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The effect of porcine somatotropin (pST) and gender on production parameters and tissue yield of pigs slaughtered at 135 kg live weight

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Abstract

Eighteen F1 crossbred (commercial-type terminal crosses) pigs (boars, barrows and gilts) with an initial weight of 27.2 ± 2 kg were used to investigate the effect of porcine somatotropin (pST) administered for six weeks prior to slaughter on production parameters and tissue yield in the South African scenario. Pigs were grown to 135 kg live weight, which is heavier than the average weight at slaughter in South Africa of 80 - 100 kg. Porcine somatotropin had no significant effect on average daily gain or feed intake. However, pST administration caused a significant increase in feed conversion ratio (kg feed/kg gain) of treated boars, indicating that boars converted their feed less efficiently when treated with pST. This contradicts most of the findings in the literature. The effect of pST on the different carcass cuts was not significant, except for the percentage loin back, which was higher for pST-treated animals and percentage middle back of boars and barrows, which was slightly higher. No significant pST effects were found for live weight, carcass weight, % bone, % fat or % lean meat, but a significant increase in percentage skin was found.

Keywords: FCR, P2 back fat, pST, porcine somatotropin, pork, tissue yield
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Introduction

The production of acceptable animal-derived products in a sustainable manner has been the aim of farmers since they started domesticating meat animals. The emphasis has, however, changed as consumer demands have changed from people who do physical labour to health conscious consumers demanding low fat, healthy food. Therefore, in recent times, the consumption of leaner meat has become the norm.

Despite the advances made in terms of genetics, associated problems with breeding lean pigs, such as the occurrence of pale, soft and exudative (PSE) meat, has slowed down the progress in breeding leaner animals. The production of recombinant porcine somatotropin (pST) has made it economically viable to produce leaner animals at higher bodyweights, with better carcass characteristics (McNamara *et al.*, 1991), or to produce animals at similar bodyweights with better carcass characteristics (Thiel *et al.*, 1993; White *et al.*, 1993). This was also noted for both boars and gilts (Klindt *et al.*, 1995).

The advantages of pST treatment of animals grown to normal slaughter weights (90 kg) are well documented in terms of increased average daily gain, decreased back fat thickness, feed conversion ratio and meat quality characteristics (Carter & Cromwell, 1998; Campbell, *et al.*, 1990; Bidanel *et al.*, 1991; Hagen *et al.*, 1991; Klindt *et al.*, 1992; 1995).

A number of studies investigating the influence of pST on carcass composition and carcass characteristics of animals grown up to 90 or 100 kg live weight (Thiel *et al.*, 1993; White *et al.*, 1993) have been reported, but few studies have been reported where animals were fed up to 135 kg. McNamara *et al.* (1991) treated animals up to 136 kg and found significant effects on the reduction of fat and increase of protein in the carcasses of treated animals, but they found only a small effect on bodyweight.

The aim of the current study was to ascertain whether pST treatment of animals used in commercial production in the South African scenario would have a positive effect on the performance and tissue yield (composition) of animals grown up to a bodyweight of 135 kg. Carcasses were also divided into commercial cuts that were dissected to ascertain how the distribution of body tissue is affected by pST treatment as has been noted previously (Thiel *et al.*, 1993, White *et al.*, 1993; Fabry *et al.*, 1991). The effect of the sex type of the treated animals was also studied on all these parameters.

Materials and Methods

Eighteen crossbred animals (commercial-type terminal crosses, deemed by the South African Pork Producers Organisation to be representative of the South African slaughtering) were used. They were individually marked and housed in individual pens. The animals were equally divided into three sex types: boars, gilts and barrows with three animals per sex type receiving the treatment whilst the other three represented the control. The trial started with animals of 9-10 weeks of age, weighing 27.2 ± 2 kg. Pens were equipped with a self-feeder and automatic water nipple. The facilities comprised of a commercial-type temperature controlled grower house with self opening curtains.

Porcine somatotropin was administered to animals randomly allocated to the pST treatment group after they reached an average bodyweight of 95 kg. A daily dose of 1 mL (5 mg rpST) reconstituted Reporcin® (Alpharma Animal Health, Victoria, Australia) was administered intramuscularly at the base of the neck for six weeks prior to slaughter. A commercial grower diet (Diet 1, Table 1) containing 180 g crude protein (CP), 11g lysine, 14 MJ/kg digestible energy (DE)/kg and oxytetracycline (10%) (included at 2 kg/ton) was fed for the first 14 d after arrival. Thereafter Diet 2 was fed until six weeks into the trail, when the animals attained an average live weight of *ca.* 65 kg. Diet 2 had the same composition as Diet 1, but contained no medication. Diet 3, containing 160 g CP, 9 g lysine and 13.5 MJ DE/kg was then fed to all the animals from 6 - 12 weeks into the trial (average live weight *ca.* 95 kg).

It is well documented that the voluntary feed intake of pST-treated pigs decreases significantly (Kanis *et al*., 1990; Johnston *et al*., 1993). To ensure that the control groups and the pST-treated groups had similar total protein (lysine) intakes, a diet with a higher concentration protein was fed to the pST-treated groups. Thus, when administration of pST commenced at 12 weeks, the pST-treated animals were fed a 180 g CP/kg diet (Diet 2) until the end of the trial. The control animals remained on Diet 3 (160 g CP). All animals had *ad libitum* access to feed and water.

