Short Communications / Kort Mededelings

Utilization of the phosphorus in Langebaan rock phosphate by growing sheep

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Growing wether sheep were given a low-phosphorus (P) diet (1,06 g P/d) supplemented with 1,75 g P in the form of either Langebaan rock phosphate (Langfos) or two different calcium phosphates, composed of either a mixture of monocalcium and dicalcium phosphate (MDP) or pure dicalcium phosphate (DCP). Without P supplementation, the sheep were in negative P balance (–0,03 g P/d). When the low-P diet was supplemented with Langfos, 94% of the additional P supplied was excreted in the faeces and only 0,08 g P/d was apparently retained. In contrast, supplementation with MDP and DCP resulted in significantly improved apparent P retentions of +1,10 and 1,01 g P/d respectively. Only MDP and DCP significantly increased blood plasma P concentrations.

'n Lae-fosfor dieët (1,06 g P/d) is aan groeiende hamels gevoer. Die dieet is aangevul met 1,75 g P in die vorm van óf Langebaan rotsfosfaat (Langfos) óf twee verskillende kalsiumfosfate. Die laasgenoemde het bestaan uit 'n mengsel van 'n mono- en di-kalsiumfosfaat (MDP) of uit suiwer dikalsiumfosfaat (DCP). Sonder P-aanvulling was die skape in 'n negatiewe P-balans (–0,03 g P/d). Waar die lae-P-dieet met Langfos aangevul is, is 94% van die P-aanvulling in die mis uitgeskei, terwyl die skynbare P-retensie slegs 0,08 g P/d was. In teenstelling hiermee, het die aanvulling met MDP en DCP gelei tot betekenisvolle hoër skynbare P-retensies van +1,10 en 1,01 g P/d, onderskeidelik. Slegs MDP en DCP het bloedplasma-P-konsentrasies betekenisvol verhoog.

Keywords: Apparent phosphorus retention, growing sheep, rock phosphate.

A few studies have been performed on the direct use of naturally occurring rock phsophates as P sources in ruminant diets over the years. Curacao Island rock phosphate (Curaphos) was found to be equivalent to dicalcium phosphate for both cattle and sheep (Ammerman *et al.*, 1957) and for cattle (Wise *et al.*, 1961). In contrast, Reinach & Louw (1958) recorded that the P present in two Transvaal rock phosphates was wholly unavailable to sheep which developed clinical aphosphorosis. This was attributed to their high iron and aluminium contents (49—108 g Fe and 81—88 g Al/kg). Fishwick (1976) evaluated two Christmas Island rock phosphates; the raw rock phosphate dried and ground to 100 mesh (C-Grade Phosphate) and calcined C-Grade Phosphate. Both C-Grade Phosphates were inferior to feed-grade dicalcium phosphate as P sources for growing sheep given a low-P diet. Nevertheless, they were more effective than the iron-aluminium products described by Reinach & Louw (1958).

In this study, a natural rock phosphate sand from the Langebaanweg Region of South Africa [Langebaan Rock Phosphate (Langfos), African Metals Corporation Ltd.] was evaluated in a P balance experiment with growing sheep. The method of extraction of Langfos [129 g P, 324 g Ca, 10 g Fe, 4,5 g Al and (maximum) 29 g F/kg] has been described previously (Krumm *et al.*, 1974). Comparisons were made with two commercially available calcium phosphates, composed principally of either a mixture of monocalcium phosphate and dicalcium phosphate (MDP, 202 g P, 201 g Ca, 1,2 g F/kg) or pure dicalcium phosphate (DCP, 166 g P, 260 g Ca, 0,9 g F/kg) [Kynoch Feeds (Pty) Ltd., Randburg, South Africa].

Four groups of six 40 kg growing wether sheep (Suffolk × Greyface cross, aged about 4 months) in metabolism cages, were given a basal low-P diet (1,06 g P/d) consisting of 1020 g shredded unmolassed sugar-beet pulp [0,88 dry matter (DM), 1,00 g P/kg DM], 180 g barley husk siftings (0,88 DM, 1,02 g P/kg DM), 20 g urea, 10 g salt and 3 g of a trace element/vitamin supplement.

