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APPLICATION OF TECHNOLOGY FOR MAXIMIZING LEAN GROWTH

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Summary

The swine industry is at a crossroads that either may or may not change the way we produce pork in the future. As we head into the 90's, we are entering a new era in terms of growth promotion and carcass modification,which will produce overnight what would have taken generations to select for. Of the compounds tested, porcine somatotropin (pST) has the most potential to alter the structure of the swine industry. Many fear the application of this technology because of potential increases in pork production displacing and leading to fewer producers. Because pork quality will be improved tremendously (50% reduction in fat and 5 to 25% increase in protein), this will offset the increase in production by increasing demand for lean pork (initial estimates of 4 to 5%). However, it still remains to be seen if adoption of this technology will be economically feasible. I believe that the adoption of pST technology will have a beneficial impact on pork production and, as a result, increase the profit potential by approximately $8.00 to $16.00 per head, whether you are finishing five or five thousand pigs per year. Although many questions still remain to be answered, in this paper I will attempt to put together as complete a picture as possible to determine the economic impact of pST on the swine industry.

(Key Words: Pig, Porcine Somatotropin, Growth and Development, Carcass Composition, Economics.)

Introduction

Based on three years of research investigating the effects of porcine somatotropin on growth and carcass traits of finishing pigs, I believe that we can now begin to piece together some of the missing parts of the pST puzzle and begin to assess some of its potential impact on the swine industry. With the pace of scientific knowledge, many of the assumptions made today may soon be out-dated. Therefore, the assumptions I will make are best estimates of current industry costs and prices, as well as some projections as to what they might be in the future. Furthermore, the values given will not take into account the price of the pST itself.

It is well established that porcine somatotropin (pST) is an effective growth promotant in swine. Long-term pST administration dramatically increases protein accretion and reduces adipose tissue growth. Many experiments have focused upon determining the optimal pST dosage to improve growth performance and carcass leanness in swine. However, little is known about the potential changes in nutrient requirements of pigs treated with pST. Although many factors affect nutrient requirements, lean, rapidly growing pigs probably require higher levels of amino acids than fat, slow growing pigs. Low amino acid levels (diets containing 16% CP or less) may have limited the response (< 10% improvement in growth performance) of pigs to exogenous pST administration in some experiments. However, experiments with higher protein diets (> 18% CP) have observed larger responses (> 15% improvement in growth performance) to pST administration. Although many variables (recombinant or pituitary pST, dosage, pig weight, genotype, nutrient density, etc.) may contribute to the response of pigs to pST, it is my contention that maximizing the potential for increased lean tissue deposition by pigs treated with pST would necessitate high amino acid levels. Therefore, nutrient density of the diet will play an important role in the application of pST technology.

Effects of pST on Pig Performance

Porcine somatotropin is a protein hormone secreted by the anterior pituitary. Through isolation of the gene that produces pST and its incorporation into the DNA of bacteria, large quantities of pST can be produced. Since 1985, several experiments have been conducted to determine the effects pST on growth rate, feed utilization, and carcass composition. Since previous research indicated an interaction between the response to pST administration and nutrient density of the diet, a series of experiments was conducted here at Kansas State University to examine the effects of pST on the lysine and energy requirements of finishing pigs. Results indicated that pigs injected with 4 mg pST/d require approximately 30 to 32 g/d lysine, which corresponds to dietary lysine levels of approximately 1.2% (Table 1). In comparison to control pigs, pST-treated pigs fed 1.2% lysine grew 33% faster and 33% more efficiently with 16% less backfat and 65% less intramuscular lipid content. In subsequent studies, when we increased the potential for lean growth by doubling the dosage of pST and increasing the lysine level to 1.4%, feed efficiency and carcass characteristics continued to improve dramatically (Table 2). In addition, there appear to be no adverse effects on pork quality as indicated by taste panel evaluation. These data should help to dispel the fears that all these effects on growth rate will produce a product with the consistency of shoe leather. In fact, the production of pork with 50% less fat should help to stimulate pork consumption in an ever increasing, "diet" conscious, consumer population.

Consumer Response to pST

Consumer concerns about additives in livestock production are increasing. Although it is not bad to be aware of what we eat, a tiny misconception or some erroneous "misinformation" may cause irrevocable damage. Therefore, we need to stress the importance of safety factors involved with pST: that it is a "natural" protein hormone and is inactivated and broken down by the digestive system or when cooked. In addition, porcine somatotropin is metabolized quickly, and plasma concentrations return to normal approximately 18 to 22 hours following an injection. But most important is that the "P" in pST means that it is only effective in pigs. There would be no effect of pST on humans, even if it were inadvertently injected into a person's bloodstream.

