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MAGNESIUM UTILISATION BY WEST AFRICAN DWARF GOATS DURING GESTATION

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Target Audience: Nutritionists, Toxicologists, Livestock farmers.

ABSTRACT

Twelve monoparous WAD goats aged 2-4 years and weighing 15 ± 1.2kg were used in a 20 wk gestation trial to study the effect of dietary inclusion of Mg supplementation at 0.01, 0.11 and 0.21% with $MgSO_4.7H_2O$ in isonitrogenous and isocaloric diets. The does were synchronised and pregnant does were randomly allotted into each of the three groups of four animals. Results showed that Mg supplementation had a significant ($P < 0.05$) effect on feed intake, body weight change, birth weight, Mg-intake, faecal-Mg, urine-Mg, and serum-Mg. The general trend was that increasing dietary Mg inclusion decreased DMI, BW change, birth weight but an increase in Mg excretions. The mean values for the DMI were 820, 650 and 470 g/d while those of BW change were 27.8, 25.7 and 16.0g/d. Birth weight was significantly ($P < 0.05$) stimulated with mean values 2.7, 2.8 and 1.7 kg. Wider variations ($P< 0.05$) of 82.0, 715 and 987 mg/d were observed for **Mg-intake while non-significant ($P>0.05$) differences of values 27.4, 26.9 and 28.1 mg/d Mg-balance were noted. The mean values for digestibility coefficient and blood serum Mg were 47.3, 17.5 and 15.8; and 1.7, 2.5 and 3.4 mg/100 ml respectively.**

Key words: Magnesium, gestating goats

DESCRIPTION OF PROBLEMS

Animal performance and productivity cannot be separated from conducive environment, the animals' genetic make-up and nutritional level. Although, greater population of goats numbering 142.5 million is found in sub-Saharan Africa (1), the reproductive loss in abortion, still birth, and the pre-weaning mortality were reportedly a stumbling block for small ruminant production and profitability in developing countries (2).

In Nigeria, it has been observed that mortality of pre-weaned sheep and goats is high. Opasina (3) indicated malnutrition and starvation as major factors responsible for mortality of pre-weaned animals. Economids (4) reported a consequent reduction in growth rate of foetus during the first hundred days of gestation and rapid development to the tune of about 80 % during the last few weeks of gestation owing partly to poor or inadequate nutrition.

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Nutrition is wide in scope with numerous reports (5, 6, 7) on energy and protein needs of small ruminants. Scanty reports (8, 9) also exist on calcium and phosphorus requirements of goats in the tropics. Numerous of the available studies on Mg utilisation were mainly centred on sheep (12, 13). However, recently, Babayemi *et al.* (14) established some reports on Mg supplementation for WAD goats during lactation.

It has been observed for sheep (15) that during late pregnancy, inadequate dietary Mg, that is well below recommended levels, resulted in the production of lambs with poor birth weight, significant disparity in birth weight within litter and low energy reserve in lambs with a consequence of heightened peri-natal mortality. Thus, the influence of sufficient dietary Mg supplementation on intake, weight gain, foetal development and birth weight should be studied. Therefore, the present study was undertaken to determine the effect of Mg supplementation on performance characteristics of gestating West African dwarf goats.

MATERIALS AND METHODS

Animals and their management

Twelve (12) monoparous West African dwarf (WAD) goats, aged 2-4 years and weighing 15± 1.2kg were used. The animals were subjected to complete confinement for a 4 week period of adaptation. During acclimatization the animals were treated for both ectoparasites and endoparasites. They were also placed on antibiotics by veterinarians.

Synchronisation of Oestrus

To ease management and handling, the experimental does were heat-induced by administering a 0.5 ml per head of prostaglandin $F_2\alpha$ intramuscular injection. After the 24 Hr of inducement, the twin buck was released to each doe in individual pens and this was repeated thrice daily for four consecutive days in order to detect heat. Does confirmed to be on heat were accordingly served by the buck. Additional dose of prostaglandin $F_2\alpha$ of 0.5 ml of what was repeated for animals that failed to come on heat as at the first instance. Pregnancy was assumed to have occurred when the served does did not exhibit heat signs by the next estrus.

Experimental Design

The pregnant does were randomly allocated into one of the three levels of Mg supplemented diets (Table 1) as reported elsewhere (14). Animals were offered diets as 4 % their body weights in two split doses at 8.00 Hr and 1600 Hr daily. Daily feed intake and weekly body changes were noted.

Blood, Urine and Faecal Collection

Blood samples were withdrawn via jugular venipuncture at each trimester period. The blood was coagulated, centrifuged and then the serum was harvested and stored in a freezer cabinet at -20°C till required for analysis. The method of Akinsoyinu (5) was employed for a separate collection of faeces and urine for Mg balance at Wks 8, 12, 16 and 20. Ten per cent (10 %) faeces and 30 % urine were collected and bulked separately for analysis. Samples of feed offered, faeces, urine and blood collected were analysed for minerals and proximate composition as reported (14).