There were four dietary treatments, viz. (A) no phosphorus supplement, or an additional 1,75 g P/sheep/d given as either (B) 13,61 g Langfos, (C) 8,65 g MDP, or (D) 10,75 g DCP intermixed with the basal low-P diet. Each diet was given in two approximately equal parts at 07h30 and 17h00. Following a seven-day introductory period, seven-day P balances were conducted. Blood samples were obtained 1 h after the morning feed on day 13 for the determination of plasma P and calcium (Ca) concentrations. The sheep were weighed on the first and the last days of the 14-day feeding period.

The results are detailed in Table 1. There were no food refusals apart from one sheep given MDP which left 20 g DM/d. The mean live-weight gain of the sheep given additional P in the form of either Langfos or DCP was low (0,11 g/d), and was very similar to the value recorded for the sheep given the low-P diet alone. With MDP supplementation, live-weight gain was significantly increased to 0,22 kg/d. This increase is difficult to interpret, since live-weight gain was recorded over two weeks only, and with sheep given feed to rather less than full appetite.

Table 1 Mean daily live-weight gain (kg), phosphorus balances (g P) and blood phosphorus and calcium concentrations (mg/100 ml blood plasma)

Diet	A	B	C	D	*SE* of mean	
Supplement	Nil	Langfos	MDP	DCP	(+)	Signficance
Live-weight gain	0,10	0,11	0,22	0,11	0,035	C>A,B,C**
Phosphorus						
Intake	1,06	2,81	2,76	2,81	–	–
Urine	0,01	0,01	0,01	0,01	0,001	NS[a]
Faeces	1,08	2,72	1,65	1,79	0,095	B,C,D>A*** B>C,D***
Retention	–0,03	+0,08	+1,10	+1,01	0,096	C,D>A,B***
Blood P	5,5	5,8	6,9	7,3	0,44	C,D>A,B*
Blood Ca	10,7	10,1	10,2	10,5	0,19	NS[a]

[a] No significant difference.

* Difference $P<0,05$; ** difference $P<0,01$; *** difference $P<0,001$.

Without P supplementation, the sheep were in negative P balance (−0,03 g P/d) compared with similar and significantly improved apparent P retentions of +1,01 and +1,10 g P/d when the low-P diet was supplemented with DCP and MDP, respectively. In contrast, only very small amounts of P (+0,08 g P/d) were apparently retained by the sheep given Langfos. Indeed, 94% of the additional P given as Langfos was apparently excreted in the faeces. Urinary P excretion in all four groups of sheep was small (0,01 g P/d), irrespective of diet.

The balance results suggest that Langfos is a very poor source of dietary P. If the amounts of P apparently available in each supplement is defined as that proportion of added P which was not excreted in the faeces, then the values for Langfos, MDP and DCP are 6,3, 66,5 and 59,4% respectively. The marked inferiority of the P present in Langfos cannot be attributed to a difference in particle size. Both Langfos and DCP had similar particle size distributions with only 3% (Langfos) and 0,2% (DCP) retained by a 0,5-mm sieve and 50 and 66%, respectively, retained by a sieve finer than 0,25 mm. In contrast, MDP [with the highest apparent P availability, (66,5%)] was a much coarser, granular product with 72% particles greater than 0,5 mm and only 6% finer than 0,25 mm. There was no increase in blood plasma P concentration over the unsupplemented diet when Langfos was given, but both MDP and DCP signficantly increased concentrations. Nevertheless, neither Langfos nor the low-P diet resulted in plasma P concentrations that would be considered abnormally low. Much lower plasma P concentrations of about 2,5 mg/100 ml were recorded in similar experiments with sheep given unsupplemented low-P diets (Hemmingway & Fishwick, 1975), but they used younger sheep given only about 0,7 g P/d. The apparent P retention and availability data both underestimate the true values for each product since no account is taken of endogenous faecal loss of P. Braithwaite (1985) had indicated that, when growing lambs are given P-deficient diets despite the need to retain as much P as possible until all P requirements for growth are met, an increased endogenous faecal loss of P with increased P intake is inevitable. It is considered unlikely that a very high endogenous faecal loss of P from the particular sheep given Langfos could account for the very low apparent availability and retention of P from this product.

It is concluded that Langfos is of no value as a P source for ruminants. Additionally, the fluorine content is excessive. The apparent availability of the P in MDP (66,5%) and to a lesser extent in DCP (59,4%) is similar to that of several feed-grade dicalcium phosphates and other inorganic phopshates (mean about 70%) evaluated by Hemmingway & Fishwick (1975).

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