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# Zeranol Administration to Gestating Sows Alters Sow Blood Serum IGF-I Concentrations and Improves Piglet Performance

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**Abstract:** Objectives were to determine the effects of the estrogenic compound zeranol on maternal and piglet performanceand components of the somatotrophic axis. Treated sows (R) were administered a Ralgro® implant, which contains 36 mg zeranol, subcutaneously in the ear on d 60 of gestationand control (C) sows were administered a sham implant. There was no difference ($P>0.38$) in serum growth hormone (GH) between C and R sows, but there was a trend for increased ($P<0.12$) insulin-like growth factor-I (IGF-I) in R sows. There was no difference ($P<0.14$) in litter size, number born alive, or piglet survival to weaning; however, there was a trend ($P<0.11$) for greater total litter weight at birth in C sows. There was no difference ($P>0.47$) in piglet body weight at birth, but there was a treatment effect ($P<0.002$) on average daily gain (ADG) to 7 d of age, with increased ADG in R pigsand the increased ADG continued until weaning ($P<0.02$). Treatment did not affect piglet serum concentrations of GH at birth ($P>0.18$) or weaning ($P>0.64$); however, it increased ($P < 0.0006$) serum concentrations of IGF-I in R pigs at birth, but not weaning ($P>0.31$). Hypothalamic mRNA expression of growth hormone-releasing hormone tended ($P<0.07$) to be greater in R pigs. These data indicate that zeranol administration to gestating sows increases circulating concentrations of IGF-Iand improves pre-weaning ADG of pigs exposed to zeranol *in utero*.

**Key words:** Growth; Ralgro®; Pigs

## Introduction

Growth promoting agents, such as pST and GHRH, administered to gestating sows have been shown to increase fetal growth and birth weight. When recombinant porcine somatotropin (rpST) was given daily to gilts from d 30 to 43 of gestation, fetal weight was increased on d 44 of gestation (Sterle *et al.*, 1995). Daidzein, a phytoestrogen from soy, increased male piglet birth weight when fed daily from d 85 of gestation to parturition (Ren *et al.*, 2001). Increased piglet birth weight may improve piglet survivability to weaning. When sows were injected twice daily with growth hormone-releasing hormone (GHRH) from d 102 of gestation to parturition, greater survivability of piglets was observed (Etienne *et al.*, 1992). Greater survivability of piglets from sows fed daidzein late in gestation has also been reported (Ren *et al.*, 2001). Increased birth weight and piglet survivability should lead to increased weight of litter weaned per sowand therefore improved sow performance.

Stimulation of the somatotrophic axis *in utero* may lead to a reprogramming of the axis and an increase in average daily gain (ADG) or increased efficiency of muscle deposition. Piglets from sows treated with GHRH during gestation did not demonstrate increased body weight at birth, but had increased body weight by 13 d as compared to piglets from sows not treated with GHRH (Etienne *et al.*, 1992). Additionally, pigs from sows treated with GHRH during gestation did not demonstrate overall growth differences at 100 kg of weight, but had an increased gain:feed ratio as compared to pigs from control sows (Etienne *et al.*, 1992).

Growth promotants, such as Ralgro® (R), that stimulate the somatotrophic axis (Williams *et al.*, 1991) are commonly administered to beef cattle. Ralgro® is an implant that contains the estrogenic compound zeranol. The implant is placed in the earand zeranol then will persist in the circulation for approximately 90 d (Pusateri and Kenison, 1993). This provides growth promoting effects in a single administration, as compared to daily injections of rpST or GHRH, or daily feeding of daidzein. Therefore, the purpose of this experiment was to evaluate the effects of zeranol, when administered to gestating sows as a Ralgro® implant, on maternal and neonatal piglet performanceand components of the somatotrophic axis.