Table 1 Ingredient and nutrient composition (g/kg) of diets fed to pigs

Ingredient	Diet 1	Diet 2	Diet 3
Yellow maize	689.7	688.2	674.4
Soya bean oilcake meal (470 g CP/kg)	116.1	127.3	118.6
Sunflower oilcake meal (380 g CP/kg)	33.8	32.0	113.0
Fishmeal (650 g CP/kg)	79.9	72.9	-
Wheaten bran	50.0	50.0	50.0
Synthetic lysine	9.0	9.0	3.2
Synthetic methionine	-	-	4.0
Synthetic threonine	-	-	8.0
Monocalcium phosphate	9.4	10.1	16.8
Feed lime	11.8	12.0	14.9
Fine salt	2.4	2.6	3.9
Vitamin & mineral premix	4.0	4.0	4.0
Oxitetracycline (10%)	2.0	-	-
Digestible energy* (MJ/kg)	14	14	13.5
Lysine*	11	9	9

* Calculated from analysed raw materials.

Feed intake and animal weights were measured weekly. The data was then used to calculate a feed conversion ratio (FCR) by dividing the total feed intake by the total body mass gain of the animals during the trial period. Average daily gain was analysed by fitting a linear model.

After 15 weeks on these treatments, animals were slaughtered at an average live weight of 135 kg in a commercial abattoir. The transport and handling of the animals *ante mortem* was conducted in such a manner so as to minimise stress. Due to the vehicle design, animals had to be mixed during transport and in the holding pens at the abattoir.

Animals were led into a stunning cage where they were stunned with an electrical stunner set at 220V and 1.8A, with a current flow of no longer than six seconds. Electrodes were placed at the base of the ear. Within 10 seconds exsanguination followed, and within 50 seconds shackling and hoisting of the carcass was completed. Scalding commenced within five min after stunning. Thereafter the carcasses were dressed using the standard commercial procedures.

The carcasses were hung in a cold storage room (4 °C) for 12 h before they were dissected. After the head, tail, kidneys, peritoneal and intestinal fat had been removed from each carcass (Figure 1) it was sawn into two halves from top to bottom. The right side was dissected to determine the yield of skin, bone, fat and lean meat.

The fillet was removed by cutting it away on the inside of the carcass directly below the hip bone by cutting along the hip bone and the lumbar vertebrae. Membranes and connective tissue were removed from the fillet. The neck was removed by cutting at a 90° angle to the ventral line between the last cervical and first thoracic vertebrae, after which the rind, bones and fat were dissected. The shoulder was removed by cutting along the inside of the front leg and around the shoulder blade up to the spinal cord and along the 5th and 6th thoracic vertebrae. The trotters were removed by cutting through the metacarpal region (joint between the carpal bones and the radius and ulna). The rind, fat and bones were dissected from the remaining part of the right shoulder.

The hind leg was removed between the 2nd and 3rd sacral vertebrae perpendicular to the stretched leg. The trotter was removed from the ham at the distal end of the tibia and fibula parallel to the cut made to remove the leg from the carcass. The trotters were removed by cutting through the crural region (across the middle of the tibia and fibula). The rind, fat and bones were dissected from the remaining part of the right leg. The belly was removed from the back by cutting parallel to the spinal cord, next to the eye muscle, approximately 18 cm from the spinal column, i.e. a straight line from the posterior ventral point of the *M. psoas major* to the cranio-ventral edge of the 4th thoracic vertebra at the anterior end.

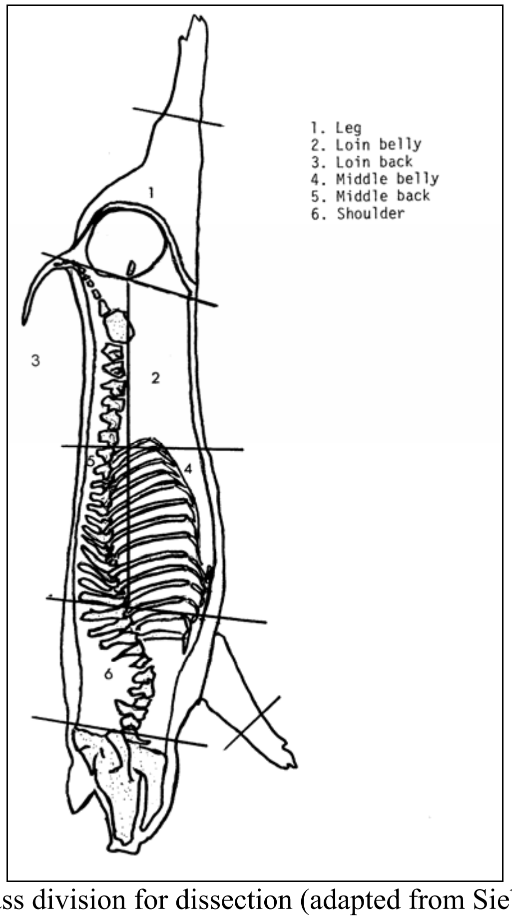

Figure 1 Carcass division for dissection (adapted from Siebrits, 1984).

