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# INTERACTIVE EFFECTS OF PORCINE SOMATOTROPIN AND THE BETA-AGONIST SALBUTAMOL ON GROWTH AND CARCASS CRITERIA OF THREE GENOTYPES OF SWINE

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## Summary

The objective of this research was to examine the interactive effects of porcine somatotropin (pST) and the beta-agonist salbutamol on the growth and carcass characteristics of three genotypes of pigs differing in lean and fat deposition potential. Thirty-two pigs each of either 1/4 Duroc-3/4 white composite (Duroc crossbred), purebred Meishan, or 1/4 Meishan-3/4 white composite (Meishan crossbred) breeding were injected daily with 0 or 4 mg pST and fed a diet containing 0 or 2.75 ppm salbutamol for approximately 34 d and subsequently slaughtered. As the percentage Meishan in the genotype increased, loin muscle area, semitendinosus weight, average daily gain (ADG), and carcass gain decreased. There was an interaction between salbutamol and genotype for ADG, daily protein gain, and total carcass gain, resulting in Meishan crossbred pigs having similar rates to non-treated Duroc crossbred pigs. When Duroc crossbred pigs were treated with salbutamol, both daily protein gain and total carcass gain were greatest, whereas ADG was nonsignificantly greater than that of untreated Duroc crossbred and salbutamol-treated Meishan crossbred pigs. Meishan pigs did not respond to salbutamol treatment for the criteria mentioned. Both pST and salbutamol increased loin muscle area and semitendinosus weight across genotypes. Leaf fat was reduced more by pST treatment in purebred Meishan pigs than in the other two genotypes, and salbutamol treatment resulted in small reductions in leaf fat across genotypes. Efficiency of feed utilization was similar among genotypes but increased with either pST or salbutamol treatment. The results of this research indicate that porcine somatotropin and the beta-agonist salbutamol have additive effects on the growth and carcass criteria of pigs. However, both growth modifiers appear to have differing degrees of response in different genotypes of swine.


(Key Words: G-F, Performance, Carcass, Repartitioning, Hormone)

## Introduction

Porcine somatotropin (pST) is an effective modifier of swine growth. In general, pST increases both daily protein accretion and total carcass protein mass, while causing reductions in carcass fat percentage and daily fat accretion. The efficiency of feed utilization is greater for pST-treated pigs than non-treated pigs as well. To a lesser degree, beta-agonists (in particular salbutamol) increase both daily protein accretion and carcass protein mass but have a less profound effect on carcass fat content and accretion. Improvements in feed efficiency have been observed when salbutamol is included in the diet. Limited research is available concerning the combined use of pST and a beta-agonist on pig performance and carcass criteria. Thus, the purposes of this research were to determine if the combined use of

[1]This was a cooperative research study with researchers at the USDA-ARS, Roman L. Hruska Meat Animal Research Center, Clay Center, NE. Appreciation is expressed to S. Cummins for technical assistance, data collection, and sample analyses.

porcine somatotropin and the beta-agonist salbutamol would result in additive or interactive changes in growth and carcass criteria and to evaluate these responses in three genotypes of pigs differing in lean and fat deposition potential.

## Procedures

A total of 120 pigs was used in an experiment lasting approximately 34 d. The three genotypes equally represented were of the following ancestry: 1/4 Duroc - 3/4 white composite (Duroc crossbred); purebred Meishan; and 1/4 Meishan - 3/4 white composite (Meishan crossbred). Because purebred Meishan pigs exhibit a slow growth rate, all pigs were placed on test at a similar age (130 to 140 d). The biological treatments imposed were 0 or 4 mg pST/d in combination with 0 or 2.75 ppm salbutamol in the diet resulting in a 2 × 2 × 3 factorial treatment arrangement. Pigs were housed in 4 ft × 4 ft pens and allowed ad libitum access to feed and water. A 1.20% lysine corn-soybean meal diet containing 5% each select menhaden fish meal and porcine plasma protein and 2% soybean oil was fed throughout this research (see Hansen et al., 1991; KSU Swine Industry Day, Report of Progress 641, p. 112 for details). Initial carcass composition was estimated from the composition of eight pigs from each genotype slaughtered at the beginning of the study. The remaining 96 pigs were randomly allotted to one of four biological treatment groups and placed on test at weekly intervals. Average daily gain (ADG), average daily feed intake (ADFI), and feed:gain (F/G) were measured from 0 to 28 d. Organ weights were obtained immediately postmortem, whereas loin muscle area and semitendinosus weight were obtained at approximately 6 h postmortem. The right half of each carcass was ground for analysis of water, fat, protein, and ash and computation of daily component accretion rates.