## Materials and Methods

**Animals and Treatments**: Sixteen second parity white crossbred sows were utilized to determine the effects of Ralgro® implantation on sow and piglet performance. All sows were utilized under the guidelines of an approved University of Missouri Animal Care and Use Committee Protocol. On d 60 of gestation, a blood sample was collected from 16 sows housed at the University of Missouri Swine Pasture Farm. Sows were randomly assigned to either a control (C; $n=8$) or R ($n=8$) treatment. After the blood sample was collected, R sows were administered a Ralgro® implant, which contained 36 mg of the estrogenic compound zeranol, subcutaneously in

the back of the earand control sows were administered an empty implant. Sows were monitored throughout the remainder of gestation, with a second blood sample collected at d 80 of gestation.
Approximately 5 d prior to projected farrowing, sows were removed from the University of Missouri Swine Pasture Farm and placed in farrowing crates at the University of Missouri's Middlebush Farm. Sows were monitored a minimum of three times daily for signs of impending parturition. A maximum of 12 hours after farrowing, a third blood sample was collected from the sows as was a colostrum sample. Piglets were processed at this time (weight and sex recorded, ear notched, needle teeth clipped, tails docked, naval sprayed with iodine) and a blood sample was collected on all piglets. Piglets remained with the sowand sows were limit-fed twice daily until weaning.
Male piglets were castrated 3-5 d after birth and all piglets were weighed at 7 d intervals after birth. At approximately 20.1 ±0.5 d of age, piglets were weaned. At weaning, pigs were weighed and a blood sample was collected. At this time, a blood sample and milk sample was also collected from the sow. Half of the pigs from each litter were sacrificed at weaning for collection of tissues of the somatotrophic axis. Piglets were selected for sacrifice with weight and sex balanced within litter. Tissues collected included the hypothalamus, anterior pituitary gland, liverand longissimus dorsi muscle. All tissues were immediately placed on dry iceand subsequently stored at -80°C until further analysis.
The remaining piglets were placed on a nursery starter diet and monitored until they reached approximately 27.2 kg, which is the weight nursery pigs are typically removed and placed in a grow-finish barn. This nursery phase lasted approximately six wksand pigs were switched to different phase diets every two wks, after body weights and blood samples were collected.

**Hormone Assays:** Serum was collected from all blood, colostrumand milk samplesand utilized to determine circulating concentrations growth hormone (GH) and insulin-like growth factor-I (IGF-I). To yield serum from blood, samples were allowed to clot for 1 hrand then were centrifuged at 1,700 x g for 30 min at 5°C. Colostrum and milk samples were stored at -80°C until harvested for serum. To yield serum from colostrum and milk, samples were centrifuged at 100,000 x g for 1 hr at 5°C. All serum was then stored at -80°C until assays were conducted.
Serum concentrations of GH from sow and pig blood were determined in two radioimmunoassays using commercially available porcine kits as per the instructions of the manufacturer (Porcine/Canine Growth Hormone RIA; Linco Research, Inc., St. Charles, MO) and as previously validated in our laboratory (Salfen *et al.*, 2003). The intra-assay CV was 6.1% and the inter-assay CV was 6.3%, with a minimum detectability of 1 ng/mL. Serum concentrations of GH from colostrum and milk were determined in a single RIA as described above with an intra-assay CV of 9.0%. Validation of this assay was conducted by verifying parallelism of dilutions of spiked colostrum serum and milk serum samples with the standard curve. Recovery of known amounts of unlabeled GH diluted in pools of colostrum or milk serum was 73.9% for colostrum serum and 89.5% for milk serum.
Serum concentrations of IGF-I from sow and pig blood were determined in two immunoradiometric assays as per the instructions of the manufacturer (Active Non-extraction IGF-I IRMA; Diagnostic Systems Laboratories, Inc., Webster, TX) and as previously validated in our laboratory (Salfen *et al.*, 2003). The intra- and inter-assay CV's were 5.0% and 5.1%, respectivelyand assay sensitivity was 2.06 ng/mL. Serum concentrations of IGF-I from colostrum and milk samples were determined in similar fashion in a single assay with an intra-assay CV of 2.1%. Validation of this assay was also conducted by verifying parallelism of dilutions of spiked colostrum serum and milk serum samples with the standard curve. Recovery of known amounts of unlabeled IGF-I diluted in pools of colostrum serum or milk serum was 100% for colostrum serum and 93.9% for milk serum.

