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# Dietary Calcium and Phosphorous: Relationship to Beef Tenderness and Carcass Maturity

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Dietary levels of calcium and phosphorous for finishing cattle have no effect on overall maturity scores and tenderness of beef.

**Summary**

*The effect of dietary mineral status as related to carcass maturity or meat tenderness was studied. Finishing yearling steers were individually fed varying levels of calcium and phosphorous. Neither mineral was significantly related to overall carcass maturity scores or meat tenderness. When fed at the levels in this trial, it appears there are no adverse effects of dietary calcium and phosphorous on carcass or meat characteristics.*

**Introduction**

Beef carcass maturity is determined by visually assessing lean color and the degree of ossification (conversion of cartilage to bone) in the skeleton. Younger animals (about 9-30 months of age) usually possess characteristics of "A" maturity. Maturity classification is important, as advancing maturity is often associated with a decline in meat tenderness. Recent changes in the USDA quality grades for beef impose a strict penalty for carcasses which possess small or slight amounts of marbling and "B" maturity (the next classification after "A" in the quality grading system). Carcasses, which would formerly have qualified for Choice and Select grades now qualify only for Standard grade. Accordingly, it is important to determine factors which influence physiological maturity and ossification. Current speculation suggests mineral status may play a role in the ossification rate, meaning younger animals with improper mineral status might be classified as older than "A" maturity, with a subsequent loss of value. This project was conducted to assess the relative significance of dietary Ca and P on maturity scores and beef tenderness.

**Procedure**

Sixty yearling crossbred steers were individually fed once daily from September 4 to December 18, 1996 (105 d). Steers were randomly assigned one of 10 treatments, consisting of two levels of calcium (Ca), either 0.35 or 0.70 % of the dietary DM, with limestone as the

