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EFFECT OF PORCINE SOMATOTROPIN (pST) ON CARCASS, MEAT AND FAT QUALITY OF GROWING-FINISHING PIGS

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INTRODUCTION

Improvements in carcass composition and meat quality by the reduction of fat are of substantial importance for the consumers and the meat industry. PST has been shown to increase daily gain while at the same time reducing the proportion of that gain that is fat (Etherton et al., 1987; Kanis et al., 1988). A research project in Dummerstorf, Germany, started in 1988. The topics were growth experiments with fattening pigs of different sexes, slaughter weights, breeds and diets. The study involved measurements of carcass composition, meat quality factors, muscle biology traits, fatty acid composition and the energy/protein deposition (Ender, 1992).

Most reports in the literature have used traditional live weights of 100 to 115kg. However, the effects of pST when used in pigs of high slaughter weights are of interest because heavy lean carcasses have a very practical significance. Also results of different sexes, breeds and the dose response are of special interest. Furthermore it is indicated that the ratio of energy/protein has an influence on the repartitioning effects.

MATERIAL AND METHODS

A total of 426 pigs were used in sequential experiments. The experiments were designed to examine the effects of different doses, sexes, final weights and diets in Landrace pigs. The animals used in the experiments were Schwerfurter and Pietrain breeds with different halothane reactivity (Tables 1, 2 and 3).

Treatment groups consisted of two groups:

Group 1:	0,2, 2-4 and 4mg pST/day; and
Group 2:	administered daily for 67 to 75 or 102 days (i.m. injections).

The experimental diet composition was characterized by:

15MJ/kg DM metabolic energy
190g/kg DM crude protein and
11.5g/kg DM lysine.

In the diet experiment the composition was 15.5MJ/kg metabolic energy and 129-188g/kg crude protein, 8.4-13.3g/kg lysine. To get a comparable final weight with the treated animals the controls were slaughtered one week later. The live weights were: normal weight about 115kg and heavy weight about 150kg.

Grading, carcass measurements, chemical and histological analysis were done according to standard methods.

RESULTS AND DISCUSSION

Sex/dose

Table 4 demonstrates the dose effect of 2 and 4mg pST daily injections. This effect occurs in all investigated traits of all sexes. In barrows the analytical fat content decreased from 37.9% in the control group to 25.7% (70% of the control) in the 2mg pST/d group and to 21.8% (58% of the control) in the group with the higher dose of 4mg. pST. Therefore, the higher dose caused a difference in fat content of 3.9% absolutely and 12% relatively to the control. In comparison, the analytical protein content was increased by 2.9% (2mg group)and 3.7% (4mg group).

The amounts (muscle meat)of lean meat in the higher pST dose experimental regime were +4.9%, +7.9% and +4.5% of controls of gilts, barrows and boars respectively. The fat thickness and the fat content have decreased in all sexes as shown (see above for barrows). For the pigs given pST administration during growth, the carcass was leaner with a lower fat content. These results are similar in all sexes with slightly lower effects in boars with the lowest fat content.

Slaughter weight

The effects for the heavy pigs were also similar with respect to performance, organ weights and carcass composition. Heavy treated pigs look like normal weight untreated animals (Table 5). However, the lean meat percent in pST treated carcasses of the second group were +4.9(111%) compared to the normal weight controls and +8.0% compared to the heavy weight controls. That means that pST works with the same activity in hogs at heavier weight. The meat percentage of the 40kg heavier treated pigs (49.1%)is even higher compared with that of untreated pigs at normal weight (44.2%). The decrease of fat in the treated heavy carcasses was 63% relative to and/or 72.8% in absolute terms of the untreated normal controls. This implies that the heavier treated pigs reach an 8% lower level of fat than untreated pigs at normal weight.

The chemical composition of the carcass is of substantial importance. Fat content of the whole carcasses of pigs at normal weight decreased by 16.1% (58% of control), and comparably, by 16.5% (62% of control) in pigs at heavy weight. The analytical fat content of pST treated heavy pigs was 11.2% lower than that of untreated ones at normal weight.

Breed

The experiment with both the breeds Schwerfurter and Pietrain and different halothane reactivity have shown that the effects in genotypes with more or less meatiness are relatively unique with slightly less effects in the lean Pietrains (Table 6).

The decrease in daily fat gain for Schwerfurter was 64.1% compared to controls and 51.6% compared with Pietrains. Effects in H^- were more significant than in H^+. Porcine Somatotropin administration to Pietrain $^+$and H pigs demonstrated no advantage.

