Trop. J. Anim. Sci. 4 (2): 1 - 6 (2001)
ISSN: 1119 - 4308

UTILIZATION OF PHOSPHORUS BY PREGNANT WEST AFRICAN DWARF GOATS

*O. G. TAYO, A. O. AKINSOYINU AND O. J. BABAYEMI
Department of Animal Science, University of Ibadan, Ibadan, Nigeria.
*Department of Agriculture, Babcock University, Ilishan-Remo.

Target Audience: Livestock Farmers, Nutritionists

ABSTRACT

A total of twelve West African Dwarf (WAD) goats of about 10 months old were involved in this experiment. On attaining a body weight of 18kg, oestrus was synchronized and service effected by twin herd bucks. Does confirmed pregnant were randomly alloted to one of three isocaloric and isonitrogenous diets. These diets contained three increasing levels of phosphorus (P) as treatment A (0.28%), B (0.55%) and C (0.81%). Balance trials were carried out at weeks 8, 12, 16, and 19 of gestation. Results showed that treatment effects on P balance and apparent digestibility were highly significant (P<0.01). The trend observed showd an increase in P balance with increasing dietary level of P. There was however a decrease in apparent digestibility with increasing dietary P inclusion. Variations recorded for the mean daily gains of does on treatments A, B, C, were not significant (P<0.05). Serum P as within the range 4-6mg 100^{-1} recommended for the goats.

Key words: Phosphorus, pregnancy, goats, requirement.

DESCRIPTION OF PROBLEM

There has always been paucity of information on the mineral requirements of goats under different production conditions (1). This issue is serious in the tropics where shortage of minerals particularly dietary phosphorus (2) has been reported for goats. Phosphorus has more known functions than any other mineral element in the animal body (3).

Gestation period is a critical time when nutrient requirement increases due to the developing foetus. According to Ferrel et al. (4), the foetal development phase, while perhaps the most critical period in an animal's lifetime, has, because of technical difficulties, been overlooked by most nutritionists. This is unfortunate because it is during this period that the pattern for lifetime is established. The West African Dwarf (WAD) goats of the humid tropics of Nigeria are small in size, characterized by low productivity and inability to exhibit their full genetic potential because of undernutrition. With increase interest in rectifying the energy and protein limitation on animal productivity (5), local mineral deficiencies are likely to become more apparent and critical. There has been few reports (6,7) on the calcium and phosphorus requirements of WAD goats for maintenance

and production. This work was carried out to appraise the performance of gestating WAD goats for varying levels of phosphorus.

MATERIALS AND METHODS

Animals And Their Management

The experiment involved twelve female WAD goats, 10 months old, raised together until they attained a body weight of abourt 18kg. They were treated against endoparasites and ectoparasites. They were also allowed free grazing and fed 3% of their body weight as concentrate supplement (Maize 43.9%, Dusa 18%, BDG 15%, Ricebran 12%, PKM 10%, Common Salt 0.6%, Vitamim/Mineral Premix 0.5%).

Oestrus was synchronized by giving each goat 2mls of ultramuscular prostaglandin $F_2\alpha$ injection. The does were brought together with a teaser buck for four subsequent days. Does confirmed to be on heat were separated and served by a twin buck in a pen.

The does were kept in individual pens and randomly alloted to one of three isonitrogenous and isocaloric diets (Tables I and II) containing 3 increasing levels of P at ratio 1:5:1. Monosodium phosphate ($NaPO_4$) was added to achieve the desired variation of treatments, A (0.28%), B (0.55%) and C (0.81%). Does were offered 5% of their body weight as dry matter with diet of grass hay *Cynodon nlemfuensis* and concentrate. Balance trials were carried out during weeks 8, 12, 16 and 19 of gestation when does were placed in individual metabolic cages modified for separate collection of feaces and urine. Ten percent (10%) of daily faeces collected was oven dried for each doe and kept in cellophane bag till required for analysis.

