ASSESSMENT OF MINERAL STATUS OF TWICE-YEARLY LAMBING YANKASA EWES 1. APPRAISAL OF MINERAL STATUS IN THE DIET AND BLOOD SERUM

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(Received 8 May, 1989, accepted 11 September, 1990)

ABSTRACT

An appraisal of mineral status of twice-yearly lambing Yankasa ewes was carried out in order to trace any evidence of mineral deficiency in the diet and to obtain baseline information of clinical, physiological and nutritional interest. A total of thirty pregnant and lactation ewes, weighing between 27 - 37kg was sampled for mineral profile in blood serum. The basal and supplemental diets were also analysed for chemical and mineral composition. Average daily dry matter intakes ranged from 0.92 to 1.5kg per head per day. Higher concentration of magnesium, iron, manganese and zinc were obtained in the serum of both pregnant and lactating ewes than values obtained for temperate breeds. Average calcium concentrations (mg/100ml) in the blood serum during gestation and lactation were 10.0 ± 1.7 and 6.1 ± 1.3 respectively. The values were higher during gestation than lactation. The differences were significant ($P < 0.05$). On the other hand, the mean phosphorus concentration (mg/100ml) was 12.6 ± 2.2 during gestation and increased to 17.4 ± 3.2 during lactation. The differences were also significant. ($P < 0.01$). The concentrations of calcium and phosphorus (mg/100ml) were observed to be influenced by parturition.

Key words: Yankasa ewes, Minerals, Blood, Diets

INTRODUCTION

Besides proteins, fats and carbohydrates the body also requires minerals for optimum functioning and growth. All animal issues, feeds and feedstuff contain inorganic or mineral elements in widely varying amounts and proportions. The mineral elements exist in the cells and tissues of animal body in a variety of functional chemical combinations and in characteristic concentrations which vary with the element and tissue. The concentrations must be maintained within quite narrow limits or normal ranges, if the functional and structural integrity of the tissues are to be safeguard and the growth, health and productivity of the animals are to remain unimpaired.

Twice-yearly lambing Yankasa ewes reflect a high degree of breeding in that it results in doubling of annual lamb crop through synchronized oestrus (Osinowo and Ekpe 1985).

This system of management had been in operation at the National Animal Production Institute, (NAPRI) for over five years. The nutritional requirements of the animals would surely be altered and need to be well defined.

Attempts had been made to establish the effect of nutrition on the reproductive performance of Yankasa Sheeps under twice-yearly lambing (Osinowo, Doma, Pathiraja and Buvaendran 1985). Signs of mineral deficiency such as hypomagnesaemia and depraved appetite had been observed.

In order to have a general picture of mineral status of the ewes, the nature and composition of the whole diet and the environment of the animals deserve some attention.

The present experiment was therefore designed to assess the mineral status of twice-yearly lambing Yankasa ewes in order to appraise any trace of mineral deficiency.

MATERIALS AND METHODS:

Animals and their Management

Flock Record: The study was conducted on thirty Yankasa Sheep used for twice-yearly lambing at the National Animal Production Research Institute (NAPRI), Ahmadu Bello University, Zaria. The experimental animals weighed between 27 and 37kg live weight.

Oestrussynchronization with progestagen sponges were routinely carried out 2 - 3 weeks post partum as a means of reducing the spread in breeding dates and of inducing Oestrus, both of which led to a shortening of rebreeding interval. Yearling rams were used for breeding in order to reduce the generation interval.

A selection programme for growth rate and twinning was incorporated in the twice-yearly lambing programme. Lambs were weaned at about 90 days of age. About 5 - 10% of rams were selected at weaning and the rest

Table 1: AVERAGE DAILY DRY MATTER INTAKE BY TWICE-YEARLY LAMBING YANKA EWES

FEED	%D.M.	Average intake		Ave. Daily intake (kg)	Daily D.M. intake (kg)	Total D.M. intake/ day(kg)
		0700-1000H	1500-1800H			
Forage Mixture	23.2	1.7 ± 0.4	1.0 ± 0.0	2.9 ± 0.4	0.67	
Concentrate	83.4	-	-	0.3	0.25	0.92
Hay	83.6	0.9 ± 0.1	0.6 ± 0.4	1.5 ± 0.2	1.25	1.5

± Standard Error

turned to the fattening scheme. The traits of importance that were used in genetic improvement in the twice-yearly lambing flock were: reproductive performance of the female, and growth rate.

Rearing System: The animals were kept under

Andropogon gayanus and *stylosanthes gracilis* during the dry periods.

