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ALTERED MATURATION RATE OF MUSCLE AND ADIPOSE POSTNATALLY IN PROGENY RESULTING FROM IN UTERO MANIPULATION OF EMBRYONIC GROWTH[1]

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BACKGROUND

New technologies which enhance production efficiency and carcass composition will likely be key determinants of global competitiveness of animal products. Because of competitive sources of muscle protein, novel, systematic approaches for achieving and utilizing "Lean Product" are of paramount importance to animal industries. Some of the work that we have done for the last few involved the examination of expression of myogenic regulatory genes and myogenesis in porcine embryos and in cultured muscle cells. We have been looking at myogenesis at this level or at these very early stages of embryos of somite formation to examine some of the expression of these genes and even manipulate the expression of these genes during this critical periods of time during embryonic development. In addition to developmental changes in expression, a model that we have been employing involves gestational manipulation where we administer porcine somatotropin to the gestating animal at very strategic or key windows of development, trying to alter then the milieu of growth factors that embryos are exposed to in the utero-placental units A few years ago, our lab first reported results from an embryonic model where pST altered uterine and fetal development when gilts were injected during the late-first trimester of pregnancy (Kelley et al., 1992). Some of our observations have been corroborated by others (Gerrard et al., 1994). In addition to improvements in early embryonic mortality, we reported that fetuses from this in utero model have increased crown-rump lengths and altered activity of genes known to influence muscle cell differentiation (Kelley et al., 1995) and increased myofiber number. The impact of this manipulation is observed in reduced fatness and increased muscle mass of young pigs through market weights (102 kg). Selected muscles are increased in a dose dependent kind of fashion to increased mass. We have consistently observed 25% increases in longissimus muscle area in pigs from treated litters at market weights, and 25-30% reduction in carcass 10th rib fatness. While the mechanisms for these profound alterations, it is suggested that the timing of major regulatory events are shifted in this model and that maturity pattern of muscle and adipose development may be altered.

OBJECTIVE: Determine relationships of backfat or longissimus muscle area at different times during growth to actual carcass values at 102 kg live weight in progeny of gilts treated with pST.

EXPERIMENTAL DESIGN AND METHODS

This research was approved by the Auburn University Animal Care and Use Committee and the Food and Drug Administration. Crossbred Chester White X Yorkshire gilts (n=54) were mated to Duroc boars. Bred gilts were randomly assigned to receive injections in the dorsal neck region of 0, 30 or 60 μg/kg/bw recombinant somatotropin (rpST) from day 28-39 of gestation. Another group of gilts were used in an experiment with daily doses of 0 and 60 μg/kg/bw. In experiment one, twenty-four of the gilts were farrowed and twelve from experiment two to enable observation of pig growth to market weight. Carcass indices (10th rib backfat and longissimus muscle area) were estimated on live pigs by ultrasound using an Aloka 500 using a 3.50 MHz probe. Only animals for which 2 interpretable scans at each weight plus final carcass measurements were reported. All analyses were subjected to the GLM procedure of SAS. Ultrasound estimates were analyzed with a model which included treatment sex, litter within treatment and a linear covariate for live weight. The statistical model for carcass traits encompassed the main effects of treatment and sex, the interaction of sex with treatment, litter within treatment and a linear covariate for weight at slaughter. Tukey's Multiple Range Test was used to separate least square means for treatment differences.

RESULTS

The interpretations for ultrasound images of longissimus area and 10th rib backfat, and actual carcass measurements are presented in Table 1 and 2. Using the percentage of longissimus size or depth at 102 kg that the pigs achieved at lighter weights and the lack of differences between groups for time to reach 102 kg, relative maturity may be altered by treatment (higher percentage for muscle and lower percentage for BF for pigs from pST treated litters compared to controls) . These observations are consistent with our observations of advanced embryonic development and expression of myogenic genes during muscle formation.

CONCLUSIONS

It appears that treatment of gilts with pST during early gestation results in an advanced development of muscle growth and delayed adipose deposition at the 10th rib area of the loin of progeny as indicated by ultrasound image of the longissimus muscle. These observations will need to be considered further if pST is to be included as part of a management strategy of swine production.

TABLE 1. Ultrasound (US) estimates and carcass traits of progeny from gilts treated with pST during day 28-39 of gestation[a,b]

Parameter		pST Treatment 0 μg	30 μg	60 μg	SE
US LMA, cm_2	Weight:				
	65, kg	19.5	23.9	25.8*	.54
	% of Actual	67.7	70.0	72.6	
	81, kg	23.5	27.5	29.7*	.78
	% of actual	81.6	80.6	83.7	
Actual	102 kg	28.8	34.1	35.5*	.86
US FAT, cm	Weight:				
	65, kg	2.42	2.00	25.8*	.15
	% of Actual	68.4	63.5	54.8	
	81, kg	2.98	2.54	2.07*	.19
	% of actual	84.1	80.6	79.3	
Actual	102 kg	3.54	3.15	2.61*	.17

[a]LS means and standard error. [b]Treatment was d 28-39 of gestation. *data within rows differ significantly from 0 μg group ($p < .05$).

TABLE 2. Ultrasound estimates and carcass characteristics of progeny from gilts treated with pST during d 15-30 of gestation[a,b]

Parameter		pST Treatment 0 ug	60 ug	SE
US LMA, cm_2	Weight:			
	80, kg	24.1	31.8*	.77
	% of actual	81.7	87.1	
Actual	102 kg	29.5	36.5*	.82
US FAT, cm				
	80, kg	2.38	1.53*	.13
	% of actual	82.9	73.6	
Actual	102 kg	2.87	2.08*	.22

[a]Least square means and standard error. [b]Ultrasound estimates are also expressed as a percentage of the actual at 102 kg.
*data within rows differ significantly from 0 μg group ($p < .05$).

PERTINENT LITERATURE

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