The back was split into the loin back and middle back by cutting through the back between the vertebrae at the caudal position of the last rib. The last three ribs were removed from the middle back by cutting through the spinal cord above the 3rd last rib (3-rib cut). The belly was split into the middle belly and loin belly by cutting at the position of the last rib. The rind, bones and fat were dissected from each of the parts.

Data obtained in this study were analysed using the GenStat (2000) statistical program. A randomised trial design utilising 18 pens (animals) was used in a 2 (treatment) X 3 (sex) factorial design. Each sex group consisted of six pens, three control animals and three treated with pST. One of the animals died during the trial (cause of death was a heart-attack at the abattoir) and no data were obtained from it. Analysis of variance (ANOVA) was used to test for differences between the groups. Treatment means were separated (Snedecor & Cochran, 1980) by using Fisher's F-test with a protected least significant difference (LSD) at a 5% level of significance ($P < 0.05$). Percentage variance accounted for was calculated as the percentage ratio of the sum of squares of the parameter in relation to the total sum of squares. Values below 10% indicated a low residual and were therefore deemed coincidental.

Average daily gain (ADG) was analysed by fitting a linear model to the weekly live weight measurements of the animals. The slope of the model would then represent the average daily gain.

Results and Discussion

Feed intake, calculated cumulatively on a weekly basis, was not significantly influenced by pST or sex type in this study (Tables 2 and 3). This is in contrast with the findings of Goodband *et al.* (1993) and Klindt *et al.* (1995) who found a decrease in feed intake for animals treated with pST and fed diets with increased levels of lysine. Klindt *et al.* (1995) also found a dose-dependent decrease in feed intake of boars and gilts slaughtered between 81.1 and 94.4 kg. However, lysine levels were not adjusted in diets fed in their study and the eventual slaughter weight was lower than in the current study (94.4 kg *vs.* 135 kg) and pST treatment only started at a more advanced age in the current study which could be the cause for the lack of response noted.

It can be seen in Tables 4 and 5 that pST had no significant effect on the live weight increase of animals grown up to 135 kg, this finding confirms the results of Klindt *et al.* (1995) who found gains to be unchanged or greater in the pST treated group and that the effect of pST treatment was dose dependant. Given the fact that the trial of Klindt *et al.* (1995) grew the animals up to 94.4 kg and the current

Table 2 F-probabilities and percentage variance accounted for, for cumulative feed intake of animals fed up to 135 kg live weight

Week	Sex		Treatment		Interaction	
	F Prob	% Var	F Prob	% Var	F Prob	% Var
Week 1	0.089	33.57	0.670	0.20	0.663	4.71
Week 2	0.269	21.09	0.902	0.11	0.968	0.47
Week 3	0.662	6.53	0.835	0.35	0.566	9.15
Week 4	0.134	26.11	0.979	0.00	0.298	14.62
Week 5	0.192	22.60	0.834	0.27	0.379	12.47
Week 6	0.239	20.32	0.847	0.24	0.435	11.17
Week 7	0.315	17.53	0.911	0.00	0.598	0.02
Week 8	0.362	15.57	0.876	0.18	0.599	7.49
Week 9#	0.379	15.08	0.812	0.42	0.653	6.29
Week 10#	0.503	10.71	0.589	2.26	0.651	6.54
Week 11#	0.679	7.28	0.721	1.23	0.587	10.17
Week 12#	0.893	1.81	0.919	0.09	0.516	11.13
Week 13#	0.805	3.44	0.602	2.24	0.589	8.66
Week 14#	0.643	6.74	0.347	7.08	0.691	5.61
Week 15	0.427	12.88	0.433	4.63	0.680	5.59

pST treatment; %Var - % variance accounted for; F Prob - F Probability.

Table 3 Average cumulative feed intakes (kg) of animals fed up to 135 kg live weight