Diet

The carcass value is mainly determined by the carcass composition (Table 7). Therefore, the meat percentage is of special interest. The increase to 112% of control in all groups, except group E on the low level of digestive crude protein and lysine, is impressive, but the addition of synthetic lysine adjusts the low level of digestive crude protein. Also, the chemical composition of the carcass is of substantial importance. The analytical fat content of the whole carcass decreased to 66% of the controls with pST administration and was without differences between the high and

middle level groups A and C. Also the addition of synthetic lysine in group F on 13.3g/kg DM showed no further improvement. Therefore, the optimum could be in that range of 160g/kg DM digestive crude protein and 10g/kg DM lysine. Decreased effects are caused by diets containing low levels of protein and lysine as shown in group E. Lysine seems to have a limiting influence. Because in group H with a low digestive crude protein level of 135g/kg DM, compared with group E, the completion with synthetic lysine to 10.5g was able to adjust the effects of the group with 160g/kg DM digestive crude protein and 10g lysine.

Fatty acids

Table 8 indicates the fat characteristics (means) of control groups, the differences to the treated group (4mg pST/d) and the relation to the control. The greatly reduced fat deposition after pST-application was evident through the significant reduction of the intramuscular fat of the m.longissimus dorsi (LD), the decrease of the chemical fat content of backfat and the drastic reduction of the backfat thickness in all sexes.

The decrease in intramuscular fat content (by 30%) in pST treated pigs probably negatively influenced the sensory characteristics of meat in all sexes.

The treated groups of the three sexes reach only 80% of the analytical raw fat content in backfat in relation to control animals. The boars indicate the lowest analytical fat level in the backfat. Furthermore, water is increased in every sex. The fat consistency, measured by means of a special instrument, is considerably lower in the treated groups in comparison to control animals. The general rules are that fat firmness decreases, i.e., softness increases, with decreasing lipid concentration in fatty tissues, thereby increasing water percentage and increasing proportions of unsaturated fatty acids. Studies relating chemical composition to objective measurement of fat firmness have shown that stearic (C18:0) and linoleic acid(C18:2) are good predictors of fat consistency. The essential linoleic acid is increased in the treated groups (Table 8). The saturated fatty acids are reduced after pST-application while the total polyunsaturated fatty acids content is higher.

CONCLUSIONS

In finishing pigs, repartitioning effects increase by increasing the dose from 2mg pST/d to 4mg pST/d. The effects are similar in all sexes, breeds and slaughter weights and slightly increased in pigs with more fat and in pigs fed with a higher protein diet.

pST administration:

- improves the meat attributes by 4.5 to 7.9%;
- decreases the analytical fat percent by 9 to 16% (58% in barrows, 65% in boars and 71% in gilts) compared to controls;
- maintains these relative effects compared with controls up to heavy weights;
- is more effective in breeds with more fat and in H^- populations.

Only slight improvements of pST action were found over a relatively great range of feed composition. To get a high carcass quality, a feed containing 160g/kg DM digestible crude protein and 10g/kg DM lysine has been characterized as optimal. The decrease of carcass fat leads to a poor fat quality. The increased percentage of C18:2 is positive from the perspective of nutritional physiology.

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Table 1. Experimental design: dose/sexes final weights.
Number of animals in groups and treatment periods.

# Animals	Control	2mg pST/d	4,g pST/d	Treatment Period/d
gilts	20	18	20	74
barrows	19	20	18	75
boars	18	20	19	68
heavy barrows	19	18	16	102[+]

[+] The lower dose increased from 2 to 4mg per day on day 42.

Table 2. Experimental design: breeds.
Number of animals, by breed.

	SCHWERFURTER 2-4mg		PIETRAIN 2-4mg	
	Control	pST/d[+]	Control	pST/d[+]
# Animals	18	20	18	16
Hlothan[+]	4	5	7	10
Hlothan[-]	14	15	11	6
Treatment period/d	70	70	67	69

[+] The does increased from 2 to 4mg per day in the middle of the treatment.

Table 3. Experimental design: diets.
By group.

Group	# Animals	Treatment	Dig. Crude Protein g/kg DM	Lysine g/kg DM
A	24	2-4	188	12.1
C	23	2-4	162	10.0
E	24	2-4	129	8.4
F+	11	2-4	159	13.3
H+	12	2-4	135	10.5

Treatment: 121-162 DAY 2mg/d.
85 days: 163-204 DAY 4mg/d
Feed/energy: 15.5MJ ME/kg DM
+ Completed by synthtic lysine

Table 4. Carcass composition: different sexes.