A recent survey from the University of Georgia reported that although approximately 80% of the consumers are concerned about growth promotants in red meat, approximately 42% of consumers feel that pST should be used to produce leaner pork. This survey estimated that only 25% of consumers would purchase more pork because it was leaner, but some estimates place this figure at approximately 55%. On the other hand, about 12.5% of consumers surveyed would only buy pST-free pork. Estimates such as these have led to the speculation that with improvements in "lean" pork production by pST technology, pork consumption will increase by approximately 4%.

Economic Impact of pST Technology

Like so many advances in technology, including even the scoop shovel or skid loader, some things work on some people's operations, but the same technology may fail miserably on another's. Therefore, the adoption of pST technology will be relatively slow and varied. Producers will have the option of marketing pigs at the same market weight they are presently using and taking advantage of selling pigs 14 to 21 days earlier. This would result in greater turn-around in finishing facilities and might lead to expansion of the sow herd. A second possibility is to market at a constant time (average approximately 180 d of age) and take advantage of marketing an extra 40 to 50 lb heavier pig. Although this is an economically attractive situation, and the average market weight is increasing in the swine industry today, the increases in ham and loin weights of 280 lb pST-treated pigs may begin to exceed practical serving sizes considered by the packing industry.

Because of the interaction between nutrient density and performance of pST-treated pigs, it will be necessary to increase diet costs considerably. Based on $4.00/cwt milo, $240/ton soybean meal, $1.75/lb synthetic lysine, and $.30/lb soy oil, a 1.2 % lysine, 5% added fat diet will cost approximately $160.00/ton, whereas a 14% crude protein finishing diet will cost approximately $110.00/ton. Although pST-treated pigs will be approximately 33% more efficient, feeding to a market weight of 275 lb will result in an increase in diet costs. However, for pST-treated pigs marketed at 235 lb, increased diet expenses would be offset by improved feed efficiency, resulting in little change in feed costs (Table 3).

Labor costs will be an important consideration based on the delivery system by which pST will be administered. Ideally, it will be developed into a product that can be administered once or possibly twice during the pig's lifetime. However, at this time, as unpractical as it sounds, we may need to consider daily injections as the delivery system. However, improvements are rapid and, in time, prices should be lowered. Even in a worst-case situation involving daily injections, it is reasonable to expect one person to inject up to 300 hogs per hour. Based on personal experience, I would want at least $8.00/hour to do this, or a total of $1.80/head over 70 d. Presently, long lasting delivery systems for pST are being heavily investigated.

We can hope that the packing plant incentives for lean pork production, which are already in place, will increase in accordance with the improvement in pork quality. From personal observation, I believe a 275-lb pST-treated pig will be leaner than an average finishing pig currently marketed. Combined with superior muscling, this should receive a $2.00/cwt premium. Furthermore, a $3.00/cwt premium could be expected for a 235-lb pST-treated pig with superior muscling and even less backfat. These are very conservative estimates and indicate the need for cooperation between the producer and packer to develop fair and accurate guidelines to assess lean value.

Therefore, based on these assumptions for feed efficiency, length of feeding period, carcass premium, labor, and yardage figures, it will not be unreasonable to expect returns on pST-treated pigs ranging from $8.00 to $16.00/head. However, this does not take into account the actual price of the pST.

Table 1. Effect of pST and Dietary Lysine on Growth Performance and Carcass Characteristics[a]

Item	Control .6% lysine	pST-treated, % lysine .6	.8	1.0	1.2	1.4
Daily gain, lb						
Day 28[bc]	1.87	1.57	1.94	2.56	2.73	2.62
Overall[bc]	1.98	1.65	2.14	2.56	2.65	2.56
Daily feed intake, lb						
Day 28[d]	5.47	4.78	4.87	5.20	5.34	5.14
Overall[d]	6.11	4.98	5.42	5.53	5.45	5.29
Feed conversion (F/G)						
Day 28[bc]	2.91	3.13	2.52	2.04	1.96	1.98
Overall[bc]	3.07	3.03	2.54	2.18	2.07	2.08
Carcass traits						
Adjusted backfat thickness, in.	1.02	.85	.84	.90	.85	.89
Longissimus muscle area, in.^{2}[bc]	4.94	4.87	6.06	6.28	6.56	6.59
Loin weight, lb[bc]	14.97	14.20	15.57	16.21	15.72	15.99
Ham weight, lb[bc]	15.26	15.24	17.11	17.51	17.40	17.24
Longissimus						
Crude protein, %[bc]	20.05	19.51	20.52	21.15	21.97	21.23
Lipid, %[b]	7.19	5.07	5.10	3.40	2.54	2.61

[a]A total of 72 finishing pigs with an avg initial wt of 130 lb and avg final wt of 230 lb. Overall trial duration ranged from 42 to 66 d. Linear and quadratic comparisons correspond to only pST treatments.
[b]Linear effect of lysine ($P<.01$).
[c]Quadratic effect of lysine ($P<.01$).
[d]Quadratic effect of lysine ($P<.10$).

