

Economic Evaluation of Ractopamine Step-up Programs Using a Biological Growth Model

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Introduction

Recently, three trials have been conducted to compare the response of ractopamine (RAC, Paylean[®]) fed at increasing dietary concentrations to feeding a similar constant level throughout late finishing. These trials indicated that the magnitude and duration of the RAC response could be increased by using a step-up program, increasing the RAC concentration during the late finishing period. The objective of this research was to evaluate the economic returns of using a step-up RAC program in which the dietary concentration of RAC is increased over time in comparison to feeding a constant RAC concentration.

Materials and Methods

A biological growth model was used that incorporated the RAC response for both step-up and constant level RAC feeding programs (Schinckel et al., 2001; Schinckel et al., 2002). The model used the results of three recent RAC step-up trials - two conducted at Purdue University, and one conducted at North Carolina State University - to modify the pig growth equations. Increasing the dietary concentration of RAC results in a greater RAC response in improving ADG and feed efficiency; this was primarily accounted for in the model by increasing the daily protein accretion for Step-up RAC fed pigs above the constant RAC level fed pigs (Schinckel et al., 2002).

The profitability of a RAC step-up program was evaluated under the current RAC price and historical average prices for pigs, feed and production costs. The price levels used were the average annual prices from 1991 to 2000 (Table 1). Feeder pig prices, transportation costs and daily variable costs, which include utilities, veterinary and medical expenses, were obtained from the statistics of the Cooperative Extension Service of Iowa State University. Profitability was evaluated on the basis of average contribution margin per pig space per day. Thus the model implicitly assumes that the hog production operation is a continuous process, and there are always replacement feeder pigs available.

Two payment schemes were used to estimate the contribution margin: one set the lean to fat price ratio at 4:1, which is close to true carcass cut-out value (Whipker and Akridge, 1990), and the other set the lean to fat price ratio to 2:1, approximating carcass merit pricing systems commonly used in pork processing plants today. For both payment schemes, the actual lean and fat prices were calculated so that the total payment for a control pig weighing 250 lbs was approximately the same as the value paid by the base price in Table 1. The actual lean prices employed in the two payment schemes were \$1.061/lb and \$0.925/lb, respectively.

The model focused on the growth of late finishing hogs starting from 150 lb. Two durations of RAC feeding were evaluated: 4 weeks and 5 weeks. The 4-week RAC supplementation began at 172 lb live weight. The five week RAC supplementation began at 160 lbs live weight. Three diets were fed: one before RAC supplementation and two with RAC. Therefore, in step-up cases, the second diet was fed for two weeks or 17 d with 4.5 g/ton RAC, and the third diet was fed with the higher dosage of RAC for another two weeks or 18 d, for the 4 and 5-week periods,



respectively. If the RAC level was constant, then the switching day between second and third diets was optimized, with the total period for the two diets being fixed at 4 or 5 weeks. For control pigs, the second diets were restricted to begin at 172 lb and 160 lb for a 4-week and 5-week growth period, respectively, so they were consistent and comparable with RAC-fed pigs.

Four-week Ractopamine Feeding Program

With a 4:1 ratio of lean value to fat value, in the 4-week trial, RAC resulted in increased net returns from \$5.36 to \$7.53 per pig. The 4.5 to 9.0 g/ton step up program had the greatest returns over the controls, followed by the 4.5 to 6.75 g/ton step-up, and 9.0 and 4.5 g/ton constant feeding programs (Table 2). The optimal lysine levels in the first and second diets of step-up programs were the same as those of 4.5 g/ton constant concentration, and their difference lies in the lysine level of the third diet. The optimal lysine levels of the third diet in both step-up programs were higher than for either the 4.5 g/ton or the 9 g/ton constant RAC diets.

With a 2:1 lean:fat value ratio, the 4.5 to 9 g/ton step-up program produced the highest average daily return, while the constant levels of 4.5 g/ton and 9 g/ton resulted in almost the same levels of return (Table 3). On average, step-up programs had a \$0.94 per pig advantage over the constant levels of feeding RAC and had a \$3.15 per pig advantage over the control pigs. The optimal lysine levels generally are slightly lower for the 2:1 lean to fat price ratio than those under the 4:1 lean to fat price ratio.

