EFFECT OF PLANE OF NUTRITION OF THE DOE ON THE BIRTH WEIGHT, SURVIVAL RATE AND VIGOUR OF KIDS OF GWEMBE VALLEY GOATS

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The effect of plane of nutrition on the birth weight and survival rate of kids of Gwembe valley goats in Zambia was investigated in a completely randomized design experiment in which three levels of protein and energy were fed to pregnant does. The diets designated as HL (high protein, low energy), MM (medium protein, medium energy) and LH (low protein, high energy) were used in the trial. The goats had initial average body weight of 23.2 ± 0.82 and 18–24 months of age. The goats received equal amount of concentrate and hay twice a day. Mean birth weights of female and male kids were 0.96 ± 0.02, 1.12 ± 0.03 and 1.50 ± 0.18; 1.52 ± 0.82, 2.07 ± 0.22 and 1.75 ± 0.28 kg for HL, MM and LH diets, respectively. Mean birth weights of kids (male and females) were 1.24 ± 0.42, 1.60 ± 0.13 and 1.63 ± 0.23 kg for HL, MM and LH, respectively. Female birth weight was higher ($P < 0.05$) in LH than in HL. However, the difference between LH and MM in female kids birth weight was not significantly different ($P > 0.05$). Birth weight of male kids was higher ($P < 0.05$) in MM than in HL and LH. Mean birth weight of all kids was lower ($P < 0.05$) in HL than in MM and LH, however there was no difference between MM and LH ($P < 0.05$). As to the sexes, male birth weights were higher ($P < 0.05$) than the females in all the treatments. Survival rate was best in MM, followed by HL and least in LH. All the kids on MM survived until the trial was terminated. While HL lost two kids, LH lost one. Mortality was observed in two female kids and one male. Male kids had higher vigour score than the females. LH kids had the highest vigour, followed by MM and the least in HL. Results seem to indicate that plane of nutrition of the doe has a significant influence on the performance of kids in terms of birth weight, survival rate and vigour. Based on the results of this trial, it seems a diet that contains a medium to high energy (13.20–14.60 MJ GE/kg) and a medium protein (13.40 CP) value is ideal for the Gwembe valley doe. Thus it could be concluded that medium protein and medium energy diets should be considered ideal for pregnant Gwembe valley does.

Gwembe valley goats; nutrition; protein level; energy level; kids; birth weight; survival rate; vigour

INTRODUCTION

The goat regarded as the poor man's cow is next to poultry as a potential source of meat to meet the increase demand for dietary protein of animal origin by the teeming population of the developing countries of the world. The goat therefore occupies a special place in almost every household. Livestock are an important and integral part of most farming systems in Zambia and indeed the goat in some provinces is a major asset. Subsistence and emerging farmers throughout the provinces of Luapula, Northern and Southern rely on their indigenous goat for meat and as a source of family income.

In Zambia, the Gwembe valley is the most suitable place for goat husbandry. Zambia's goat population as at 1990 was estimated at 384,000 (Kasonde, 1990), however recent report by Lovelace et al. (1993) puts the population at 500,000, and herd sizes varied from 3 to 300 goats with a buck: doe ratio of 1 : 18. Zambia's small holder farmers attach much importance to the local breed therefore it is important to raise healthy kids as a replacement stock. Information on the birth weight of kids of the local breed in Zambia is scant.

Except for the reports of Aregheore et al. (1992), Lungu et al. (1992), Lovelace et al. (1993) and Aregheore (1994), very little is known about the nutritional requirements and performance of pregnant Gwembe valley goats. There are reports that the nutrition of the pregnant doe has influence on the survival of the kids (Thomson, Thomson, 1948; Gill, Thomson, 1954; Sachdeva et al., 1973). Since the kids of today are the does and bucks of tomorrow it therefore becomes imperative to investigate how the nutrition of pregnant Gwembe valley does influence the birth weight and survival rate of their kids. The objective of this study therefore is to contribute to the knowledge on the effect of plane of nutrition of pregnant goats on the birth weight, survival rate and vigour of kids.

MATERIAL AND METHODS

Nine pregnant Gwembe valley goats, with a mean live weight of 23.20 ± 0.82 kg and between 18–24 months old were divided into three groups in a completely randomized design experiment. The goats were subjected to synchronized mating and were nine weeks pregnant at the start of the trial. They were randomly divided according to body weight and fed three diets that were formulated to contain three different protein and energy levels. The diets fed had the following protein and energy – 14.30, 13.40 or 121.20, and 12.20, 13.30 or 14.60 MJ GE/kg. The diets were designated as HL, MM and LH. The first letter in each diet designated protein while the second letter designated energy respectively. Tab. I presents the particulars of the experimental diets offered.