**Tissue Expression of mRNA:** Tri-Reagent was utilized according to the manufacturer's instructions (Molecular Research Center, Inc., Cincinnati, OH) to extract total RNA from all tissues collected. The extracted RNA was utilized to determine mRNA expression of components of the somatotrophic axis using the slot blot detection method. Hypothalamic RNA was analyzed for mRNA specific for GHRH. Pituitary RNA was analyzed for mRNAs specific for GHand GHRH receptor (GHRHr). Liver RNA was analyzed for mRNAs specific for the GH receptor (GHr), IGF-Iand insulin-like growth factor binding protein-3 (IGFBP-3). Muscle RNA was analyzed for mRNAs specific for GHr and IGF-I. All of the aforementioned RNAs were additionally analyzed for mRNA specific for 28s rRNA. The probes and procedures for slot blot detection of GHRH, GHRHr, GH, GHr, IGF-I, IGFBP-3and 28s rRNA have been described previously (Carroll, 2000; Carroll *et al.*, 2000; Matteri and Carroll, 1997). Riboprobes were biotinylated and synthesized for use in chemiluminscence-based detection (BrightStar System, Ambion Inc., Austin, TX). Total RNA was transferred to a nylon membrane with a slot-blot apparatus (Bio-Dot SF, Bio-Rad Laboratories, Hercules, CA). Hybridization and detection were carried out with a commercially available kit according to the manufacturer's instructions (BrightStar System, Ambion, Inc., Austin, TX). Signal intensities were quantified by densitometry, with mRNA values of interest expressed relative to 28s rRNA for each sample.

**Statistical Analysis:** Statistical analyses were conducted using Statview software (SAS Inst. Inc., Cary, North

Carolina, USA). Sow data were analyzed using analysis of variance, with treatment as the main effect. Repeated measures analysis was utilized for sow hormone data. Pig data was analyzed using analysis of variance with treatment and pig sex as main effects. The analysis was conducted with litter and litter size as covariates; however, these effects were not significant and were removed from the model. During the nursery period, pig hormone data were analyzed using repeated measures. A P-value less than 0.05 was considered significant and P-values less than 0.10 were considered tendencies.

## Results

**Sow Performance:** Five sows were removed from the study due to litter size less than 6, which could bias growth performance of the piglets due to increased milk availability to pigs in small litters. Prior to removal of the sows from the study, however, there were no treatment differences observed in litter size; therefore, treatment did not have an effect on number of pigs raised. Of the remaining sows, 4 were C and 7 were R. All statistical analyses include these sows and their progeny.

There was no difference in gestation length ($P>0.68$; $115\pm0.6$ d C; $115\pm0.5$ d R) or litter size ($P>0.14$) in C sows vs R sows ($15.8\pm0.9$ vs $11.9\pm1.7$; C vs R, respectively); however, there was a trend for increased total litter weight ($P<0.11$) in C sows ($19.4\pm2.3$ vs $15.4\pm1.2$ kg; C vs R). There was no difference ($P>0.33$) in number born alive ($14.0\pm1.3$ vs $11.6\pm1.6$; C vs R) or litter size weaned ($P>0.65$; $12.0\pm2.1$ vs $10.9\pm1.4$; C vs R), nor was there a difference in percent survivability ($P>0.21$; $84.0\pm10.0$ vs $95.0\pm2.6$; C vs R). There was no difference in blood serum concentrations of GH by treatment ($P>0.34$), time ($P>0.84$), nor the treatment by time interaction ($P>0.35$). There was no difference in GH concentration in colostrum serum ($P>0.15$)and milk serum GH concentrations were undetectable. There was an overall treatment trend ($P<0.12$) for increased blood serum concentrations of IGF-I in R sows as compared to C sows (Fig. 1). Blood serum concentrations of IGF-I for both treatments increased across time ($P<0.0001$), but there was no treatment by time interaction ($P>0.36$). There was no difference in colostrum serum ($P>0.74$) concentrations of IGF-Iand milk serum concentrations of IGF-I were undetectable.

**Piglet Performance:** There were 62 male (M) pigs (18 C, 44 R)and 62 female (F) pigs (30 C, 32 R) that survived to weaning. There was no treatment effect on piglet body weight at birth ($P>0.45$; $1.46\pm0.04$ kg C, $1.39\pm0.04$ kg R)and there was no sex effect on birth weight ($P<0.17$; $1.46\pm0.04$ vs $1.37\pm0.32$ kg; F vs M). Piglet ADG during the first 7 d of life was affected by both treatment ($P<0.002$) and pig sex ($P<0.003$); however, there was no interaction between treatment and pig sex ($P>0.62$; Fig. 2). The advantage in ADG for R ($P<0.02$) and F ($P<0.007$) pigs continued until weaning (Fig. 3). Therefore, R ($P<0.03$) and F ($P<0.004$) pigs weighed more at weaning than C and M pigs, respectively (Fig. 4).

