Effect of Increased Average Daily Gain after Removal of Pigs on the Optimal Management of Ractopamine

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Introduction

The economically optimal use of ractopamine (RAC, Paylean) using a stochastic swine growth model has been recently reported (Li et al., 2003). The model derives the optimal dietary lysine, RAC concentration and duration of use, and marketing decisions for late finishing pigs. The model develops a live weight body composition and feed intake curves for each individual pig. The model reproduces the total variation for body weight, carcass composition, and carcass weight at each age.

Recent research indicates that if pigs are provided only seven square feet per pig, the removal of the fastest gaining pigs increases the growth rate of the remaining pigs in comparison to leaving the pens intact (Bates and Newcomb, 1997; DeDecker, 2002). This increased growth rate may have an impact on the optimal use of Paylean.

Materials and Methods

The model used assumed a 1000 head grow-finish facility (Li et al., 2003). The returns were calculated using 10-year average prices.

The optimal management was derived for four payment schemes: (1) carcass payment with discounts on underweight and overweight carcasses; (2) carcass merit payment system adopted from Hormel's Carcass Lean Value Program; (3) producers are paid based on a lean to fat price ratio of 2:1, with discounts on underweight and overweight carcasses; and (4) producers are paid based on a lean to fat price ratio of 4:1, with discounts on underweight and overweight carcasses. The carcass weight discount grid for payment schemes 1, 3, and 4 was also adopted from Hormel's Carcass Lean Value Program, which was the standardized grid with backfat ranging between 0.51-0.90 inches. Payment schemes 1 and 2 reflected the marketing approaches by independent producers. Payment scheme 3 simulated the producers under limited coordination with packers, while payment scheme 4 allowed producers to capture the full benefit from lean pork, thus these would be vertically integrated producers.

The model optimized the return for a feeder pig (50 d of age) to market. The optimization of dietary lysine and Paylean concentration management focused on the late finishing pigs starting at age 101 d (with an average weight of 145 lbs for SEW gilts). Pigs were assumed to be fed with 3 diets from 101 d to market, with switching days between diets optimized by the model.

It was assumed that pigs were marketed by semi-truck with a capacity of 170 head. Thus, the 1000 pigs were to be marketed on six truckloads. Any number of truckloads can be marketed on the same day. Therefore, the resulting batches for marketing the 1000 animals can be less than or equal to 6. The pigs must be marketed as long as the number of pigs heavier than the sort weight (a variable to be optimized in the model) exceeds one truckload, except for the last batch.

The variables optimized in the model were dietary lysine concentration for three diets, the optimal starting days for diets 2 and 3, six optimal marketing days for each truckload, and an optimal sort weight. Since the RAC starting time was the same as diet 2, the RAC onset day was

already included in the optimization. Paylean feeding duration equaled the sum of the feeding durations for diets 2 and 3; therefore, the RAC feeding duration was also optimized.

The data from DeDecker et al. (2002) was used to predict the increased average daily gain and feed intake expected as a result of removing the heaviest pigs and increasing space per pig. The proportional increase in average daily gain was predicted as .32 (($ft^2/7$) – 1). The maximal response, a 13.7% increase in ADG was achieved when pigs had 10 ft^2/pig or greater. The research data indicated no changes in carcass composition, which indicates similar percentage increases in both protein (lean) and lipid (fat tissue) accretion rates. The model predicted a 6.55% increase in both protein and lipid accretion after removal of the first semi-load (170 head) and 13.7% increase after removal of the second semi-load.

The economic impact of increasing growth rate as a result of removing the heaviest pigs may increase when the marketing age is fixed (the barn must be emptied for the next group of pigs) and the pigs are slower growing than normal. In this tight scheduling situation, faster growth of the remaining pigs in a pen will reduce the number of pigs discounted for having too light of a carcass weight. This situation was modeled by fixing the age of last marketing to 153 and 149 days of age for marketing scheme 3. The optimal last marketing date was 157 days.

Results

The optimal nutrition and marketing strategies were found when the increased space effect was (Table 1) and was not (Table 2) incorporated into the model. The increased pen space effect had little impact on the optimal Paylean use strategy. The optimal sort weights, days at marketing, and Paylean management with the space effect were nearly identical to those when the space effect was not included. The increased average daily gain resulted in slightly higher returns with market systems based only on carcass weight. The space effect resulted in 4 marketing days (152, 157, 161 and 162 d) versus 3 days without the space effect (152, 158, and 160 d).

The optimal lysine and Paylean concentrations for the two models were identical for payment systems 1, 2, and 3. For payment system 4, payment for true carcass value, the model with space effect, resulted in a slightly higher optimal Ractopamine concentration (9.5 versus 8.6 g/ton). This resulted in slightly higher lysine concentrations (1.04 and .87% lysine vs. 1.01 and .84% lysine) for the two diets phase fed with RAC. The optimal duration of feeding Paylean was either within one day or was the same day for the two models.

