Effect of dietary protein supplementation on performance of West African Dwarf (WAD) does during pregnancy and lactation

P.A. Nnadi a,*, T.N. Kamalu a, D.N. Onah b

a Department of Animal Health and Production, University of Nigeria, Nsukka, Nigeria
b Department of Veterinary Parasitology and Entomology, University of Nigeria, Nsukka, Nigeria

Received 19 September 2005; received in revised form 19 May 2006; accepted 23 June 2006
Available online 22 August 2006

Abstract

The effect of dietary protein supplementation on the reproductive performance of West African Dwarf goats (WAD) was studied. Eighteen 9–12-month-old female WAD goats that were free from both helminth and trypanosome infections were divided into two groups (A and B) of nine females each and confined separately in concrete floored, fly proof pens. Group A was maintained on a high dietary protein (HDP) diet of 13% crude protein (CP) per day and group B on a low dietary (LDP) protein diet of 9% crude protein (CP) per day from mating until 6 weeks postpartum. The mean live weights and body condition scores were determined weekly from mating (day zero of pregnancy) up to 6 weeks postpartum. These were also determined in neonates within 12 h of birth and at 6 weeks of age. The results showed that animals on HDP gained significantly more weight \( P < 0.01 \) and also had significantly higher body condition scores \( P < 0.05 \) than those on LDP. Equally, they delivered and weaned kids of significantly higher birth and weaning weights than those on LDP \( P < 0.01 \). It was concluded that protein supplementation in reproducing traditionally managed WAD goats enhanced foetal development, birth weight, mammary gland development and promoted lactation, all of which enhanced survivability of the neonates. These translated into the delivery of viable kids and weaning of kids of higher body weights, which are requirements for early disease resistance and finish.

© 2006 Elsevier B.V. All rights reserved.

Keywords: WAD goats; Protein supplementation; Gestation; Lactation

1. Introduction

The West African Dwarf (WAD) goat is the indigenous hardy breed of goat in the humid and derived Savannah zones of West Africa. They are characterized by small size, early sexual maturity, low per head nutrient requirement and capital cost. These attributes in addition to their hardiness should enhance their productivity with rapid capital turn over if well managed. In the south-eastern zone of Nigeria, WAD goats are mostly raised by the traditional semi-intensive management system with cut-and-carry grass as the major source of nutrition. There is hardly any feed supplementation. This is one of the major constraints to WAD goat productivity as the quality and quantity of the grass vary with season. Even where extensive system of husbandry can be practiced, the pastures are usually of poor quality because of lack of proper range management. The genetic make up of WAD goats is believed to negatively influence most production attributes such as birth and weaning weights, size and weight at maturity, fecundity, etc. (Devendra, 1974). Presently, there is no successful breeding pro-
gramme based on selection for these attributes in Nigeria. Rather the situation is worsened by the practice of negative selection whereby best performing animals are sold for cash while poor performers are retained for breeding. Among the numerous production constraints associated with WAD goats in Nigeria, the nutritional factor appears to be the most crucial as most of the others can be manipulated by their improvement (Smith and Akinbamijo, 2000). Essentially, adequate nutrition encourages mediocre biotypes to attain their full genetic potential, alleviates the effects of the harsh environment and also reduces the consequences of bad management including improved resistance to diseases (Rhind, 1992).

On the importance of good nutrition in goat production, Devendra (1988) showed that high producers do not prove themselves in the tropics due to low feed intake and also that a 50% increase in live weight could be attained by improved nutrition. Earlier, it was also shown that improved dietary protein and energy intake significantly increased WAD goat productivity (Satchdeva et al., 1973). Ademosun (1992) who acknowledged inadequate protein nutrition as a major limiting factor to small ruminant production in tropical Africa, suggested the use of agro-industrial by-products as feed supplements to boost dietary protein levels. Some of these by-products such as palm kernel cake (PKC) are cheap and locally available.

There is a dearth of information on the productivity of WAD goats under the low dietary protein nutrition that characterize the traditional husbandry method in Nigeria and on the probable effects of protein supplementation. This study was, therefore, designed to investigate the effects of improved dietary protein supplementation on the performance of WAD does during pregnancy and lactation.