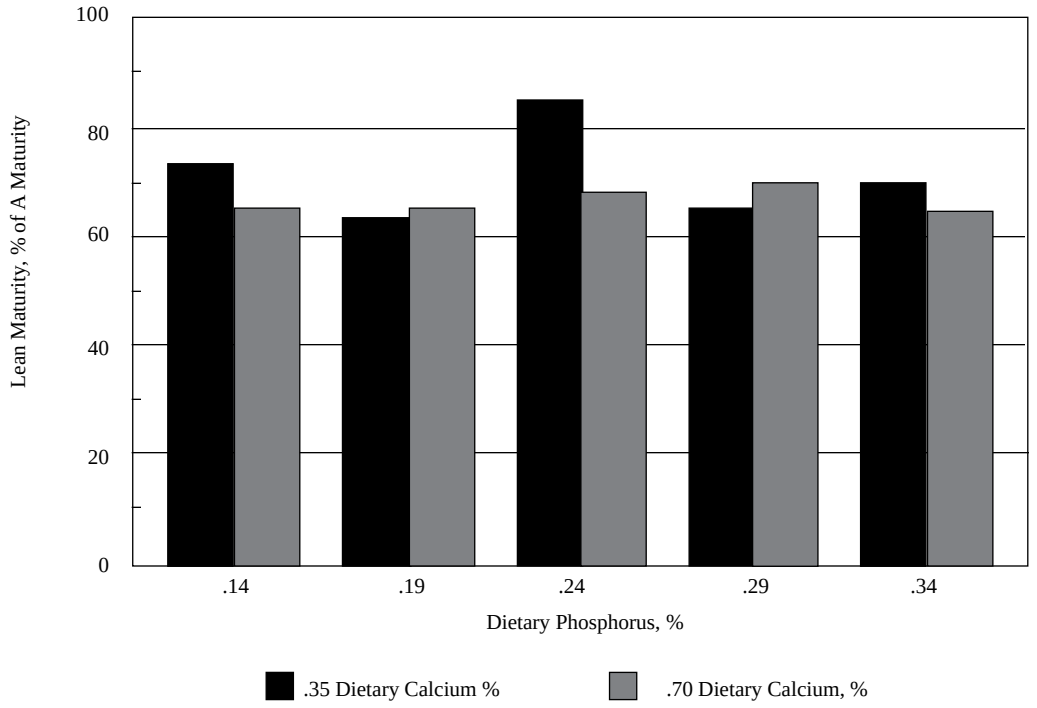


**Figure 1. Dietary mineral level and beef lean maturity.**

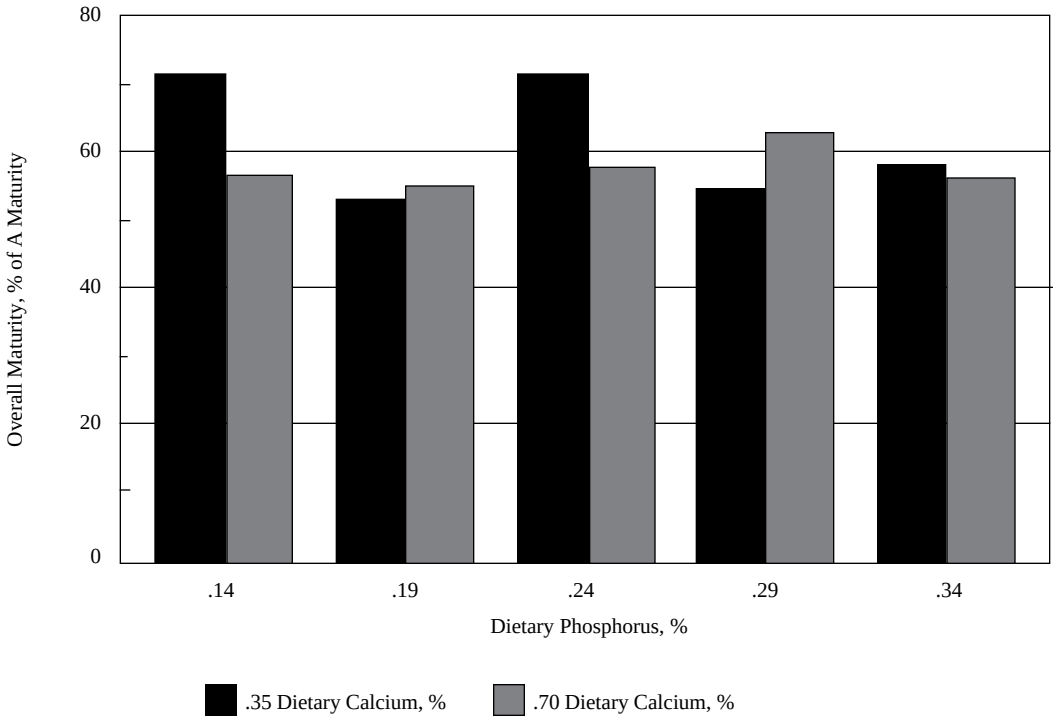


**Figure 2. Dietary mineral level and beef overall maturity.**

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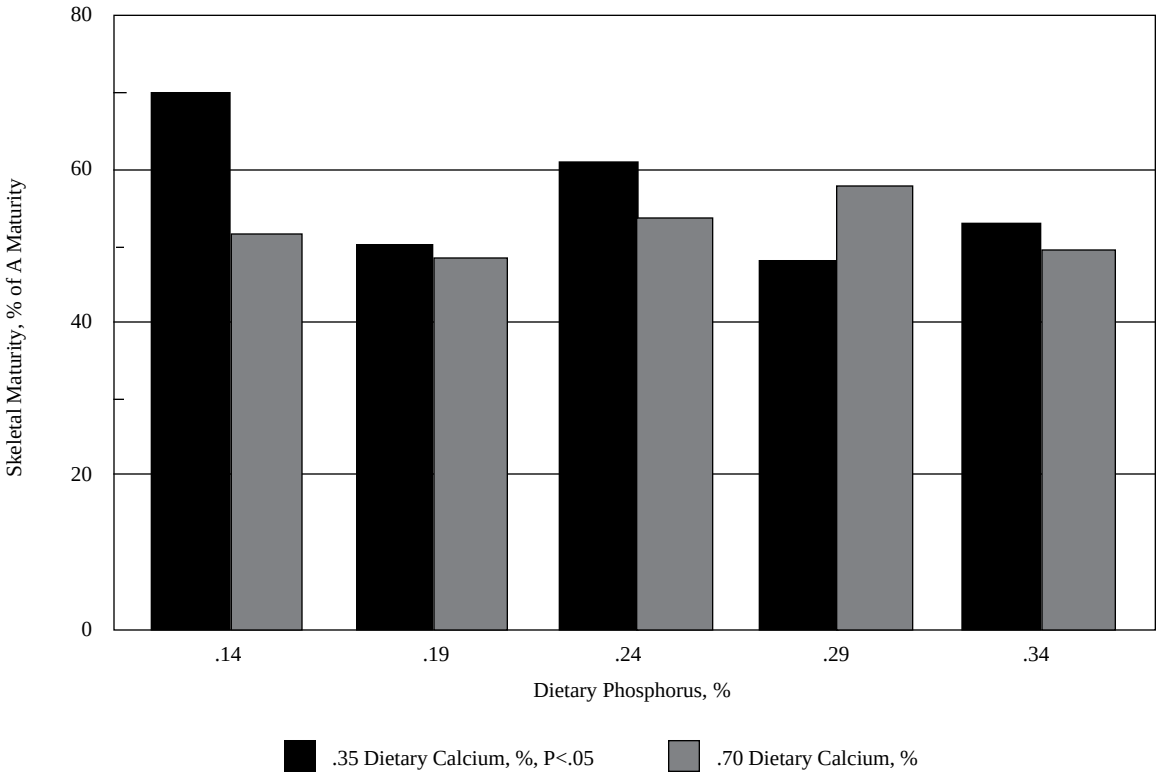


