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J Hsu

G L. Allee

B A. Koch

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Femur or Phalange Bones as Indicators of Dietary Phosphorus Deficiency

Jin-Chen Hsu, G. L. Allee, and B. A. Koch

Summary

Fifteen crossbred gilts averaging 115 pounds were fed one of three phosphorus levels 70 days (to 219 pounds average) then their femur and phalange bones were compared. Each group of five gilts had received either 0.40%, 0.50% or 0.60% total dietary phosphorus and 0.65% dietary calcium during the 70-day feeding period. The basal sorghum-soybean meal ration contained 0.30% of plant phosphorus. Specific gravity and Xray or chemical analysis of femurs showed no significant differences among groups, but the breaking strength of femurs from gilts fed 0.6% phosphorus was significantly higher than that from gilts fed 0.4% phosphorus. Femur and phalange comparisons were inconclusive.

Introduction

A significant number of females in swine breeding herds are lost because of bone fractures, usually the femur or pelvic girdle. Many studies have shown that currently recommended phosphorus levels are adequate to carry animals to market weight, but few have continued on into the productive life of females. Additionally, recent high costs (and even unavailability) of phosphorus have suggested reevaluating currently recommended phosphorus levels for swine and the value of plant sources of phosphorus. Animals we used were gilts of breeding age that had been part of another

long-time dietary phosphorus study.

Procedure

Sixty gilts averaging approximately 115 pounds were assigned by initial weight and litter, to 15 slotted-floor pens for 5 replications of dietary treatments. Dicalcium-phosphate was added to a 14% protein sorghum-soybean meal ration containing 0.30% phosphorus to raise phosphorus content to 0.40, 0.50 or 0.60%. Dietary calcium was maintained at 0.65%. Five gilts from each dietary treatment were slaughtered in the department meat laboratory after 70 days on treatment.

Routine carcass data were collected from each carcass, also the outside phalange bone from the right front foot and the femur from the right hindquarter.

Bones were autoclaved 5 minutes at 100 C., then loose tissue remaining was manually removed. Autoclaved bones were placed individually in plastic bags and stored in the freezer until analyzed.

Specific gravity of femurs was determined in the department meats laboratory. Breaking strength was determined with the help of Prof. Donald Lindley in the laboratory of the civil engineering department. Xrays of the femurs were made in the School of Veterinary Medicine

with the help of Dr. Mark Guffey, Department of Surgery and Medicine. Chemical Analyses were by the A.S.I. department's biochemical services laboratory.

Results and Discussion

Carcass data from the 15 gilts studied are given in table 14.

Table 14. Carcass data from gilts fed indicated levels of total phosphorus.

Phosphorus, % No. of gilts	0.4 5	0.5 5	0.6 5
Factor measured			
Avg. backfat, cm. (in.)	2.87(1.13)	2.95(1.16)	3.20(1.26)
Avg. loin eye cm. (in.)	30.13(4.67)	25.81(4.00)	26.98(4.15)
Carcass length, cm. (in.)	81.3(32.0)	83.1(32.7)	83.6(32.9)

Xrays of the femurs showed no differences among bones. Results of the specific gravity measurements, breaking strength comparisons, and chemical analyses are summarized in table 15. Differences in treatment averages were not consistent, and the only significant differences were in breaking strengths. Femurs from gilts fed 0.60% phosphorus were significantly stronger

than femurs from gilts fed 0.40% phosphorus. Gilts receiving 0.40% phosphorus showed no outward signs of phosphorus deficiency. It appears that 0.4% total dietary phosphorus (three-fourths of it from plant phosphorus) is adequate for gilts at least until they reach 220 pounds.

Phosphorus contents of femur and phalange bones from the same animal fed one of three levels of phosphorus gave inconsistent results.

Table 15. Bone data from gilts fed indicated levels of total phosphorus.

Phosphorus, % No. of femurs	0.40 5	0.50 5	0.60 5
Indicated measurement			
Avg. specific gravity	1.189±.025	1.21±.033	1.200±.016
Avg. wall thickness, cm. (in.)	1.090(.169)	1.136(.176)	1.100(.172)
Avg. breaking strength			
Lbs.	867.20	948.00	961.20
Lbs./in. ²	6459.60 ^a	7656.40 ^{ab}	8841.10 ^b
Avg. ash ¹ , %	70.13	69.79	70.57
Avg. Ca ¹ , %	26.74	26.20	26.50
Avg. P ¹ , %	13.08	13.08	13.38

¹Fat-free, dry matter basis.

^a^bSignificant difference (P<.05).