2. Materials and methods

2.1. Animals and housing

Pubertal female and male WAD goats aged between 9 and 12 months were purchased from traditional goat keepers in the Nsukka area of Enugu state, Nigeria. They were on arrival weighed and faecal samples collected for routine analysis for gastrointestinal (GI) nematode eggs. Thereafter, they were dusted liberally with an insecticide powder (Asuntol®, Bayer Leverkusen, Germany) against ectoparasites before being kept in isolation pen in a concrete- floored fly-proof experimental animal house. They were allowed to acclimatize for 2 weeks before the experiment started. Faecal cultures were also set up for the recovery and identification of any infective larvae (L₃) if present. Blood samples were also collected through the external jugular vein and screened for the presence of haemoparasites. In the end, 18 females and 2 males animals found negative for both helminth ova and haemoparasites were, respectively transferred to separate experimental pens for the study. A second faecal analysis was done during the last 2 weeks. During this acclimatization period the animals were provided with concentrate diet comprising of PKC and bambara nut chaff in the ratio of 1:1 ad libitum in addition to cut and carry grass comprising of Panicum maximum and Andropogon muncunoides. Water was also provided free choice. All the animals received pestes des petits ruminants (PPR) vaccine produced by the National Veterinary Research Institute (NVRI) Vom, Nigeria at the dose rate recommended by the producers.

2.2. Diets, experimental design, heat detection and mating, doe and kid performance

Two types of diets as mentioned above were prepared and comprised of high dietary protein (HDP) and low dietary protein (LDP), respectively. Table 1 shows the chemical composition of the feedstuffs used in the diet formulation. Each feedstuff was analysed separately by the proximate method (AOAC, 1990). The requirements for metabolisable energy (ME) and metabolisable protein (MP) were determined using the AFRC system (AFRC, 1993). During the period of

<table>
<thead>
<tr>
<th>Serial number</th>
<th>Feedstuff</th>
<th>Crude protein (%)</th>
<th>Energya ME (Mcal/kg)</th>
<th>Fibre (%)</th>
<th>Ether extract (%)</th>
<th>NFE (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mixed grass (P. maximum + A. muncunoides)</td>
<td>5.15</td>
<td>1.78</td>
<td>40.70</td>
<td>3.0</td>
<td>10.0</td>
</tr>
<tr>
<td>2</td>
<td>Palm kernel cake (PKC)</td>
<td>18.0</td>
<td>2.18</td>
<td>12.0</td>
<td>6.0</td>
<td>5.7</td>
</tr>
<tr>
<td>3</td>
<td>Bambara nut chaff</td>
<td>13.1</td>
<td>2.19</td>
<td>25.6</td>
<td>4.5</td>
<td>5.2</td>
</tr>
</tbody>
</table>

Table 2
Diet composition and protein levels in HDP and LDP groups and mean variations in body weight and body condition scores, birth and weaning weights

<table>
<thead>
<tr>
<th>Feedstuffs</th>
<th>Plane of nutrition</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HDP</td>
<td>LDP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>% Ingredient DM</td>
<td>Protein supplied (%)</td>
<td>% Ingredient DM</td>
<td>Protein supplied (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mixed grasses</td>
<td>32.3</td>
<td>1.66</td>
<td>51.6</td>
<td>2.66</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Palm kernel cake</td>
<td>51.6</td>
<td>9.29</td>
<td>–</td>
<td>–</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bambara nut chaff</td>
<td>16.1</td>
<td>2.11</td>
<td>48.4</td>
<td>6.34</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100</td>
<td>13.06</td>
<td>100</td>
<td>9.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean initial body weight (kg)</td>
<td>9.80</td>
<td>9.24</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean final body weight (kg)</td>
<td>12.42</td>
<td>9.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean initial body condition score</td>
<td>3.80</td>
<td>3.6</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean final body condition score</td>
<td>3.00</td>
<td>2.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean birth weights of kids (kg)</td>
<td>1.18</td>
<td>0.88</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean weaning weights of kids (kg)</td>
<td>3.30</td>
<td>2.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

study the HDP and LDP group, respectively, received 13% and 9% crude protein diets daily. In addition salt lick and water were made available free choice.

The experimental design involved the division of the does into group A (HDP) and group B (LDP) of nine animals each. The does were then served either on coming on heat naturally or after inducing heat in them by the male effect as described by Whitten (1956). Briefly this involved the introduction of a buck into the flock of does allowing them to have physical contact with the buck, withdrawing the buck after 6 h and reintroducing it 7 days later. Thereafter, those on heat were identified by their exhibition of classical oestrous signs of incessant bleating, restlessness, chasing and mounting of pen mates, vulval swelling and reddening. Does standing to be mounted and mated upon the re-introduction of the buck confirmed oestrus. Although not all the females came on heat the same day; this method helped in bringing about oestrous synchronization and relative uniformity in the period of kidding. The feeding regimen (HDP) and (LDP) was maintained for each group throughout the 27 weeks of study. The bucks were similarly given adequate feed and water.