Week	Sex			Treatment	
	Gilt	Boar	Barrow	pST	Control
Week 1	15.0 ± 0.9	12.7 ± 0.9	16.1 ± 1.1	14.7 ± 0.8	14.2 ± 0.8
Week 2	27.6 ± 2.1	27.6 ± 2.2	32.9 ± 2.7	28.9 ± 1.9	28.8 ± 1.8
Week 3	44.3 ± 3.0	42.8 ± 3.2	47.3 ± 3.9	44.9 ± 2.8	44.1 ± 2.6
Week 4	62.6 ± 3.6	65.2 ± 3.9	75.9 ± 4.8	66.4 ± 3.4	66.8 ± 3.2
Week 5	82.3 ± 4.3	84.8 ± 4.6	96.3 ± 5.7	86.8 ± 4.0	86.2 ± 3.8
Week 6	102.6 ± 5.1	105.3 ± 5.5	118.1 ± 6.8	107.6 ± 4.8	106.9 ± 4.5
Week 7	124.3 ± 5.9	127.3 ± 6.4	140.1 ± 7.8	129.2 ± 5.5	128.9 ± 5.2
Week 8	144.1 ± 6.3	147.8 ± 6.7	159.9 ± 8.3	149.5 ± 5.8	148.8 ± 5.5
Week 9#	165.6 ± 6.6	171.0 ± 7.2	182.0 ± 8.8	172.1 ± 6.0	170.7 ± 5.8
Week 10#	190.1 ± 7.7	197.6 ± 8.3	205.8 ± 10.2	199.0 ± 7.2	194.2 ± 6.8
Week 11#	216.4 ± 8.1	222.9 ± 8.7	228.6 ± 10.7	223.3 ± 7.6	220.1 ± 7.2
Week 12#	242.4 ± 9.6	248.0 ±10.3	249.2 ± 12.7	246.4 ± 9.0	245.6 ± 8.4
Week 13#	263.2 ± 10.1	272.3 ±10.9	271.3 ± 13.3	271.7 ± 9.4	265.4 ± 8.9
Week 14#	281.4 ± 11.5	296.8 ±12.4	293.4 ± 15.2	296.8 ± 10.8	283.3 ± 10.1
Week 15	298.2 ± 13.6	321.8 ±14.7	322.6 ± 18.0	318.9 ± 12.7	306.4 ± 12.0

pST treatment.

Table 4 F-probabilities and percentage variance accounted for, for live weights of animals fed up to 135 kg live weight

Week	Sex		Treatment		Interaction	
	F Prob	% Var	F Prob	% Var	F Prob	% Var
Week 1	0.662	6.83	0.608	2.22	0.823	3.16
Week 2	0.383	15.50	0.579	2.43	0.958	0.64
Week 3	0.524	10.87	0.709	1.16	0.952	0.78
Week 4	0.449	13.29	0.669	1.49	0.980	0.30
Week 5	0.420	14.17	0.644	1.70	0.917	1.32
Week 6	0.393	15.28	0.653	1.58	0.873	2.03
Week 7	0.394	15.05	0.723	0.98	0.847	2.50
Week 8	0.372	15.57	0.674	1.34	0.762	4.00
Week 9#	0.375	15.42	0.727	0.92	0.731	4.64
Week 10#	0.291	18.75	0.735	0.82	0.657	5.92
Week 11#	0.401	14.04	0.624	1.80	0.648	6.38
Week 12#	0.314	18.17	0.861	0.23	0.751	4.15
Week 13#	0.244	21.30	0.953	0.02	0.650	5.92
Week 14#	0.240	21.44	0.849	0.25	0.645	6.00
Week 15	0.143	28.43	0.600	1.77	0.797	2.83

pST treatment; %Var - % variance accounted for; F Prob - F Probability.

study only started treating with pST at *ca.* 95 kg live weight the lack of response could further be attributable to a lower than needed dose for response. Etherton *et al.* (1986) found a significant increase in carcass length and live weight of pST-treated pigs, slaughtered between 76 and 80 kg live weight, in contrast with what was observed in the current study, where animals were slaughtered at a higher weight. Chung *et al.* (1985) also found an increase in live weight, but found no significant influence on carcass length of pigs slaughtered at 60 kg live weight. Klindt *et al.* (1995) found a dose-dependent increase in gain of boars and gilts slaughtered between 81.1 and 94.4 kg. In this study no significant differences in live weight ($P > 0.05$) and carcass weight were detected between pST animals and control animals ($P > 0.05$). Animals were slaughtered at an average live weight of 135 kg (ranging from 113 - 160 kg) and average carcass weight was 113.4 kg. Since all documented studies tested the use of pST up to a substantially lower slaughter weight it is believed that the dose of pST expressed as mg per kg of live weight was much lower in the current study and probably insufficient to obtain a proper response.

When the FCR of the animals was calculated, a significant effect pertaining to sex type and pST was detected (Tables 6 and 7). Contrary to the results obtained by Etherton *et al.* (1986) and Chung *et al.* (1985), all animals treated with pST in this study had an increased FCR. It is interesting to note that from week 10 onwards very low F-probabilities (weeks 10 and 13 were significant) were detected for the interactions

