

Mineral Elements in the Muscle Groups of West African Dwarf Goats

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Abstract: A study was conducted to determine the distribution of mineral elements (Na, K, Ca, P and Mg) in certain muscle groups and organs of both male and female West African dwarf goats. Treatment means ($p < 0.05$) were observed for all mineral elements studied for each age group except Mg. Na concentrations in the liver were influenced ($p < 0.05$) by age; 1.01 and 1.15 g 100 g⁻¹ dry matter at 24 and 52 weeks old, respectively. Liver concentrations of K, Ca and P were higher when goats were 52 weeks old. Sex had no significant ($p > 0.05$) effect on the mineral status of the muscle groups and organs.

Key words: Goats, minerals, sodium, potassium, calcium, phosphorus, magnesium, muscles, organs

INTRODUCTION

The presence of mineral elements in an animal's body is of vital importance since they are required for the normal functioning of all biochemical processes in the body. They are dietary essentials for all classes of livestock and they comprise about 5% of the body of vertebrates (McDowell *et al.*, 1983). They are essential constituents of the soft tissues, fluids and skeleton.

Goats are multipurpose animals producing meat, milk, skin and hairs (French, 1970). However, out of these products meat is the major form in which goats are consumed in Nigeria. Goat meat is widely accepted and consumed in Nigeria since there is no taboo against it (Peacock, 1996).

The West African dwarf goats are widely distributed in the forest zone of Nigeria due to their relatively high trypanotolerant qualities (Upton, 1985) and are commonly managed extensively by the peasant farmers. However there is paucity of information on the distribution of mineral elements in their muscles at different ages relative to their organoleptic properties.

In this study, the distribution of certain mineral elements (Sodium, Potassium, Calcium, Phosphorus and Magnesium) in the various muscle groups and organs of West African dwarf goats in relation to age and sex was investigated.

MATERIALS AND METHODS

Animals and feeding: Eighteen healthy West African dwarf goats (9 males, 9 females) used in this study were from the Teaching and Research Farm, University of

Table 1: Ingredient and mineral composition of concentrate mixture and Cynodon

Ingredients	Concentrate mixture	Cynodon
Cassava flour	39.00	
Soyabean meal	40.00	
Brewer's grains	20.00	
Dicalcium phosphate	0.50	
Mineral/vitamin mixture	0.50	
Total	100.00	
Mineral composition (g 100 g ⁻¹)		
Sodium	0.30	0.24
Potassium	1.99	2.37
Calcium	18.40	16.40
Magnesium	0.30	0.32

Ibadan, Nigeria. They were offered concentrate mixture (Table 1) when they were 2 weeks old. *Cynodon nlemfuensis* was fed as the sole roughage to all the goats. Clean and fresh drinking water was ad libitum. The sexes were reared separately.

Slaughter: At 24 weeks of age a group of these animals (4 males, 4 females) were allowed free access to water but fasted for 24 h before they were slaughtered. The carcass were dressed and split into halves. The muscles from each half as well as certain organs were grouped into the following:

Group 1: The proximal muscles of the pelvic limb.

Group 2: The muscles surrounding the spinal column in the thorax and lumber region. It also included the intrinsic muscles of the neck and thorax.

Group 3: The muscles of the abdominal wall.

Group 4: The proximal intrinsic muscles of the thoracic limb which arise from the scapula or proximal half of the humerus.

Group 5: The distal muscles of the thoracic limb.

Group 6: The muscles connecting the thorax to the thoracic limb plus the muscles joining the neck to the thoracic limb.

Group 7: Lungs.

Group 8: Liver.

The same procedure was adopted for animals when they were 52 weeks of age.

Chemical analyses: Each group was weighed individually after which it was dried in the oven in accordance with AOAC (1990) until it became brittle to enhance grinding to very fine powder and then stored in polythene bags for subsequent analyses. Mineral elements in the muscles and organs were then determined (Fick *et al.*, 1979).

Statistical analysis: Data obtained were subjected to analysis of variance and mean differences were tested by Duncan's New Multiple Range Test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

Mineral concentrations of muscle groups and organs as affected by age: Table 2 shows the mineral components of muscle groups and organs of West African dwarf goats as affected by age. Treatment means ($p < 0.05$) were observed for all mineral elements studied for each age group except for Mg. Age affected the concentrations of Na in the muscle groups and organs of West African dwarf goats; higher concentrations were recorded at 52 weeks of age. The increase in Na content of all the muscle groups and organs did not agree with the result obtained by Spray and Widdowson (1950) and Weiss *et al.* (1971). This could be due in part to the fact that the muscles and organs did not dry properly since the amount of Na in any tissue is a direct function of its moisture content (Toal *et al.*, 1961). The mean liver concentrations of K, Ca and P obtained for 52 weeks old animals were higher ($p < 0.05$) than the values recorded at 24 weeks old. This was attributed to the numerous physiological activities carried out by the liver. McDowell *et al.* (1984) reported that liver mineral concentrations are valuable for determining mineral status of Co, Cu, Mn and Se. All these indicate that liver serves as a storage organ for most mineral elements. The high positive correlation coefficients established between the liver and muscle group 1 further emphasized this