The does were housed individually in pens of concrete floor and separated from each other with wire mesh. The floors were covered with wood shavings to serve as litter materials, and these were changed on a regular basis. To each of the pens were attached a rack for hay feeding. Also each pen had provision for feeding and watering troughs. Each goat, based on the experimental group, received 1.50 kg of concentrate and 1.00 kg of hay (*Hyparrhenia* spp.) in two equal portions at 8.30 h and 17.30 h. The does body weights were estimated on a weekly basis using the heart girth measurement and the formula: weight of goat = 0.879 (heart girth in cm) – 33.78 (Lungu, unpublished data) was used. Records of individual feed intakes and body weights were kept. At kidding assistance was available to the does if required. Immediately after kidding the doe and the kid(s) were weighed. The kids were weighed with a 50kg spring balance with an accuracy of 10 kg. Survival rate (mortality) and vigour of kids were also observed for 4 weeks before the does and kids were handed over. Concentrate feeds and the hay offered were processed and analyzed according to AOAC (1980). The methods outlined by Goering and Van Soest (1970) were used for NDF, ADF and ADL. Hemmicellulose was calculated by difference between NDF and ADF, while cellulose was by difference between ADF and ADL plus ash. Gross energy values of concentrates and hay were determined by a bomb calorime-

I. Composition of experimental diets fed to pregnant does until kidding (air dry basis)

Ingredients (%)	Treatments*		
	HL	MM	LH
Maize	19.90	19.90	25.90
Malt screenings	29.90	32.70	35.70
Maize bran	30.70	29.90	23.90
Sunflower meal	17.50	15.50	12.50
Mineral-vitamin mix**	1.50	1.50	1.50
Salt	0.50	0.50	0.50
Total	100.00	100.00	100.00

* First letter in each treatment designated protein level, while the second designated energy level; H – high, M – medium, L – low

** Supplied the following: 500,000 i.u. vitamin A, 1,250,000 i.u. vitamin D_3, 1,330 mg cobalt, 250 g calcium, 22,570 mg copper, 41,730 mg iron, 44,180 mg manganese, 38,220 mg zinc and 11,340 mg magnesium

ter (Adiabatic Bomb, Parr Instrument Co., Moline IL) using thermo-chemical benzoic acid as a standard. Vigour score was carried out by observation and a four (4) point scale was used. The scoring results were converted into numbers and these were subjected to analysis of variance and differences among means were assessed by Turkey's multiple range test. All data on feed intake, birth weight of does after kidding, kids birth weights were subjected to analysis of variance (Steel, Torrie, 1980) and where significant differences occurred, Bonferronit's statistics were utilized for comparison among treatment means (Gill, 1978).

RESULTS AND DISCUSSION

Data on the proximate chemical composition of concentrate and hay offered are presented in Tab. II, while Tab. III presents data on the effect of dietary protein and energy densities on body weight of does before and after kidding, voluntary fed intake and kids birth weight, respectively. Voluntary concentrate and hay intakes were not significantly different ($P > 0.05$) among the does in the different treatments. Mean birth weight of female kids was 0.96 ± 0.02, 1.12 ± 0.05 and 1.50 ± 0.18 kg for HL, MM and LH. Birth weight of female kids was significantly ($P < 0.05$) different and does on LH diet had the best birth weights, followed by MM and the least HL. Mean birth weight of male kids were 1.52 ± 0.85, 2.07 ± 0.22 and 1.75 ± 0.18 kg for diets HL, MM and LH, respectively. MM kids were higher ($P < 0.05$) in birth weights than HL and LH, however, LH was higher than HL. Birth weight of male kids was higher than the females in the three treatments. Mean birth weight of all kids (males and females) were 1.24 ± 0.42, 1.60 ± 0.13 and 1.63 ± 0.23, respectively, for HL, MM and LH diets. There were no significant differences ($P > 0.05$) between LH and MM, however, significant ($P < 0.05$) differences were observed between HL and the other diets. Voluntary feed intakes had no influence on birth weight of kids, rather than the densities of the two major nutrients, protein and energy had influence.