Five-week Ractopamine Feeding Program

With a 4:1 ratio of the lean value to fat value, five weeks of RAC resulted in increased net returns from \$5.74 to \$7.78 per pig. The 4.5 to 9.0 g/ton step-up program had the greatest returns over the controls, followed by the 4.5 to 6.75 g/ton step-up and 9.0 and 4.5 g/ton constant programs (Table 4). The best step-up program (4.5 to 9.0 g/ton) had a \$1.26 per pig advantage over the 9 g/ton constant program. For the five-week program, the optimal lysine concentrations for diet two, the first diet on RAC, were slightly greater than those for the four-week programs, as the pigs start diet two at lighter weights. The optimal lysine concentrations are slightly lower for diet three for the 5-week program versus the 4-week program, as the RAC response was predicted to be smaller as the duration of RAC increased.

With a 2:1 lean to fat value ratio, the 4.5 to 9.0 g/ton and 4.5 to 6.75 g/ton step-up 5-week programs resulted in similar net returns on either a per pig or per pig per day basis (Table 5). The 9 g/ton constant level had an advantage over the 4.5 g/ton constant level. Overall, the step-up programs resulted in a \$0.84 per pig advantage over the 9 g/ton constant program. The pigs fed the step-up programs for 5 weeks had a greater return per pig than pigs on the 4-week step-up programs.

Implications and Summary

The step-up programs increase the duration and magnitude of the RAC response. Dietary lysine levels must be increased to realize the full benefit of ractopamine. Optimal lysine levels are higher when ractopamine concentrations are increased during the feeding period. Initial economic evaluations indicate there are greater returns for step-up programs than for constant programs. In this evaluation process, the diet durations are fixed rather than optimized, and hence may underestimate the profitability potential of RAC step-up programs.



Reference

- 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. pp. 26-34.
- Schinckel, A. P., N. Li, B. T. Richert, M. E. Einstein, P. Preckel, and T. See. 2002. Development of a model to predict the growth of pigs when increasing dietary levels of Paylean® are fed. Purdue Swine Research Reports.
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Table 1. Ten-year average price levels used in the model simulation

	Corn, \$/bushel	SBM, \$/ton	Feeder pig, \$/head	Live hog, \$/cwt	RAC, \$/gram	Transportation, \$/pig	Vet, med & misc, \$/day/pig
Average	2.32	177.45	42	43	2.25	2	0.09

Table 2. Return and nutrition levels under constant and step-up RAC levels when the lean and fat price ratio was 4:1 with a four week feeding period

RAC level	Control pigs		4.5 g/ton for 4 weeks		9 g/ton for 4 weeks		4.5 to 9 g/ton Step-up		4.5 to 6.75 g/ton Step-up	
	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow
Sex										
Diet 1 lysine, %	0.80	0.75	0.80	0.75	0.80	0.75	0.80	0.75	0.80	0.75
Diet 2 lysine, %	0.71	0.68	0.96	0.91	1.01	0.96	0.96	0.91	0.96	0.91
Diet 3 lysine, %	0.63	0.60	0.78	0.73	0.81	0.76	0.96	0.90	0.92	0.86
Market age	143	140	143	140	143	140	143	140	143	140
Market wt., lb	233.0	236.1	240.2	242.7	240.8	243.1	242.7	244.9	242.2	244.5
Hot carcass wt., lb	174.5	175.4	181.9	182.3	183.1	183.3	184.4	184.5	183.8	184.0
Revenue, \$/pig	104.72	101.54	111.93	108.37	113.26	109.67	114.33	110.65	113.71	110.06
Cost, \$/pig	78.16	77.48	79.65	78.97	80.57	79.93	80.27	79.60	80.03	79.36
Return, \$/pig	26.56	24.06	32.28	29.40	32.70	29.74	34.06	31.05	33.68	30.70
Daily return, \$/pig space/day	0.286	0.267	0.347	0.327	0.352	0.330	0.366	0.345	0.362	0.341



Table 3. Return and nutrition levels under constant and step-up RAC levels when the lean and fat price ratio was 2:1 with a four-week feeding period

