Profitable Use of Ractopamine in Hog Production – Economic Evaluation Using a Pig Growth Model

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Introduction

The inclusion of ractopamine (RAC) in late finishing swine diets can be potentially profitable for hog producers by improving feed efficiency, growth rate and carcass lean percentage. The introduction of RAC may fundamentally change the profitability and management strategies of the pork industry. Recently, a pig growth model has been developed, that incorporates the impact of RAC on pig compositional growth and nutritional requirements (Schinckel et al., 2001). The objective of this research was to utilize the compositional pig growth model to evaluate the economically optimal use of RAC with different marketing systems.

Model Assumptions

Two categories of assumptions are core to the model: those affecting the biological potential and realized growth of the pigs, and those affecting the economic returns. The model utilizes farm-specific protein accretion and lipid accretion curves. Two growth environments - high health (SEW) and low to average health (continuous flow management, CF; Schinckel et al., 2001) - were considered with pigs of the same genetic population.

The model was designed as a farm level model, where prices of feed, feeder pigs, and RAC are taken as given and are transparent to the producer. That is, in economic terms, both input and output markets were assumed to be perfectly competitive. The price levels used in this model are listed in Table 1. The price of RAC was assumed to be $2.25 per gram.

Pork producers were assumed to have the goal of maximizing return per pig space per day. Maximizing return per pig space per day is the appropriate objective variable because farmers typically have feeder pigs ready to replace the finishers and fill up the facility.

Four marketing systems were modeled, where hog producers receive different relative values for dissected lean and fat tissue. The four payment schemes were: (1) producers are paid for carcass weight, thus lean and fat are valued equally, with discounts on underweight and overweight carcasses (Table 2); (2) producers are paid for carcass weight with a discount on fat and a premium on lean based on a lean percentage estimated from optical probe muscle and fat depth measurements (Table 3); (3) producers are paid based on a lean to fat price ratio of 2:1 ($0.95/lb for lean and $0.475/lb for fat tissue); and (4) producers are paid based on a lean to fat price ratio of 4:1 ($1.08/lb for lean and $0.27/lb for fat tissue).

Payment schemes 1 and 2 are typical of those currently used by pork processors. With payment scheme 3, packers and retailers share with pork producers the downstream benefits associated with RAC. In payment scheme 4, producers were assumed to capture the full benefit from RAC.

Three dietary concentrations of RAC were considered: 5 ppm (4.5 g/ton), 10 ppm (9 g/ton), and 20 ppm (18 g/ton), in comparison to 0 ppm for control pigs. The starting weight on RAC is a variable that is restricted to being between 154 lb and 240 lb. The simulated growth starts at 104

days of age (141 lb for gilts and 150 lb for barrows). Marketing weight was optimized with an upper bound at 240 lb.

Production costs included the price of the 50 lb feeder pig, feed expenditures, transportation cost and a variable cost covering daily expenditures of the operation. Fixed costs such as facilities were not included. The cost of a 154 lb finishing pig was computed from the model by summing the feeder pig price, feed cost and daily variable costs over the 50 lb to 154 lb growth period. The diets included corn and soybean meal, 0.15% lysine HCL and a vitamin-mineral premix. Dietary lysine percentage is used as a measure of meeting all essential amino acid concentrations. Dietary lysine concentrations were identified that optimized daily returns above feed costs. Besides the feed cost, two categories of production costs were included in the model: a nine cent per day variable cost for labor, utility, miscellaneous, veterinary and medicine, and a two dollar per head transportation cost.

Two alternative phase feeding scenarios were simulated: a two-diet option, where the pigs were fed one diet before and one diet during RAC supplementation; and a three-diet option, where pigs were given one diet before RAC and two diets with RAC. It is assumed that the additional diet does not incur any additional management cost. However, a minimum ten-day feeding period was set for each diet except for the last diet.

Economic Analysis

As expected, feeding diets in three phases was more profitable than two phases. Net returns of SEW pigs were higher than CF pigs. Producers with superior health management and higher growth rates will continue to have higher returns after RAC adoption. Returns of RAC pigs over control pigs were higher for SEW pigs than for CF pigs under each payment scheme. This implies that better health management will obtain greater benefits from RAC.

There was an optimal RAC concentration which gave the highest return per pig space per day for each farm, sex and payment scheme. For CF pigs, 5 ppm was the optimal RAC concentration under payment schemes 1, 2 and 3, while 10 ppm was the optimal RAC concentration for payment scheme 4. For SEW pigs, 5 ppm was the optimal RAC concentration for payment scheme 1 and 10 ppm was optimal for payment schemes 2 and 4. With payment scheme 3, returns from 5 ppm and 10 ppm were essentially equal.

The maximum returns for gilts and barrows were affected by the payment scheme (Table 4). For RAC-fed pigs, the returns above the control pigs ranged from 0.6 to 6.2 cents per pig space under four payment schemes. The annual RAC benefit per pig space ranged from $2.28 to $21.44 based on the average of the two farms.

Analysis on RAC Management

Generally, higher lean value and lower concentration of RAC resulted in an earlier initial optimal RAC supplementation weight (Tables 5 and 6). The RAC feeding period was sensitive to the relative value of lean to fat tissue, RAC price, and its concentration in the diet. Under the price levels specified in the model, the starting weight for payment schemes 3 and 4 ranged from 155 to 181 lb.

