

Correlation Between Femur and Metatarsal Mineral Content in Swine

A.S. Leaflet R2651

Jillian Lekander, undergraduate student;
Kenneth Stalder, professor of animal science;
Anna K. Johnson, assistant professor of animal science;
Department of Animal Science, Iowa State University,
Ames, IA;
Tom Crenshaw, professor of animal science, University of
Wisconsin-Madison
Locke A. Karriker, associate professor, Veterinary
Diagnostic and Production Animal Medicine

Summary and Implications

The mineral density of the femur in swine has been used to provide an estimate of bone content for a variety of minerals in previous research. For example, femur mineral content has been used to evaluate the efficiency of calcium usage in pigs through a recent study by Crenshaw (2007). The objective of this trial was to evaluate bone mineral when measured in the metatarsal and femur in swine. Sixteen gilts were selected for this trial based on their visual evaluation for the absence of structural soundness defects, feet and leg injuries, and health challenge indicators. All pigs were euthanized and the left femur and rear metatarsal from each pig were collected and sent to the University of Wisconsin to measure metatarsal and femur mineral content and area using a DEXA Scan. The metatarsal and femur mineral density was then calculated from these two values. A strong correlation was observed between the mineral densities in the metatarsal and the femur, thus concluding that the femur mineral density can accurately be estimated from the metatarsal mineral density.

Introduction

The mineral density of the femur in swine has been used to provide an estimate of bone content for a variety of minerals in previous research. For example, femur mineral content has been used to evaluate the efficiency of calcium usage in pigs through a recent study by Crenshaw (2007). Crenshaw reported that calcium efficiency is highly dependent on phosphorus levels, and these results were concluded directly from evaluating bone mineral composition through a DXA scan. Finding cost and time efficient methods to determine mineral content in pigs would benefit swine research. The objective of this trial was therefore to evaluate bone mineral when measured in the metatarsal and femur in swine. A high correlation between mineral densities of the metatarsal and femur would be advantageous to researchers who want to determine mineral density in pigs because the foot is easier to excise from the

carcass when compared to the femur. Researchers investigating a variety of other topics might be interested in the pigs' mineral content but found collecting samples cumbersome to do and difficult to replicate procedures precisely among pigs. Collecting mineral data from the pig will find the metatarsal a much more accessible and convenient option. The ease of obtaining the foot when compared to the femur may allow more researchers to investigate various treatment effects on bone mineral content than had previously been completed.

Materials and Methods

This trial was approved by the Institutional Animal Care and Use Committee, #1-10-6860-S.

Pig selection criteria: On April 1, 2010, sixteen gilts were selected for this trial based on their visual evaluation for the absence of structural soundness defects, feet and leg injuries, and health challenge indicators. Additionally, all animals were noted to have relatively even toes on the front and rear feet. This was to ensure that any animal having structural soundness or obvious injuries was not included in the study.

Pig genetics: The genetics of the gilts were commercially available lines from Pig Improvement Company where the dam was a C22 and the sire is a 337 which yielded the offspring used in this study. These lines represent what is commonly used in the U.S. pork industry which would result in commonly achievable growth rate, feed efficiency, and other performance parameters.

Housing and husbandry: Pigs were individually identified using standard ear tags used for grow-finish pigs and placed into pens. The pens were 1.5 m x 2.74 m (5 ft. x 9 ft) (providing the animals with 4.18 m² (45 ft.²) per animal (well above the 7 to 8 ft. normally provided to grow finish pigs). The pens had partially slotted flooring with the slatted area of 20 ft.² or 1.86 m² (4 ft x 5 ft) () and a 25 ft.² or 2.32 m² (5 ft. x 5 ft.) solid concrete area. Each pen was equipped with a nipple watering device that could be adjusted to various heights depending on size and / or age of pigs in the pen. The pigs were given *ad libitum* access to water throughout the entire experiment. Additionally, each pen was equipped with a two-hole, stainless-steel Smidley hog feeder (Marting Manufacturing, Britt, IA) with a 68 kg (150 lbs.) feed capacity. The gilts were fed a commercially prepared grow-finish ration (Heart of Iowa Cooperative, Nevada, IA) that had 0.85% lysine content. The diet was

Iowa State University Animal Industry Report 2011

composed of 640.9 kg corn (1413 lbs) (70.7% corn), 136.1 kg distillers dried grains with solubles or DDGs (300 lbs.) (15% DDGs) 15.9 kg premix (35 lbs) (1.75% premix), and 2.25 kg lysine (4.97 lbs) (0.17% added lysine).

Euthanization procedures: All pigs were euthanized using AVMA and AASV approved methods and guidelines.

Measures: The left femur and rear metatarsal from each pig were collected and sent to the University of Wisconsin to measure metatarsal and femur mineral content and area using a DXA Scan. The metatarsal and femur mineral density were then calculated from these two values. Correlations were computed using SAS (SAS Institute, Cary, NC)

Table 1. Correlation Coefficients¹ among Femur and Metatarsal Mineral Traits in swine when estimated using a DXA Scan²

Trait	Femur			Metatarsal		
	Mineral (Min.)	Area	Mineral Density (M.D.)	Min.	Area	M.D.
Femur Mineral	1.00					
Femur Area	0.84	1.00				
Femur Mineral Density	0.93	0.58	1.00			
Meta-tarsal Mineral	0.96	0.85	0.87	1.00		
Meta-tarsal Area	0.60	0.79	0.36	0.65	1.00	
Meta-tarsal Mineral Density	0.91	0.64	0.95	0.90	0.27	1.00

¹Peason Correlation Coefficients. All correlations are significant from zero.

² DXA or Dual Energy X-Ray Absoptiometry Scans.

Results and Discussion

The correlation found between the metatarsal and femur is shown in Table 1. The value of 0.95, shown in bold on the table, represents a 0.95 correlation coefficient between the estimates of femur mineral density and metatarsal mineral density. This value demonstrates a very strong correlation between the femur and metatarsal mineral densities.

These correlations found were based solely upon the values obtained through the DXA Scan. As mentioned earlier, previous research has used DXA scans (Crenshaw et al., 2007) to estimate bone mineral content. That study reported values obtained through the DXA scan are relatively the same as the mineral content values obtained by traditional analyses of bone ash. This work indicates that the DXA scan can be used to obtain accurate bone mineral content estimates (Crenshaw, 2007). The data therefore show that the femur bone mineral density can accurately be estimated from the metatarsal mineral density. This gives those wishing to determine the femur mineral density an advantage because determining the foot mineral density value is easier to determine.

Acknowledgements

Thank you to the staff at the Iowa State University Swine Nutrition Farm for their help with this trial.