It was observed that HL diet that had the highest protein but the least energy content had the lowest birth weight for females, males and the mean. However the does that received MM and LH (medium-high energy and medium-low protein) had the best male, female and mean birth weights. The results obtained seem to demonstrate that energy is more crucial than protein in the diets of the pregnant doe, since the does that received the high protein but low energy diet had low kids birth weights, and the results agreed with the earlier reports of Sachdeva et al. (1973) and Aregheore et al. (1992) for pregnant does.

The birth weights obtained in this trial are lower than the values obtained by Ndlovu and Sibanda (1993), who reported that birth weight of kids was not affected by level of feeding of the doe pre-partum, but there was evidence of interaction between pre- and post-partum levels of feeding of doe on kid weights at 42 and 105 days. Also birth weights reported by Hassan (1989) are higher than the values obtained in this report.

The breed, location of trial and probably the period of the year at which the different trials were carried out may be implicated for the variations

II. Proximate chemical composition of diets and hay

Nutrients (%)	Treatments			
	HL	MM	LH	hay
Dry matter	91.70	93.70	92.70	92.90
Crude protein	14.30	13.40	12.20	3.90
Ash	4.70	5.20	6.60	5.40
Ether extract	5.70	5.50	5.20	0.87
NDF	30.90	32.50	37.90	78.70
ADF	22.50	23.40	25.50	41.10
ADL	4.00	5.20	6.70	11.50
Hemicellulose	8.40	9.10	12.40	37.60
Cellulose	23.20	23.40	25.40	35.00
GE MJ/kg	12.20	13.30	14.60	9.10

III. Effect of dietary protein and energy densities on body weight of does before and after kidding, voluntary feed intake and kids birth weight

Parameters	Treatments		
	HL	MM	LH
Body weight of does before kidding (kg)	25.47 ± 0.90	27.01 ± 0.10	24.83 ± 0.18
Body weight of does after kidding (kg)	21.42 ± 0.18	22.57 ± 0.01	20.23 ± 0.35
Average daily feed intake concentration + hay (kg)	1.11 ± 2.06	1.28 ± 1.35	1.14 ± 0.54
Mean birth weight of female kids (kg)	0.96 ± 0.02^{c}	1.12 ± 0.03^{ab}	1.50 ± 0.18^{a}
Mean birth weight of males (kg)	1.52 ± 0.82^{b}	2.07 ± 0.22^{a}	1.75 ± 0.28^{ab}
Mean birth weight of kids – females and males (kg)	1.24 ± 0.42^{c}	1.60 ± 0.13^{a}	1.63 ± 0.23^{a}

a, b, c – values on the same row with different superscripts differ significantly ($P < 0.05$)

observed. Males were observed to have higher birth weights than the females in all the diets. The results obtained in this trial on male weight are in agreement with Singh et al. (1990), Gokhale et al. (1996) and Iyeghe et al. (1996) who reported that males had higher birth weight than females. The effect of sex on birth weight of kids could be due to gene effects associated with sex differentiation and differential prenatal growth of male and female kids (Singh et al., 1990).

Earlier, Williams (1968) attributed the advantage of males over females in birth weights to the hormonal influence of the androgens which stimulate protein anabolism, and increased nitrogen and mineral retention for growth and development. Although data are not provided for single and twin birth weights, it was interesting to note that the birth weight of the single births obtained in HL and LH were heavier than the twins in all the treatments. Between the two groups the single kid of LH was heavier than the HL fed doe. Singh et al. (1990) and lately Gokhale et al. (1996) reported that single births had heavier birth weights than twins and triplets.

Tab. IV presents data on the number of kids per treatment, sex, type of birth (single or twins), survival rate (mortality) and vigour score. The number of kids per dietary treatment were 5, 6 and 5 for HL, MM and LH, respectively. For the treatments the following sexes were recorded: HL – 4 males, 1 female, MM – 4 males, 2 females and LH – 3 males, 2 females. Twins were higher than single births. There is no evidence to show the influence of dietary treatment on the sex, and type of birth (single or twins) in this study. Survival rate and vigour were however influenced by dietary treatments. HL lost 2 kids, a female and a male, after four days and one week of birth, respectively, after kidding, while LH lost a female kid five days after kidding. The survival rate (mortality) obtained in this trial agreed with Quartermain (1975), who reported 21% kid mortality for the Zambian indigenous goat. Vigour score was higher in the males than in the females. Also the highest vigour score ($P < 0.05$) for males was obtained in LH followed by MM and the least HL. However female vigour score was higher ($P < 0.05$) in the MM than in HL and LH. Mean vigour scores were 3.02, 3.4 and 3.23 for the HL, MM and LH kids. The kids could not be referred to as weak kids going by the average vigour score for all treatments, therefore the deaths obtained could be due to other factors.

