

Concentrations of Leptin in Serum of Gilts and Barrows Sired by Boars of Different Breeds and Adiposity

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ABSTRACT

Leptin secreted from adipocytes is postulated to be a metabolic link between heart disease and obesity in humans. Use of swine in biomedical research is increasing and the animal represents an excellent model for studying leptin. This experiment was conducted to provide basic information on the effects of sire and gender on serum concentrations of leptin in swine. A Berkshire boar, considered fat using swine industry standards, sired pigs with greater ($P < 0.01$) tenth rib backfat thickness and greater ($P = 0.01$) serum leptin compared to pigs sired by a Hampshire boar selected for production of lean, deep-muscled market hogs. Across sires, barrows were fatter ($P < 0.01$) than gilts. Circulating levels of leptin in swine are influenced by sire, and differences are likely due to genetically dictated differences in adiposity

INTRODUCTION

Leptin is a 167-amino acid hormone produced primarily by adipocytes¹ and in general, blood levels are positively correlated with body fatness. Leptin participates in a number of physiological processes, including feed intake regulation, immune function, and reproduction.² Moreover, leptin has

been implicated as a metabolic link between heart disease and obesity in humans. In a prospective investigation, plasma leptin levels were significantly higher in men who subsequently experienced a coronary event compared with control subjects who remained free of a coronary event during the five-year follow-up period of the study.³

Due to similarities in size, anatomy, physiology, organ development and disease progression, there is increasing interest in the use of swine for biomedical research,⁴ and the animal represents a potentially excellent model for studying leptin. A limited amount of research, however, has been conducted examining leptin in swine,⁵ and rudimentary issues such as possible effects of genetics or gender on circulating concentrations are to some extent, unresolved. Thus, the objective of this experiment was to characterize serum concentrations of leptin in gilts and barrows sired by boars with either a fat or lean phenotype.

MATERIALS AND METHODS

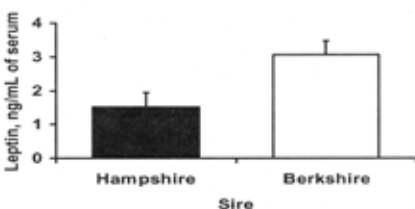
The experimental protocol was approved by the Institutional Animal Care and Use Committee of Virginia Polytechnic Institute and State University. Yorkshire x Landrace sows were artificially inseminated with semen collected from one of two boars housed at a commercial facility (International Boar

Semen; Eldora, IA): ¹. A Hampshire boar selected for commercial production of lean, deep-muscle market hogs, or ². A Berkshire boar selected for production of pork with superior eating quality but characterized as fat using modern swine industry standards. Barrows (boar piglets castrated at 7 days post-farrowing) and gilts produced from these mating were weaned at 4 weeks of age and were reared using husbandry practices consistent with intensive pork production. Pigs were allowed ad libitum access to water and diets that met or exceeded the recommendations for the various nutrients.⁶

There were a total of 40 pigs (10 barrows and 10 gilts sired by each boar). At the conclusion of the finisher phase of production (114 kg body weight) blood samples were collected via jugular venipuncture. Serum was harvested following centrifugation and leptin concentrations determined using radioimmunoassay procedures as previously described.⁷

Pigs were then transported to the University of Georgia Meats Laboratory (Athens, GA) and were harvested under standard government inspection. Back-fat over the loin muscle cross section at the tenth rib location was measured. Data were subjected to analysis of variance using the GLM procedure of SAS (SAS Institute Inc., Cary, NC). The model included sire, gender, and the sire by gender interaction as possible sources of variation.

Figure 1. Concentrations of leptin in serum of gilts and barrows sired by either a Berkshire or Hampshire boar (10 gilts and 10 barrows per sire). Values are LS means (+ SE) and levels of leptin were greater ($P = 0.01$) for the Berkshire-sired swine.



RESULTS

The Berkshire-sired pigs had greater ($P = 0.01$) levels of leptin in serum than the Hampshire-sired pigs (Figure 1). There were no effects of gender (barrows, 2.62 ng/mL; gilts, 1.97 ng/mL; SE = 0.42; $P = 0.27$) or sire by gender ($P = 0.31$) on leptin concentrations.