This basal diet was supplemented daily with 300g per head of a protein concentrate compounded from a mixture of 1 part cotton seed cake and 3 parts brewers' dried grains. They had

Table 2: PROXIMATE COMPOSITION OF PASTURE HAY AND CONCENTRATE MIXTURE FED TO TWICE-YEARLY LAMBING YANKASA EWES

	D.M. (%)	CP	CF	EE	NFE	ASH	Ca	P	Mg	K	Na	Mn	Fe	Cu	Zn
	(%)			(%DM)		(g/100gDM)			(g/kgDM)				(ppm)		
Mixture	83.4	25.5	17.5	5.8	48.4	2.8	1.0	1.4	5.4	0.7	4.6	88.2	793.5	20.4	91
Grass Mixture	23.2	10.7	28.3	1.3	49.5	10.2	2.1	1.5	4.0	3.5	3.2	135.7	1598.3	13.2	29
<i>Cynodon dactylon</i> (cut Aug.)	20.7	14.8	26.2	1.6	45.1	12.3	2.9	1.1	2.7	3.4	1.9	89.4	990.8	15.1	33
<i>A. gayanus</i> (cut Aug.)	26.9	5.8	31.2	1.3	52.8	8.9	1.1	0.6	2.3	1.7	6.9	153.5	2030.7	13.8	21
<i>Setaria bartata</i> (cut Aug.)	19.8	7.9	23.9	1.7	53.6	12.9	2.8	1.4	4.3	4.1	2.1	101.1	1149.3	12.9	40
Gamba Hay	84.6	6.4	36.3	1.5	49.4	6.4	2.3	0.2	2.4	1.0	0.5	244.3	337.6	6.4	18
<i>Stylosanthes</i> Hay	82.6	15.2	34.5	0.8	47.3	2.2	1.2	0.2	2.5	1.9	0.7	44.1	326.4	5.2	13

a semi - intensive system of management. They were grazed on natural pasture twice daily and offered concentrate supplements at the rate of 300g/adult animal/day. Water and salt licks were provided in the pens free choice.

The ewes were housed in general flock sheds which allowed for adequate ventilation and lighting in the sheds. Deworming drugs were administered every 21 days and animals were dipped regularly in order to control parasites.

Diets

Feeding:- The animals were allowed to graze on natural pasture during the rainy season. They were kept on a basal diet of ha, made from

free access to salt lic and fresh clean water daily.

Available grass species present within the grazing area: The field where the animals spent most time grazing constituted the study area. The percent availability of grass species present was estimated by marking out the area into 1m x 1m quadrats. Known weights of grass species enclosed within were cut at about 5cm to the ground and the various grass species separated from the bulk. They were weighed separately and the percent availability of the grass species was calculated in relation to the total amount of grass mixture that was cut.

Estimation of forage intake of Yankasa Sheep

TABLE 3: SUMMARY OF MINERAL NUTRIENTS INTAKE PER DAY BY TWICE-YEARLY LAMBING YANKASA EWES

	Daily(kg) intake	% DM	Daily DM (kg/day)	Ca	P	Mg	K	Na	Mn	Fe	Cu	Zn
				-----g/day-----					-----mg/ day-----			
Concentrate												
Mixture	0.3	8.34	0.25	2.6	2.9	1.4	1.5	1.1	2.3	29.1	4.6	22.8
Grass Mixture	2.9	23.2	0.67	1.2	0.54	1.6	1.7	0.8	6.8	60.9	7.1	16.2
Hay Mixture	1.5	83.6	1.25	0.89	0.2	2.9	2.2	0.7	9.6	41.6	7.2	20.1
(Aug - Nov)												
wet season Total	2.9	-	0.92	3.8	3.44	3.0	3.2	1.9	9.1	90.0	11.7	39.0
(Feb - May)												
Dry season Total	1.8	-	1.5	3.49	3.11	4.3	3.7	1.8	11.9	70.7	11.8	42.9
Dietary												
Allowance	-	-	0.91	1.0	1.0	0.7	0.97					
ARC (1980)	-	-	1.53	3.3	3.1	3.7	3.0	1.3	10.0	30.40	8.7-10.5	34-46

The actual forage and mineral intakes measured with stall-fed animals and the total amount of minerals ingested estimated from analysis of the feed comprising the whole diet.

Ten adult ewes were randomly paired into 5 pens. For seven days, fresh forage was harvested and about 5kg. was given to each pair of animals in pens during the grazing hours (0700 - 1000h and 1500 - 180h). The residues were weighed and the approximate amount of forage consumed by each animal during the 6 hours grazing period per day was estimated. The same procedure was carried out to estimate average daily intake from hay.