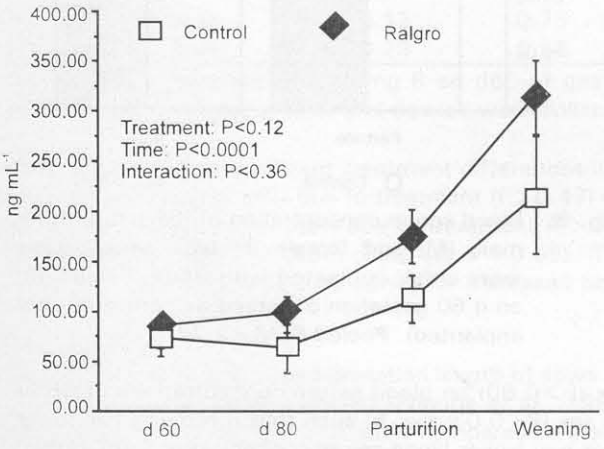


Fig. 1: Blood serum concentration of IGF-I on d 60 and 80 of gestation, as well as at parturition and weaning, in sows that were either implanted with 36mg Ralgro® (R) on d 60 of gestation or in sows serving as control (C; no implant)

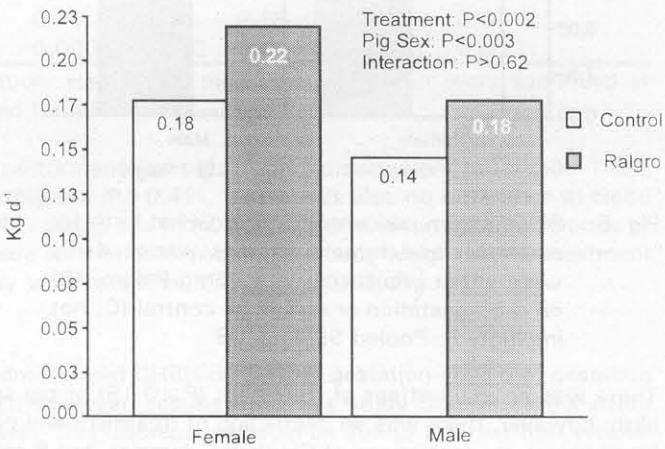


Fig. 2: Average daily gain during the first 7 d of age for male (M) and female (F) pigs whose dams were either implantd with 36mg Ralgro (R) on d 60 gestation or served as control (C; not implanted). Pooled SEM = 0.01

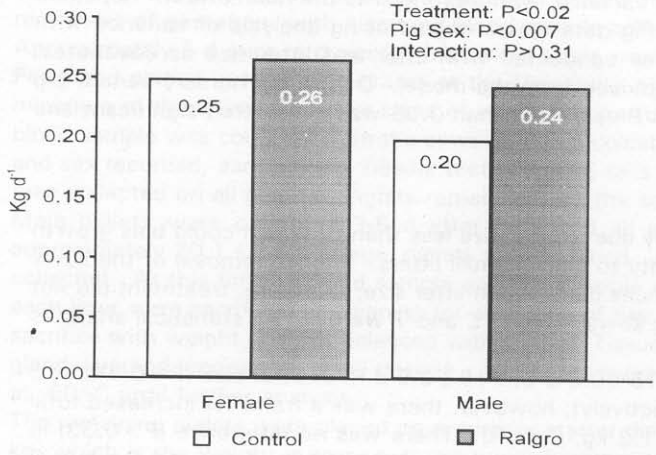


Fig. 3: Average daily gain from birth to weaning (20.1 ± 0.5 d) for male (M) and female (F) pigs whose dams were either implantd with 36 mg Ralgro® (R) on d 60 of gestation or served as control (C; not implanted). Pooled SEM = 0.01

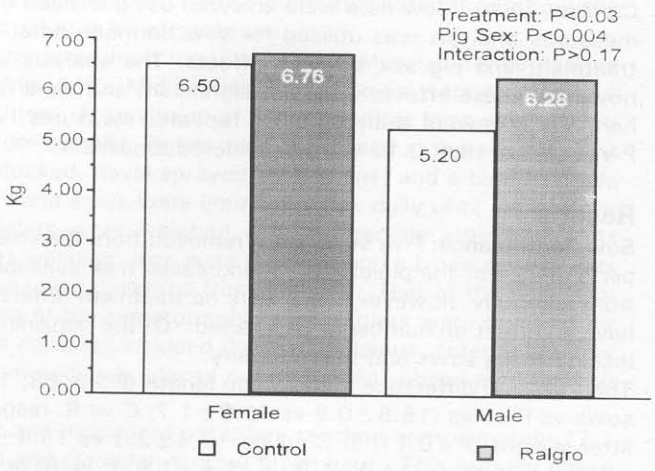


Fig. 4: Body weight at weaning (20.1 ± 0.5 d of age) for male (M) and female (F) pigs whose dams were either implanted with 36mg Ralgro® (R) on d 60 gestation or served as control (C; not implanted). Pooled SEM = 0.01