The data generated were analysed by the General Linear Model Procedures of SAS (16). Means were separated when significant using the method of Duncan multiple range test (17).

Table 1. Ingredient Composition of the diets fed Pregnant WAD goats

	Diets		
Ingredients (%)	A	B	C
Dussa++	11.0	10.0	10.5
Yellow maize	39.0	38.0	38.0
Dried Brewers' grains	18.0	18.7	17.3
Palm kernel cake	12.0	12.0	12.0
Groundnut cake	10.0	10.0	10.0
Corn cobs	7.0	7.3	7.2
Oyster shell	1.0	1.0	1.0
Common salt	2.0	2.0	2.0
$MgSO_4.7H_2O$	-	1.0	2.0
Total	100	100	100

++ Dussa is a by-product of fermented sorghum

RESULTS AND DISCUSSION

Presented in Table 2 is the proximate composition of the diets. The isonitrogenous (CP = 16.4 %) and isocaloric (M = 2.74 Mcal) formulated diets were in conformity with the range 13-18 % and 2.1 -2.7 Mcal respectively as recommended (8) for pregnant goats. The inclusions were considered adequate since the present goats were gaining weights. The Mg levels of 0.01 % (control diet), 0.11 % (medium) and 0.21 % (high) in the diets were lower than that reported by Fontenot *et al.* (18).The level of 0.21 % in the current study was however higher by 14.6 % of 0.15 % Mg established elsewhere (7) as requirement for all classes of sheep. Mineral requirement of goat could be different from that of sheep since there are some unique metabolic differences in them.

Performance characteristics of the goats are also summarised in Table 3. The weight changes of the animals fed 0.01 and 0.11 % Mg level were similar ($P < 0.05$) but significantly higher ($P < 0.05$) than those observed for goats on 0.21 % Mg supplement. Similarly, daily dry matter intake increased tremendously ($P < 0.05$) with decreasing level of Mg among treatments. The highest ($P < 0.05$) feed intake was recorded for animals on the diet that contained 0.01 % Mg. As shown in Figure 1, the feed intakes by the animals on diets 0.01 and 0.11 % Mg slightly increased especially during the first and second trimesters. The DMI by the goats on diet with 0.21 % Mg was at an comparatively decreasing rate. The decrease in food intake by the third trimester was general for all the treatments and therefore might not have been influenced by the Mg inclusion. The resultant reduction in weight change confirmed

the report of Genry *et al.* (19) in which high dietary Mg emanated in instantaneous reduction of DMI and weight gains after fortification of 2 % and 4 % Mg levels. The report (14) established a sharp decrease in DMI, weight change and lower milk yield for lactating goats with increasing levels of dietary Mg. A reduction in DMI at third trimester was in accordance with the report (20) that the growth of the foetus and supporting tissue follows an exponential curve, although nutrients requirements supporting tissue follows an exponential curve, although nutrients requirements

Table 2. Proximate composition of the diets fed to pregnant WAD goat

Parameters	Diets		
	A	B	C
Dry matter (%)	96.82	96.89	96.78
Crude protein (%)	16.14	16.10	16.20
Neutral Detergent fibre (%)	60.40	62.31	61.70
Ash (%)	3.18	3.11	3.22
Energy (Mcal/kg.DM)	2.74	2.73	2.73
Calcium (%)	1.45	1.35	1.40
Phosphorus (%)	0.17	0.17	0.17
Magnesium (%)	0.01	0.11	0.21

increased but with a decrease in DMI. Bertics *et al.* (21) and Van Saunt (22) established a 23 to 30 % decrease in DMI during the last week of gestation. Decreasing DMI could be observed as the development of foetus would push the alimentary canal thereby reducing the quantity of feed to be consumed by the pregnant does.

Feed conversion efficiency of goats fed 0.11 % Mg was higher ($P < 0.05$) than those animals placed on diets 0.01 and 0.21 % Mg. Encouraging conversion efficiency in 0.11 % Mg probably suggests the optimal level of Mg fortification in the diet. Interestingly, the kids of the does on this diet enjoyed higher birth weight. Performance of goat at this (0.11 %) Mg dietary level slightly deviated as established (23) that maximal tolerable level of Mg has been taken as 0.4 % of the ration and that below or above this level may have an adverse effect on the pregnancy. The Mg requirement of animal could be determined by many factors which range from species, type, environment and, more importantly, physiological state of such animal (24, 25, 26).

Magnesium intake, faeces Mg, urinary Mg, Mg-balance, apparent digestibility and Mg in blood serum are presented in Table 4. There were differences ($P < 0.05$) observed in Mg intakes, Mg in faeces and urine of the animals as the Mg levels in the diet increased. Suttle and Field (27) and Chester-Jones *et al.* (28) observed that increasing dietary Mg resulted in a linear increase of Mg intake, faeces and urine. The Mg balance was similar with no significant ($P < 0.05$) difference among treatments. However, goats' fed the 0.01 % Mg diet tended ($P < 0.05$) to have increased digestible Mg as a percentage of Mg intake when compared to the other treatments. In a similar report (28) apparent digestibility of certain nutrients progressively decreased with increasing Mg intake.

