GROWTH, CARCASS AND SENSORY CHARACTERISTICS FOR PIGS INJECTED DAILY WITH NATURAL PORCINE SOMATOTROPIN

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INTRODUCTION

In the United States, consumers are eating more meals away from home and purchasing more meals that are precooked and/or prepared quickly at home. However, the greatest change that is taking place is consumer emphasis on reduction of dietary fat intake. Consumer surveys are indicating large increases in the number of people who have a very active life style and often do not have or don't want to spend a large amount of time preparing meals. These same surveys show a growing consumer concern regarding the nutritional quality of food, which is often expressed as concern as to the fat content of red meats. There is clearly a growing market for lean meat products. The challenge to the pork industry is to alter the basic propensity of the pig to deposit fat (National Research Council 1988).

Porcine somatotropin (PST) is a small protein synthesized and secreted from the pituitary gland into the blood stream. It has been known for many years that animals which lack somatotropin fail to grow and that giantism often results from large excesses of somatotropin. However, it was not until the 1970's that somatotropin was produced in large enough quantities to be fully evaluated as a farm animal growth promoting compound. Currently, a number of pharmaceutical and biotechnology firms have cloned the PST gene, inserted the gene into microorganisms, and harvested PST for potential commercial applications.

The objectives of this study were to evaluate the effect on:

1. Growth characteristics;
2. Carcass characteristics and organ weights; and
3. Pork sensory properties

of pigs injected daily with natural PST, over the weight range 56.7 kg to 103.3 kg at slaughter.

MATERIALS AND METHODS

One hundred and twenty crossbred pigs were used in an experiment to test the effect of daily injection of either a saline vehicle or 1.5, 3.0, 6.0 or 9.0 mg of natural PST. There were three pen-replicates of the 1.5 mg and 9.0 mg doses and six pen-replicates of the remaining doses, with five pigs per pen. Average initial and final weights were 56.7 ± .5 and 103.3 ± .8 kg, respectively. An 18% crude protein, corn-soybean meal diet and water were provided ad libitum. Individual pig growth rates and pen feed intakes were recorded. Organ weights were collected at slaughter. Carcass measurements were made after 24 hr at 4°C. An experienced sensory panel was used to evaluate 2.54 cm thick pork chops broiled to an internal temperature of 70°C. The fixed statistical models assumed in the analyses included effects of block, breed or sire, sex and two-factor interactions (where significant), plus treatment level and final weight as covariables. The degree of polynomial assumed for treatment-level effects was determined by backward elimination.

RESULTS AND DISCUSSION

The effect of PST on ad libitum feed efficiency was to reduce feed consumption and increase average daily gain (Table 1). These two factors result in a faster growing animal with an increased efficiency. At a dose of 6 mg/d PST for 6 weeks the pigs reached slaughter weight (103 kg) 12 days before controls and feed efficiency (gain/feed) was increased up to 40% in a dose dependent manner. Because of reduced intake and increased efficiency, PST treated pigs will require a greater amino acid concentration in the diet to maximize response.

Table 1. LEAST SQUARES MEANS FOR GROWTH CHARACTERISTICS OF PST TREATED PIGS

	PST Dosage Level (mg/day)				
	0	1.5	3.0	6.0	9.0
Gain, kg/d	.774	.828	.865	.886	.838
Age, d	184	177	173	172	179
Gain/feed	.267	.306	.336	.374	.379
Feed, kg/d	2.93	2.69	2.50	2.28	2.26

TABLE 2. LEAST-SQUARES MEANS FOR CARCASS AND ORGAN MEASUREMENTS OF PST TREATED PIGS

	PST Dosage Level (mg/day)				
Trait	0	1.5	3.0	6.0	9.0
Carcass wt, kg	78.09	75.95	74.62	74.42	77.49
Carcass length, cm	80.38	80.12	80.11	80.83	82.54
Liver wt, g	1495	1759	1768	1988	2097
Heart wt, g	303.3	319.2	335.2	367.1	399.0
Kidney wt, g	342.7	390.4	428.5	476.7	487.1
Femur wt, g	327.8	333.0	338.4	349.0	359.6

TABLE 3. LEAST-SQUARES MEANS FOR MUSCLE CHARACTERISTICS OF PST TREATED PIGS

	PST Dosage Level (mg/day)				
Trait	0	1.5	3.0	6.0	9.0
Semitendinosus wt, g	387.3	409.5	427.2	448.9	452.4
Biceps femoris wt, g	1141	1158	1175	1208	124.2
Loin eye area (LEA), cm^2	34.70	38.35	39.34	37.68	38.49
Muscle color[a]	2.92	2.70	2.56	2.45	2.61
Muscle firmness[b]	2.94	2.73	2.89	2.54	2.97
Marbling[c]	2.99	2.62	2.38	2.27	2.63

[a]Scale was 1 = pale, 5 = dark.
[b]Scale was 1 = soft, 5 = very firm.
[c]Scale was 1 = no marbling, 5 = excess marbling.