Blood Sampling

Twenty pregnant ewes, averaging 34kg in weight were bled each trimester of gestation (1 1/2 mts, 3 mts and 4 1/2 mts of gestation); 10 lactating ewes, averaging 29kg in weight were bled at lambing and once per week for eight weeks.

About 8mls of whole blood samples were collected by jugular puncture from each animal into separate venoject tubes. The serum of each sample was harvested and saved for analysis. Seasonal effects were checked by conducting the experiment both in the rainy (August - November) and dry (February - May) seasons.

Analytical Procedures

The milled samples of grasses, hay and concentrate were analysed for their proximate composition by A.O.A.C. (1975) procedures.

Two mls each of serum sample and feed samples in duplicates were subjected to wet oxidation using a mixture of (5.1) nitric and perchloric acid. The mineral content of the samples were determined using Atomic absorption spectrophotometer model 290. Phosphorus in digest was estimated with phosphorus auto analyzer.

The data obtained were subjected to analysis of variance with the aid of computer at the

Ahmadu Bello University Computer Center, Zaria using the Multiple classification analysis.

This is the SPSS Subprogram ANOVA which performs one-to five-way analysis of variance for factorial design (Kim and Kohout 1975).

RESULTS

Available Forage and Chemical Composition of Diet:

Andropogon gayanus, *Cynodon dactylon* and *Setaria bartata* constitute over 80% of total forage within the study area, while other grass species were present in trace amounts.

The average daily dry matter intake are shown in Table 1. Although hay was fed to the ewes free choice during the dry periods, results of stall-fed animals showed an average daily dry matter intake of 1.25kg/day from hay. Daily dry intakes (kg/day) during the wet and dry periods were 0.92 and 1.5 respectively.

The proximate composition of pasture, hay and concentrate mixture is presented in Table 2

TABLE 4: SUMMARY OF STATISTICAL ANALYSIS OF MINERAL ELEMENTS IN THE SERUM OF PREGNANT YANKASA EWES

ELEMENTS	S. OF VAR.	d.f.	M.S.	F. VALUE
CALCIUM	Season	1	35.35	4.45
	Stage	2	4.75	0.59ns
	Replicate	19	5.45	0.69ns
	Residual	97	7.98	
PHOSPHORUS	Season	1	0.46	0.08ns
	Stage	2	106.48	18.44**
	Replicate	19	7.85	1.36ns
	Residual	97	5.77	
MAGNESIUM	Season	1	0.46	1.87ns
	Stage	2	1.17	3.18*
	Replicate	19	0.41	1.1ns
	Residual	97	0.37	
POTASSIUM	Season	1	7.75	4.45*
	Stage	2	1.14	0.65ns
	Replicate	19	1.69	0.97ns
	Residual	97	1.74	
SODIUM	Season	1	1383.12	9.11
	Stage	2	107.56	0.71
	Replicate	19	119.58	0.79ns
	Residual	97	151.90	
IRON	Season	1	188416.88	32.03**
	Stage	2	14660.21	2.49*
	Replicate	19	4474.33	0.76ns
	Residual	97		
MANGANESE	Season	1	0.05	0.05ns
	Stage	2	0.90	0.82ns
	Replicate	19	0.63	0.57ns
	Residual	97		
COPPER	Season	1	3.01	10.86*
	Stage	2	0.81	2.92**
	Replicate	19	0.11	0.39ns
	Residual	97		
ZINC	Season	1	524.17	0.78ns
	Stage	2	82.42	0.1ns
	Replicate	19	433.56	0.64ns
	Residual	97	676.29	

*Significant ($P < 0.05$) **Highly significant ($P < 0.01$) ns Not significant ($P > 0.05$)