## Results and Discussion

No interactions were observed between pST and salbutamol. However, significant interactions were observed between genotype and both pST and salbutamol. Therefore, results are presented in two tables. Table 1 represents the means for the criteria where a significant pST or salbutamol × genotype interaction was observed. Consequently, those values are not presented in Table 2, which shows the main effect means for each genotype and biological treatment.

Meishan pigs consumed the least amount of feed ($P<.05$) among genotypes, resulting in the slowest rate of growth and accretion of carcass components ($P<.05$). Average daily gain, daily protein accretion, and daily total carcass gain were similar for Meishan crossbred pigs treated with salbutamol and the untreated Duroc crossbred pig. When Duroc crossbred pigs consumed salbutamol, both daily carcass accretion and daily protein accretion were greatest ($P<.05$) among treatments, whereas ADG was nonsignificantly greater than that of untreated Duroc crossbred pigs. Salbutamol increased the proportions of protein and water in the carcass at the expense of both carcass fat and ash ($P<.05$) across genotypes. Daily water accretion was increased across genotypes with salbutamol treatment, although daily accretions of fat and ash were unaltered by salbutamol feeding. Salbutamol did not influence ADG, daily carcass gain, or daily protein gain in purebred Meishan pigs. Porcine somatotropin injection resulted in a greater proportion of the carcass being protein, water, and ash ($P<.05$) at the expense of carcass fat. Consequently, accretion rates for these components were increased ($P<.05$) at the expense of carcass fat. Although no differences were detected between genotypes for carcass composition, it is important to realize that purebred Meishan pigs would have been considerably fatter at a similar weight compared to the other two genotypes.

Both pST and salbutamol improved ($P < .05$) the efficiency of feed utilization independently of genotype. Although purebred Meishan pigs consumed less feed than the other two genotypes, no differences were observed in feed efficiency across genotypes. Loin muscle area and semitendinosus weight increased with a decreasing proportion of purebred Meishan in the genotype ($P < .05$), and both were increased with pST and salbutamol treatment ($P < .05$), resulting in an additive response. Both liver and kidney weights were higher ($P < .05$) in purebred Meishan pigs and with pST treatment, whereas salbutamol decreased liver mass. Leaf fat weight was reduced with salbutamol treatment across genotypes, but reduced more in purebred Meishan pigs than others with pST treatment, suggesting a more profound effect in fattier genotypes.

In summary, no interactions between pST and salbutamol were observed for the criteria presented. Consequently, these data indicate that the combined use of pST and salbutamol results in an additive response to each growth modifier. Furthermore, these data indicate that both growth modifiers have differential effects in different genotypes of swine.

**Table 1. Mean Differential Response to Somatotropin and Salbutamol Treatment among Genotypes[ab]**

| | D × Wc | | M | | M × Wc | | |
|---|---|---|---|---|---|---|---|
| Item | Buffer Basal | pST Salb | Buffer Basal | pST Salb | Buffer Basal | pST Salb | SD |
| Somatotropin | | | | | | | |
| Leaf fat, % | $1.56^{vw}$ | $1.05^{xy}$ | $2.12^{z}$ | $1.01^{x}$ | $1.82^{v}$ | $1.31^{wy}$ | .41 |
| Salbutamol | | | | | | | |
| ADG, lb (0 to 28 d) | $2.01^{w}$ | $2.18^{w}$ | $1.30^{x}$ | $1.17^{x}$ | $1.70^{y}$ | $2.01^{w}$ | .33 |
| Protein accretion, g/d | $78^{w}$ | $102^{x}$ | $39^{y}$ | $47^{y}$ | $62^{z}$ | $95^{x}$ | 17 |
| Total accretion, g/d | $496^{w}$ | $567^{x}$ | $233^{y}$ | $225^{y}$ | $376^{z}$ | $493^{w}$ | 83 |

[a]Values are means of 15 (D × Wc-Basal and M-Basal) or 16 pigs each. Values are presented for traits only observing a significant ($P < .05$) interaction.

