Effects of concentrate diets supplementation of pregnant Kalahari Red goats grazed on Chloris gayana on performance characteristics in South-Western Nigeria

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Effects of concentrate diets supplementation of pregnant Kalahari Red goats grazed on *Chloris gayana* on performance characteristics in South-Western Nigeria

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Abstract. The amount of meat and milk produced depends largely on the performance of does during and after pregnancy among other factors. High performing does have the tendency of producing more milk and healthy kids with reasonable weight at birth compared to least performing does. Thus, increased meat and milk production. A study was conducted to investigate the effects of concentrate diets supplementation of pregnant Kalahari Red goats grazed on Rhodes grass (C*hloris gayana*) on their performance characteristics. A total of 33 primiparous Kalahari Red does between 2-2$^1/_2$ years with an average body weight of 38.10 ± 1.13 kg were randomly allotted to 3 treatments consisting of 11 does per treatment for a feeding trial that lasted for 22 weeks. Concentrate diets with CP levels of 12.42% (LPD; 124.93 g day^{-1}), 14.18% (MPD; 145.87 g day^{-1}) and 16.35% (HPD; 168.19 g day^{-1}) were fed to the does at 3% of their body weight from mating till kidding. Data obtained were subjected to ANOVA in a completely randomized design at 5% probability level using SAS® 9.1 Statistical package. It was observed at the end of the study that pregnant Kalahari Red does fed MPD recorded highest values for weight gain (20.57 kg); net weight gain (10.73 kg); daily weight gain (135.87 g day^{-1}); and daily weight gain less foetal and afterbirth weights (71.06 g day^{-1}) compared to other does. From the results of this study, it can be concluded that dietary supplementation of grazing pregnant Kalahari Red does with concentrate diet containing 14.18% CP had the best performance characteristics for increased meat and milk production.

Keywords. Kalahari Red goat – Pregnancy – Performance characteristics – Grazing – Concentrate supplementation.

Effets de la supplémentation en concentré sur les caractéristiques de performances chez des chèvres gestantes de race Kalahari Rouge broutant Chloris gayana, dans le Sud-Ouest du Nigeria

Résumé. *La quantité de viande et de lait produits dépend largement des performances des chèvres pendant et après la gestation, entre autres facteurs. Les chèvres à fortes performances tendent à produire plus de lait et de chevreaux sains ayant un poids raisonnable à la naissance, comparées aux chèvres à moindres performances. Ainsi la production de viande et de lait est augmentée. Une étude a été menée pour examiner les effets de la supplémentation en concentré sur les caractéristiques de performances chez des chèvres gestantes de race Kalahari Rouge broutant l'Herbe de Rhodes (Chloris gayana). Un total de 33 chèvres primipares Kalahari Rouge entre 2-2,5 ans avec un poids corporel moyen de 38,10 ± 1,13 kg ont été réparties au hasard en 3 traitements avec 11 chèvres par traitement pour un essai d'alimentation qui a duré 22 semaines. Des régimes à concentré ayant des niveaux de PB de 12,42% (LPD ; 124,93 g/jour-1), 14,18% (MPD ; 145,87 g/jour-1) et 16,35% (HPD ; 168,19 g/jour-1) ont été distribués aux chèvres à 3% de leur poids corporel depuis la mise à la lutte jusqu'à la mise bas. Les données obtenues ont été soumises à ANOVA selon un dispositif complètement aléatoire avec un niveau de probabilité de 5% en utilisant le logiciel statistique SAS® 9.1. Il a été observé qu'à la fin de l'étude, les chèvres gestantes Kalahari Rouge recevant MPD ont enregistré les plus fortes valeurs pour le gain de poids (20,57 kg) ; le gain de poids net (10,73 kg) ; le GMQ (135,87 g/jour-1) ; et le GMQ moins le poids fœtal et pla-*

centaire (71,06 g/jour-1) comparées aux autres chèvres. D'après les résultats de cette étude, on peut conclure que la supplémentation alimentaire des chèvres gestantes de race Kalahari Rouge au pâturage, avec un concentré contenant 14,18% de PB permettait de meilleures performances pour une production accrue de viande et de lait.