Table 1: Percentage Composition of the Diets

Ingredients	Diets		
	A	B	C
Maize	43.00	42.00	40.60
Dusa*	18.00	17.60	17.00
Brewers Dry Grain	15.00	15.00	14.70
Rice Bran	12.00	11.18	11.40
Palm Kernel Cake	10.10	10.10	9080
Common Salt (NaCl)	0.60	0.50	0.50
Vit \ Min Premix	0.50	0.50	0.50
Na H2PO4	-	1.10	2.65
CaCO3	0.78	1.40	2.85
Total	100.00	100.00	100.00

*Dusa- Brewers waste from sorghum

Urine sample was also collected in bottles containing 3mls of 0.2N of concentrated H_2SO_4 to curtail bacteria action and stored in a freezing cabinet until required for analysis.

Blood samples were obtained via jugular venipuncture at the end of each collection period. The serum was harvested and served for analysis.

Chemical Analysis

Ground samples of grass samples of hay and concentrate were analysed for their proximate components (8). The milled faeces, urine and serum samples were analysed for P after wet digestion of samples with a mixture of perchloric and nitric acids (1:4). Phosporus in the digest was determined

Table 2: Proximate Composition (g 100-1DM) of the Diets Fed to Goats

Parameters	A	B	C	**GRASS
Ether Extract	2.60	3.00	3.00	1.00
Crude Protein	16.63	17.06	16.79	6.56
Crude Fibre	12.50	12.65	13.00	33.00
Ash	8.60	9.00	8.50	8.00
Moisture	8.50	8.00	8.50	8.00
NFE	51.17	50.29	51.21	34.94
P	0.28	0.55	0.81	0.15

** Hay (*Cynodon nlemfuensis)*

as phosphomolydrate (8). The colour developed was read with spectrophotometer at 420nm.

Statistical Analysis

Data obtained were subjected to analysis of variance (9). Means were separated by the multiple range test (10). Correlational analysis was carried out using SPSS.

RESULTS

The proximate composition of hay and the diets are shown in Table 2. Treatment effects on P-balance and P-excreted in feaces were highly significant ($P<0.01$). Phosphorus intake, P balance and faecal P increased with increasing dietary inclusion. Differences observed in the P balance of goats on 0.28% and 0.55%, 0.28% and 0.81% P were significant ($P<0.05$) while that observed between 0.55% and 0.81% were not significant ($P>0.05$). Apparent digestibility values were 49.06, 40.96, 34.7 for goats on treatments A, B, and C respectively. The differences observed were not significant ($P>0.05$). Mean daily gains are shown in Table 4. Treatments effect were not significant. A significant linear relationship existed between P intake

(X)g day^{-1}kg^{-1} LW and P balance (Y)g day^{-1}kg^{-1}LW. The relationship

Table 3: Summary of Performance and Phosphorus Utilization by WAD Goats during Gestation.

Parameter	Diets		
	A	B	C
Dry matter intake (kg day-1)	0.843^{a}	0.911^{b}	0.896^{ab}
p intake (g day-1 Kg-1 LW)	0.1077^{a}	0.2213^{b}	0.3197^{c}
Faecal output (g day-1 Kg-1 LW)	0.055^{a}	0.1297^{b}	0.2070^{c}
Urinary P output (g day-1 Kg-1 LW)	0.0084^{a}	0.0107^{b}	0.0106^{b}
P-balance (g day-1 Kg-1 LW)	0.044^{b}	0.084^{b}	0.102^{b}
Apparent digestibility (%)	49.06^{a}	40.96^{b}	34.47^{c}
Mean initial weight (kg)	17.87±0.58	18.00±0.46	18.50±0.58
Mean final weight (kg)	24.89±0.64	26.13±0.67	26.30±1.09
Mean daily gain (g)	46.67±1.15	54.22±2.12	52.22±7.59

a,b,c - means along the same row with identical superscript are not significant (P>0.05)
± - Standard Error

is described by
$Y = 0.0076 + 0.3197X$ equation (1).

Serum P (mg 100^{-1} ml) ranged from an average of 4.17 for goats on treatment A to 5.04 for goats on treatment C.

DISCUSSION

Voluntary dry matter intake (DMI) of the goats amounted to 3.9% of their body weight. This compares with 3 to 3.5% (11) and 1.9 to 3.8% (2) of liveweight recommended for goats. This indicates that the goats had adequate DMI. The DMI was however highest for goats on treatment B. The percentage protein of the diets (17%) and the digestible energy (3.10Kcal Kg^{-1} DM) were comparable to 14 - 18% and 2.7Kcal Kg^{-1} DM respectively as recommended for pregnant goats by NRC (11). These were assumed to be adequate as the animals were on positive gain in weight throughout the period.

