

## DIETARY CALCIUM AND PHOSPHORUS REQUIREMENTS FOR GROWING LAMBS – ASSESSMENT OF TCORN (1988) REVISED MODEL

M. Wan Zahari

Malaysian Agricultural Research and Development Institute  
(MARDI), P.O. Box 12301, G.P.O. 50774 Kuala Lumpur, Malaysia

J.K. Thompson

School of Agriculture, 581 King Street, Aberdeen AB9 1UD, Scotland

and

D. Scott

Rowett Research Institute, Bucksburn, Aberdeen AB2 9SB, Scotland.

### Introduction

Revised estimates of Ca and P requirements of ruminants published by ARC (1980) were lower than the values proposed earlier (ARC, 1965). These changes in requirements were not accepted by the agricultural industry and were not put into practice. In 1984, a Working Party representing several authorities in U.K. advised the continued use of the 1965 estimates as a basis for formulating dietary requirements.

In view of this response, the new requirements based on model related to bone growth and maturity have recently been proposed by TCORN (1988). This paper reported the assessment of TCORN's new estimates, based on a practical long-term feeding trial.

### Materials and Methods

Fifty young cross-bred lambs (Suffolk x Blackface), weighing about 25 kg live-weight were randomly allocated into five groups. The first group was used as an initial slaughter group, while the other four groups were fed a basal diet supplemented with Ca and P at levels below or above those recommended for lambs growing at about 0.2 kg/day (TCORN, 1988). The treatment groups were feeding approximately 0.75 times of the requirement for Ca and P (Group A), feeding the requirement for Ca and P based on TCORN's new estimates (Group B), 1.5 times of the requirement for Ca and P (Group C) and 1.5 times of the requirement for Ca and 0.75 times of the requirement for P (Group D).

The basal diet consisted of Chinese sweet

potato, flaked maize, oat husk, sugar beet pulp, soya bean meal, urea, molasses, Norvite 317 and limestone. This basic diet provided about 0.75 of the TCORN's requirement for Ca and P. The concentrations of Ca and P in groups B, C and D were met by supplementation with calcium carbonate and dicalcium phosphate.

The lambs were housed in individual pens and weighed weekly. The diet and blood plasma were collected and analysed for mineral. Rumen samples were obtained for P analysis. The lambs were slaughtered at 48 kg live-weight (93 days after the trial commenced). Bones (metatarsus and metacarpus) were dissected for radiography and mineral analyses. Whole carcass and soft tissues together with blood were minced, freeze-dried, freeze-milled and analysed for mineral. Fleece was analysed separately. The composition of gains were estimated using body composition data and similar data from initial group.

### Results and Discussion

The average DMI over the whole growth period were 106, 107, 106 and 103 kg for groups A, B, C and D respectively, while the respective growth rates were 0.260, 0.255, 0.232 and 0.207 kg/day. Calcium and P intake were not exactly as planned with the respective means of 3.73 and 2.15, 5.00 and 2.53, 6.77 and 3.51, and 7.12 and 1.98 g/day for groups A, B, C and D as compared to 4.77 and 3.01, 4.71 and 2.98, 4.42 and 2.81 and 4.06 and 2.57 g/day when calculated based on TCORN (1988). Although P was less than calculated in diet B, it did not appear to be limiting, suggesting TCORN (1988) allowance was

TABLE 1. THE COMPOSITION OF THE EMPTY-BODY WEIGHT (EBW) AND GAINS (EBG) OF LAMBS BETWEEN TREATMENTS

Dietary treatments	A	B	C	D	s.e.d. of treatments
EBW (kg)+					
Ash (kg)	1.35 <sup>a</sup>	1.53 <sup>b</sup>	1.56 <sup>b</sup>	1.34 <sup>a</sup>	0.051 *
Ca (g)	324 <sup>a</sup>	373 <sup>b</sup>	374 <sup>b</sup>	319 <sup>a</sup>	14.26 *
P (g)	198 <sup>a</sup>	225 <sup>b</sup>	226 <sup>b</sup>	187 <sup>b</sup>	6.99 *
Mg (g)	11.3 <sup>b</sup>	12.3 <sup>c</sup>	12.3 <sup>c</sup>	9.35 <sup>a</sup>	0.451 *
EBG (kg)++	20.6 <sup>b</sup>	20.2 <sup>b</sup>	19.1 <sup>ab</sup>	17.4 <sup>a</sup>	0.800 *
Ash (g/kg EBG)	27.4 <sup>a</sup>	35.8 <sup>b</sup>	37.9 <sup>b</sup>	26.8 <sup>a</sup>	2.36 ns
Ca (g/kg EBG)	5.56 <sup>a</sup>	7.91 <sup>b</sup>	8.24 <sup>b</sup>	5.43 <sup>a</sup>	0.663 *
P (g/kg EBG)	3.56 <sup>b</sup>	4.88 <sup>c</sup>	5.00 <sup>c</sup>	2.89 <sup>a</sup>	0.325 *
Mg (g/kg EBG)	0.211 <sup>b</sup>	0.254 <sup>c</sup>	0.254 <sup>c</sup>	0.084 <sup>a</sup>	0.021 *

+Adjusted for EBW as covariate (The estimated EBW is 38.7 kg)

++Based on regression equations of components to the live-weight of lambs at the start of dietary treatments (ILW = initial live-weight, kg, r = correlation coefficient).