Mots-clés. *Chèvre de race Kalahari Rouge – Gestation – Caractéristiques de performances – Broutage – Supplémentation en concentré.*

I – Introduction

The Kalahari Red is regarded as an indigenous goat breed that originates from South Africa with characteristics such as adaptation to arid and semi-arid savannah, good foraging and excellent mothering abilities. It is regarded as a "minimum care/ maximum profit" breed (Ramsay *et al*., 2001). For animals kept primarily for meat production, reproductive rate is the most important factor contributing to the efficiency of production (Shelton and Willingham, 1992). Reproductive performance of goats is a major determinant of productivity and economic viability of commercial goat farms (Mellado *et al.,* 2006). The reproductive process is regulated by genetic and environmental factors (Guerra *et al*., 2011; Notter, 2012) such as feeding regime and other management practices.

Some Kalahari Red goats were imported from South Africa to the Institute of Food Security, Environmental Resources and Agricultural Research IFSERAR, Federal University of Agriculture, Abeokuta, Nigeria in September, 2011 for improvement of Nigerian indigenous goats in terms of meat and milk production. In order to manage the Kalahari Red goats efficiently and to also properly utilise them for the purpose of importation there is need to know their dietary requirements for optimal performances since little or no information was available on these, most especially reproductive and growth performances. Therefore, this study was conducted to investigate the effects of concentrate diets supplementation of pregnant Kalahari Red goats grazed on Rhodes grass (C*hloris gayana*) on their performance characteristics in South-Western Nigeria.

II – Materials and methods

1. Site of the experiment

The study was conducted at the Kalahari Red Goat Unit of Livestock Production Research Programme, Institute of Food Security, Environmental Resources and Agricultural Research (IFSERAR), Federal University of Agriculture Abeokuta (FUNAAB), Ogun State, Nigeria. The region is 76m above the sea level and falls within latitudes 7º18'2"N and 7º18'30"N; and longitude 3º22'10"E and 3º22'41"E. The climate is humid and located in the forest zone of South-Western Nigeria. The mean annual precipitation and the temperature are 1,330mm and 29.3^{0}C respectively, with an average relative humidity of 80% throughout the year (ORBDA, 2013).

2. Animal management and experimental procedure

A total of 33 matured Kalahari Red does of parity one within age range of 2 to 2$^1/_2$ years with an average body weight of 38.10 ± 1.13 kg were used. Flushing of the does was done two weeks before the commencement of experiment, while flock treatment was also carried out prior to mating for general control of infection(s) from insect vectors and pathogens. Gentamycin was administered intramuscularly as broad-spectrum antibiotics, while Taktik was administered to combat ecto-parasites using knapsack sprayer.

Experimental animals used were selected from Kalahari Red flock of 68 dry does. To ensure that only does on heat were selected, three (3) experienced and proven vigorous Kalahari Red bucks

were introduced into the flock to detect does on heat. Does that exhibited signs of heat were removed from the flock, and then placed in a holding pen. The selected does were ear-tagged and randomly assigned to three pen houses used for the study. Each of the pen houses measured 18.79 m x 5.15 m out of which 9.09 m lengthwise was covered with slates as shed against adverse weather conditions. The floor of the pens is cemented, with a slight slope to ease draining of urine and other liquid substances. There was also perimeter fencing round the pen houses with strong iron net to confine and restrict the movement of the does. The surrounding of the pen houses was kept clean always, with bush cut to ground level at all time. Weight of individual doe was determined using Avery weigh-Tronix® Digital scale- 400 kg capacity before they were pen-mated. The mating was done by introduction of 3 Kalahari Red bucks into the pen houses (i.e. a buck per pen). Proper observation was done to ensure that mating was successful before data collection commenced.

The does, after mating were fed experimental concentrate diets at three levels of protein, viz.- Low Protein Diet (LPD- 12.42% CP; 14.95 MJ/kg DM), Medium Protein Diet (MPD- 14.18% CP; 15.64 MJ/kg DM) and High Protein Diet (HPD- 16.35% CP; 15.60 MJ/kg DM) as supplements to forage (*Chloris gayana*) on the paddock which resulted to daily CP intakes of 124.93 g day^{-1}; 145.87 g day^{-1}; and 168.19 g day^{-1} from the respective diet. LPD, MPD and HPD were fed to the pregnant does at 3% of their body weight on dry matter basis. Each experimental diet was fed to eleven (11) pregnant does.

The nutrient composition of Rhodes grass according to Oderinwale (2014) is DM- 39%; CP- 3.24%; Fat- 0.15%; Ash- 3.33%; NFE- 29.39%; OM- 96.67%; NDF- 58.92%; ADF- 46.72%; ADL- 24.82%; Hemicellulose- 12.20%; Cellulose- 21.90% and ME- 14.56 MJ/kg DM (determined using MAFF, 1984 equation)

3. Feeding trial

A feeding trial of 22 weeks (153 days) was carried out on the pregnant does. Live weight of each doe was taken at the beginning of the experiment (when mating was confirmed successful) for three consecutive days and the mean weights were recorded as initial weight. Thereafter, individual animal was weighed on weekly basis before feeding throughout the experimental period. Final live weight of each doe was taken on week 22 i.e. within 24 hours prior to kidding and within 24 hours after kidding.