Table 5 Average live weights (kg) of animals fed up to 135 kg live weight

Week	Sex			Treatment	
	Gilt	Boar	Barrow	pST	Control
Week 1	30.3 ± 1.8	29.8 ± 1.9	32.5 ± 2.3	31.3 ± 1.7	30.1 ± 1.6
Week 2	38.2 ± 2.2	37.0 ± 2.4	42.2 ± 2.9	39.6 ± 2.1	38.0 ± 1.9
Week 3	44.7 ± 2.6	44.8 ± 2.8	49.2 ± 3.4	46.4 ± 2.4	45.3 ± 2.3
Week 4	51.5 ± 2.7	51.8 ± 2.9	57.0 ± 3.6	53.6 ± 2.5	52.2 ± 2.4
Week 5	58.1 ± 3.0	60.2 ± 3.2	64.8 ± 3.9	61.2 ± 2.8	59.7 ± 2.6
Week 6	65.5 ± 3.0	68.6 ± 3.2	72.5 ± 4.0	69.0 ± 2.8	67.6 ± 2.7
Week 7	73.1 ± 3.3	76.6 ± 3.5	80.6 ± 4.3	76.7 ± 3.0	75.5 ± 2.9
Week 8	80.2 ± 3.3	84.9 ± 3.5	87.6 ± 4.3	84.4 ± 3.0	82.9 ± 2.9
Week 9#	86.4 ± 3.5	91.8 ± 3.7	94.0 ± 4.6	90.7 ± 3.2	89.5 ± 3.1
Week 10#	92.6 ± 3.5	99.6 ± 3.7	100.5 ± 4.6	97.5 ± 3.2	96.4 ± 3.1
Week 11#	100.2 ± 3.6	107.3 ± 3.9	105.5 ± 4.8	104.9 ± 3.4	103.0 ± 3.2
Week 12#	108.0 ± 3.8	116.7 ± 4.1	113.6 ± 5.0	112.6 ± 3.6	112.2 ± 3.3
Week 13#	115.4 ± 4.1	126.0 ± 4.4	120.3 ± 5.4	119.9 ± 3.8	120.7 ± 3.6
Week 14#	122.1 ± 4.6	134.0 ± 4.9	127.0 ± 6.0	126.5 ± 4.3	128.3 ± 4.0
Week 15	128.7 ± 4.4	142.5 ± 4.7	135.0 ± 5.8	133.1 ± 4.1	136.8 ± 3.9

pST treatment.

Table 6 F-probabilities and percentage variance accounted for, for calculated FCR of animals fed up to 135 kg live weight

Week	Sex		Treatment		Interaction	
	F Prob	% Var	F Prob	% Var	F Prob	% Var
Week 1	0.198	24.930	0.639	1.537	0.945	0.749
Week 2	0.571	9.070	0.946	0.037	0.667	6.456
Week 3	0.150	25.415	0.990	0.000	0.350	12.969
Week 4	0.533	7.441	0.742	0.638	0.109	30.504
Week 5	0.371	11.720	0.950	0.022	0.112	28.961
Week 6	0.314	13.396	0.925	0.048	0.101	29.498
Week 7	0.208	18.799	0.859	0.171	0.143	24.136
Week 8	0.159	21.391	0.978	0.003	0.126	24.676
Week 9#	0.105	25.281	0.894	0.084	0.108	24.838
Week 10#	0.024	33.967	0.637	0.746	0.032	30.382
Week 11#	0.012	43.799	0.411	2.355	0.100	18.409
Week 12#	0.022	37.742	0.529	1.446	0.072	23.101
Week 13#	0.009	39.376	0.066	10.838	0.047	21.194
Week 14#	0.018	27.382	0.002	39.901	0.259	7.133
Week 15	0.018	31.026	0.014	22.530	0.074	17.503

pST treatment; %Var = % variance accounted for; F Prob = F Probability.

Table 7 Average calculated FCR by week for animals fed up to 135 kg live weight

Week	Sex			Treatment	
	Gilt	Boar	Barrow	pST	Control
Week 1	2.00 ± 0.11	1.76 ± 0.12	1.66 ± 0.15	1.81 ± 0.11	1.86 ± 0.10
Week 2	1.95 ± 0.08	1.84 ± 0.09	1.97 ± 0.11	1.92 ± 0.08	1.91 ± 0.07
Week 3	2.10 ± 0.06	1.94 ± 0.06	1.94 ± 0.08	2.01 ± 0.05	2.00 ± 0.05
Week 4	2.26 ± 0.10	2.16 ± 0.11	2.37 ± 0.13	2.23 ± 0.09	2.27 ± 0.09
Week 5	2.34 ± 0.09	2.20 ± 0.09	2.42 ± 0.11	2.30 ± 0.08	2.31 ± 0.08
Week 6	2.40 ± 0.08	2.26 ± 0.08	2.47 ± 0.10	2.37 ± 0.07	2.36 ± 0.07
Week 7	2.49 ± 0.07	2.32 ± 0.08	2.54 ± 0.10	2.44 ± 0.07	2.45 ± 0.07
Week 8	2.57 ± 0.07	2.39 ± 0.07	2.60 ± 0.09	2.52 ± 0.06	2.51 ± 0.06
Week 9#	2.67 ± 0.07	2.46 ± 0.07	2.68 ± 0.09	2.60 ± 0.06	2.59 ± 0.06
Week 10#	2.72^a ± 0.05	2.56^b ± 0.05	2.82^a ± 0.06	2.71 ± 0.05	2.67 ± 0.04
Week 11#	2.79^a ± 0.05	2.57^b ± 0.05	2.82^a ± 0.06	2.75 ± 0.04	2.69 ± 0.04
Week 12#	2.85^a ± 0.06	2.58^b ± 0.06	2.84^a ± 0.08	2.79 ± 0.06	2.73 ± 0.05
Week 13#	2.88^a ± 0.05	2.62^b ± 0.05	2.88^a ± 0.06	2.86^c ± 0.05	2.72^d ± 0.04
Week 14#	2.86^a ± 0.05	2.64^b ± 0.05	2.86^a ± 0.06	2.92 ± 0.05	2.66 ± 0.04
Week 15	2.87^a ± 0.05	2.69^b ± 0.06	3.01^a ± 0.07	2.94^c ± 0.05	2.75^d ± 0.05

pST treatment; a,b,c,d, Row means with common superscript do not differ significantly (P >0.05).