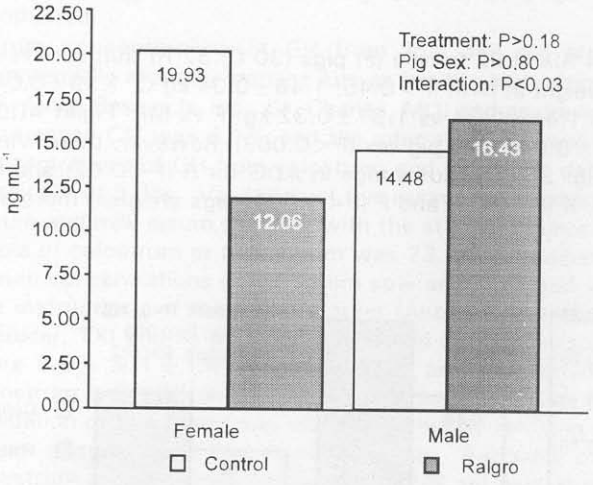


Fig. 5: Blood serum concentrations of GH at birth for male (M) and female (F) pigs whose dams were either implanted with 36mg Ralgro® (R) on d 60 gestation or served as control (C; not implanted). Pooled SEM = 1.08

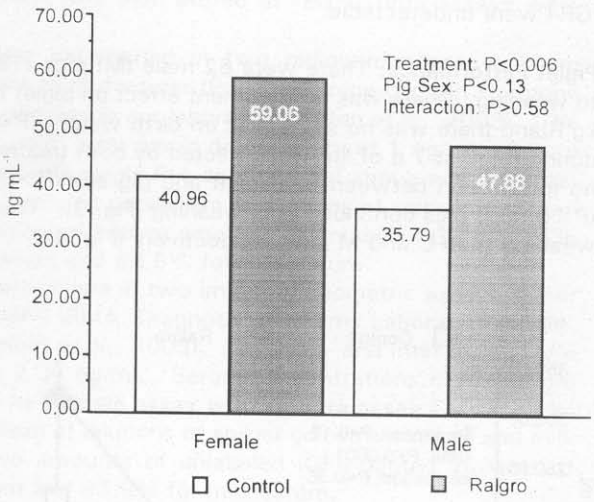


Fig. 6: Blood serum concentration of IGF-I at birth for male (M) and female (F) pigs whose dams were either implanted with 36mg Ralgro® (R) on d 60 gestation or served as control (C; not implanted). Pooled SEM = 2.72

There was no main effect of treatment ($P > 0.18$) or pig sex ($P > 0.80$) on blood serum concentrations of GH at birth; however, there was an interaction of treatment and pig sex ($P < 0.03$; Fig. 5) such that R females had lower blood serum concentrations of GH than C females, but R males had higher blood serum concentrations of GH than C males. Blood serum concentrations of IGF-I at birth were greater in R pigs than in C ($P < 0.006$) and there was a trend for greater concentrations in F than M pigs ($P < 0.13$; Fig. 6). Blood serum concentrations of GH at weaning were not affected by treatment ($P > 0.64$), pig sex ($P > 0.39$), or the treatment by pig sex interaction ($P > 0.64$). Blood serum concentrations of IGF-I at weaning were also not affected by treatment ($P > 0.31$), pig sex ($P > 0.18$), or the treatment by pig sex interaction ($P > 0.23$). Tissue mRNA expression results are presented in Table 1. There was a tendency ($P < 0.07$) for increased GHRH mRNA expression in the hypothalamus of pigs exposed to R *in utero* (Fig. 7)and a trend for increased mRNA expression of GHr in the muscle of R pigs ($P < 0.13$; Table 1).

