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Placental Mass of Grazing Tswana Goats Kidding at Two Different Periods During the Dry Season

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Abstract: Two trials were carried out to investigate placental mass of Tswana goats kidding at two different periods during the dry season. Treatments groups with similar weights in Trial 1 were: Supplementing throughout the trial (SS I), no supplementation at all (NN I), supplementing during the first 103 days of gestation (SN I) and no supplementation during the first 103 days and feed offered thereafter (NS I). In Trial 2 the treatment were similar to those of Trial 1 except that crossover between SN and NS occurred at day 145 of gestation. In Trial 1 there was treatment and dam parturition weight (DPW) effect on total birth weight/doe (TBW). This was not the case with Trial 2. Placental mass (PM) in Trial 1 was neither affected by treatment or DPW while in Trial 2 treatment affected PM. TBW was correlated with DPW in Trial 1 while in Trial 2 correlation was moderate. PM tended to be correlated to DPW in Trial 2 but was significantly correlated with TBW and DPW in Trial 2. Trial 1 suggests that supplementing pregnant does with the aim of improving PM and TBW should start only after day 100 of gestation. In Trial 2, veld condition was responsible for improving TBW and supplementation was not necessary. It is concluded that a model of a grazing goat to assess the influence of placental mass on birth weight is flawed because of the difficulty to control forage intake of animals.

Key words: Placental mass, Tswana goats, dry season, supplementation, gestation

INTRODUCTION

The importance of birth weight in livestock is emphasized by the fact that it influences performance of individual later in life. The postnatal growth rate of lambs during the first few weeks is correlated with birth weight[1]. Lower birth weight causes small lambs[2] and small piglets[3] to be at disadvantage when competing with larger siblings for colostrum and feed. Therefore viability of small offspring with low birth weight is greatly reduced[1] since they are vulnerable to infection [2] and dehydration in hot environment[4]. In addition the differences in performance caused by the inability to compete may confound differences due to birth weight[3].

It has been identified that inappropriate maternal nutrition at key stages of pregnancy is one of the major factors leading to low birth weight[2,4,5]. Maternal nutrition and the size of the placenta are well recognized as determinants of foetal growth rate[1]. Placental growth and development of its functional ability are important because they are the means by which the foetus receives metabolic substrates for growth[6] and account for two-third of the variance in foetal weight[1]. Severe underfeeding leading to small placenta causes low fetal growth[1] or spontaneous abortion in goats. However, it has been reported that mild form of underfeeding during the end of first trimester in mature animals promotes high birth weights through enhanced placental growth[5-7].

Paradoxically, maternal overnourishment has been reported to result in restriction in total placental growth leading to a significant decrease in birth weight[2]. In Botswana goats grazing natural pasture and kidding during the dry season are unlikely to become overnourished at any stage of their pregnancy. This is because nutrition is limited and does are moderately underfed throughout most of the pregnancy. Placenta size is likely to be retarded by underfeeding rather than by over feeding. Though a high proportion of Botswana goat population is under suboptimal nutritional conditions in communal areas, there is little information on the effects of nutrition on reproduction of this species. Therefore this study was carried out to understand the effects of nutrition on placental mass of grazing Tswana goats kidding at two different periods during the dry season.

MATERIALS AND METHODS

Location of the study: The study was carried out at the Sebele Station which is situated between latitude of 24° 33'S and longitude 25° 57' E, at an altitude

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of 994 m a.s.l. The vegetation type was has been described by Madibela *et al.*[8]. Grass quality and quantity fluctuate with season, being adequate in months of October-March and in short supply or low in quality in April-September. During the dry season browse supplies most nutrient requirements of goats. The soil type of the area is classified as moderately deep to very deep, imperfectly to moderately well drained, dark brown to red, sandy clay loams to clays[9]. Data for rainfall and temperature for Sebele was collected from Botswana Meteorology Services weather station located approximately 0.5 km from the study site. Mean rainfall for the area is 500 mm. Monthly average minimum and maximum temperature is 12.8 and 28.6°C, respectively.