Table 8 Average calculated FCR by week for animals fed up to 135 kg live weight (sex X treatment interaction)

Week	Boar		Gilt		Barrow	
	pST	Control	pST	Control	pST	Control
Week 1	1.71 ± 0.71	1.81 ± 0.17	2.00 ± 0.17	2.00 ± 0.15	1.61 ± 0.21	1.70 ± 0.21
Week 2	1.84 ± 0.13	1.83 ± 0.13	2.01 ± 0.13	1.90 ± 0.11	1.90 ± 0.16	2.04 ± 0.16
Week 3	1.97 ± 0.09	1.92 ± 0.09	2.04 ± 0.09	2.15 ± 0.07	2.03 ± 0.11	1.86 ± 0.11
Week 4	2.33 ± 0.15	2.00 ± 0.15	2.17 ± 0.13	2.34 ± 0.13	2.16 ± 0.18	2.55 ± 0.18
Week 5	2.37 ± 0.13	2.04 ± 0.13	2.26 ± 0.13	2.41 ± 0.11	2.28 ± 0.16	2.54 ± 0.16
Week 6	2.43 ± 0.11	2.11 ± 0.11	2.32 ± 0.11	2.46 ± 0.10	2.37 ± 0.14	2.56 ± 0.14
Week 7	2.46 ± 0.11	2.19 ± 0.11	2.41 ± 0.11	2.57 ± 0.10	2.45 ± 0.14	2.62 ± 0.14
Week 8	2.53 ± 0.10	2.27 ± 0.10	2.50 ± 0.10	2.64 ± 0.09	2.54 ± 0.12	2.65 ± 0.12
Week 9#	2.61 ± 0.10	2.32 ± 0.10	2.60 ± 0.10	2.72 ± 0.09	2.61 ± 0.12	2.74 ± 0.12
Week 10#	2.71^a ± 0.07	2.42^b ± 0.07	2.67^a ± 0.07	2.78^a ± 0.06	2.77^a ± 0.09	2.87^a ± 0.09
Week 11#	2.70 ± 0.07	2.45 ± 0.07	2.77 ± 0.07	2.80 ± 0.06	2.79 ± 0.09	2.86 ± 0.09
Week 12#	2.75 ± 0.09	2.43 ± 0.09	2.78 ± 0.09	2.91 ± 0.08	2.84 ± 0.11	2.85 ± 0.11
Week 13#	2.82^a ± 0.07	2.45^b ± 0.07	2.86^a ± 0.07	2.89^a ± 0.06	2.92^a ± 0.09	2.85^a ± 0.09
Week 14#	2.85 ± 0.07	2.45 ± 0.07	2.97 ± 0.07	2.77 ± 0.06	2.94 ± 0.09	2.80 ± 0.09
Week 15	2.92^a ± 0.08	2.49^b ± 0.08	2.93^a ± 0.08	2.82^a ± 0.07	3.01^a ± 0.10	3.00^a ± 0.10

pST treatment; a,b, Row means with common superscript do not differ significantly (P >0.05).

between sex type and pST treatment. Since these probabilities described more than 10% of the variation, these observations cannot be seen as merely co-incidental. It can thus be seen in Table 8 that boars had a tendency to have an increased FCR when treated with pST. For all treatments boars converted their feed to live weight better than barrows and gilts from week 10 onwards. However, pST had a negative effect on the FCR of boars although they had the best FCR of all sex types. It would appear that the animals did not have the ability to utilise the higher quality feed for growth and actually deposited this oversupply as carcass fat, this inability could also be explained by the suboptimal levels, on a mg per kg live weight basis, believed to have been administered in the trial. The animals are therefore physiologically older than what the researchers expected and the supply of the trial diets actually represented a substantial oversupply of nutrient in relation to level of maturity.

Average daily gain was analysed by fitting a linear model $R^2 \geq 0.98$. Although sows (0.869 kg/day) and barrows (0.848 kg/day) had a slower rate of gain than boars (0.934 kg/day), pST had no significant effect on the rate of gain attained by any group of animals in this experiment. This is in contrast with results documented by earlier investigators who generally reported an increase in ADG (Campbell *et al.*, 1989; McLaughlin *et al.*, 1989). This response was, however, further noted to be dose dependent (Fabry *et al.*, 1991; Klindt *et al.*, 1995) with the former author noting some responses only at 6 mg per day. The lack of response thus noted in this study is then attributed to the probable below optimum level of administration of pST. Animals were slaughtered and dissected as described earlier. Probabilities for differences are tabulated in Table 9.

As can be seen from Table 9, pST had very little effect on the commercial cuts. Animals treated with pST had a significantly lower percentage (11.2%) loin back than control animals (12.1%). The percentage middle back showed a treatment X sex interaction where pST caused a significantly lighter middle back in the boars and barrows (see Table 10), but not in the gilts. No significant differences could be detected with pST treatment for any of the other carcass cuts.

