Effects of Weekly Administration of Implant-type Recombinant Porcine Somatotropin on the Performance and Carcass Characteristics of Finishing Pigs

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ABSTRACT : The present study was undertaken to investigate the effects of weekly administration of implant type recombinant porcine somatotropin (rpST) on the performance and carcass characteristics in finishing pigs. A total of 120 crossbred (Landrace×Yorkshire×Duroc) pigs were employed for 11 weeks in a growth trial in experiment. A rpST designed to implant every 7 d was used. Forty pigs, each weighing 75 kg, were allocated into three rpST treatments; control (CONT), implant of rpST from 75 kg (TRT1) or 90 kg (TRT2) of body weight. The CONT pig and pigs in TRT2 from 75 kg to 90 kg were treated without rpST but with placebo. In rpST-treated pigs, each 100 mg and 125 mg of the equivalent rpST was implanted from live weight of 75 kg to 90 kg and from 90 kg to market weight, respectively. Half of the pigs from each treatment were marketed at live weight of 110 kg and the rest at 130 kg. All pigs were allowed *ad libitum* access to a commercial feed containing 0.94% and 0.88% of lysine from 75 to 110 kg, 110 to 130 kg of body weights, respectively. rpST had no effect on daily gain, while feed efficiency was improved by 7 to 13% ($p<0.05$) in the rpST-treated groups compared with the CONT. Compared with the CONT, backfat thickness was decreased by 12% ($p<0.05$) in TRT1 at 110 kg of market weight, and by 23 to 32% ($p<0.05$) in the rpST-treated groups at 130 kg of market weight, respectively. Lean muscle rate tended to be higher in TRT1 at both 110 kg and 130 kg of market weight, and carcass fat percentage in the rpST-treated groups was decreased by 33 to 46% ($p<0.05$) compared with the CONT. ***(Asian-Aust. J. Anim. Sci. 2005. Vol 18, No. 4 : 557-561)***

Key Words : Recombinant Porcine Somatotropin, Growth Performance, Carcass Quality, Hormones, Finishing Pigs

INTRODUCTION

Somatotropin (ST), first detected in the anterior pituitary of the rat, subsequently was shown not only to increase rate of gain but also to result in accretion of proportionately more muscle and less fat tissue.

The discovery that exogenous administration of porcine somatotropin (pST) could preferentially alter body composition toward increased lean mass and decreased fat deposition (Machlin, 1972; Etherton et al., 1987; Boyd and Bauman, 1989; Evans et al., 1991) presented an opportunity for improving the efficiency of pork production.

Results of recent experiments with swine are difficult to interpret due in part to the small numbers of animals involved. More recent work reported by Chung et al. (1985), Etherton et al. (1987), Campbell et al. (1988) and Evock et al. (1988) have provided with data concerning the growth-promoting effects of porcine somatotropin (pST) on the pig. Pigs treated with somatotropin show an increase in protein accretion and a decrease in lipid accretion and feed intake (Etherton et al., 1987; Boyd et al., 1991; Lee et al., 1994).

The alteration of body composition by enhancing leanness and reducing fat is important both for the diet-conscious consumer who wants wholesome and lean pork and the pork producer who wants to produce pigs efficiency will be improved.

Interest in the effects of pST has been stimulated greatly by the development of recombinant DNA technology. Daily injections of finishing pigs with pST has shown improvements in gain and feed conversion, a reduction in carcass lipid content, and an increase in protein deposition. In practical terms, however, daily injections involve a lot of labors.

Therefore, this study was conducted to determine the effects of weekly administration of implant-type recombinant porcine somatotropin on the performance and carcass characteristics of finishing pigs.

MATERIALS AND METHODS

A total of 120 pigs (Landrace×Yorkshire×Duroc, 75 kg of average initial body weight) were allotted in a randomized complete block (RCB) design with three treatments; 1) Control (CONT), 2) implant of rpST from 75 kg (TRT1), 3) implant of rpST from 90 kg (TRT2) of body weight. Each treatment has 8 replicates with 5 pigs per pen.