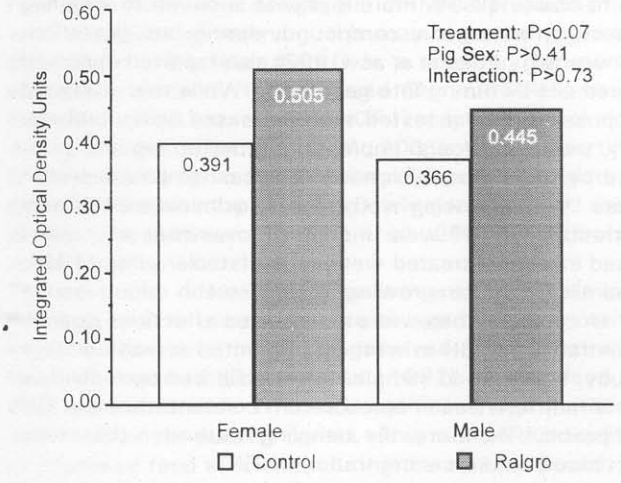


Fig. 7: Hypothalamic mRNA expression of GHRH at weaning for male (M) and female (F) pigs whose dams were either implantd with 36mg Ralgro® (R) on d 60 gestation or served as control (C; not implanted). Pooled SEM = 0.03

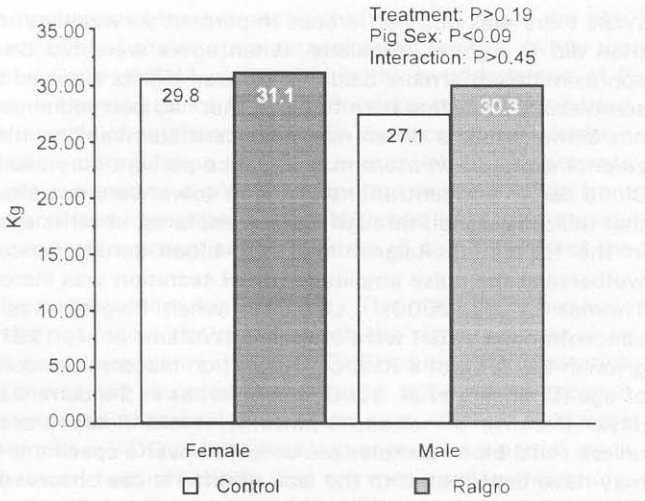


Fig. 8: Final body weight at the end of the nursery period for male (M) and female (F) pigs whose dams were either implanted with 36mg Ralgro® (R) on d 60 gestation or served as control (C; not implanted). Pooled SEM = 0.59

Table 1: Tissue expression of mRNA for components of the somatotrophic axis in female (F) and male (M) pigs either exposed to 36mg Ralgro® in utero (R) or not exposed (C) [a]

| mRNAb | Tissue | P Value, Treatment | P value, Sex | R, F | R, M | C, F | C, M | Pooled SEM |
|---|---|---|---|---|---|---|---|---|
| GHRH | Hypothalamus | 0.07 | 0.41 | 0.51 | 0.45 | 0.39 | 0.37 | 0.03 |
| GH | Anterior Pituitary | 0.40 | 0.90 | 0.59 | 0.55 | 0.58 | 0.63 | 0.02 |
| GHRHr | Anterior Pituitary | 0.26 | 0.15 | 0.38 | 0.25 | 0.26 | 0.25 | 0.02 |
| Ghr | Liver | 0.61 | 0.35 | 0.67 | 0.82 | 0.68 | 0.72 | 0.09 |
| IGF-I | Liver | 0.98 | 0.35 | 1.20 | 1.28 | 1.18 | 1.30 | 0.05 |
| IGFBP-3 | Liver | 0.17 | 0.69 | 0.82 | 0.80 | 0.95 | 0.91 | 0.04 |
| Ghr | Muscle | 0.13 | 0.75 | 0.79 | 0.72 | 0.59 | 0.71 | 0.03 |
| IGF-I | Muscle | 0.23 | 0.53 | 0.023 | 0.023 | 0.016 | 0.021 | 0.002 |

[a]Sows were implanted with 36mg R on d60 of gestation. Half of the pigs from each litter were sacrificed at weaning (20.1 ± 0.5d of age) and tissues were collected for mRNA analysis

After weaning, no significant treatment differences in performance of pigs in the nursery were observed. There was no difference in ADG due to treatment (P > 0.47) or pig sex (P > 0.42). There was also no difference in blood serum concentrations of IGF-I due to treatment (P > 0.42) or pig sex (P > 0.33) or blood serum concentrations of GH due to treatment (P > 0.56) or pig sex (P > 0.55). There was no difference in final body weight due to treatment (P > 0.19), but there was a tendency for increased body weight in F vs M pigs (P < 0.09; Fig. 8).