**Figure 3. Dietary mineral level and beef skeletal maturity.**

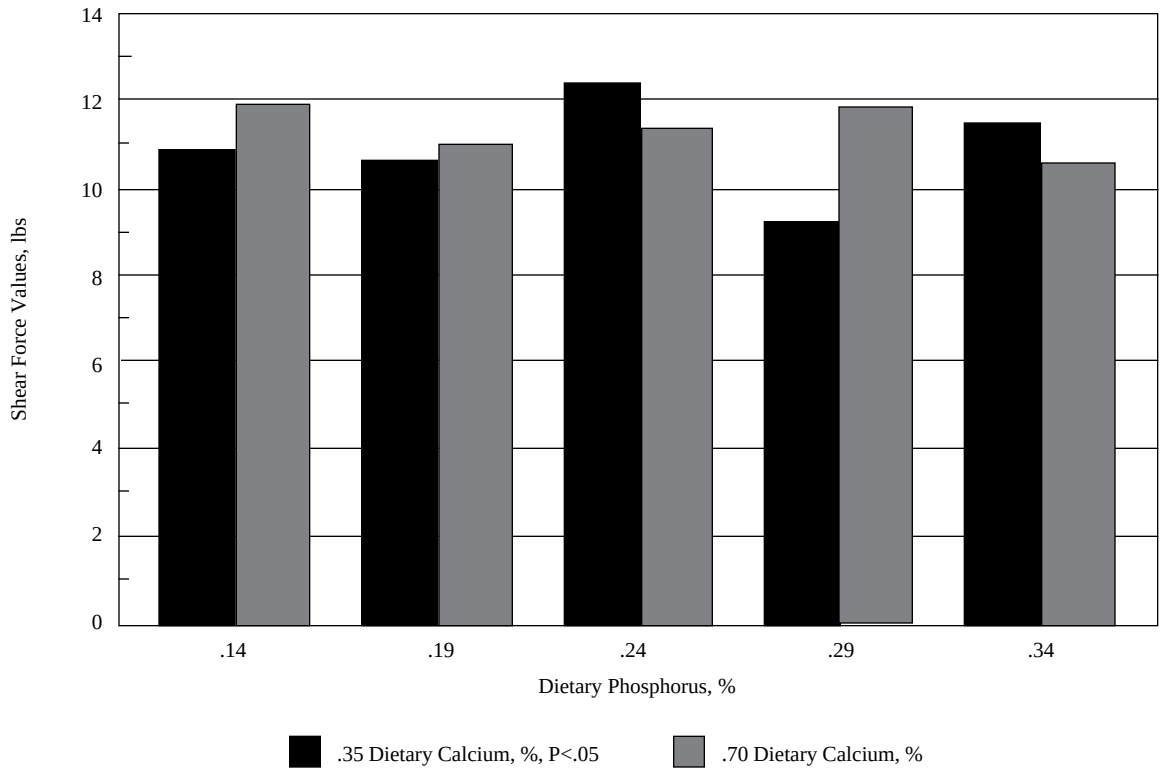


**Figure 4. Dietary mineral level and beef tenderness.**

source of supplemental Ca. Within each Ca level, there were five levels of phosphorous (P): 0.14, 0.19, 0.24, 0.29 or 0.34% of dietary DM. Supplemental P was provided by mono-sodium phosphate (NaP). Diets during this trial were formulated for 12% protein. Cattle were also implanted with Revalor-S® at the start of the trial.

Carcass data (lean maturity, skeletal maturity, overall maturity and marbling score) were assessed by a Federal USDA Meat Grader and recorded at the meat plant. Wholesale rib sections (IMPS 122A) were shipped to the University of Nebraska, aged for 7 days, then frozen. A one-inch thick steak was removed for tenderness assessment. Thawed steaks were cooked on a Farberware Open Hearth broiler to an internal temperature of 158°F, cooled to about 70°F, and 8-10 cores (1/2 inch in diameter) were removed parallel to fiber direction. The cores were then sheared using a Warner-Bratzler shear attachment to an Instron Universal Testing Machine.

The analysis of variance included Ca and P as main effects. Significant ($P < .05$) interactions were separated using contrasts to test for linearity.

## Results

Dietary levels of Ca and P had no effect on either lean maturity or overall maturity scores (Figures 1 and 2). This was to be expected, as there is little information that suggests Ca or P would affect meat color. Given the slight effect on skeletal maturity and no effect on lean color, it was expected there would be no effect on overall maturity because of dietary Ca and P levels.

Figure 3 graphically depicts the relationship of dietary mineral level and beef skeletal maturity. At 0.35% dietary Ca, skeletal maturity score decreased in a linear relationship ($P < .05$) with an increase in dietary phosphorous. Higher levels of dietary P might be expected to cause an increase in ossification, as Ca and P act synergistically to form bone. However, the magnitude of the skeletal maturity difference was slight (A 70 to A 48). While a significant relationship did exist, the effect on skeletal maturity was minimal. Changing diet formulations to garner this response may not be merited. The relationship was not significant at the 0.70% Ca level. In related work, Erickson et al. (1998 Nebraska Beef Cattle Report, pp. 78) found no difference in animal gain or bone strength from the cattle used in this trial.

No significant correlations were found linking tenderness to skeletal or overall maturity. The range in cattle age in the study may have been insufficient to detect the overall relationship. Lean maturity scores were related ($r = .29$, $P < .05$) to shear force.

No significant relationships were found among mineral levels and meat tenderness (Figure 4). These data indicate Ca and P, at the levels used in this study, are not responsible for maturity or tenderness changes in beef.

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