RAC level	Control pigs		4.5 g/ton for 4 weeks		9 g/ton for 4 weeks		4.5 to 9 g/ton Step-up		4.5 to 6.75 g/ton Step-up	
	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow
Diet 1 lysine, %	0.79	0.74	0.79	0.74	0.79	0.74	0.79	0.74	0.79	0.74
Diet 2 lysine, %	0.71	0.67	0.95	0.90	1.00	0.95	0.95	0.90	0.95	0.90
Diet 3 lysine, %	0.63	0.59	0.76	0.72	0.80	0.75	0.94	0.89	0.90	0.85
Market age	143	140	143	140	143	140	143	140	143	140
Market wt., lb	233.0	236.1	240.2	242.7	240.7	243.1	242.6	244.9	242.2	244.5
Hot carcass wt., lb	174.5	175.3	181.9	182.2	183.0	183.2	184.3	184.5	183.7	184.0
Revenue, \$/pig	103.26	101.75	109.14	107.44	110.24	108.54	110.92	109.14	110.47	108.71
Cost, \$/pig	78.14	77.44	79.58	78.93	80.52	79.89	80.21	79.56	79.97	79.32
Return, \$/pig	25.12	24.31	29.56	28.51	29.72	28.65	30.71	29.58	30.50	29.39
Daily return, \$/pig space/day	0.270	0.270	0.318	0.317	0.320	0.318	0.330	0.329	0.328	0.327

Table 4. Return and optimal lysine levels under constant and step-up RAC levels when the lean and fat price ratio was 4:1 with a five week feeding period

RAC level	Control pigs		4.5 g/ton for 5 weeks		9 g/ton for 5 weeks		4.5 to 9 g/ton Step-up		4.5 to 6.75 g/ton Step-up	
	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow
Diet 1 lysine, %	0.81	0.76	0.81	0.76	0.81	0.76	0.81	0.76	0.81	0.76
Diet 2 lysine, %	0.74	0.70	1.0	0.95	1.05	1.00	1.00	0.95	1.00	0.95
Diet 3 lysine, %	0.63	0.60	0.76	0.71	0.79	0.76	0.91	0.86	0.87	0.82
Market age	145	142	145	142	145	142	145	142	145	142
Market wt., lb	237.5	240.36	244.9	247.5	245.5	247.7	247.0	249.4	246.6	249.1
Hot carcass wt., lb	178.2	179.2	189.1	186.6	187.2	187.5	188.3	188.6	187.8	188.2
Revenue, \$/pig	106.50	103.29	114.44	110.83	115.89	112.26	116.78	113.08	116.13	112.45
Cost, \$/pig	79.14	78.49	80.92	80.28	82.03	81.46	81.65	81.05	81.36	80.74
Return, \$/pig	27.36	24.81	33.52	30.55	33.86	30.80	35.14	32.03	34.77	31.71
Daily return, \$/pig space/day	0.288	0.270	0.353	0.332	0.356	0.335	0.370	0.348	0.366	0.345



Table 5. Return and optimal lysine levels under constant and step-up RAC levels when the lean and fat price ratio was 2:1 with a five week feeding period

RAC level	Control pigs		4.5 g/ton for 5 weeks		9 g/ton for 5 weeks		4.5 to 9 g/ton Step-up		4.5 to 6.75 g/ton Step-up	
	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow	Gilt	Barrow
Diet 1 lysine, %	0.81	0.76	0.80	0.76	0.80	0.76	0.80	0.76	0.80	0.76
Diet 2 lysine, %	0.73	0.69	0.96	0.93	1.03	0.98	0.98	0.93	0.98	0.93
Diet 3 lysine, %	0.62	0.59	0.73	0.70	0.78	0.73	0.89	0.84	0.85	0.80
Market age	145	142	145	142	145	142	145	142	145	142
Market wt., lb	237.4	240.7	244.7	247.5	245.25	247.6	247.0	249.3	246.6	249.0
Hot carcass wt., lb	178.1	179.2	185.9	186.5	187.1	187.5	188.2	188.5	187.7	188.1
Revenue, \$/pig	105.12	103.68	108.04	109.93	112.77	111.10	113.30	111.56	112.84	111.12
Cost, \$/pig	79.10	78.44	80.77	80.22	81.96	81.36	81.56	80.96	81.27	80.66
Return, \$/pig	27.36	24.81	33.52	30.55	33.86	30.80	35.14	32.03	34.77	31.71
Daily Return, \$/pig space/day	0.274	0.274	0.287	0.323	0.324	0.323	0.334	0.333	0.332	0.331