## Discussion

**Sow Performance:** Increased gestation length of sows administered GHRH during late gestation (102 d of gestation to farrowing) has been reported (Etienne *et al.*, 1992); however, results from this study did not demonstrate increased gestation length of R sows compared to C sows. This discrepancy could be due to the fact that zeranol was administered much earlier in gestation (d 60), or to differences between the two compounds.
Previous reports of effects of gestational treatment on litter size or number of fetuses have been variable. When sows were administered GHRH (Etienne *et al.*, 1992) or fed daidzein (Ren *et al.*, 2001) during late gestation, there was no difference in number of pigs born per litter. Administration of rpST during early to mid-gestation did not affect number of fetuses (Sterle *et al.*, 1995; Rehfeldt *et al.*, 2001; Sterle *et al.*, 2003) or number of pigs per litter at birth (Rehfeldt *et al.*, 2001). In contrast, increased embryo survival on d 41 was reported when gilts were administered rpST from d 28 to 40 of gestation (Kelley *et al.*, 1995). Collectively, most previous data agrees with the lack of treatment effect on litter size that was observed in this study.

While there was not a difference in percent survivability, numerically, 10.9% more R piglets survived to weaning than did C piglets. Similarly, when sows were fed daidzein, an estrogenic compound, during late gestation, approximately 8% more daidzein exposed piglets survived to weaning. Etienne *et al.* (1992) also reported improved survivability of piglets born to sows that had been administered GHRH during late gestation. While this study did not demonstrate a difference in percent survivability, it is possible that if tested with increased sow numbers, zeranol exposure *in utero* may enhance percent survivability, perhaps through improved pig performance.

Blood serum concentrations of GH in sows were not altered by treatment, which is in contrast to past research that utilized zeranol, through Ralgro® implants, in other species. When growing wethers were administered zeranol in the form of a Ralgro® implants, blood serum concentrations of GH were increased over that of control wethersand the pulse amplitude of GH secretion was increased in zeranol treated wethers (Hufstedler *et al.*, 1996; Thomas *et al.*, 2000). Likewise, when Ralgro® was administered to growing steers, mean blood serum concentrations of GH were increased (Williams *et al.*, 1991). In contrast, there were no reported effects of zeranol, given in the form of a Ralgro® implant, on blood serum concentrations of GH in wethers implanted at various days of age (Chanesta *et al*, 2000); however, as in the current study, single blood samples were collected on individual days. Because GH release is pulsatile, it is difficult to ascertain differences in blood serum concentrations of GH unless serial blood samples are collected over a specific time period. Therefore, the sampling method in this study may have contributed to the lack of differences observed in blood serum concentration of GH.

There was a trend for increased blood serum concentrations of IGF-I in R sowsand concentrations of IGF-I increased in both R and C over time. This would agree with previous research that has demonstrated increased blood serum IGF-I in wethers administered zeranol through a Ralgro® implant (Hufstedler *et al.*, 1996; Thomas *et al.*, 2000). Administration of rpST also increased blood serum concentrations of IGF-I (Sterle *et al.*, 1995; Sterle *et al.*, 2003) in gestating gilts. Because GH induces IGF-I secretion from the liver (Frohman, 1991), it is intriguing that IGF-I concentrations were increased by zeranol while GH concentrations were not; however, as previously mentioned, sampling method may not have been adequate to detect differences in GH concentrations.

**Piglet Performance:** There was no difference in piglet body weight at birth. This is in contrast to previous research where male pigs born to sows fed daidzein during late gestation were heavier than male pigs from control sows (Ren *et al.*, 2001), but in agreement with research where GHRH was administered to sows late in gestation and no differences in body weight at birth were observed (Etienne *et al.*, 1992). When gilts were administered rpST during gestation, increased fetal weight was observed (Sterle *et al.*, 1995), however, in a later study, variable results were observed in fetal weight depending on the stage of gestation at which rpST was administered (Sterle *et al.*, 2003). Additionally, another study in which rpST was administered to gestating gilts failed to demonstrate differences in fetal size or birth weight (Rehfeldt *et al.*, 2001). In this study, zeranol was administered through a Ralgro® implant on d 60 of gestation, which is during mid-gestationand the zeranol in Ralgro® implants has been shown to persist in the circulation for 90 d (Pusateri and Kenison, 1993), which would have been beyond the end of the weaning period. Taken with the results from previous studies, it appears that the gestational stage at which sows were implanted with zeranol may have contributed to the lack of differences observed in piglet birth weight.