The rpST was designed to implant every 7 day. The CONT group and pigs from 75 kg to 90 kg in TRT2 group were treated placebo instead of rpST. In rpST-treated pigs, each 100 mg and 125 mg of the equivalent rpST was

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Table 1. Formula and chemical composition of the diet

Item	Implanted in rpST	
	75 kg	90 kg
Ingredient		
Yellow corn	44.68	43.95
Wheat	20.00	15.00
Wheat bran	-	9.72
Rice bran	2.50	-
Lupin hull	2.00	3.00
Corn gluten feed	1.50	1.50
Rapeseed meal	1.00	1.00
Soybean meal	18.50	14.61
Sesame oil meal	1.00	1.00
Cornseed meal	-	2.00
Limestone	0.60	1.34
Dicalcium phosphate	1.16	0.28
Phytase	-	0.01
Salt	0.30	0.30
Tallow	2.02	1.50
Molasses	4.00	4.00
Vitamin-Min. mixture[1]	0.47	0.58
Cholin chlorine	0.08	0.05
L-lysine HCL	0.17	0.15
Methionine	0.02	0.01
Total	100.00	100.00
Chemical composition[2]		
Crude protein (%)	16.53	15.81
Lysine (%)	0.94	0.88
NE (kcal/kg)	2,430	2,330
Calcium (%)	0.67	0.75
Phosphorus (%)	0.66	0.52

[1] Contains the following nutrients per kg of diet: Vitamin A, 2.000.000 IU; Vitamin D_3, 400.000 IU; Vitamin E, 250 IU; Vitamin K_3, 200 mg; Vitamin B_1, 20 mg; Vitamin B_2, 700 mg; Riboflavin, 10,000 mg; Pantothenic calcium, 3.000 mg; Choline chloride, 30.000 mg; Niacin, 8,000 mg; Folacin, 200 mg; Vitamin B12, 13 mg; Mn, 12.000 mg; Zn, 15.000 mg; Fe, 4.000 mg; Cu, 500 mg I, 250 mg; Co, 100 mg; Mg, 2,000 mg.
[2] Calculated values.

implanted from live weight of 75 kg to 90 kg and from 90 kg to market weight, respectively. Half of the pigs from each treatment were marketed at live weight of 110 kg and the rest at 130 kg. All pigs were injected by pellet type rpST in the extensor neck muscle between 1100 and 1200 h.

Pigs were allowed *ad libitum* access to water and diets throughout the whole experimental period. Body weights and feed intake were recorded at 8 week, 11 week and marketing. Feed conversion ratio was calculated by dividing the amount of feed consumed with the corresponding body weight gain.

The diet of 75 kg to 110 kg contained 16.53% crude protein, 0.94% lysine and 2,430 kcal/kg NE and the diet of 110 kg to 130 kg contained 15.81% crude protein, 0.88% lysine and 2,330 kcal/kg. All other nutrients met or exceeded requirements of NRC (1998). The formula and chemical composition of experimental diets was presented in Table 1.

Table 2. Effects of weekly administration of implant-type rpST on growth performance of finishing pigs

Item	Control	Implanted in rpST		SEM
		75 kg	90 kg	
Daily gain (kg/day)				
Initial to 8th week[1]	0.76	0.75	0.69	0.014
8th to 11th week[2]	0.91	0.89	0.83	0.024
Initial to 11th week[2]	0.81	0.77	0.74	0.018
Feed intake (kg/day)				
Initial to 8th week[1]	2.51^{a}	2.12^{b}	2.22^{b}	0.059
8th to 11th week[2]	3.18^{a}	2.71^{ab}	2.59^{b}	0.111
Initial to 11th week[2]	2.75^{a}	2.20^{b}	2.34^{ab}	0.095
Feed/gain				
Initial to 8th week[1]	3.31^{a}	2.84^{b}	3.20^{a}	0.056
8th to 11th week[2]	3.51	3.10	3.15	0.115
Initial to 11th week[2]	3.36^{a}	2.92^{c}	3.14^{b}	0.065
Backfat thickness				
Initial	1.21	1.24	1.23	0.029
8th week[1]	1.91^{a}	1.48^{b}	1.60^{b}	0.043
11th week[2]	2.35^{a}	1.73^{b}	1.80^{b}	0.073

[a,b,c] Means with different superscripts in the same row are significantly different ($p<0.05$).
[1] n=40. [2] n=20.

Backfat probe (Renco lean-meter, USA) was used to determine 10th rib backfat thickness.

When the mean weight of pigs in a pen reached market weight (100 or 130 kg), 20 pigs of each treatment were selected and slaughtered according to industry-accepted procedures for carcass analysis at the abattoir.