The starting age for gilts and barrows are close with these two dietary concentrations of RAC. In some cases, with payment system 2, the optimal length of RAC feeding is longer for barrows than gilts. This is due to the fact that control barrows have 50.8% lean predicted by the optical probe, and feeding 10 ppm RAC for 29 days or 20 ppm RAC for 21 days increased

predicted percent lean into the next higher predicted percent lean category (53.0%). With three phases, pigs start RAC at a lighter weight and have a longer duration than two-diet regime given the same payment system. Two dietary lysine concentrations were fed to pigs while on RAC 5 or 10 ppm diets to reduce cost and allowing each dietary protein level to more precisely meet the pigs' nutritional requirements.

Summary

Under present economic conditions, the feeding of RAC is profitable to pork producers. The highest return from the use of RAC will accrue to producers with a better growth environment and those using a 3-diet, phase-feeding program after 154 lbs live weight.

Part of the additional profit due to the use of RAC comes from faster growth rate and less days on feed. As the payment for leanness increases, the return to RAC use also increases. Greater payment for lean versus fat tissue results in higher optimal RAC concentrations being fed for longer durations, given the same economic conditions.

References

Schinckel, A. P., B. T. Richert, and M. E. Einstein 2001. Evaluation of an updated model to describe the compositional growth of pigs fed Paylean™. Purdue Swine Research Reports.

Table 1: Price and cost levels in the model

Commodity	Feeder pig, 50 lbs	Hog carcass base price	Corn	SBM	RAC	Pre-mix & lysine & mixing cost
Unit	$/head	$/cwt	¢/lb	¢/lb	$/gram	¢/lb of diet
Price	50	60	3.5	9.0	2.25	1.15~1.3*

*1.3 cents for weight range 55-90 lb, 1.2¢ for 100-200 lb, and 1.15¢ for 200 lb and above.

Table 2. Payment scheme 1: Carcass discount grid.

Estimated live weight, lb	Hot carcass weight range, lb	Discount, carcass cwt.
211-220	156-163	($4.05)
221-229	164-169	($1.35)
230-240	170-177	Base Price
241-250	178-185	Base Price
251-260	186-192	Base Price
261-270	193-200	Base Price
271-280	201-207	Base Price
281-290	208-214	($0.68)
291-300	215-222	($2.03)
301-310	223-229	($3.38)
311-320	230-237	($6.08)
Over 320	Over 237	($8.78)

Table 3. Payment scheme 2: Percentage lean schedule

Lean percentage[a]	Lean premium or (discount) per carcass cwt.
59% - Higher	$2.00
57-58.9%	$2.90
55-56.9%	$2.50
53-54.9%	$1.25
51-52.9%	Base Price
49-50.9%	($1.25)
47-48.9%	($2.50)
45-46.9%	($5.00)
43-44.9%	($7.50)
Less than 43%	($10.00)

[a]Percent Lean is calculated as: 58.86-0.61 × fat depth (mm) + 0.12 × muscle depth (mm). Fat and muscle depth are measured at 3rd and 4th rib from the last rib by an optical probe.

Table 4. Profitability of ractopamine (RAC) under optimal RAC and nutrition levels[a]

	SEW farm, ¢/pig space/day		CF farm, ¢/pig space/day		Average profit, $/year	Average profit, $/pig
Payment scheme	Return	Over control	Return	Over control	Over control	Over control
1	25.30	0.65	18.23	0.60	2.28	0.76
2	27.95	3.50	22.34	2.23	10.45	3.48
3	28.55	4.25	21.49	3.53	14.20	4.73
4	29.80	6.20	24.39	5.55	21.44	7.15

[a]Based on 3-diet option and average of gilts and barrow.

Table 5. Ractopamine (RAC) start time and duration for SEW pigs (2 diets)

RAC level, ppm	5		10		20	
Sex	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow
Payment 1						
Start age, d	126	126	137	136	138	137
Start wt., lb	194.2	202.7	219.1	226.3	221.3	228.8
Days on RAC	20	16	10	7	9	6
Payment 2						
Start age, d	126	126	129	112	138	120
Start wt., lb	194.2	208.4	201.8	169.7	219.8	188.7
Days on RAC	20	16	17	29	9	21
Payment 3						
Start age, d	109	107	115	112	119	117
Start wt., lb	155.6	157.8	169.3	169.6	178.4	181.4
Days on RAC	37	34	30	29	26	24
Payment 4						
Start age, d	109	106	110	106	113	110
Start wt., lb	155.6	155.5	158.0	155.5	164.8	164.9
Days on RAC	36	35	35	35	32	31

Table 6. Ractopamine (RAC) start time and duration for SEW pigs (3 diets)

RAC level, ppm	5		10		20	
Sex	**Gilt**	**Barrow**	**Gilt**	**Barrow**	**Gilt**	**Barrow**
Payment 1						
Start age, d	126	125	129	128	NA	NA
Start wt., lb	194.1	200.2	189.8	207.6	NA	NA
Days on RAC	20	17	17	14	NA	NA
Payment 2						
Start age, d	126	106	109	113	117	120
Start wt., lb	194.1	155.6	155.7	172.1	173.8	188.7
Days on RAC	20	32	32	27	27	21
Payment 3						
Start age, d	109	106	109	106	116	112
Start wt., lb	155.7	155.6	155.7	155.6	171.3	169.3
Days on RAC	36	35	36	35	29	29
Payment 4						
Start age, d	109	106	109	106	109	106
Start wt., lb	155.7	155.6	155.7	155.6	155.7	155.6
Days on RAC	36	35	36	35	36	35