	Control	2mg pST/d	% of control	4mg pST/d	% of control
Backfat thickness (cm)					
gilts	3.2	2.6+	81	2.5+	78
barrows	3.2	2.4+	75	2.1+	66
boars	2.4	2.1+	88	1.9+	79
Loin muscle area (cm^2)					
gilts	39.9	45.8+	115	46.5+	117
barrows	33.6	40.6+	121	40.8+	121
boars	35.2	38.1+	108	42.4+	119
Lean meat (%)					
gilts	46.3	49.9+	108	51.2+	111
barrows	44.2	50.1+	113	52.1+	118
boars	49.2	51.8+	105	53.7+	109
Analytical fat (%)					
gilts	34.0	27.0+	79	24.0+	71
barrows	37.9	25.7+	70	21.8+	58
boars	25.1	20.0+	80	16.3+	65
Analytical protein (%)					
gilts	15.1	16.7+	111	17.2+	114
barrows	13.9	16.8+	121	17.6+	127
boars	16.6	17.9	108	18.7+	113

Table 5. Carcass composition: different final weights.

	Normal Con'l	4mg pST/d	%	Heavy Con'l	4mg pSt/d	%
Backfat thickness, cm	3.2	2.1+	66	3.9	2.7+	69
Muscle area/ mld, cm^2	33.6	40.8+	121	40.5	48.2+	119
Lean meat, %	44.2	52.1+	118	41.1	49.1+	119
Analyt. fat, %	37.9	21.8+	58	43.2	26.7+	62
Analyt. protein, %	13.9	17.6+	127	12.9	16.8+	130

Table 6. Slaughtering performance: different breeds.
Daily gain (grams/day).

	SCHWERFURTER Ha+	Ha-	Total	PIETRAIN Ha+	Ha-	Total
Daily gain (g/d) Protein						
Control	55	51	52	60	69	65
4mg pST/d	63	63	63	66	71	67
% of Control	114.5	123.5	121.3	110.0	102.9	103.1
Daily gain (g/d) Fat						
Control	80	111	103	51	69	62
4mg pST/d	65	67	66	31	37	32
% of Control	81.2	60.4	64.1	60.8	53.6	51.6

Table 7. Carcass composition: diets.

Group CP/L	% of Control A 188/12.1	C 162/10.0	F+ 159/13.3	E 129/8.4	H+ 135/10.5
Backfat cm thickness	119	81	85	89	85
Loin muscle area, cm^2	83	128	125	118	125
Meat, %	112	112	112	107	112
Fat, %	69	70	68	76	70
Analy. fat, %	66	66	6	70	69
Analy. protein, %	120	118	119	115	117

+ Completed by synthetic lysine

Table 8. Fat parameters of several sexes.

	Boars		
	Control	4mg pST/d	%
intramusc. fat of mLD, %	1.1	-0.3	73
analytical fat of backfat, %	50.2	-10.7	82
water content of backfat, %	30.7	8.3+	127
backfat thickness, cm	1.8	-0.5+	69
backfat consistency, N	1.7	-0.5+	71
remission of backfat (520 nm)	66.1	0.83+	61
	Gilts		
	Control	4mg pST/d	%
intramusc. fat of mLD, %	1.2	-0.3	74
analytical fat of backfat, %	72.5	-10.5	86
water content of backfat, %	20.4	8.1+	140
backfat thickness, cm	2.8	-0.9+	68
backfat consistency, N	3.0	-1.4+	53
remission of backfat (520nm)	67.3	-2.7+	96

Table 8 (cont). Fat parameters of several sexes.

	Barrows		
	Control	4mg pST/d	%
intramusc. fat of mLD, %	1.6	-0.5+	67
analytical fat of backfat, %	74.6	-14.1+	81
water content of backfat, %	19.4	10.3	153
backfat thickness, cm	2.8	1.5	48
backfat consistency, N	3.8	-2.4+	37
remission of backfat (520nm)	68.5	-8.9+	94

Table 9. Fatty acid composition of backfat from barrows.

	Begin	End of trail		
		Control	2mg pSt/d	4mg pST/d
C14:0	1.6	1.4	1.3	0.3
C16:0	25.5	26.2	24.9	24.0
C16:1	4.4	2.8	3.3	3.3
C18:0	11.5	14.2	13.0	13.4
C18:1	44.6	45.9	46.3	45.5
C18:2	7.6	6.3	7.6	8.5
PUFA	9.0	7.2	8.6	9.7