Experimental design

Experiment 1: Data on placental mass was collected from twins kidding mature (4-6 years) Tswana goats in a flock of 57 animals under four different feeding regimes. The feeding regimes were supplementation, which was switched over in accordance with rainfall pattern. Data was collected from mating to parturition and the feeding treatments were like this; supplementing throughout the trial (SS I), no supplementing at all (NN I), supplementing during the first 103 days of gestation (SN I) and no supplementing during the first 103 days and feed offered thereafter (NS I). Since birthrates were different among the treatment groups, the number of animals from which data was collected was unbalanced. In addition placental tissue for some animals was not available since some animals delivered in the grazing area. This resulted in the following sample sizes; SS I = 11, NN I = 5, SN I = 8 and NS I = 12.

Experiment 2: In this trial, data was collected from twins kidding mature (2-7 years) Tswana goats in a flock of 73 animals under four different feeding managements. The supplementation from mating to parturition was like this; supplementing throughout the trial (SS II), no supplementing at all (NN II), supplementing until 145 days of gestation (NS II) and no supplementing until 145 days of gestation (NS II). Due to different birthrate and the fact that some placental tissue was not available the sample sizes were as follows; SS II = 5, SN II = 8, NS II = 9 and NN II = 6.

Routine management of the animals in both experiments: The supplementary diet composed of 40% sorghum stover, 14% wheat bran, 42% ground maize grain, 2% molasses, 1.4% urea, 0.3% dicalcium phosphate and 0.3 % salt, containing nutrients; 106 g kg^{-1} protein, 10.2 MJ/kg metabolisable energy, 4 g kg^{-1} calcium, 3 g kg^{-1} phosphorous and 244 g kg^{-1} acid detergent fibre. The diet was fed at a rate of 400 and 500 g/animal/day in Experiment 1 and Experiment 2, respectively. Feeding took place in the afternoon when the animals returned from grazing. The amount of supplementary feed consumed varied depending on the condition of the veld and stage of gestation. When the veld condition was good or/and when foetal size limited rumen capacity, the amount consumed would decline. The animals were treated for internal parasites using an anthelmitics (Ivomec, Logos Agrivet, Republic of South Africa) at the beginning of the trial. A plunge dip (9%v/v chlorfenvinphos concentrate, Agricura, Republic of South Africa) was used to control ticks only when infestation was observed.

Female animals were accompanied by Tswana bucks throughout the trial, as is the case in traditional farming system of Botswana. During grazing the four groups moved as one flock and were accompanied by three bucks in Trial 1 and four in Trial 2. The females were separated from the bucks at the night. Conception was estimated to have occurred 150 days prior to the date of birth. Average conception date for Trial 1 was estimated to have occurred in May 2000 and February 2001 for Trial 2. Doe parturition weights (DPW) and birth weights were recorded within 24 h. According to Mellor[1] variable autolysis of placental tissue occurs within one to six after birth so it is important to weight the placenta as soon as possible. After the placenta was delivered it was cleaned of debris and weight while still fresh.

Statistical analysis: Weights from the twins were added together to get total weight per doe (TBW). Analysis on TBW, DPW and Placental Mass (PM) was performed using the General Linear Models (GLM) procedure[10]. Goats in which pregnancy did not occur or aborted were excluded from the analysis. Those of which PM was not available were only included in TBW and DPW analysis. When TBW and PM were analysed DPW was used as a co-variate. Differences between specific treatments were tested for significance by least significant difference (LSD). Correlations between PM and TBW, between DPW and TBW and between DPW and PM were calculated. Means are reported as least square means ± standard error.

RESULTS

Trial 1: There was a treatment and DPW effect ($p<0.01$) on TBW. Does from SS I gave birth to heaver twins while NN I, NS I and SN I had similar TBW. PM was not ($p>0.05$) affected by treatment or DPW. SN I does tended ($P= 0.095$) to have heavier PM than NN I. There was no ($p>0.05$) treatment effect on DPW. Table 1 shows effects of treatment on TBW, PM and DPW.

Table 1: Effects of treatment on TBW, PM and DPW when supplementation was either stopped or introduced at day 103 of gestation

Variable	SS I	SN I	NS I	NN I	Probability level
TBW (kg)	6.10±0.18a	5.20±0.21b	5.50±0.17b	5.10±0.27b	0.007
PM (kg)	0.58±0.07	0.60±0.07	0.56±0.06	0.39±0.09	0.34
DPW (kg)	39.60±1.30	40.00±1.60	38.20±1.30	36.40±2.00	0.45

TBW was significantly ($p<0.01$) correlated ($r = 0.47$) with DPW. No significant correlation ($r = 0.28$, $p>0.05$) was observed between PM and TBW. However PM tended to be correlated ($r = 0.31$, $P=0.067$) with DPW.