Table 2. Main Effects of pST Dosage and Dietary Lysine on Growth Performance[a]

Item	pST, mg · day^{-1}			Lysine, %			
	0	4	8	.8	1.0	1.2	1.4
Daily gain, lb							
Day 28[bcd]	2.29	2.58	2.54	2.34	2.49	2.65	2.78
Overall[bcd]	2.27	2.62	2.64	2.50	2.55	2.66	2.82
Daily feed intake, lb							
Day 28[bef]	6.68	5.89	5.35	5.89	5.53	5.49	5.56
Overall[bdf]	6.70	6.13	5.62	6.26	5.79	5.66	5.78
Feed conversion, (F/G)							
Day 28[bcdg]	2.94	2.33	2.18	2.58	2.25	2.13	2.07
Overall[bcd]	3.02	2.39	2.23	2.54	2.30	2.25	2.14
Carcass traits							
Adjusted backfat thickness, in.[bd]	1.12	1.00	.91	1.01	.96	.93	.92
Longissimus muscle area, in^2 [fd]	5.29	5.82	6.27	5.86	5.98	6.07	6.26
Loin weight, lb	14.29	14.75	15.20	14.91	14.93	15.00	15.05
Ham wt, lb	16.79	17.39	18.09	17.45	17.81	17.75	17.95
Belly							
Crude protein, %[bcef]	13.61	16.71	17.88	16.40	17.50	17.57	17.72
Lipid, %[bce]	32.51	21.21	15.96	20.61	18.49	18.53	16.69
Sensory evaluation (longissimus)[g]							
Juiciness[g]	6.5	6.1	6.0	6.4	6.2	6.2	5.8
Flavor[g]	7.1	7.2	7.2	7.4	7.1	7.1	7.1
Tenderness[g]	8.4	7.9	7.1	8.3	7.7	7.8	7.8

[a]A total of 144 pigs (carcass data 72 pigs), avg initial wt 126 lb, avg final wt 230 lb, trial duration 31 to 47 d. Observation per treatment: Control = 8; pST = 32; Lysine level = 16.
[b]Linear effect of pST (P<.05).
[c]Quadratic effect of pST (P<.05).
[d]Linear effect of lysine (P<.05).
[e]Linear effect of lysine (P<.10).
[f]Quadratic effect of lysine (P<.10).
[g]Based on a 10-point scale with 0 = extremely dry, no flavor, and extremely tough; 10 = extremely juicy, intense flavor, and extremely tender.

Table 3. **Potential Economic Benefits Obtained from Adoption of pST Technology**

Item	Control	pST-treated	
Initial wt, lb	120	120	120
ADG, lb	1.65	2.20	2.20
F/G	3.50	2.30	2.30
Market wt, lb	235	275	235
Days on feed	70	70	52
Total gain, lb	115	155	115
Feed consumed	403	357	265
Feed costs, $/lb	.055	.080	.080
Total feed costs	22.17	28.56	21.20
Backfat thickness	1.20	1.00	.90
Carcass premium[a]	--	5.50	7.05
Labor[b]	--	1.90	1.40
Yardage[c]	--	--	1.80

[a]Estimate of $2.00/cwt on 275-lb pST-treated hog and $3.00/cwt on 235-lb pST-treated hog.
[b]Based on labor of $8.00/hr and 300 pigs injected/h.
[c]Based on $.10/d.

Table 4. Summary of Economic Impact by Adoption of pST Technology

Item	Control	pST-treated	
Live weight marketed, lb	235	275	235
Feed and labor costs, $	22.17	30.46	22.60
Added carcass value, $[a]	--	24.70	8.85
Total benefit/pig, $[b]	--	16.41	8.42

[a]Assumes $2.00 and $3.00/cwt premium for 275 and 235 lb pST-treated pigs, respectively, and marketing 40 extra lb at $48/cwt for pigs carried to 275 lb. Also includes: yardage savings for pST-treated pigs marketed at 53 d.
[b]This does not include cost of pST.