The average P level in the blood was within the range of 4-6mg P 100^{-1}ml serum (7,11) for goats and sheep respectively. This is an indication that the goats had adequate P in their diets throughout the period. The significant effect of treatment on faecal excretion and balance of P agrees with reports for sheep (12), (13) and goats (5). It shows that as P inclusion level increases, faecal P output and P balance also increase. The apparent digestiblity of P ranging between 34.47 and 49.06% is comparable to a range of 34.9 to 38.6% reported elsewhere (5) and a range of 31.7 to 38.2% (12). It is however lower than 55% (14) and 60% (15) reported for sheep. Results showed that apparent digestibility could however be a difference in the source of P

inclusion. Dietary treatment had no appreciable effect on daily gains observed. This suggests that increasing P level above 0.28% did not have appreciable effect on daily gains. It also indicates that the dietary P at this level was adequate for maintenance and pregnancy as depicted by the value of P that circulates in the serum. From equation 1, the maintenance requirement for P during gestation was found to be 7.6mg day^{-1} kg^{-1} LW. Therefore, the maintenance requirement for P during gestation was found to be 7.6mg day^{-1}. This is about 40% of a value of 0.2g P day^{-1} recommended for a 10kg sheep by ARC (1980). The value reported in this study is low compared to 0.7g P day^{-1} reported for a 10kg goat by NRC (1981). It should be noted that the values reported by NRC (1981) were extrapolated from requirements of sheep and cattle and also from a limited research with temperate breeds of goats. These breeds are larger in size when compared to the WAD goats, as such their small size might have resulted in a lower requirement for maintenance. The low maintenance requirement could also be the result of an adaptation to the tropical humid climate and a low level of nutrition, which are factors that can presume lower P requirement.

REFERENCES

1. **Haelein, G. F. W. 1980.** Mineral Nutrition of Goats. J. Dairy Sci. 63:1729-1748.)
2. **Devendra, C. and M. Burns 1983.** Goat production in the Tropics. Tech. Comm. Bur. Anim. Breed Farnham Royal, U.K.
3. **N R C .1980.** National Research Council. Mineral Tolerance of Domestic Animals. National Academy of Sciences. Washington D.C.
4. **Ferrell, C. L., W. N. Garett and N. Hinman. 1976.** Growth, Development and Composition of the Udder and Gravid Uterus of Beef Heifers During Pregnancy. J. Anim Sci. 42:1477.
5. **Akinsoyinu, A. O. 1985.** Minimum Phosphorus Requirement of the Dwarf Goat for Maintenance. Trop. Agric. (Trinidad). 63:333-335.
6. **Akinsoyinu, A. O. and Adeloye, A. A., 1983.** Calcium Requirement of the West Arican Dwarf Goat. Int. J. sheep and goat Res. 4:7-13.
7. **Underwood, E. J. 1987.** The Mineral Nutrition of Livestock. Farnham Royal: Commw. Agric. Bur. FAO.
8. **A. O. A. C. 1980.** Association of Official Analytical Chemists. Official Methods of Analysis. Washington D. C.
9. **NRC 1985.** National Research Council Nutrient Requirement of Sheep. 5th edn. Washington D. C. National Academy of Sciences.
10. **Duncan, D. B. 1955.** Multiple Range and F-tests. Biometrics 11: 1-42.
11. **NRC 1985.** National Research Council Nutrient Requirement of Sheep. th edn. Washington D. C. National Academy of Sciences of Science.

12. Preston, R.L. and W.H. Pfander, 1964. Phosphorus Metabolism in Lambs Fed varying Phosphorus Intakes. J. Nutr. 83:369-378.
13. Braithwaite, G.D. 1984. Some Observations on Phosphorus Homeostasis and Requirements of Sheep. J.Agric. Sci. Camb. 102:295-306.
14. Leuker, G.D. and G.P. Lofgreen 1961. Effects of Intake and Calcium to Phosphorus Ratio on Absorption of These Elements by Shep. J. Nutri. 74:233-238.
15. ARC.1980. Agricultural Research Council. The Nutrient Requirements of Rumainant Livestock. Commwealth Agric. Bur. Farnham Royal, Slough England.