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Phosphorus Requirement for Finishing Heifers

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Summary

Sixty head of crossbred heifers (614 lb initial BW) were individually fed one of five levels of phosphorus of 0.10, 0.17, 0.24, 0.31, 0.38 % of diet DM with supplemental P from mono-sodium phosphate. Heifers were fed an energy-dense diet composed primarily of corn starch and corn fiber to minimize P from corn. When compared to the other four levels, heifers fed at the 0.10 % P level had lower DMI, ADG and final BW. Heifers fed 0.10%P had lower plasma P concentration. Break-point analysis of ADG suggests that the P requirement for finishing heifers is 0.115% P of diet DM within the range of 8.2 to 10.3g P/day (0.104 and 0.127% P on a DM basis).

Introduction

Current recommendations on the P requirement may be over-estimated for finishing cattle. Previous research suggests the P requirement for yearling steers is less than 0.14% (DM basis; 1996 Nebraska Beef Report, pp. 78-80), and steer calves is less than 0.16% (DM basis; 2002 Nebraska Beef Report, pp. 45-48). In both experiments, P requirements were not determined because performance was similar across all levels of P fed. The objective of our experiment was to determine the P requirement for calf-fed heifers.

Procedure

The experiment used 60 cross-bred, large framed heifers (initial BW= 614 lb). Two heifers were taken off of the trial due to pregnancy. Heifers were fed individually using Calan gates from Nov. 14, 2002 to May 15, 2003 (180 days). Heifers were stratified by weight and assigned randomly to one of five treatments. The treatments consisted of five different P levels of 0.10, 0.17, 0.24, 0.31, 0.38 % of DM. The five P levels were achieved by feeding one base diet (0.10 % P) and top dressing mono-sodium phosphate at feeding. The diet consisted of 50% coarse brewers grits, 15% high moisture corn, 15% corn bran, 10% sorghum silage, 5% tallow, and 5% supplement. Limestone was fed at 1.4% of diet DM to meet the Ca requirement. In order to formulate a diet low in P, coarse brewers grits (0.05% P DM basis) replaced corn (0.30% P DM basis). The diet was balanced to 12.5% CP, and it also contained 28 g/ton DM Rumensin, 10g/ton DM Tylan, and .46 mg/head/day MGA. Heifers were adapted to treatment diets by limiting intake at 1.5% of BW and increasing 0.5 lb/day until ad libitum intakes were achieved (approximately 21 days). They were implanted on day 1 with Revalor IH and re-implanted with Revalor 200 on day 84.

Heifers were weighed three consecutive days following a 5-day limit feeding period and averaged for initial BW. Samples of blood also were collected on day 0 and every 28 days throughout the feeding period. Blood was collected in the morning, prior to feeding, in 10 ml

vacutainers containing sodium heparin. Samples were centrifuged at 2500 RPM for 15 minutes. Plasma was removed from the top of the sample. Plasma was transferred into 2 ml conicles then frozen at -20 degrees C for later analysis. Plasma was analyzed using a commercial kit (Diagnostic Chemicals Limited) for plasma P concentration.

Final weights were calculated from hot carcass weight using a common dressing percentage of 62. After a 24 hour chill 12th rib fat thickness and marbling scores were taken.

Results

Performance

Heifer performance data are shown in Table 1. Significant quadratic ($P < 0.01$) effects were present for DMI and ADG. Cattle on treatments 0.10 and 0.38 had lower DMI and consequently lower ADG compared to cattle on the 0.17, 0.24, and 0.31 treatments. This indicates that the heifers on the 0.10 treatment were experiencing a P deficiency.

There were no significant quadratic or linear effects in feed conversion, despite differences in DMI and ADG. No differences were found in marbling score or 12th rib fat thickness; however, heifers fed 0.10% P had numerically lower marbling scores (linear effect: $P = 0.10$).

When calculated using non-linear regression analysis for % P of diet DM, the requirement for P was estimated to be 0.115%, ranging between 0.104 and 0.127% P of diet

(Continued on next page)

Table 1. Performance data for heifers consuming different levels of P.

	P Intake (% of DM)					SEM	P- value	
	0.10	0.17	0.24	0.31	0.38		Linear	Quadratic
P Intake (g/day)	7.40	14.2	20.5	25.9	29.6	0.71	<.01	<.01
Initial BW (lb)	619	613	616	617	612	12.0	0.77	0.98
Final BW (lb)	1086	1167	1163	1158	1114	24.00	0.52	<.001
DMI (lb/day)	16.2	18.3	18.7	18.3	17.0	0.60	0.38	<.01
ADG (lb/day)	2.58	3.06	3.03	2.99	2.78	0.09	0.26	<.01
F:G	6.24	5.94	6.15	6.10	6.13	0.12	0.85	0.35
HCW ^c	674	723	721	718	691	14.8	0.52	<.01
Marbling ^a	486	565	529	546	554	22.4	0.10	0.28
12 th Rib ^b	0.35	0.38	0.42	0.34	0.39	0.03	0.76	0.42

^aMarbling Scores: 400=Slight, 500=Small, 600 =Modest

^b12th Rib: Back fat thickness at the 12th rib measured in inches.

