 | 0.008 | ns |

## Discussion

Work with trypanotolerant West African Dwarf goats (Zwart et al 1991; Wassink et al 1993) and sheep (Reynolds and Ekwuruke 1988) infected with *T. vivax* showed total DM intake to decrease in response to infection in some animals. In the present study, overall DM intake of infected animals also decreased, as a result of changes in intake of the *Andropogon* hay. Changes in liveweight appeared to follow alterations in hay intake and there was no evidence that efficiency of nutrient utilisation was altered in these animals. In contrast, Little et al (1990) suggested *T. congolense* infection in cattle decreased efficiency of nutrient utilisation, while Verstegen et al (1991), observed increased requirements of energy for maintenance in goats infected with *T. vivax*. Insufficient data were available to draw firm conclusions on this in the present study.

Akinbamijo et al (1992) and Verstegen et al (1991) observed no change in OM and DM digestibility in response to infection in trypanotolerant goats. These observations are in agreement with the present trial, where no difference due to diet or infection occurred in any period. It is not easy to explain the higher digestibilities in the final period, although it should be pointed out that animals on all treatments spent more time eating during this period, despite similar intakes, which may reflect changes in rate of passage, possibly lower rates having the effect of increasing digestibility.

In a previous study, Katunguka-Rwakinshaya et al (1993) fed Scottish Blackface sheep isoenergetic diets of high or low protein concentration (17.6 vs 8.1% CP, respectively), designed to provide CP intakes slightly below and above requirements for a liveweight gain of 120 g/day. Animals fed the high protein diet had

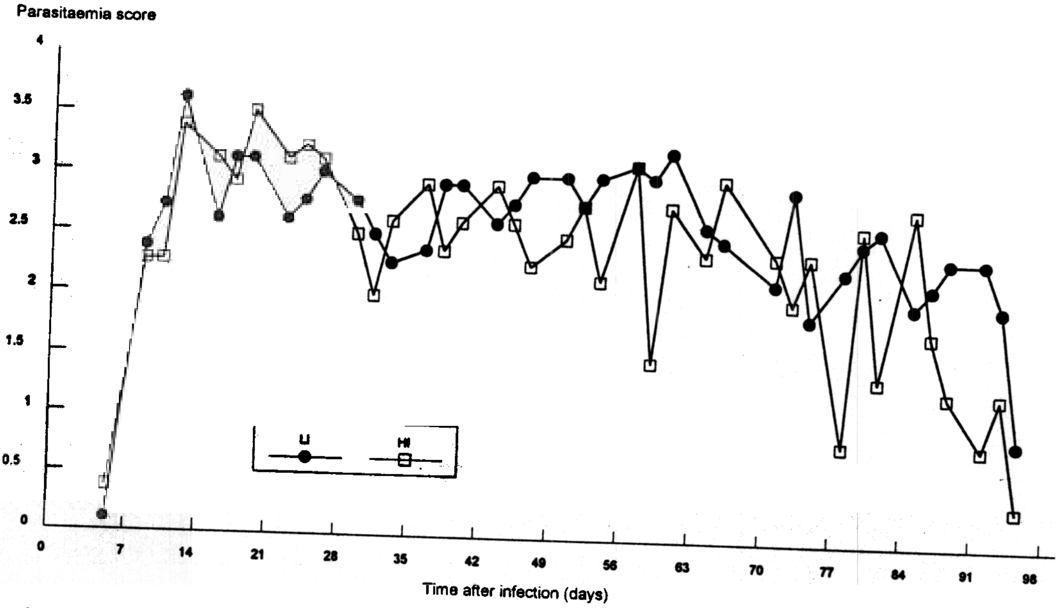


**Figure 4.** *Mean parasitaemia scores following infection with* T. congolense.

significantly lower parasitaemia values during 16–70 days following infection with *T. congolense.* In the present trial no differences in parasitaemia levels were observed. However, it may be noted that CP concentrations in the diets used in our trial (approximately 11.5 and 5.2% of DM for H and L diets, respectively) were lower than those fed to the sheep. It may be that higher protein concentrations are required to affect parasitaemia levels.