[b]D × Wc = Duroc × white composite; M = Meishan; M × Wc = Meishan × white composite; Buffer = 0 mg/d somatotropin; pST = 4 mg/d somatotropin; Basal = 0 ppm salbutamol; Salb = 2.75 ppm salbutamol.

[vwxyz]Values in the same row lacking a common superscript are different ($P < .05$).

**Table 2. Least Square Main Effect Means for Growth and Carcass Criteria[a,b]**

| Item | Genotype | | | Injection | | Diet | | | Significance[c] |
|---|---|---|---|---|---|---|---|---|---|
| | D × Mc | M | M × Wc | Buffer | pST | Basal | Salb | SD | P<.05 |
| Initial wt, lb | 137 | 108 | 141 | 130 | 128 | 130 | 128 | 13 | G1,2 |
| Slaughter wt, lb (d-34) | 198 | 141 | 194 | 174 | 181 | 179 | 176 | 18 | G1,2 |
| ADG, lb (0 to 28 d) | - | - | - | 1.65 | 1.81 | - | - | .33 | G × S; P |
| ADFI, lb (0 to 28 d) | 2.63 | 1.66 | 2.56 | 2.59 | 1.98 | 2.31 | 2.26 | .79 | G1,2; P |
| Feed/gain (0 to 28 d) | 2.70 | 2.86 | 2.94 | 3.45 | 2.44 | 2.94 | 2.78 | .51 | P; S |
| Dressing percentage | 64 | 51 | 62 | 60 | 58 | 59 | 60 | 2 | G1,2,3; P; S |
| Loin muscle area, $in^2$ | 5.20 | 2.55 | 4.76 | 3.90 | 4.39 | 3.91 | 4.42 | .66 | G1,2,3; P; S |
| Semitendinosus wt, % | .42 | .21 | .33 | .30 | .34 | .30 | .33 | .04 | G1,2,3; P; S |
| Leaf fat, % | - | - | - | - | - | 1.56 | 1.39 | .41 | G × P; S |
| Liver, % | 1.71 | 1.86 | 1.70 | 1.53 | 1.98 | 1.82 | 1.69 | .23 | G1,2; P; S |
| Kidney, % | .36 | .43 | .35 | .33 | .43 | .38 | .38 | .11 | G1,2; P |
| Water, % | 53.8 | 53.4 | 52.2 | 49.1 | 57.2 | 51.8 | 54.5 | 3.6 | P; S |
| Fat, % | 27.4 | 27.8 | 29.4 | 33.7 | 22.7 | 30.0 | 26.4 | 4.9 | P; S |
| Protein, % | 15.7 | 15.5 | 15.3 | 14.2 | 16.8 | 15.0 | 16.0 | 1.1 | P; S |
| Ash, % | 2.9 | 3.1 | 2.9 | 2.8 | 3.2 | 3.0 | 2.9 | 0.3 | P; S |
| Water accretion, g/d | 77 | 129 | 241 | 158 | 273 | 186 | 246 | 56 | G1,2,3; P; S |
| Fat accretion, g/d | 150 | 50 | 100 | 173 | 27 | 111 | 89 | 76 | G1,2,3; P |
| Protein accretion, g/d | - | - | - | 53 | 88 | - | - | 17 | G × S; P |
| Ash accretion, g/d | 14 | 7 | 14 | 9 | 15 | 12 | 12 | 5 | G1,2; P |
| Total accretion, g/d | - | - | - | 393 | 404 | - | - | 83 | G × S |

[a]For genotype values are means of 31 pigs (D × Wc and M) or 32 pigs (M × Wc). For injection, values are means of 48 pigs (Buffer) or 46 pigs (pST). For diet values are means of 46 (Basal) or 48 pigs (Salb).

[b]D × Wc = Duroc × white composite; M = Meishan; M × Wc = Meishan × white composite; Buffer = 0 mg/d somatotropin; pST = 4 mg/d somatotropin; Basal = 0 ppm salbutamol; Salb = 2.75 ppm salbutamol.

[c]Comparison for pST (P), salbutamol (S) and genotype [G (1 = D × Wc vs M; 2 = M vs M × Wc; 3 = D × Wc vs M × Wc)]. Values are presented separately for criteria involving significant interactions (P<.05).