Table 2: Mineral components of muscle groups and organs of West African dwarf goats as affected by age

Age (Weeks)	Mineral (g 100 g ⁻¹ DM)	Muscle groups								±SEM
		1	2	3	4	5	6	7	8	
24	Na	0.46 ^b	0.57 ^b	0.51 ^b	0.56 ^b	0.48 ^b	0.48 ^b	1.01 ^a	0.06 ^c	0.059
	K	2.05 ^a	1.84 ^{ab}	1.65 ^b	1.94 ^a	1.98 ^a	1.51 ^b	1.71 ^b	1.84 ^{ab}	0.116
	Ca	1.34 ^b	1.26 ^b	0.98 ^c	1.23 ^b	1.36 ^b	1.03 ^{bc}	1.83 ^a	1.88 ^a	0.074
	P	0.73	0.67	0.52	0.69	0.73	0.57	1.00	1.20	0.039
	Mg	0.10	0.08	0.07	0.08	0.07	0.07	0.07	0.07	0.006
52	Na	0.56 ^b	0.76 ^b	0.54 ^b	0.84 ^b	0.68 ^b	0.76 ^b	1.15 ^a	1.06 ^a	0.109
	K	2.03 ^{bc}	2.14 ^b	1.90 ^c	2.40 ^b	1.87 ^c	2.15 ^b	1.87 ^c	3.06 ^a	0.220
	Ca	1.41 ^c	1.40 ^c	1.01 ^c	1.63 ^b	1.29 ^d	1.43 ^c	1.72 ^b	2.30 ^a	0.127
	P	0.74 ^b	0.76 ^b	0.57 ^b	0.92 ^b	0.75 ^b	0.78 ^b	0.96 ^b	1.97 ^a	0.084
	Mg	0.06	0.08	0.06	0.07	0.07	0.08	0.05	0.08	0.005

^{a,b,c,d}Means in the same row followed by different superscripts are significantly different ($p < 0.05$)

Table 3: Mineral components of muscle groups and organs of West African dwarf goats as affected by age

Sex	Mineral (g 100 g ⁻¹ DM)	Muscle groups								±SEM
		1	2	3	4	5	6	7	8	
F	Na	0.43	0.66	0.50	0.55	0.53	0.55	1.15	0.85	0.081
M	"	0.60	0.67	0.56	0.85	0.64	0.69	1.01	0.75	0.094
F	K	2.08	1.88	1.78	2.17	1.98	1.86	1.85	2.51	0.250
M	"	2.28	2.11	1.77	2.23	1.87	1.80	1.73	2.39	0.184
F	Ca	1.22	1.29	1.02	1.43	1.40	1.34	1.84	2.00	0.144
M	"	1.53	1.37	1.02	1.44	1.26	1.12	1.72	2.18	0.117
F	P	0.66	0.68	0.56	0.83	0.79	0.75	1.02	1.60	0.090
M	"	0.82	0.75	0.52	0.78	0.69	0.60	0.94	1.58	0.067
F	Mg	0.08	0.08	0.07	0.08	0.07	0.08	0.07	0.08	0.009
M	"	0.08	0.09	0.07	0.08	0.07	0.07	0.07	0.08	0.009

F = Female; M = Male

Table 4: Correlation coefficients between muscle groups of West African dwarf goats at different ages

Comparison between	Element (s)	Correlation coefficient (weeks)	
		24	52
Liver and muscle group 1	Na	0.28	0.17
"	K	0.64**	-0.62*
"	Ca	0.74**	0.04
"	P	0.24	-0.43*
"	Mg	0.76**	-0.11
All muscle groups	Na and K	0.18	-0.06
"	Ca and P	0.40	0.82**

* Significant difference at $p < 0.05$, ** Significant difference at $p < 0.01$

(Table 4). The closeness in the values of Ca content at both ages might be due to the reported decline in Ca absorption with age (Hansard and Crowder, 1957; Braithwaite and Riazaddin, 1971). Also a relatively lower Ca/P ration (1.63) obtained in this study at the older age compared with 1.78 at younger age implies that more Ca than P was incorporated into the bone as the animals grow.

Mineral concentrations of muscle groups and organs as affected by sex: Sex was observed (Table 3) to have no significant ($p > 0.05$) effect on the mineral status of the muscle groups and organs. This might have been due to the non-attainment of matured weight of 18-25 kg (Devendra and McLeroy, 1987) because the weight of the female and male animals ranged from 8.30-13.35 kg and 11.20-14.68 kg, respectively at 52 weeks of age.

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