TABLE 5: SUMMARY OF STATISTICAL ANALYSIS OF MINERAL ELEMENTS IN THE SERUM OF LACTATING YANKASA EWES

ELEMENTS	S. OF VAR.	d.f.	M.S.	F. VALUE
CALCIUM	Season	1	5.08	2.93*
	Stage	7	2.55	1.47ns
	Replicate	9	1.74	.55ns
	Residual	142	1.74	
PHOSPHORUS	Season	1	307.75	34.99**
	Stage	7	198.29	22.55**
	Replicate	9	11.93	1.36ns
	Residual	142	8.79	
MAGNESIUM	Season	1	1.44	4.61*
	Stage	7	0.75	2.38*
	Replicate	9	0.35	1.11ns
	Residual	142	0.31	7.081ns
POTASSIUM	Season	1	2.97	0.78ns
	Stage	7	28.69	0.89ns
	Replicate	9	32.58	
	Residual	142	36.61	79.49**
SODIUM	Season	1	11944.69	0.73ns
	Stage	7	179.32	0.74ns
	Replicate	9	180.30	
	Residual	142	244.58	
IRON	Season	1	20340.1	4.63*
	Stage	7	11369.46	2.59*
	Replicate	9	4958.04	1.13ns
	Residual	142	4377.07	
MANGANESE	Season	1	45.05	19.90**
	Stage	7	15.15	6.69*
	Replicate	9	0.57	0.25ns
	Residual	142	2.26	
COPPER	Season	1	4.06	
	Stage	7	0.68	23.64**
	Replicate	9	0.08	3.96**
	Residual	142	0.17	
ZINC	Season	1	0.19	0.45ns
	Stage	7	1.60	
	Replicate	9	0.57	
	Residual	142	0.85	0.22ns

*Significant ($P < 0.05$) **Highly significant ($P < 0.01$) ns Not significant ($P < .05$)

while the summary of mineral element intakes per day within each season are duplicated in Table 3. The apparent differences observed between the mineral intake figures in the wet and dry seasons were not significant, except for iron consumed which was appreciable ($p < 0.05$). Information on recommended mineral intake (ARC, 1980) is also presented in Table 3.

Mineral concentrations in the serum

The general analysis of variance for mineral elements in the serum of pregnant and lactating ewes are presented in Tables 4 and 5 respectively. Seasonal effects on the concentrations of iron (g/dl), copper (ug/ml) in the blood serum of pregnant ewes were highly significant ($p < 0.01$). In addition, highly significant seasonal effects ($p < 0.01$) on the concentrations of phosphorus (mg/dl), sodium (MEg/L), manganese and copper (ug/ml) were observed.

The estimated mineral concentrations in the serum of various groups of sheep were compared with values in literature (Tables 6 and 7). The values observed for calcium and phosphorus (mg/dl) during pregnancy were 8.93 - 10.1 and 12.55 - 12.65 respectively, while during lactation, calcium concentration dropped (6.05 - 6.14) and phosphorus concentration increased (15.6 - 17.7). Magnesium values ranged from 4.5 to 4.8mg/dl for both pregnant and lactating ewes. Serum iron concentrations (ug/dl) were 537.8 - 617.1 and 489.8 - 512.3 for pregnant and lactating Yankasa ewes respectively.

DISCUSSION

As shown in Table 3, the mineral nutrients in the diet of twice-yearly lambing Yankasa ewes were not below the dietary allowances recommended by A.R.C. (1980) for sheep in the temperate.

Daily dry matter intakes (kg/day) during the wet and dry periods (0.92 and 1.5 respectively) agrees with the range 0.91 - 1.53 kg/day recommended as dietary allowance for 40kg pregnant ewe with twin lambing through gestation.

The blood calcium of normal ewe is about 10mg/dl and could be slightly altered by the diet of the animal. The phosphorus (4 - 8mg/dl) is low (Underwood 1981). The control of calcium iron in the extracellular fluid to maintain a constant concentration despite marked variations in the intake and excretion is effected by endocrine action of parathyroid hormone (PTH), Calcitonin (CT) and estrogen, thyroxine, somatotropin and glucagon may contribute to the maintenance of calcium homeostasis under

mechanism for PTH secretion is the concentration of blood calcium. Although the concentration of blood phosphorus has no direct regulatory influence on the synthesis and secretion of PTH, it may, when elevated, contribute to parathyroid stimulation by virtue of its ability to lower blood calcium. As the phosphate concentration increases, blood calcium decreases reciprocally according to the mass-law equation when the serum is saturated with respect to these two ions. (Krook, 1957; Krook and Lowe, 1964).

Magnesium values ranged from 4.5 - 4.8mg/dl for both pregnant and lactating ewes. The clinical signs of Hypo-magnesemic tetany are associated with fall in serum magnesium from a normal range of 1.8 - 3.2mg/dl to 10-7 mg/dl or less and are most likely to occur at values below 1.0mg/dl (Underwood 1981). Blood sodium values have little diagnostic significance but the sodium in the urine and the Na:K ratio in the saliva have some value for diagnosis (Underwood 1981). However, in the present study, observed values were 8.5-9.6 MEg/l and 156 - 186 MEg/l for Potassium and Sodium respectively in the serum of both pregnant and lactating ewes.