The does were weighed on the day of mating and thereafter weekly using a spring balance (five goats R), made in China. At birth, the kids were weighed within 12 h and thereafter at 6 weeks of age. The dams’ milk yield was determined according to the method of Robinson et al. (1969). The body condition score (BCS) of the does were determined from week 0–27 weeks of study by lumbar palpation on a scale of 1–5 (Houdijk et al., 2000).

3. Statistical analysis

The data obtained were rearranged so as to bring all the animals to week zero of pregnancy when individual observations started for body weight and BCS. Statistical analyses were carried out using two-way (factorial) analysis of variance (Steel and Torrie, 1980). The birth weights and weaning weights of the two groups were compared using Students t-test (Steel and Torrie, 1980).

4. Results

All the does carried their pregnancy to term and kidding was without complications. One of the does in LDP group delivered twin kids weighing 300 g each. These died within 24 h of delivery. Another doe from the same LDP group delivered a single kid weighing 400 g, which also died within 24 h of delivery.

Table 2 shows the differences in mean body weight of the does in the two dietary groups. There was a significant interaction between the diets and time on the mean body weights (P < 0.05) in favour of the HDP group. Also, Table 2 shows the differences in the mean body condition scores of the two groups. The HDP does generally had significantly higher body condition scores (P < 0.01) than the LDP group. In addition, the high dietary protein group (HDP) kidded and weaned kids of significantly higher mean body weights compared to the LDP (P < 0.01). Higher weaning weights among the HDP kids may be indicative of better milk yield by the (HDP) dams.
5. Discussion

It has been shown that under severe chronic underfeeding, even to the point of starvation, ewes continue to ovulate and that at no level of under-nutrition was complete ovarian quiescence observed (Hafez, 1952). However, under-nutrition adversely affects some other areas of productivity in ruminants.

The results of this study show that embryo survival and early foetal development were not affected by the doe’s low protein intake. Thus the does in both dietary groups had successful gestation. However, low dietary protein appears to have imposed some constraints on some aspects of the reproductive efforts in the does. The low birth weight of some of the neonates in the LDP group, sometimes below survival threshold, seems to be related to the poor nutrition of the does. It has been established that during mid gestation in sheep and goats, when the placentas are developing, under-nutrition can lead to reduced cotyledon and foetal weights (McCrab et al., 1986; Robinson, 1983). These manifest as reduced birth weights and lamb/kid viability especially in young ewes with poor body condition (Genty and Rattray, 1987; Owens, 1985; Robinson, 1983; Vincent et al., 1985). These are in agreement with the results of this study.

Supplementation with dietary protein caused significant live weight increase among the does. This was more apparent during late gestation. The body condition of the supplemented groups was also significantly higher during this period. These were probably due to the availability of adequate protein for both reproduction and maintenance needs among the HDP does. The LDP does it appears, started tissue protein withdrawal to support the reproductive efforts from week 15 of gestation, thus the lower body condition score. The reduction in body condition, low birth weights and agalactia among the LDP does could be as a result of tissue loss of protein for the prioritised late gestation foetal growth and mammmogenesis/lactogenesis as it has been shown that under-nutrition in late pregnancy could retard these developments. (Treacher, 1983; Oddy et al., 1984; Mellor and Murray, 1985; Heap et al., 1986; Mellor et al., 1987).

The observed significant higher birth and weaning weights among the HDP kids indicate adequacy of dietary protein to fully support the reproduction efforts of the does including milk yield. As the diet of the LDP does in this study is the same with those used in traditional management of WAD goats in the humid ecological zone in Nigeria, this study shows among other things that such diets are deficient in their nutritional needs especially protein for adequate productivity. Writing on the nutritional limitation of sheep and goat production. Attempts are being made to find means of addressing the rising demand for goat and goat products in this ecological zone in view of the fluctuations in quality and quantity of forages. Use has to be made of agro-industrial by products as feed supplements. Palm kernel cake (PKC) is cheap, available and acceptable to goats and we suggest further definitive nutritional studies on it as a component of caprine diet. The above observations are based on the differences in dietary protein in the diets of the two groups alone. This is because the dietary energy level in the LDP diet was high enough to have eliminated any effect due to energy deficit.

In conclusion, dietary protein supplementation as an adjunct to traditional WAD goat nutrition enhances live body development. It also improves foetal survival, growth and lactation ability resulting in birth of viable kids and weaning of kids of higher body weights.

References