The optimal marketing and Paylean use management strategies were developed when the marketing age was fixed at either 153, 149 or 145 days of age (Table 3). When the last marketing age was fixed at 153 days, the inclusion of the pen space effect decreased the age at marketing the first semi-load by only two days, reduced the optimal sort weight by 7 lbs, and reduced the optimal average days on Paylean by approximately two days. At a fixed last marketing age of 149 days , the inclusion of the pen effect resulted in two marketing ages (145 and 149 days) instead of one (149 d) and reduced the optimal average duration of Paylean feeding by less than one day.

Discussion

Inclusion of the pen space growth effect was expected to slightly decrease the optimal age and weight of the first two semi-loads of market pigs. It was possible that this projected increased growth rate of the remaining pigs would encourage earlier marketing of the heaviest pigs. This was not the case, as the initial ages and weights of marketing remained essentially the same. The value of the increased average daily gain produced by the remaining lightest pigs was

expected to be greater when the marketing age was fixed at 153 or 149 days. In these cases the optimal age at marketing the first group was only reduced 2 and 4 days. This is likely due to the fact that marketing too early the fastest growing pigs, reduces daily returns by reducing the number of pigs in the facility.

Also, marketing too early the fastest growing pigs would have decreased the number of days the pigs received Paylean below the optimal duration for an individual pig which is approximately 24, 25, 26 and 28 d for the four marketing systems. The net result is that the optimal marketing strategy and Paylean use strategies are affected in minimal amounts by a pen space effect.

In this example, the research data from two studies were used to model the expected increase in average daily gain and feed intake as a result of removing the heaviest pigs in a pen. In the summer months when heat stress can occur, the effect of increasing pen space might become greater. The need to empty barns to make room for nursery pigs is most common during the summer months.

Applications

Research has indicated that the remaining pigs in a pen grow faster when the heaviest pigs are removed. The modeling of this effect did not substantially affect optimal marketing or Paylean strategies. The optimal concentration and duration of Paylean use was affected by the marketing system and payment for lean.

References

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Table 1. Predicted optimal return and management for SEW gilts with ractopamine (RAC; 1000 head/barn) when a pen space effect is included for removing heavy weight pigs

Payment system	Scheme 1	Scheme 2	Scheme 3	Scheme 4
Return, $ barn, day	249.05	283.34	316.11	348.86
RAC, g/ton	4.5	5.0	5.9	9.5
% lysine in diet 1	0.77	0.82	0.80	0.82
% lysine in diet 2	0.91	0.95	0.94	1.04
% lysine in diet 3	0.78	0.82	0.80	0.87
RAC and Diet 2 start age	135	130	129	125
Diet 3 start age	146	144	145	140
Marketing age for 1st batch, d	152	152	152	148
Marketing age for 2nd batch, d	157	157	157	153
Marketing age for 3rd batch, d	161	157	157	155
Marketing age for 4th batch, d	162	N/A	N/A	N/A
Batch 1, number pigs	170	170	170	170
Batch 2 ,number pigs	170	170	170	170
Batch 3, number of pigs	170	660	660	660
Batch 4, number of pigs	490	N/A	N/A	N/A
Sort weight, lb	271	271	271	265
Days on RAC (last batch)	27	27	28	30

Table 2. Predicted optimal return and management for SEW gilts with ractopamine (RAC; 1000 head/barn) without a pen space effect

Payment system	Scheme 1	Scheme 2	Scheme 3	Scheme 4
Return, $ barn, day	245.60	281.89	314.96	346.65
RAC, g/ton	4.5	5.0	5.9	8.6
% lysine in diet 1	0.77	0.83	0.79	0.82
% lysine in diet 2	0.91	0.97	0.95	1.01
% lysine in diet 3	0.79	0.81	0.79	0.83
Diet 2 start age	134	129	128	125
Diet 3 start age	146	144	144	141
Marketing age for 1st batch, d	152	152	152	149
Marketing age for 2nd batch, d	158	157	157	155
Marketing age for 3rd batch, d	160	N/A	N/A	N/A
Sort weight, lb	271	271	271	269
Days on RAC (last batch)	26	28	29	30

Table 3. Evaluation of the pen space growth effect on two tight fixed final marketing schedules for marketing system 3 which has an optimal marketing age of 157 days

Payment scheme 3	Tight schedule with space effect		Tight schedule without space effect	
Fixed barn empty day:	153	149	153	149
Return, $/barn, day	314.67	302.48	311.76	301.51
Marketing day 1	147	145	149	149
Marketing day 2	152	149	153	149
Marketing day 3	153	N/A	N/A	N/A
Batch 1	170	170	170	170
Batch 2	170	830	830	830
Batch 3	660	N/A	N/A	N/A
Sort weight, lbs	262	258	269	265
% lysine in diet 1	0.81	0.82	0.82	0.83
% lysine in diet 2	0.98	1.02	1.00	1.02
% lysine in diet 3	0.82	0.84	0.85	0.84
RAC and diet 2 start day	125	121	125	121
Diet 3 start day	141	137	139	138
RAC, g/ton	5.9	5.9	5.9	5.9
Total days on RAC	28	28	28	28
Average days on RAC	26.81	27.32	28.72	28