PCVs dropped in both infected and uninfected animals. Although PCV values in the LI group were lower than in the HI group, there was no significant interaction between diet and infection on mean PCV values 49–63 days p.i. This agrees with observations in sheep infected with *T. vivax* by Katunguka-Rwakinshaya et al (1993) and Reynolds and Ekwuruke (1988), although in the latter work PCVs in some animals on a maintenance diet appeared to fall below levels observed in animals on a sub-maintenance diet.

In the present trial there was no firm indication that additional supplementation of infected animals assisted the mechanism for resisting disease. Effects of infection were similar on both L and H diets. This is in contrast to the work by Katunguka-Rwakinshaya et al (1993), where liveweight changes decreased in infected animals on low but not high protein intakes. In the work by Reynolds and Ekwuruke (1988), 80% of male sheep fed a sub-maintenance diet died following infection with *T. vivax*. In unpublished work from the Gambia, 10 out of 24 grazed cattle on sub-maintenance diets were withdrawn from trial as PCV levels fell below 15 (J. Bennison, personal communication). It may be that there is a critical level of nutrition, below which animals are no longer able to resist challenge with the disease, which was not reached in the present trial.

## Conclusions

The results of the trial show that locally available by-products can be used to alleviate the symptoms of trypanosomiasis in trypanotolerant cattle.

## Acknowledgements


The work described in the present paper forms part of a CEC DGXII collaborative project and the authors would like to thank DGXII for their support. The authors are also grateful for the assistance of Mr Ebrima Bah in carrying out proximate analysis of feeds.


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# Utilisation de fanes et de tourteau d'arachide comme compléments chez des génisses N'Dama exposées à la trypanosomiase en Gambie

## Résumé

32 génisses N'Dama ont reçu à volonté du foin d'*Andropogon* complémenté avec 10,2 g de fanes d'arachide par kg de poids vif (faible niveau: F) ou cette même quantité avec 3,9 g de tourteau d'arachide par kg de poids vif (niveau élevé: E). Au bout de quatre semaines de régime, le clône ITC 50 de *Trypanosoma congolense* a été inoculé à la moitié des animaux de ces deux lots (FI et EI) par voie intradermique. La parasitémie était maximum 6 à 8 jours après l'inoculation et a commencé à baisser après environ 56 jours. Aucune différence d'infection n'a été enregistrée entre les sujets des lots FI et EI. Les niveaux d'ingestion des deux rations se sont maintenus tout au long de l'essai, mais la consommation de foin d'*Andropogon* avait diminué (P<0,05) chez les animaux contaminés. Les sujets contaminés recevant la ration à faible niveau ont perdu significativement plus de poids (P<0,001) au cours de la période d'essai que les animaux témoins non contaminés du même lot (-71,4 g/j contre -13,7 g/j). Quant aux sujets EI, ils ont gagné moins de poids (P<0,001) que ceux non contaminés du même lot (E) (52,2 g/j contre 167,6 g/j). Les pertes de poids semblent dues à la diminution de la consommation de la fraction fourragère de la ration. Les niveaux d'hématocrite ont baissé pour tous les traitements (de 5,4; 13,8; 3,7 et 9,4 unités entre 49 à 63 jours après le début de l'essai respectivement pour les lots F, FI, E et EI) et les effets de l'infection et du régime étaient significatifs (P<0,001). Les chiffres de digestibilité n'étaient pas significativement différents en fonction de la ration, que les animaux aient été contaminés ou non. Ces résultats montrent que l'utilisation stratégique de compléments locaux peut atténuer l'effet de la trypanosomiase, même si l'on enregistre une baisse de la consommation fourragère.