Higher values obtained for iron in the serum of both pregnant and lactating ewes might be a reflection of the dietary iron (70.7 - 90.0mgFe/day) which was well above the dietary requirement 30 - 40mgFe/day (ARC 1980). Furthermore, lactation which is demanding for other mineral nutrients, such as calcium, phosphorus, potassium and sodium, impose relative little extra demand for iron, because of the conventionally low iron content in milk.

Blood zinc values in domestic livestock mostly lie within the range 0.8- 12mgzn/ml but individual variability can be high and many factors other than dietary zinc and known to affect serum concentrations (Underwood 1981). In the present study, the concentrations of zinc in the serum of twice-yearly lambing Yankasa ewes was 2.7 - 2.9kg/ml.

In ruminant animals, the manganese value in the blood is not of much diagnostic importance. Reported blood manganese values are extremely variable, reflecting both individual variability and analytical inadequacies. The manganese concentration in the whole diet therefore remains the most useful means of detecting possible deficiency in animals (Underwood 1981).

Although the liver is the main storage organ of the body for copper and thus provides a useful index of copper status of the animal, whole blood or plasma concentrations also reflect the

TABLE 6: COMPARISON OF ESTIMATED MINERAL CONCENTRATIONS IN THE SERUM OF PREGNANT YANKASA SHEEP WITH VALUES IN LITERATURE

MINERAL ELEMENTS (CONCENTRATION)	ESTIMATED VALUES/SEASON		NORMAL RANGES	REFERENCES
	WET	DRY		
Calcium (mg/dl)	10.0 ± 1.7	8.9 ± 2.9	9-11	Underwood (1981)
Phosphorus (mg/dl)	12.6 ± 2.2	12.5 ± 2.4	4-8	" "
Magnesium (mg/dl)	4.5 ± 0.69	4.7 ± 0.69	1.8-3.2	" "
Potassium (mEq/l)	9.1 ± 1.3	9.6 ± 1.2	7.0	" "
Sodium (mEq/l)	179.3 ± 10.1	186.1 ± 13.5	145.	" "
Iron (ug/dl)	617.1 ± 83.5	537.8 ± 65.3	102-304	Underwood - Morgan (1963)
Manganese (ug/ml)	4.4 ± 0.8	4.3 ± 1.1	Conc. in whole diet	" (1981)
Copper (ug/ml)	0.8 ± 0.15	0.48 ± 0.1	0.6-1.5	Beck (1956)
Zinc (ug/ml)	2.7 ± 0.7	2.9 ± 0.6	0.8-1.2	Underwood (1981)

± Standard Error

TABLE 7: COMPARISON OF ESTIMATED MINERAL CONCENTRATIONS IN THE SERUM OF LACTATING YANKASA SHEEP WITH VALUES IN LITERATURE

MINERAL ELEMENTS (CONCENTRATION)	ESTIMATED VALUES/SEASON		NORMAL RANGES	REFERENCES
	WET	DRY		
Calcium (mg/dl)	6.1 ± 1.3	6.4 ± 1.1		Underwood (1981)
Phosphorus (mg/dl)	17.4 ± 3.2	14.6 ± 3.2	4-8	" "
Magnesium (mg/dl)	4.8 ± 1.0	4.6 ± 1.2	1.8-3.2	" "
Potassium (mEq/l)	8.8 ± 1.4	8.5 ± 1.5	7.0	" "
Sodium (mEq/l)	178.1 ± 13.0	156.0 ± 12.2	145	" "
Iron (ug/dl)	489.8 ± 57.8	512.3 ± 58	1102-304	Underwood & Morgan (1963)
Manganese (ug/ml)	5.8 ± 0.6	6.8 ± 0.5	Conc. in whole diet	" Underwood (1981)
Copper (ug/ml)	0.77 ± 0.1	1.09 ± 0.1	0.6-1.5	Beck (1956)
Zinc (ug/ml)	2.8 ± 0.7	2.7 ± 1.20	0.8-1.2	Underwood (1981)

± Standard Error

dietary copper status. The values obtained in the present study ranged from 0.5 to 1.1kg/ml. Comparative estimates by Bec (1956) was 0.6 - 1.5kg/ml. A range of 0.8 - 1.2kg/ml was given for sheep, cattle, horses, goats and pigs in the temperate climate (Underwood 1981).

Although differences cannot be ruled out, it seems the present values represent reliable baseline information for some minerals in the blood serum of twice - yearly lambing Yankasa ewes.

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