The effect of increasing dietary Mg was significant ($P < 0.05$) source of variation for Mg absorption, which is increased with high levels of dietary Mg. Other researchers (11) reported accordingly that increase in Mg intake resulted in improved Mg-absorption.

Table 3. Weight change, gestation lengths, litter sizes and birth weights of WAD goats fed Mg supplements

Parameters	Diets A	B	C	SEM
Initial body weight (kg)	15.0	15.1	15.3	
Body weight at full term (kg)	19.0	18.8	17.7	
Weight change (kg)	4.0	3.7	2.4	
Daily weight change (gd^{-1})	27.8^{a}	25.7^{a}	16.0^{b}	1.53
Dry matter intake (gd^{-1})	820.0^{a}	650.0^{b}	470.0^{c}	28.40
Gestation length (days)	144	144	148	
Litter size	2	2	2	
Kid's birth weight (kg)	2.7^{a}	2.8^{a}	1.7^{b}	0.07
Feed conversion Ratio	29.5^{a}	25.3^{b}	29.4^{a}	1.29

a. b. c...means on the same row with different superscripts are significantly different (P 0.05).

Table 4. Magnesium utilisation by pregnant WAD goats fed different levels of Mg

Parameters	Diets A	B	C	SEM
Mg intake (mgd^{-1})	82.0^{c}	715.0^{b}	987.0^{a}	6.03
Mg faeces (mgd^{-1})	43.2^{c}	590.0^{b}	831.5^{a}	4.11
Mg faeces as % intake	52.7	82.5	84.2	
Mg absorbed (mgd^{-1})	38.8^{c}	124.8^{b}	155.5^{a}	9.37
Mg in urine (mgd^{-1})	11.4^{c}	97.9^{b}	127.4^{a}	2.86
Mg in urine as % intake	13.9	13.7	12.9	
Mg in urine as % absorbed	29.4	78.4	81.9	
Mg balance (mgd^{-1})	27.4	26.9	28.1	
Mg balance as % intake	33.4	3.8	2.8	
Apparent Mg digestibility (%)	47.3^{a}	17.5^{b}	15.8^{c}	3.51
Mg in blood serum ($mg/100ml^{-1}$)	1.7^{c}	2.5^{b}	3.4^{a}	0.24

a. b. c..... Means on the same row with similar superscripts are not significantly different (P >0.05).

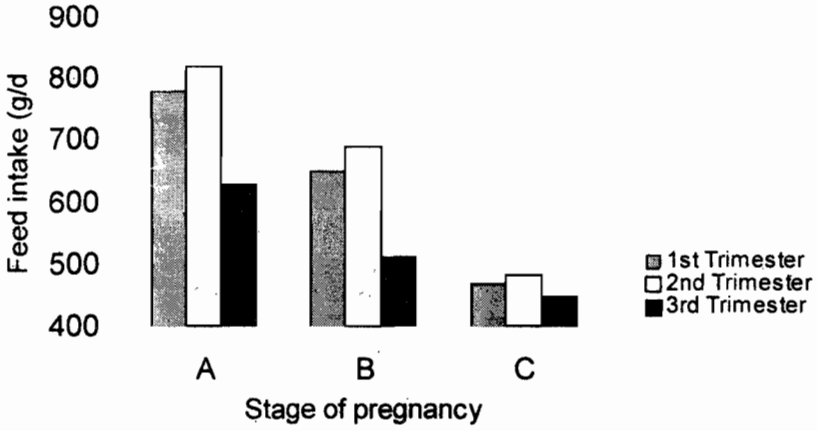

Fig 1. Effects of magnesium supplementation on feed intake (g/d) on gestating WAD goats

Serum Mg increased ($P < 0.05$) linearly with increasing levels of dietary Mg. A similar trend was established elsewhere (29). Serum Mg is an indicator of the Mg status and reflects its adequacy in of the animal. The value 1.7-3.4 (mg/100ml) for serum Mg obtained in the present study were above 1.0 - 1.2 as reported (30) to indicate Mg deficiency. Thus, the present range of values obtained implied its sufficiency of Mg to meet the animals' requirement.

CONCLUSION AND APPLICATIONS

1. Our results indicate that dry matter intake of the pregnant goats decreased tremendously as the dietary Mg increased above 0.11 %
2. The birth weight of the kids between the does fed 0.01 % and 0.11 % Mg were similar and better than those fed with 0.21 % dietary Mg.
3. Where necessary, the fortification of diet with dietary Mg may not be more than 0.11 % since the Mg intake, balance and serum seemed to be adequate at that level.

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