The does were fed the experimental diets (i.e. concentrates) throughout the feeding trial twice a day. Half of the portion was fed in the morning by 8:00h and the remaining half in the evening by 16:30h. The does after feeding on concentrate diets were led to an established 16Ha sole-pasture planted with Rhodes grass (*Chloris gayana*) by 10:00 h. This allowed some level of sunshine before grazing commenced. By 16:00h, the does were returned, and then offered concentrate for the evening portion. Total concentrate refused each day was recorded before fresh concentrates were offered the following day. Fresh and clean drinkable water was made available to the does daily *ad libitum*.

4. Data collection

The following data were collected on the performance characteristics of the does. Different weight parameters were taken using an Avery Weigh-Tronix® Digital scale- 400 kg capacity.

- **Initial weight of the does**: this was the weight of the experimental does taken at mating;
- **Final weight of the does:** this was the weight of the does taken within 24 hours before kidding;
- **Does' Live-weight after Kidding:** this was the weights of the does taken within 24 hours after kidding. Before the weight was taken, it was ensured that the placenta, umbilical cord together with other foetal membranes like allantois, chorion and amnion (together with amniotic fluid) were expelled;

- **Live-weight Changes of Does during Gestation:** this was determined by taking the initial weight of the does at mating followed by subsequent weighing of the pregnant does weekly until the last doe kidded on the 22nd week (153rd day) of the study;
- **Feed consumption and refusal:** this was determined by taking the weight of concentrates remaining each day throughout the experimental period. The difference between total concentrate remaining and total concentrate fed daily gave feed consumed per day;
- **Gestation Length of the Does:** this was estimated by determining length of time (in days) between successful mating and kidding for each of the does fed the experimental diets;
- **Litter Weight:** this was obtained by taking weight(s) of all the new-born kid(s) per doe together after their bodies were dried off either by natural air or with the use of dry towel to absorb fluid on their bodies within 24 hours after kidding;
- **Afterbirth Weight:** This was the weights of placenta, umbilical cord and foetal membranes such as allantois, chorion and amnion (together with amniotic fluid) that were expelled from uterus after kidding. This was determined by taking the weights of does that were about to kid (within 24 hours before kidding) and the weights of does that kidded within 24 hours post-kidding (after the expulsion of placenta). The resultant difference between the weight before kidding and doe's weight within 24hrs post-kidding plus litter weight per doe gave the afterbirth weight.

5. Performance characteristics formulae

Metabolic weight gain ($kgW^{-0.75}$)= $[(\text{Initial Weight (kg)} + \text{Final weight (kg)})/2]^{0.75}$

Metabolic Initial Weight ($kgW^{-0.75}$)= $(\text{Initial Weight (kg)})^{0.75}$

Metabolic Final Weight ($kgW^{-0.75}$)= $(\text{Final Weight (kg)})^{0.75}$

Weight Gain (kg)= Final weight (kg)- Initial weight (kg)

Weight Gain ($gday^{-1}$)= (Weight gained (g)) / Gestation Length (days)

Gross weight gain (kg)= Weight within 24hrs before kidding (kg)-Weight at Mating (kg)

Net weight gain (kg)= Weight within 24hours after kidding (kg)- (Weight at Mating (kg))

Weight gain less foetal and afterbirth weights ($gday^{-1}$)= (Net weight gain (g)) / (Gestation Length (days))

Afterbirth Weight (kg)= Weight within 24hours before kidding (kg) – (weight within 24 hours after kidding (kg) + Litter weight within 24hours but after drying (kg))

6. Data analysis

Data collected at the end of the study were subjected to One-way Analysis of Variance (ANOVA) by following the procedure of SAS® 9.1 Statistical package (SAS, 2002). Levels of significance were taken at 5% probability, while the significant means were separated using Duncan's Multiple Range Test (Duncan, 1955).