There were effects ($P < 0.01$) of sire (Figure 2) and gender (Figure 3) but not sire by gender ($P = 0.08$) on backfat thickness. Backfat at the tenth rib was greater in carcasses of pigs sired by the Berkshire boar and across sires, was greater in barrows compared to gilts.

DISCUSSION

The hormone leptin is produced predominantly by adipocytes, and concentrations in sows were positively correlated with last rib backfat thickness and were highest in females exhibiting the greatest amount of backfat.^{7,8} At slaughter, fat hogs had a higher level of leptin mRNA than did lean hogs.⁹ In the current study, leptin levels were greater in pigs sired by the Berkshire, compared with the Hampshire boar. Because only one boar from each breed was used, it cannot be concluded with complete certainty that the differences in leptin levels were due to breed per se. However, the boars chosen for this investigation were very typical of the Hampshire and Berkshire breeds.

Assessment of leptin concentrations among various breeds of swine is limited to

Figure 2. Tenth-rib backfat thickness of gilts and barrows sired by either a Berkshire or Hampshire boar (10 gilts and 10 barrows per sire). Values are LS means (+ SE) and backfat thickness was greater ($P < 0.01$) for the Berkshire-sired swine.

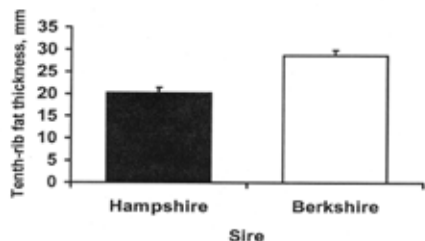
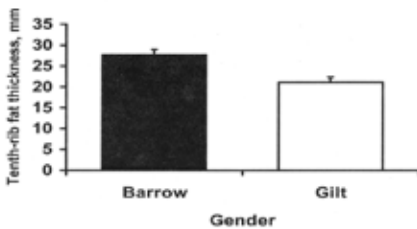


Figure 3. Tenth-rib backfat thickness of gilts (n = 20) and barrows (n = 20) sired by Berkshire and Hampshire boars. Values are LS means (+ SE) and backfat thickness was greater (P < 0.01) for barrows compared to gilts.



only one report in the scientific literature.

Consistent with the results presented here,¹⁰ this study reported that serum concentrations of leptin (ng/mL) were numerically greater in Berkshire (6.58; n = 131) compared with Poland China (6.45; n = 26) and Landrace (4.77; n = 23), and statistically greater than Chester White (4.44; n = 33), Yorkshire (3.96; n = 41), and Duroc (3.49; n = 40) market hogs at 111 kg body weight. In beef cattle, Angus bulls had greater concentrations of serum leptin than did Brangus or Brahman bulls at similar ages.¹¹

In the current study there was no effect of gender on leptin concentrations, although barrows had numerically higher values than did gilts. Effects of gender on circulating levels of leptin have been demonstrated in horses (geldings had greater leptin levels than did mares);¹² and in a previous study with swine (barrows had greater leptin levels than did gilts).¹⁰ Moreover, in humans, Hellstrom et al¹³ reported that females typically possess greater circulating concentrations of leptin than males. Leptin mRNA expression in adipose tissue was greater in estradiol-treated ovariectomized gilts than ovariectomized controls.¹⁴ Serum leptin concentrations in boars, however, did not change between 152 and 336 days of age despite dramatic increases in circulating concentrations of estradiol.¹⁵ It is unfortunate that in the current study and that of Berg et al,¹⁰ no contemporary, testicular-intact boars were available for assessment of leptin and comparison to gilts and castrated males.

In all likelihood, gender and perhaps breed effects on serum concentrations of leptin were related to different degrees of adiposity. In the current study, barrows were fatter than gilts and pigs sired by the Berkshire boar had greater tenth rib backfat thickness than pigs sired by the Hampshire Boar. This agrees with previous work in swine. For example, Berg et al¹⁰ reported that barrows had greater tenth rib backfat thickness than gilts (27.6 vs. 22.7 mm) and Berkshire pigs (29.6 mm) had numerically greater backfat thickness than Chester White (28.2) and statistically more backfat than Poland China (26.8 mm), Landrace (23.7), Yorkshire (22.2 mm), and Duroc (20.3 mm) pigs after slaughter at 111 kg live body weight.

In summary, circulating levels of leptin in swine are influenced by sire and dissimilarities are likely due to genetically-dictated differences in adiposity.

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