(a) EBW (kg) = 1.15 + 0.782 ILW (r = 0.97)

(b) Ash (kg) = 0.198 + 0.0269 ILW (r = 0.81)

(c) Ca (g) = 39.0 + 7.60 ILW (r = 0.74)

(d) P (g) = 22.1 + 4.61 ILW (r = 0.79)

(e) Mg (g) = -0.82 + 0.350 ILW (r = 0.89)

\*Significant at  $P < 0.05$ .

ns Not significant

slightly higher than needed by these lambs.

There were no differences in the ash, Ca, P and Mg contents of empty-body (EBW) or empty-body gain (EBG) in the lambs fed with diets B or C (table 1). This indicates that increases in Ca and P intake to levels above the estimated requirement were not having advantage on Ca, P and Mg retention. The two low P diets (A and D) resulted in lower gains of ash, Ca, P and Mg. The retention of Ca (7.9 g/kg EBG) and (4.9 g/kg EBG) in group B were lower than 8.7 g/kg and 5.3 g/kg respectively for lambs weighing approximately 40 kg as suggested by the TCORN model, and also lower than the representative values of 11 g/kg and 6 kg EBG for Ca and P respectively when based on the ARC (1980) model. Similar lower values than the ARC estimates have been observed in lambs fed concentrate diets (Wan Zahari, 1988) but not with forage-fed lambs (Thompson et al., 1988). The retention of Ca/kg LWG were 4.8, 6.8, 7.3 and 5.0 g for groups A, B, C and D respectively while the respective values for P were 3.0, 4.1, 4.5 and 2.7 g.

Plasma P were markedly lower in group D, reaching about 4 mg/100 ml after 6 weeks of the

trial period. Mean ruminal P concentration at the end of the trial period were 19.9, 20.2, 19.8 and 6.5 mmol/l for groups A, B, C and D respectively. The depression of plasma and ruminal P in group D were enhanced by the excess Ca in this diet, possibly due to impairment of salivary P secretion into the rumen.

The breadth, area and volume of mineralised bone tended to be lower in group D than either group B or C (table 2). Lower mineralization of bones in groups A and D were expected as a result of treatments and because of the differences in mineral retention as indicated by chemical analyses.

The estimated absorbability of Ca were 0.55, 0.50, 0.36 and 0.25 for diets A, B, C and D while the respective values for P were 0.65, 0.66, 0.47 and 0.58.

It is evident from this experiment that Ca and P were retained at rates in accordance with those predicted by the revised TCORN (1988) model. The data suggested that the revised estimates do provide a satisfactory basis on which to define growth requirements.

TABLE 2. RADIOGRAPHICAL CHARACTERISTICS AND MINERAL COMPOSITION IN METATARSUS AND METACARPUS BETWEEN TREATMENTS (G/KG COMPLETE BONE)

Dietary treatments		A	B	C	D	s.e.d. of treatments
<b>Metatarsus</b>						
Bone +	(cm)	0.545	0.577	0.582	0.508	0.031 ns
Area	(cm <sup>2</sup> )	1.03	1.10	1.06	0.972	0.048 ns
Volume	(cm <sup>3</sup> )	12.9	13.3	13.7	12.2	0.606 ns
Dried weight	(g)	41.2	41.4	41.3	39.8	1.512 ns
Ash	(g)	15.2 <sup>ab</sup>	15.8 <sup>b</sup>	16.4 <sup>b</sup>	14.4 <sup>a</sup>	0.503 *
Ca	(g)	5.71	5.78	5.77	5.31	0.242 ns
P	(g)	2.58 <sup>b</sup>	2.68 <sup>b</sup>	2.70 <sup>b</sup>	2.30 <sup>a</sup>	0.117 *
Mg	(g)	0.113 <sup>b</sup>	0.115 <sup>b</sup>	0.125 <sup>b</sup>	0.082 <sup>a</sup>	0.006 *
<b>Metacarpus</b>						
Bone +	(cm)	0.547	0.542	0.593	0.521	0.036 ns
Area	(cm <sup>2</sup> )	1.24	1.24	1.30	1.19	0.063 ns
Volume	(cm <sup>3</sup> )	14.7	14.4	15.6	14.2	0.782 ns
Dried weight	(g)	39.0	39.0	38.0	37.2	1.530 ns
Ash	(g)	14.3 <sup>ab</sup>	15.2 <sup>b</sup>	15.1 <sup>b</sup>	13.9 <sup>a</sup>	0.504 *
Ca	(g)	5.26 <sup>a</sup>	5.66 <sup>b</sup>	5.66 <sup>b</sup>	5.52 <sup>ab</sup>	0.16 *
P	(g)	2.44	2.64	2.66	2.38	0.093 *
Mg	(g)	0.105	0.110	0.110	0.080	0.005 *

+ Breadth of mineralised bone (cm)

\* Significant at P < 0.05

(Key Words: Mineral Retention, Growth Requirement)

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