Although the treatment effect was not significant (P >0.05) for the entire middle back, a trend (P <0.1) was detected for percentage bone in the middle back, with the pST-treated (14.2% *vs.* 13.2%) animals having more bone than the control animals. This is supported by the data analysed for the 3-rib cut: pST- treated animals contained a significantly higher percentage bone (13.4% *vs.* 11.5%) than the control animals. When the data was combined for all the cuts (Table 11) it was found that animals treated with pST had a higher percentage (P = 0.024) skin (5.04%) than the control animals (4.28%). Although boars had a significantly higher percentage skin than barrows and gilts, no sex X treatment interaction was detected (Table 6).

Table 9 F-probabilities and % variance accounted for in different carcass cuts of animals slaughtered at an average bodyweight of 135 kg

Carcass quality parameter	Sex		Treatment		Interaction	
	F Prob	% Var	F Prob	% Var	F Prob	% Var
% Fillet	0.599	7.841	0.970	0.010	0.470	11.823
% Intestinal & peritoneal fat	0.616	7.912	0.980	0.006	0.684	6.154
% Thigh	0.475	9.442	0.289	7.346	0.261	18.031
% Loin belly	0.777	4.124	0.767	0.737	0.644	7.310
% Middle belly	0.727	4.327	0.350	6.289	0.316	16.889
% Loin back	0.187	15.107	0.026*	25.662	0.158	16.869
% Middle back	0.454	6.219	0.103	11.587	0.020*	41.922
% Shoulder	0.034*	40.503	0.166	9.499	0.772	2.295
% Trotters	0.056	39.188	0.871	0.143	0.710	3.662
% 3-rib	0.911	1.449	0.799	0.523	0.454	13.095
% Head	0.174	23.424	0.515	2.577	0.395	11.490

[#]%Var - % variance accounted for; F Prob - F Probability.

Table 10 Effect of pST on the percentage middle back dissected from pigs slaughtered at average 135 kg

Sex	pST	Control	P
Boar	9.86 ^{a}	10.96^{b}	0.028
Gilt	10.55^{a}	9.94^{a}	0.160
Barrow	10.11^{a}	11.30^{b}	0.036

^{a,b} Row means with common superscript do not differ significantly (P >0.05).

Table 11 F-probabilities and percentage variance accounted for, regarding total percentage skin, bone, fat and lean meat of animals slaughtered at an average bodyweight of 135 kg

Carcass quality parameter	Sex		Treatment		Interaction	
	F Prob	% Var	F Prob	% Var	F Prob	% Var
% Skin	0.001	59.218	0.030	12.416	0.250	6.324
% Bones	0.917	1.426	0.365	7.242	0.885	2.014
% Fat	0.300	15.870	0.310	6.677	0.374	12.677
% Lean meat	0.790	3.595	0.343	7.325	0.634	7.083

[#] %Var - % variance accounted for; F Prob - F Probability

Table 12 Average values obtained for carcass composition (Mean ± s.d.) of pigs slaughtered at 135 kg live weight

Carcass parameter	Sex			Treatment	
	Gilt	Boar	Barrow	pST	Control
% Skin	4.4[a] ± 0.2	5.7[b] ± 0.35	3.0[a] ± 0.3	5.0[a] ± 0.2	4.3 [b] ± 0.2
% Bones	11.0 ± 0.3	11.0 ± 0.4	11.1 ± 0.5	11.3 ± 0.3	10.9 ± 0.3
% Fat	21.3 ± 1.8	18.0 ± 1.9	22.5 ± 2.3	19.3 ± 1.6	21.7 ± 1.6
% Lean meat	64.1 ± 1.6	64.0 ± 1.8	62.5 ± 2.1	64.6 ±1.4	62.6 ± 1.5

[a,b] Row means with common superscripts do not differ significantly (P >0.05).

These results did not support reports by numerous authors (Klindt *et al.*, 1992; 1995) who studied lighter animals and found a reduction in body fat as well as an increase in lean muscle. It could be speculated that the lack of response detected in this study (especially on % fat) could probably be attributed to the low number of replicates combined with the high slaughter weights which could indicate a suboptimal level of administration of pST, where the percentage fat reduction with pST could be so small that the variation between treatments was higher than the possible effect of the treatment.

The increase in average daily gain and decrease in FCR, as referred to by Etherton *et al.* (1986), Chung *et al.* (1985), Fabry *et al.* (1991) and Klindt *et al.* (1995) were not seen in this study. However, it appears that pST treatment caused boars to have similar (though slightly higher) FCRs than gilts and barrows. Since the animals slaughtered in this study were slaughtered at a higher body mass, this could have caused the animals to respond in a different manner than less mature animals used in the referenced studies. Another facet that may have influenced this result was the fact that pST was introduced later in life and at a higher live weight than in the cited literature and therefore may have had a limited effect. This warrants further investigation, especially as pertaining to increased doses for higher live weight animals.

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References

Bidanel, J-P., Bonneau, M., Pointillart, A., Gruand, J., Mourot, J. & Demade, I., 1991. Effects of exogenous porcine somatotropin (pST) administration on growth performance, carcass traits, and pork meat quality of Meishan, Pietrain, and crossbred gilts. J. Anim. Sci. 89, 3511-3522.