^cHCW: Calculated hot carcass weight using a common dressing percent of 62, measured in pounds.

DM (Figure 1). When feed conversion was plotted against P intake (g/day), no significant differences ($P>0.05$) were observed (Figure 2). P intake was positively correlated to ADG ($r = 0.13$, $P<0.01$) and DMI ($r = 0.14$, $P<0.01$). It was not correlated to feed efficiency ($r = 0.049$, $P>.60$).

Plasma P Concentration

There were no significant differences among treatments on day 0 ($P>0.30$), indicating all heifers were at the same plasma P concentration of 7.12mg/dL. A significant treatment by time interaction ($P<0.10$) occurred because the heifers fed 0.10% P had lower concentrations from day 28 to market (Figure 3). The heifers on the 0.10% P treatment were different from the other 4 treatments on day 28 to slaughter time ($P<0.10$). Heifers on the 0.10% P treatments had an initial plasma concentration of 6.98 mg/dL. Plasma P concentrations for heifers fed 0.10% P on day 28, 56, 84, 112, 140, and 180 were 4.49, 3.93, 4.82, 5.33, 4.32, and 4.18 mg/dL respectively. Plasma P concentration below 4.5 mg/dL are indicative of a P deficiency (Minerals Levels in Animal Health, R. Puls, p. 167). These results indicate heifers on the 0.10 treatment were P deficient. The plasma P concentration of cattle on

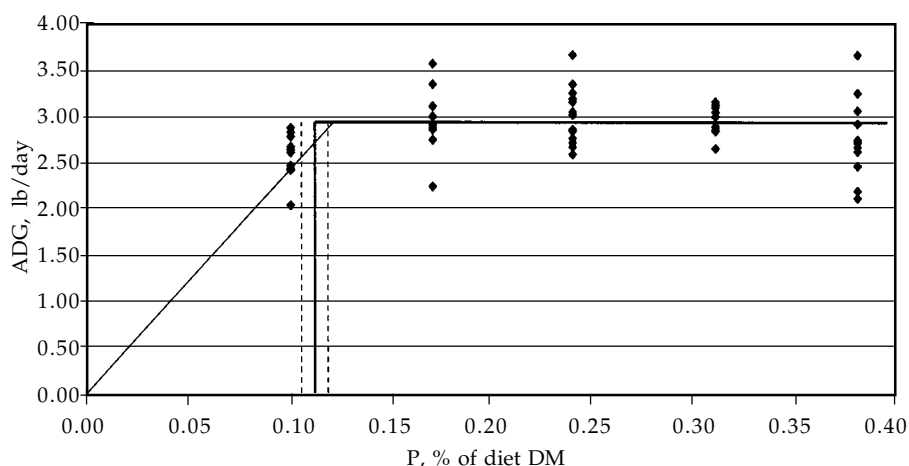


Figure 1. Non-linear effect of P% of diet DM on ADG of heifers. Breakpoint determined at 0.115% P (0.104 to 0.127% P). Solid line is the breakpoint (0.115% P) with the dashed line as the 95% confidence interval (0.104 to 0.127% P). Maximum ADG was 2.96 lb/day and the points represent ADG over entire 180 days for 58 heifers.

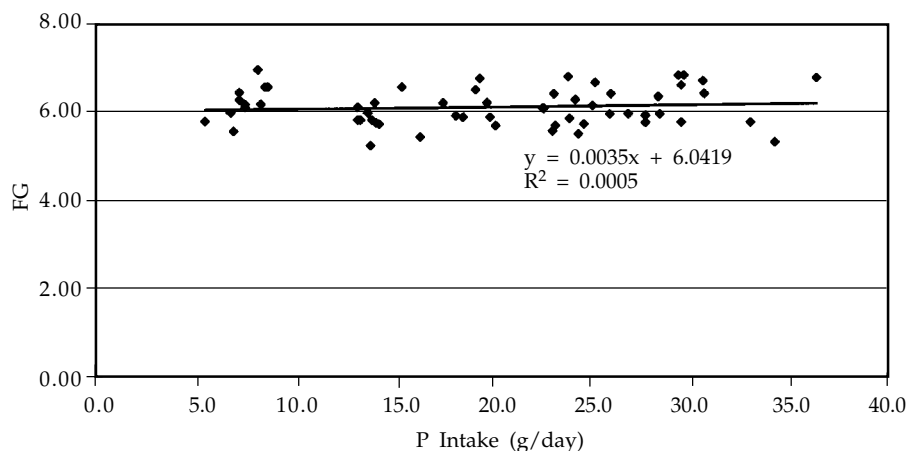


Figure 2. Scatter plot of feed conversion of heifers fed different levels of P for 180 days.