While there were no differences in piglet body weight at birth, by 7 d of age, ADG of pigs that were exposed to zeranol *in utero* was greater than that of C pigletsand this difference persisted until weaning. Previous research demonstrated that piglets from sows treated with GHRH during late gestation did not have a weight advantage at birth, but weighed more than control counterparts by 13 and 22 d of age (Etienne *et al.*, 1992). In that study, there was no difference in ADG, but there was a difference in gain:feed ratio, with piglets from sows treated with GHRH having higher gain:feed (Etienne *et al.*, 1992). In contrast, piglets from gilts that were administered rpST from d 28 to 40 of gestation demonstrated no weight advantage by 21 d of age (Rehfeldt *et al.*, 2001). As with previously discussed parameters, it is possible that differences between zeranol and other growth promotants, or the timing of administration of the growth promoting agent relative to gestation, contributed to the differences seen among studies.

In the present study, blood serum concentrations of IGF-I at birth were increased in pigs exposed to zeranol *in utero*. This is in agreement with a tendency for increased IGF-I in fetal blood serum from fetuses of gilts that were administered rpST during d 30 to 43 of gestation (Sterle *et al.*, 1995). Additionally, in pigs that tended to have greater blood serum IGF-I concentrations, mRNA expression of IGF-I was increased in the liver of rpST treated pigs (Sterle *et al.*, 1998). In the study with daidzein administration to gestating sows, neither blood serum concentrations of IGF-I or mRNA expression of IGF-I were measured; however, mRNA expression of IGF-I receptor was increased in the skeletal muscle of daidzein exposed piglets (Ren *et al.*, 2001). The increased IGF-I at birth may have contributed to increased ADG from birth to weaning; however, blood serum concentrations of IGF-I at weaning were not different according to treatment. Blood serum concentrations of GH at birth and at weaning were not affected by treatment. Again, the lack of a treatment difference may be attributed to the sampling method. Alternatively, zeranol exposed piglets had the numerically lowest concentrations of GHand this may reflect the negative feedback of IGF-I on pituitary secretion of GH.

Few differences were detected in mRNA expression of components of the somatotrophic axis. Because the pigs were sacrificed at weaning, this may be partially due to removal of the *in utero* zeranol environment. While the differences were few, there was a tendency for increased GHRH mRNA expression in the hypothalamus of R pigsand a tendency for increased GHr mRNA expression in the muscle of R pigs. Previous research reported increased mRNA expression of IGF-I receptor in the skeletal muscle of newborn pigs when dams consumed daidzein during late gestation (Ren *et al.*, 2001); thus supporting some upregulation of mRNA expression of components of the somatotrophic axis in young piglets when piglets were exposed to a growth promotant *in utero*. Pigs from dams administered rpST during early gestation and then sacrificed immediately after birth had increased muscle protein concentration (Rehfeldt *et al.*, 2001), which also supports a potential upregulation of components of the somatotrophic axis.

There were no differences in performance of piglets in the nursery following weaning. The majority of previous research with *in utero* exposure to a growth promotant did not follow the pigs through the nursery phase or to slaughter; however, increased gain:feed of pigs that were born to sows treated with GHRH during late gestation has been reported (Etienne *et al.*, 1992). A gain:feed ratio was not recorded in this study, but no differences in ADG were observed. While not significant, pigs that were exposed to zeranol *in utero* did numerically weigh more at the end of the nursery period. This may be due to differences in ADG prior to weaning or may be a partial result of improved feed efficiency during the nursery period; however, feed efficiency was not measured in this study. Results from this study indicate that a simple implantation of Ralgro®, which contains 36 mg of the estrogenic compound zeranol, to gestating sows will improve piglet performance during the preweaning period. Increased blood serum concentrations of insulin-like growth factor-I at birth, as well as increased average daily gain from birth to weaning, may lead to improved survivability of piglets in addition to enhancing growth performance. If a reprogramming of the somatotrophic axis occurs, these piglets may have enhanced performance to market weightand thus have an economic advantage over piglets that were not exposed to zeranol *in utero*.

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