Campbell, R.G., Johnson, R.J., King, R.H. & Taverner, M.R., 1990. Effects of gender and genotype on the response of growing pigs to exogenous administration of porcine growth hormone. J. Anim. Sci. 68, 2674-2681.

Campbell, R.G., Steele, N.C., Caperna, T.J., McMurtry, J.P., Solomon, M.B. & Mitchell, A.D., 1989. Interrelationships between sex and exogenous growth hormone administration on performance, body composition and protein and fat accretion of growing pigs. J. Anim. Sci. 67, 177-186.

Carter, S.D. & Cromwell, G.L., 1998. Influence of porcine somatotropin on the phosphorous requirement of finishing pigs: II. Carcass characteristics, tissue accretion rates, and chemical composition of the ham. J. Anim. Sci. 76, 596-605.

Chung, C.S., Etherton, T.D. & Wiggins, J.P., 1985. Stimulation of swine growth by porcine growth hormone. J. Anim. Sci. 60, 118-130.

Etherton, T.D., Wiggins, J.P., Chung, C.S., Evock, C.M., Rebhun J.F. & Walton, P.E., 1986. Stimulation of pig performance by porcine growth hormone and growth hormone-releasing factor. J. Anim. Sci. 63, 1389-1399.

Fabry, J., Demeyer, D., Thielemans, M.F., Deroanne, C., Van de Voorde, G., Deroover, E. & Dalrymple, R.H., 1991. Evaluation of recombinant porcine somatotropin on growth performance, carcass characteristics, meat quality, and muscle biochemical properties of Belgian Landrace pigs. J. Anim. Sci. 69, 4007-4018.

GenStat for Windows., 2000. Release 4.2, 5th ed. Oxford VSN International.

Goodband, R.D., Nelssen, J.L., Hines, R.H., Kropf, D.H., Stoner, G.R., Thaler, R.C., Lewis, A.J. & Schricker, B.R., 1993. Interrelationships between porcine somatotropin and dietary lysine on growth performance and carcass characteristics of finishing swine. J. Anim. Sci. 71, 663-672.

Hagen, D.R., Mills, E.W., Bryan, K.A. & Clark, A.M., 1991. Effects of exogenous porcine growth hormone (pGH) on growth, carcass traits, reproductive characteristics and meat sensory attributes of young boars. J. Anim. Sci. 69, 2472-2479.

Johnston, M.E., Nelssen, J.L., Goodband, R.D., Kropf, D.H., Hines, R.H. & Schricker, B.R., 1993. The effects of porcine somatotropin and dietary lysine on growth performance and carcass characteristics of finishing swine fed to 105 or 127 kilograms. J. Anim. Sci. 71, 2986-2995.

Kanis, E., Nieuwhof, G.J., de Greef, K.H., Van der Hel, W., Verstegen, M.W.A., Huisman, J. & Van der Wal, P., 1990. Effect of recombinant porcine somatotropin and dietary lysine on growth and carcass quality in growing pigs: Interactions with genotype, gender and slaughter weight. J. Anim. Sci. 68, 1193-1200.

Klindt, J., Buonomo, F.C. & Yen, J.T., 1992. Administration of porcine somatotropin by sustained-released implant: Growth and endocrine responses in genetically lean and obese barrows and gilts. J. Anim. Sci. 70, 3721-3733.

Klindt, J., Buonomo, C.F. & Yen, J.T., 1995. Administration of porcine somatotropin by sustained-release implant: Growth, carcass, and sensory responses in crossbred white and genetically lean and obese boars and gilts. J. Anim. Sci. 73, 1327-1339.

McLaughlin, C.L., Baile, C.A., Qi, S-Z., Wang, L-C. & Xie, J-P., 1989. Responses of Beijing black hogs to porcine somatotropin. J. Anim. Sci. 67, 116-127.

McNamara, J.P., Brekke, C.J., Jones, R.W. & Dalrymple, R.H., 1991. Recombinant porcine somatotropin alters performance and carcass characteristics of heavyweight swine and swine fed alternative feedstuffs. J. Anim. Sci. 69, 2273-2281.

Siebrits, F.K., 1984. Some aspects of chemical and physical development of lean and obese pigs during growth. D.Sc. dissertation, University of Pretoria, South Africa.

Snedecor, G.W. & Cochran, W.G., 1980. Statistical Methods. 7th ed., The Iowa State University Press. Ames, Iowa. pp. 233-236.

Thiel, L.F., Beerman, D.H., Krick, B.J. & Boyd, R.D., 1993. Dose-dependent effects of exogenous porcine somatotropin on the yield, distribution, and proximate composition of carcass tissues in growing pigs. J. Anim. Sci. 71, 827-835.

White, B.R., Lan, Y.H., McKeith, F.K., McLaren, D.G., Novakofski, J, Wheeler, M.B. & Kasser, T.R., 1993. Effects of porcine somatotropin on growth and carcass composition of Meishan and Yorkshire barrows. J. Anim. Sci. 71, 3226-3238.