IV. Number of kids, sex, type of birth, survival rate (mortality) and vigour

Parameters	Treatments		
	HL	MM	LH
Number of kids born	5	6	5
Sex of kids – males	4	4	3
Sex of kids – females	1	2	2
Type of births – single	1	–	1
Type of births – twins	2	3	2
Mortality	2	–	1
Survival up to 4 weeks	3^{c}	6^{a}	4^{bc}
Sex of dead kids – females	1	–	1
Sex of dead kids – males	1	–	–
Vigour score – males (mean)	3.20^{b}	3.60^{a}	3.65^{a}
Vigour score – females (mean)	2.83^{b}	3.20^{a}	2.80^{b}
Mean – males/females	3.02^{c}	3.40^{a}	3.23^{b}

Vigour score – weak (1), slightly weak (2), strong (3), very strong (4)
a, b, c – values on the same row with different superscripts differ significantly ($P < 0.05$)

Thompson, Thompson (1948) and Gill, Thompson (1954) reported that ewes on low plane of nutrition produced smaller and weaker lambs and most of which died after birth or soon after, compared with vigorous lambs with fewer deaths from ewes on a high plane of nutrition. The results of this trial demonstrated that plane of nutrition actually has influence on the birth weight, survival rate (mortality) and vigour of kids. It was observed that the does on the medium to high energy diets (MM and LH) produced better kids compared to the does that received the high protein but low energy diet indicating therefore that energy level of pregnant does diet plays a significant role in the health status of the kids after birth. However, kids survival rate (mortality) was not observed to be related to does weight at kidding.

References

AREGHEORE, E. M.: Effect of plane of nutrition on voluntary feed intake and nutrient utilization by the pregnant Gwembe valley goats. Nigerian Agric. J., 1994.

AREGHEORE, E. M. – CHIBANGA, C. O. C. – LUNGU, J. C. N.: Effect of plane of nutrition on body weight and birth weight of pregnant Gwembe valley goats in Zambia. Small Rumin. Res., *9*, 1992: 201–208.

GILL, J. L.: Design and analysis of experiments. Vol. 1. Ames, Iowe State Univ. Press 1978.

GILL, J. L. – THOMSOM, W.: The effect of energy intake during the last six weeks of pregnancy on the live weight gains of ewes and the birth weight of their twin lambs. J. Agric. Sci. (Camb.), *45*, 1954: 229–236.

GOERING, H. K. – VAN SOEST, P. J.: Forage fibre analyses (apparatus, reagents, procedures and some applications). Agric Handbook 379. Washington, D.C., ARS, USDA 1970: 1–20.

GOKHALE, S. B. – WADHER, M. H. – RATHOD, B. G. – SHARMA, M. S. – RANGNEKAR, D. V.: Growth of goats under village conditions in Rajasthan. Indian J. Anim. Sci., *66*, 1996: 624–633.
HASSAN, M. M.: Effects on Somali-Arabian goats doe body weight, birth weight and hay intake of ration of varying digestible energy fed in pregnancy. In: WILSON, R. T. – MALAKU, A. (eds.): African Small Ruminant Research and Development. Addis Abeba, Ethiopia, ILCA 1989: 147–154.
IYEGHE, G. T. – OSINOWO, A. O. – ABUBAKAR, B. Y. – NWAGU, B. I. – DENNAR, F. O.: Growth rates of Yankassa sheep under semi-intensive management system. Indian J. Anim. Sci., *66*, 1996: 619–623.
KASONDE, C.: Goats. Poor man's cows. Zambia Business Mail, 1990, September 12: IV.
LOVELACE, C. E. A. – LUNGU, J. C. N. – MASEBE, P. O. C. S. – SAKALA, B. – NYIRENDA, I. – SIKAZWE, G. – MIZINGA, K. M.: Reproductive performance of Zambia goats under drought conditions. In: Improving the Productivity of Indigenous African Livestock. Results of FAO/IAEA/DGIS Co-ordinated Research Programmes Organized by the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, 1993: 73–80.
LUNGU, J. C. N. – AREGHEORE, E. M. – LOVELACE, C. E. A.: Haematological values of pregnant Gwembe valley goats fed diets of varying protein and energy values. Warri. J. Sci. Technol., *1*, 1992: 45–61.
NDLOVU, L. R. – SIBANDA, L. M.: Improving the productivity of indigenous goats in Zimbabwe. In: Improving the Productivity of Indigenous African Livestock. Results of FAO/IAEA/DGIS Co-ordinated Research Programmes Organized by the Join FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, 1993: 91–101.
QUARTERMAIN, A. R.: Aspects of biological efficiency of the Zambian goat. In: Proc. 3rd World Conf. on Anim. Prod., 1975: 102–106.
SACHDEVA, K. K. – SENGOR, O. P. S. – SINGH, S. N. – LADAHL, I. L.: Studies on goats 1. Effect of plane of nutrition on reproductive performance of does. J. Agric. Sci. (Camb.), *80*, 1973: 375–379.
SINGH, D. K. – SINGH, C. S. P. – MISHRA, H. R.: Birth weight of pure and crossbred kids under extensive system of management in villages. Indian J. Anim. Sci., *60*, 1990: 375–377.
STEEL, R. G. D. – TORRIE, J. H.: Principles and Procedures of Statistics. 2nd ed. New York, NY, McGraw Hill 1980. 389 p.
THOMSON, A. M. – THOMSON, W.: Lambing in relation to the diet of the pregnant ewe. Brit. J. Nutr., *2*, 1948: 290–305.
AOAC: Official Methods of Analysis. 13th ed. Washington, D.C., Association of Official Agricultural Chemist 1980. 1094 p.