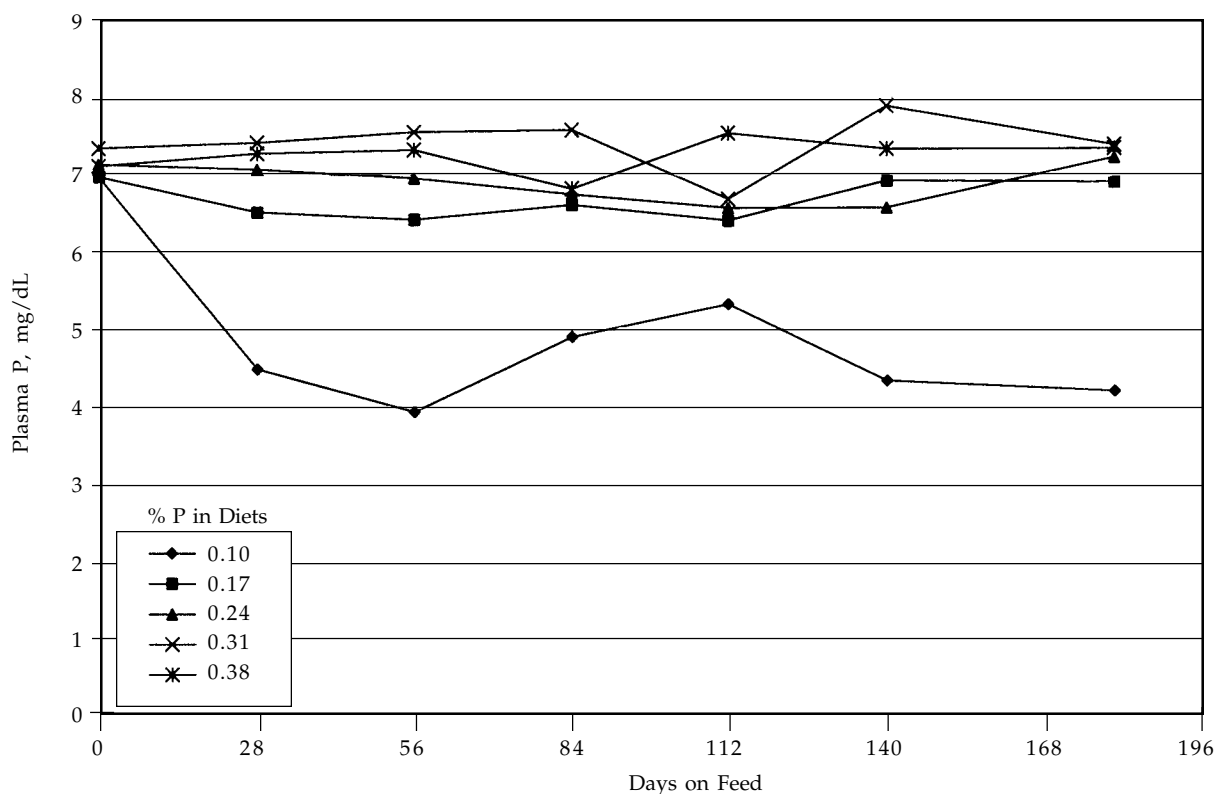


Figure 3. Plasma P concentration of heifers fed different levels of P. Significant treatment by time interaction ($P < 0.01$).

the 0.17% treatment on day 28, 56, 84, 112, 140, and 180 were 6.52, 6.42, 6.61, 6.91, and 6.90, respectively, indicating that they were not experiencing a P deficiency. The other treatments stayed at approximately 7.07 mg/dL throughout the entire feeding period. There were no significant differences within the other four P levels over time ($P > 0.05$).

Previous research indicates cattle can tolerate Ca:P ratios of 1:1 to 7:1. The Ca level in these diets was set at 0.70% of diet DM. The Ca:P ratios for these diets ranged

from 1.8:1 to 7:1, suggesting the Ca:P ratio did not effect DMI and ADG. The performance and plasma P concentration results indicate the P requirement for finishing heifers is between 8.2 and 10.3 g/day, or 0.10 and 0.17% P of diet DM. This is supported by results from Erickson et. al (2002 Nebraska Beef Report, pp. 45-48), which indicated the P requirement for calf-fed steers was below 0.16% P of diet DM. There were no differences in steer performance in their study. However, steers on the 0.16% P treatment did have significantly lower plasma P

concentrations (4.6 mg/dL) on day 56. However, by day 112 the blood plasma concentrations raised to above 5.5 mg/dL for the remainder of the trial. The results of our trials indicate corn-based finishing rations supply adequate P levels for finishing cattle and P supplementation is unnecessary.

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