TABLE 4. LEAST-SQUARES MEANS FOR FAT MEASUREMENTS OF PST TREATED PIGS

Trait	PST Dosage Level (mg/day)				
	0	1.5	3.0	6.0	9.0
P-2 fat, cm	2.58	1.78	1.41	1.33	1.07
First rib fat, cm	4.15	3.94	3.72	3.28	2.85
Last rib fat, cm	2.71	2.37	2.09	1.71	1.59
Last lumbar fat, cm	2.68	1.97	1.65	1.57	1.27
Tenth rib fat, cm	2.68	1.84	1.41	1.26	1.12
Leaf fat wt, kg	1.42	1.07	.87	.75	.65

TABLE 5. LEAST-SQUARES MEANS FOR SENSORY EVALUATION OF THE LONGISSIMUS DORSI OF PST TREATED PIGS

Trait[a]	PST Dosage Level (mg/day)				
	0	1.5	3.0	6.0	9.0
Tenderness	9.31	8.86	8.60	8.70	9.59
Off-flavor	13.96	13.77	13.67	13.76	14.23
W-B Shear force, kg	3.21	3.30	3.40	3.60	3.80
Water content	73.34	73.57	73.80	74.27	74.73

Values derived from sensory panel scores with possible range from 0-15 where 0 = extremely tough or extreme off-flavor and 15 = extremely tender or no off-flavor.

As can be seen from Table 2, carcass weight of the somatotropin treated pigs was less than controls, resulting in a decreased dressing percentage, probably due to increases in organ weights. Organ weights including the liver, kidney and heart all showed large increases (Table 2).

Table 3 shows that the semitendinosus muscle weight increased in a dose dependent manner with 16% increase in weight at the 6 mg/d dose level. Increases in biceps femoris weight and loin eye area were also found. Muscle quality indicators of colour, firmness and marbling were altered by the somatotropin treatment but remained in an "acceptable" range.

Table 4 lists measurements of backfat thickness which were reduced in a dose dependent manner by porcine somatotropin. P-2 fat thickness was reduced 59 percent at the highest dose. Leaf fat was also greatly reduced by the somatotropin treatment.

Table 5 lists the sensory properties which had significantly dose dependent changes. Differences between treatments are small indicating a small effect of PST on sensory properties. Other sensory properties (not shown in Table 5), including juiciness and pork flavour, were not different between treatments.

Because somatotropin (ST) is a protein, it is degraded in the digestive tract and therefore must be injected into the animal. Several studies have used injections of ST for 3-6 weeks prior to slaughter at approximately 100 kg (Baile et al. 1983; Machlin 1972; Boyd 1987; Grebner et al. 1987; McLaren et al. 1987; Novakofski et al. 1987). Other studies have injected somatotropin into animals slaughtered at lighter weights (Chung et al. 1985; Etherton et al. 1986; Etherton et al. 1987; Bryan et al. 1987; Smith et al. 1987; Steel et al. 1987). It is difficult to compare results from many of the somatotropin experiments due to differences in origin and type of somatotropin, dose level, treatment duration and pig age and weight.

PST has real potential to (1) lower the cost of pork production and reduce product fat, which should (2) enhance the nutritional image and lower the cost of pork.

CONCLUSION

Results of this study show a PST dose-dependent repartitioning effect with muscle mass and organ weights increasing and fat deposits decreasing. PST treatment resulted in large increases in feed efficiency and fewer days on feed were required to achieve slaughter weight. The sensory characteristics of pork from PST treated animals were in the "acceptable" range.

REFERENCES

Baile, C.A., Della-Fera, M.A. and McLaughlin, C.L. (1983). *Growth* **47**:225.

Boyd, R.D. (1987). Animal Health & Nutrition, February. p.23.

Bryan, K.A., Carbaugh, D.E., Clark, A.M., Hagen, D.R. and Hammond, J.M. (1987). *Journal of Animal Science* **65**:244(Abstr.).

Chung, C.S., Etherton, T.D. and Wiggins, J.P. (1985). *Journal of Animal Science* **60**:118.

Etherton, T.D., Wiggins, J.P., Chung, C.S., Evock, C.M., Rebhun, J.F. and Walton, P.E. (1986). *Journal of Animal Science* **63**:1389.

Etherton, T.D., Wiggins, J.P, Evock, C.M., Chung, C.S., Rebhun, J.F., Walton, P.E. and Steele, N.C. (1987). *Journal of Animal Science* **64**:433.

Grebner, G.L., McKeith, F.K., Novakofski, J., Easter, R.A., McLaren, D.G., Brenner, K., Bechtel, P.J., Jones, R.W. and Dalrymple, R.H. (1987). *Journal of Animal Science* **65**:245(Abstr.).

Machlin, L.J. (1972). *Journal of Animal Science* **35**:794.

McLaren, D.G., Grebner, G.L., Bechtel, P.J., McKeith, F.K., Novakofski, J.E., Easter, R.A., Jones, R.W. and Dalrymple, R.H. (1987). *Journal of Animal Science* **65**:245 (Abstr.).

National Research Council. (1988). Designing Foods. Animal Products Options in the Marketplace. National Academy Press, Washington, DC.

Novakofski, J., Brenner, K.-V., McKeith, F.K., McLaren, D.G., Easter, R.A., Grebner, G.L., Bechtel, P.J., Dalrymple, R.H. and Jones, R.W. (1987). *Journal of Animal Science* **65**:246(Abstr.).

Smith, V.G., Moseley, W.M., Kasson, C.W. and Kratzer, D.D. (1987). *Journal of Animal Science* **65**:243 (Abstr.).

Steele, N.C., Campbell, R.G. and Caperna, T.J. (1987). Cornell Nutrition Conference, October 27, 1987.