III – Results and discussion

The Performance characteristics of pregnant Kalahari Red does grazing on Rhodes grass (*Chloris gayana*) supplemented with three concentrate diets is presented in Table 1. Kalahari Red does supplemented with MPD was most superior in terms of performance characteristics. This was because it recorded highest values for all the performance parameters taken such as weight gain, net weight gain, and daily weight gain. When crude protein (CP) in excess of what is required by

ruminants is supplied through the diet, there will be a resultant loss of nitrogen through the faeces and urine (Oderinwale, 2014). In addition to this, pregnant Kalahari Red does fed MPD recorded best crude protein digestibility, nitrogen retention and digestibility according to Oderinwale (2014). This suggested that does fed MPD were able to utilise the concentrate diet for necessary body metabolic activities, thus improved performance characteristics of the does. The initial live weight of the does before pregnancy and weight of the does within 24hours before kidding were not statistically different, but does assigned to LPD were marginally heaviest at mating compared to other dietary supplementations. It was observed that dietary concentrate treatments influenced weight taken within 24hours post-kidding. Some authors (Akingbade *et al.,* 2001; Rastogi *et al.*, 2006) reported that weights taken within 24 hour post-kidding were not affected. This may be due to initial weights and nutrient utilisation by the does used in these studies. Gross weight gain range of 15.18-20.57 kg was obtained. Medium and high protein diets recorded the highest and lowest values respectively. Akingbade *et al.* (2001) and Rastogi *et al.* (2006) reported gross weight gains of 9.71-12.57 kg and 4.0-7.2 kg respectively, where does placed on higher protein diets recorded the highest values in their respective studies. Similarly, some authors (Bawala *et al.,* 2006; Olomola *et al.,* 2008) reported lower values of gross weight gains for pregnant West African Dwarf goats. The values reported by these authors were lower than what was obtained for this study; the reason may be attributed to variation in the period the final weights were taken.

Table 1. Performance characteristics of pregnant Kalahari Red does grazing on Rhodes grass (*Chloris gayana*) supplemented with three concentrate diets

	Experimental concentrate diets			
Parameters	**LPD**	**MPD**	**HPD**	**SEM**
Initial live weight (kg)	40.68	37.34	36.20	1.13
Final live weight (kg)	57.53	57.91	51.38	1.48
Live weight within 24hours post-kidding	49.22^{a}	48.07^{ab}	43.28^{b}	1.15
Metabolic weight gain ($kgW^{-0.75}$)	15.33	14.91	14.11	0.28
Metabolic initial live weight ($kgW^{-0.75}$)	16.10	15.08	14.75	0.34
Metabolic final live weight ($kgW^{-0.75}$)	20.87	20.97	19.19	0.41
Gross weight gain (kg)	16.85^{ab}	20.57^{a}	15.18^{b}	0.97
Net weight gain (kg)	8.54	10.73	7.08	0.74
Daily weight gain ($gday^{-1}$)	111.76^{ab}	135.87^{a}	100.57^{b}	6.43
Daily weight gain less foetal and afterbirth weights ($gday^{-1}$)	56.56^{b}	71.06^{a}	46.89^{c}	3.00

^{abc} Means on the same row having different superscripts were significantly different ($p<0.05$).

LPD- Low Protein Diet; MPD- Medium Protein Diet; HPD- High Protein Diet; SEM- Standard Error of Means.
Initial weight is live weight at buck's introduction; **Final weight** is live weight taken within 24hrs before kidding.

Net weight gain of the does (i.e. gross weight gain less products of pregnancy) ranged from 7.08 to 10.73 kg, the value which was highest and lowest for medium and high protein diets fed does respectively. This improvement in net gain was possible because does placed on MPD recorded the lowest values for all pregnancy variables especially afterbirth weight (Oderinwale *et al.*, 2016). The reduction in these pregnancy variables indicated that there was a nutrient balance between the does and the developing foetuses for maternal body tissues development. The does were gaining more body weight simultaneous as the pregnancy advanced. Akingbade *et al.* (2001) and Rastogi *et al.* (2006) reported lower values which ranged from -0.50 to 2.94 kg and 1.3 to 2.9 kg in their respective studies. This may be due to variation in breeds, and higher weights of products of pregnancy obtained (in comparison to weights of the does) in their studies. This is because weight of products of pregnancy is dependent on the breed and weight of the dam. Heavy breeds of goat with much weight tend to have much weight for products of pregnancy and vice versa. Daily weight

gain range of 100.57-135.87 g day^{-1} was obtained for the does. Does fed medium and high protein diets recorded highest and lowest values respectively. Similarly, average daily weight gain (less foetal and afterbirth weights) of between 46.89-71.06 g day^{-1} was obtained, where does supplemented with medium and high protein diets also recorded highest and lowest values respectively.