Hot carcass weight was recorded at slaughter. Carcasses were chilled at 4°C overnight, after which one-half of each carcass was separated into rough primal cuts and weighed. The primal cuts were trimmed dissected into lean and fat and weights were recorded. At 24 h postmortem, carcass measurments were collected including backfat thickness (10th rib backfat). Lean percentage was derived by dividing the lean weight of the carcass weight and multiplying by 100. Lean meat ratio was derived by dividing the lean weight of carcass weight and multiplying by 100.

Statistical analyses of the data were performed with the Duncan's multiple range test of SAS (SAS Inst. Inc., Cary, NC).

RESULTS AND DISCUSSION

Performance and backfat thickness

The main effects of administration of 7 d type-rpST implant on growth performance, feed intake and feed:gain ration are summarized in Table 2. rpST had no effect on daily gain among treatments, which was considered to be due to the abrupt fall of blood pST concentration from d 3

Table 3. Effects of weekly administration of implant-type rpST on carcass characteristics at 110 kg and 130 kg of market weight[1]

Item	Control	Implant in rpST		SEM
		75 kg	90 kg	
Slaughter weight (kg)				
110 kg	116.7	117.2	111.4	1.63
130 kg	133.2	130.4	127.9	1.40
Carcass weight (kg)				
110 kg	84.1	83.4	83.6	1.16
130 kg	100.3[a]	95.5[b]	93.5[c]	1.22
Dressing (%)				
110 kg	73.4	72.8	72.9	1.11
130 kg	76.7[a]	73.0[b]	71.6[b]	0.42
Backfat thickness (cm)				
110 kg	2.48	2.17	2.46	0.080
130 kg	2.81[a]	2.24[b]	2.04[b]	0.106

[a,b,c] Means with different superscripts in the same row are significantly different ($p<0.05$).
[1] n=20.

post-injection onwards after the highest peak on d 1. There were reduction in daily feed consumption by pigs that received the rpST implant compared to the control group. Feed efficiency was improved by 7 to 13% ($p<0.05$) in rpST-treated groups compared with CONT. The improvement in feed efficiency was mainly due to the reduction of feed intake.

Pigs treated with somatotropin show an increase in protein accretion and a decrease in lipid accretion, with an overall decrease in feed intake (Etherton et al., 1987; Boyd et al., 1991; Lee et al., 1994). Repartitioning of energy by pST should lead to an improvement in feed:gain ratio because less energy from the diet is required to deposit 1 kg of lean than is required for 1 kg of adipose tissue accretion. The reduction of feed efficiency elicited by the use of weekly administration of pST in the present study is similar in magnitude to those previously reported for pigs that received daily pST injections (Etherton et al., 1986.1987; Campbell et al., 1989b).

In agreement with our results, Knight et al. (1991) showed that pigs subcutaneously implanted with pelleted pST doses of 0, 12, 24, 36 or 48 mg/week resulted in a reduction in average daily feed intake (ADFI) and improvement in F/G. Hacker et al. (1993) reported that growth rate was not affected by the use of long-term pST implants of 100 or 200 mg. In addition, there was a 15% reduction in daily feed consumption by pigs that received the 200 mg pST compared with pigs that received the no pST implant (2.78 vs. 2.34 kg/d). Azain et al. (1992) observed no significant effect of pST on gain, feed intake was decreased by 18%, and feed:gain ratio was improved by 23%. This may be due in part to the known reduction in feed intake associated with pST treatment as well as physical activity of pigs (Dunshea et al., 1992).

On the Contrary to the reported improvement in ADG elicited by daily injection of pST (Etherton et al., 1986, 1987; Campbell et al., 1989a,b; Evans et al., 1991), the use of 7 d type rpST implants in the present experiment did not alter growth rate. The absence of improvement in ADG probably results from the dose of pST for the specific weight group of pigs used and the kinetics of pST release from the implant.

Backfat thickness was decreased ($p<0.05$) by 12% in TRT1 at 110 kg of market weight, and by 23 to 32% ($p<0.05$) in rpST-treated groups at 130 kg of market weight, respectively, compared with Cntrol (Table 2). The rpST treatment resulted in a decrease in backfat thickness relative to control and a decreased rate of backfat accretion during the exprimental period. This elimination of backfat accretion by McLaren et al. (1990), who reported net backfat changes of approximately 0.9, 0.8, 0.6 and 0.2 cm in pigs treated with 0, 1.5, 3 and 6 mg of pST/d for 42 d. Backfat acceretion was decreased in animals treated with the pST implant.