Trial 2: There was no ($p>0.05$) treatment and DPW effect on TBW. Treatment also did not ($p>0.05$) have an effect on PM. PM from SN II was heavier than that from NN II but was similar to those from SS II and NS II. PM was affected ($p<0.05$) by DPW. Treatment had an effect ($p<0.05$) on DPW. Table 2 shows treatment effects on TBW, PM and DPW. DPW of NS II was lower that than of SS II, SN II and NN II.

Table 2: Effects of treatment (SS II, SN II, NS II and NN II) on TBW, PM and DPW when supplementation was either stopped or introduced at day 145 of gestation

Variable	SS II	SN II	NS II	NN II	Probability level
TBW(kg)	6.3±0.39	6.0±0.26	5.7±0.28	5.7±0.30	0.63
PM(kg)	0.55±0.07bc	0.60±0.05ab	0.54±0.06bc	0.44±0.06c	0.23
DPW(kg)	49.50±2.6a	48.90±2.0a	41.2±1.90b	48.9±2.3a	0.02

TBW tended ($p = 0.08$) to be correlated ($r = 0.35$) with DPW. PM was significantly ($p<0.05$) correlated with TBW ($r = 0.44$) and DPW ($r = 0.49$).

DISCUSSION

Although the number of cotyledons is fixed by day 30 of gestation, growth of the placenta continues until the end of the second trimester (day 100)[2]. In Experiment 1, abruptly stopping of supplementation of does at the end of the second trimester (SN I) resulted in high but a non-significant increase in placental mass and doe parturition weight compared to all other groups. Total birth weight of SN I was lower than that of SS I, however it was similar to that of NS I and NN I. Moderately underfeeding ewes for 85 days reduces foetal growth rate irreversibly[1]. In Trial 1, it seems no supplementation for 100 days (NS I), which is similar in length of time to 85 days, did not adversely affected birth weight. These results are in contrast to those reported by Wallace *et al.*[2] in which an abrupt decrease in feed at day 50 of gestation in sheep reduced birth weight. In the present study, at 100 days growth the placental mass was well consolidated resulting in high PM but interestedly no improved birth weigh. According to Mellor[1], maternal nutrition, as indexed by doe parturition weight in the present study, is one of the major determinant of foetal growth. In the present study the effects of doe parturition weight, which was correlated to total birth weight and not placental mass, suggesting that at 100 days of gestation, placenta size did not influence birth weight. This is despite the low placental size recorded for the non-supplemented group (NN I). Wallace *et al.*[2] reported that at 103 days of gestation a growth-restricted placenta did not grossly compromise foetal organ size since at this stage the foetus has only reached 25% of its predicted birth weight. Results of Trial 1 suggests that supplementing pregnant does to improve both PM and TBW should start only after day 100 of pregnancy because that the time when both foetal and placental mass grows rapidly.

When well-fed ewes are severely underfed during late pregnancy, foetal growth rate decrease within three days by about 45%[1]. Responses in birth weight to alterations in metabolisable energy intake in late pregnancy vary greatly with differences in genotype and maternal reserves[4]. In Trial 2, though there was difference in placental mass, this was not due to treatment. Abrupt cessation of supplementation in SN II group increased placental mass compared to NN II. However, total birth weight was similar between treatments. It seems a different mechanism were used by SN II and NN II does to maintain similar birth weights. In contrast to evoking growth of placental tissue as a strategy for maintaining foetal growth, NN II does may have relied on maternal nutrition from the range to supply nutrients to the fetuses. Thus for NN II the range provided enough nutrients to meet the needs of the rapidly growing fetuses at 145 days. A few weeks before mid-pregnancy the veld condition improved due to rain that fell in April.

In terms of feed cost, Trial 1 (i.e. animals mated in March-April) is indicating that it may be useful to start supplementing pregnant does only after day 100 of gestation to reduce feed cost. For Trial 2 the animals were mated earlier and cessation of supplementation occurred while forage was still good. Rainfall fell late in the season resulting in good quality feed during the earlier months of winter, which under normal circumstance forage quality will be deteriorating. This resulted in similar birth weight hence supplementation was not necessary. In conclusion feeding grazing animals to improve birth weights should depend on the condition of the veld. In addition, the model of a grazing animal to assess the influence of placental mass on birth weight is flawed because of the difficulty to control precisely how much the animal consume.

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