Figure 1 shows weight changes from mating to kidding and within 24hour post-kidding of pregnant Kalahari Red does grazing on Rhodes grass (*Chloris gayana*) supplemented with three concentrate diets**.** The usual changes in the live weight during gestation are often assumed to be indicative of prenatal development of foetus(es) (Amoah *et al*., 1996). Therefore changes in the weight of pregnant does can be used to monitor the development of foetus(es) and health of the does. However, reductions at some points in time during pregnancy may be due to some factors other than nutrition and health of the doe which are unexplainable. Weight changes of the does from mating to kidding and within 24hours after kidding for this study showed that weight gain across pregnancy was progressive in nature, which produced a non-linear graph. This indicated that at a point in time, weight of the does either dropped or same value recorded which picked up later in subsequent week(s). For low protein (12.42%) diet supplemented does, there were reductions in weight at weeks 4 (from 42.5 kg to 39.7 kg), 13 (from 48.1 kg to 48.0 kg), 15 and 16 (51.6 kg, no weight gained). Furthermore, for does fed medium protein (14.18%) diet, weeks 7 (from 40.9 kg to 40.0 kg), and 10 (from 43.5 kg to 43.2 kg) experienced reductions in their gross weight gain. Weeks 12-14 recorded same weight (43.6 kg) and there was a reduction in weight at week 19 (from 48.9 kg to 48.6 kg) for does supplemented with high protein (16.35%) diet. This weight changes from mating until kidding were similar with the results of other authors (Dayeh *et al.,* 1996; Akingbade *et al.*, 2001) who reported graphically, non-linear nature of pregnancy graphs and reductions in weight gain during pregnancy.

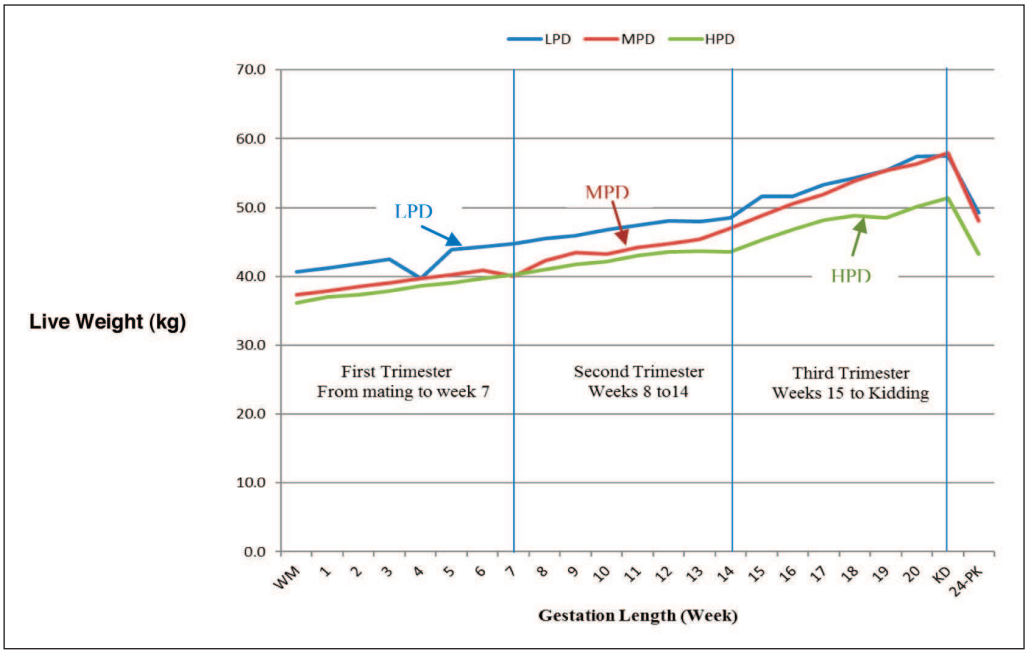

Fig. 1. Weight changes from mating to kidding and within 24hour post-kidding of pregnant Kalahari Red does grazing on Rhodes grass (*Chloris gayana*) supplemented with three concentrate diets. LPD- Low protein diet; MPD- Medium protein diet; HPD- High protein diet; SEM- Standard error of means; WM- Weight taken at mating; KD- Weight taken at kidding; 24-PK- Weight taken within 24hours post-kidding.

IV – Conclusion

It can be concluded based on the results obtained from this study that pregnant Kalahari Red does grazed on Rhodes grass (*Chloris gayana*) with medium protein diet (14.18% CP; 145.87 g day^{-1}) supplementation had the best performance in terms of weight gains which are indicators of improved milk and meat yields of the animals.

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