But, Steele et al. (1988, 1989) and Campbell et al. (1989b) reported that backfat thickness was similar between control pigs and pigs without somatotropin injection for 30 d before slaughter.

Carcass characteristics

Carcass weight was reduced ($p<0.05$) in pigs that received rpST implants at 130 kg of market weight compared to the control pigs (Table 3). Smith and Kasson (1990) also observed a significant reduction in carcass weight of pigs that received daily injection of pST. The reduction in dressing percentage is partly due to the increase in heart, liver and kidney weights (Campbell et al., 1989b; Bidanel et al., 1991) and also the pST induced increase in lungs, stomach, small intestine and blood weights (Bidanel et al., 1991).

Backfat thickness have been found to decrease in pST treated pigs (Knight et al., 1991; Becker et al., 1992). We also found that pST implantation significantly be reduced the average backfat thickness.

The effects of weekly administration rpST on the weights of wholesale cuts are presented in Table 4 and 5. Lean meat rate tended to be higher in TRT1 at both 110 kg and 130 kg of market weight. Carcass fat content in rpST-treated groups was decreased by 33 to 46% ($p<0.05$) compared with CONT. The magnitude of this reduction in fat as a result of rpST administion is constistent with partitioning effects of pST. Adipose tissue accretion is a function of the relative rates of lipolysis and lipogenesis. Results from *in vivo* studies indicate that pST potentiates

Table 4. Effects of weekly administration of implant-type rpST on wholesale cuts at 110 kg of market weight[1]

Item	Control	Implanted in rpST		SEM
		75 kg	90 kg	
Carcass weight (kg)	80.7	80.6	82.8	1.29
Lean meat weight (kg)	45.60[c]	47.81[ab]	48.03[a]	0.809
Belly	9.00	9.75	9.30	0.232
Collar butt	4.14	4.29	4.29	0.086
Loin	5.31	5.76	5.65	0.132
Spare rib	4.06	4.11	4.11	0.075
Ham	7.50	8.00	7.85	0.240
Picnic	13.92[b]	14.26[ab]	14.96[a]	0.248
Tenderloin	1.04	1.09	1.22	0.043
Skirt meat	0.31	0.30	0.30	0.013
Others	0.32	0.25	0.34	0.028
Fat (kg)	10.43	9.33	9.55	0.526
Lean meat (%)	56.5	59.7	58.4	1.23

[a,b,c] Means with different superscripts in the same row are significantly different ($p<0.05$).
[1] n=8.

Table 5. Effects of weekly administration of implant-type rpST on whole cuts at 130 kg of market weight[1]

Item	Control	Implanted in rpST		SEM
		75 kg	90 kg	
Carcass weight (kg)	101.2[a]	93.8[b]	95.3[b]	1.22
Lean meat weight (kg)	57.37	57.84	56.79	0.821
Belly	11.76	10.83	11.77	0.346
Collar butt	5.08	5.36	5.02	0.104
Loin	6.98	7.11	6.58	0.145
Spare rib	4.91	5.10	4.92	0.092
Ham	9.12	9.50	9.10	0.160
Picnic	17.55	17.76	17.40	0.258
Tenderloin	1.31	1.49	1.26	0.048
Skirt meat	0.32	0.34	0.36	0.012
Others	0.33	0.33	0.37	0.017
Fat (kg)	18.04[a]	10.15[c]	12.27[b]	0.795
Lean meat (%)	56.7	61.6	59.6	0.61

[a,b,c] Means with different superscripts in the same row are significantly different ($p<0.05$).
[1] n=8.

catecholamine-induced adipose tissue lipolysis (Boyd and Bauman. 1989). *In vitro* studies have shown that pST reduces basal rates of lipogenesis and antagonizes the stimulating effects of insulin on porcine adipose tissue lipogenesis (Walton et al., 1987). The results of this study regarding a reduction in body fat concur with these findings.

CONCLUSION

The present study indicates that the administration of implant type rpST could improve feed efficiency and backfat thickness. The weekly administration of implant type rpST was considered to be effective in improving growth performance. The effect was greater when rpST was administered from 75 kg of live weight than 90 kg. and when pigs were marketed at 130 kg of live weight than 110 kg.

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