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Vliv úrovně výživy koz na hmotnost při narození, přežitelnost a životaschopnost kůzlat plemene Gwembe valley.

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Na náhodně vybraném vzorku gravidních koz plemene Gwembe valley chovaných v Zambii byl v pokusu s třemi úrovněmi výživy zkoumán vliv úrovně výživy gravidních samic na hmotnost kůzlat při narození a jejich přežitelnost. Pokusným samicím byly podávány krmné dávky označené jako HL (vysoký obsah bílkovin, nízký obsah energie), MM (střední obsah bílkovin, střední obsah energie) a LH (nízký obsah bílkovin, vysoký obsah energie). Kozy měly počáteční průměrnou tělesnou hmotnost 23,2 ± 0,82 kg a věk 18 až 24 měsíců. Všechny kozy dostávaly dvakrát denně stejné množství koncentrovaného krmiva a sena. Průměrná hmotnost kozlíků a koziček při narození byla 0,96 ± 0,02, 1,12 ± 0,03 a 1,50 ± 0,18 kg; 1,52 ± 0,82, 2,07 ± 0,22 a 1,75 ± 0,28 kg při krmných dávkách HL, MM a LH. Průměrná hmotnost všech kůzlat při narození byla 1,24 ± 0,42, 1,60 ± 0,13 a 1,63 ± 0,23 kg při HL, MM a LH. Hmotnost koziček při narození byla vyšší ($P < 0,05$) při LH než HL. Rozdíl mezi LH a MM u koziček při narození však nebyl významný ($P > 0,05$). Hmotnost kozlíků při narození byla vyšší ($P < 0,05$) při MM než při HL a LH. Průměrná hmotnost všech kůzlat při narození byla nižší ($P < 0,05$) u krmné dávky HL než u MM a LH, nebyl však zaznamenán rozdíl mezi MM a LH ($P < 0,05$). Pokud jde o pohlaví, kozlíci měli vyšší hmotnost při narození ($P < 0,05$) než kozičky, a to během celého pokusu. Přežitelnost byla nejvyšší u MM, pak následovala krmná dávka HL a nejnižší byla u LH. Všechna kůzlata krmená MM přežila až do konce pokusu. Zatímco při krmné dávce HL uhynula dvě kůzlata, při LH to bylo jedno kůzle. Mortalita byla zaznamenána u dvou koziček a jednoho kozlíka. Kozlíci měli vyšší životaschopnost než kozičky. Nejvyšší životaschopnost byla zaznamenána u kůzlat krmených LH, následovala kůzlata krmená MM a nejnižší životaschopnost byla u HL. Výsledky naznačují, že úroveň výživy koz má výrazný vliv na užitkovost kůzlat, pokud se jedná o hmotnost při narození, přežitelnost a životaschopnost. Z výsledků pokusu je zřejmé, že ideální krmná dávka pro gravidní kozy plemene Gwembe valley měla středně vysoký obsah energie a středně vysoký obsah bílkovin.

kozy plemene Gwembe valley; výživa; obsah bílkovin; obsah energie; kůzlata; hmotnost při narození; přežitelnost; životaschopnost

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