

Effect of Paylean on Pig Performance and Carcass and Pork Quality

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Ractopamine hydrochloride (RAC) has recently been registered for use in Canada under the brand name Paylean™. Initially, at least, the product is being recommended for use at a level that will supply 5 mg RAC per kg of feed for the last 28 days prior to marketing. Much of the earlier research on this product was undertaken at higher levels of inclusion, so information on the response of pigs to RAC at 5 mg/kg is less abundant. There is also limited information available on the impact of Paylean on the eating quality of pork, and the results available are equivocal. Consequently, an evaluation of the use of Paylean by the Canadian pig industry must consider the impact on growth performance, carcass traits, eating quality and economics. The objective of our study was to evaluate the effectiveness of 5 mg RAC per kg, fed for an average of 28 days, on growth performance, carcass characteristics, pork quality and economics

The experiment was conducted at PSC Elstow Research Farm, a 600-sow single-site commercial farrow-to-finish research facility. The experiment consisted of two dietary treatments: a control finishing diet or a similar diet supplemented with 0.025% Paylean® equivalent to 5 mg RAC/kg. The control diet was typical of that used by the commercial pig industry for pigs fed from 85 kg to market (Table 1). Based on previous research on Paylean, the treatment diet was formulated to contain 1.00% total lysine compared to 0.75% in the control to support the expected increase in lean gain. The minimum ratio of other essential amino acids to lysine was the same in both diets. The level of vitamin and trace mineral premix was increased by 12% and both calcium and total phosphorus were increased by 0.05 percentage points, to ensure that nutrient supply would not impair the pig's ability to respond to Paylean.

Pigs were marketed when they reached a minimum live weight of 116 kg or after the pigs were on test for 6 weeks, whichever occurred first. Pigs not reaching the minimum marketing weight at the end of the 6-week period were considered to be "tail-enders." On d 28 of the experiment, the two pigs within each pen whose bodyweight was closest to that pen's mean were selected for more intensive carcass and meat evaluation, as described below. The experimental started when the average initial weight of the pigs was 86 kg. On the day prior to shipping, pigs that weighed a minimum of 116 kg were identified and tattooed with a slap tattoo identifying the pen from which they came. The room was completely emptied on week 14 of the growout period, or on week 6 of the experiment, as per normal barn operation.

In each of two weeks, a total of 8 animals of each gender and each dietary treatment (ie. 2 pigs from each pen), for a total of 32 animals per week, were selected for detailed meat quality analysis. This provided 16 animals within each treatment within each gender, for an overall total of 64 animals. As the carcasses left the chiller in the packing plant, the carcasses were pulled off onto separate rails in the cooler and the 32 sides from each week were tagged for further testing.

The analysis of the experimental diets confirmed that the Paylean was added at the correct level to the treatment diet, and was absent from the control diet. Lysine was elevated as expected, although both the control and treatment diets contained slightly more lysine than formulated (0.84% and 1.09% compared to 0.75% and 1.00%, respectively).

The Paylean pigs were on test an average of 26.5 days, which was very close to the average of 28 days anticipated at the start of the experiment (Table 2). Average daily gain was 13% higher in the Paylean pigs as compared to the controls ($P < 0.001$); both genders responded in a similar manner ($P < 0.001$). Interestingly, there was no effect of treatment on feed intake ($P > 0.10$), so feed conversion also increased by 13% ($P < 0.01$) by Paylean (Table 3). Because the Paylean pigs grew more efficiently, they used 11.5 kg less feed per pig started than the control pigs.

One of the expectations of the use of Paylean is to reduce the variation in market weights, and more precisely, to reduce the number of tail-end pigs that would be shipped from an all-in-all-out production system. There were no Paylean barrows and only 2 Paylean gilts as tail-enders, but there were 2 control

barrows and 18 control gilts that were tail-enders. Thus, Paylean reduced the number of tail-end pigs from 7.5% of the pigs shipped to 0.8%. The Canadian grading system heavily penalizes the marketing of lightweight pigs, so this is a noteworthy response.

Weekly growth rate, within treatment, was recorded. It can be seen that during the first week of the experiment, the response to Paylean was quite consistent, irrespective of the pig's shipping week; only the pigs shipped during week 5 appeared to not respond to Paylean during their first week on test (Table 4, Figure 1). However, those pigs responded to Paylean during their second week on test. It can be seen that for pigs marketed during their 5th and 6th week on test, the response to Paylean was diminished by week 3.

Dressed weight was the same for pigs on both treatments, so dressing percentage was also the same across treatments (Table 5). Overall, Paylean reduced backfat thickness by 1 mm from 18.1 to 17.1 mm; however gilts did not respond to Paylean while barrows did. Paylean increased loin thickness by 2.5 mm, from 68.3 to 70.8 mm; the response was the same in barrows as in gilts. Consequently, Paylean also increased estimated lean yield by 1 percentage point and tended to increase carcass index, from 110.0 to 110.6. Carcass premiums tended to be lower on the Paylean pigs; this anomaly was the result of a premium policy that reduces the loin premium from \$3.50 when loins are less than 70 mm to \$0.50 when loins exceed 70 mm. Overall value was similar between control and Paylean treated pigs.

Neither loin ultimate pH nor drip loss percentage was affected by the Paylean (Table 6). Paylean had no effect on CIE L* values, but it did lower a* and b* values of the loin chops, indicating less red and yellow intensiveness, respectively. No differences were observed for any subjective (color, marbling) quality measurements of pork loin samples nor were there any differences in marbling. There was no difference in cooking loss between loin chops from pigs fed the control or Paylean-fortified diet.

Interestingly, there was a significant gender x treatment interaction for Warner-Bratzler shear force (WBSF) of both enhanced and not enhanced chops (Table 7). Loin chops from gilts fed the Paylean-fortified diet had higher instrumental tenderness values when compared to chops from the control diet, whereas no difference was found in barrows. The presence of the interaction suggests the response to feeding Paylean may be gender dependent. No differences between dietary treatments were found for the amount of perceptible connective tissue, juiciness, pork flavour intensity and desirability or overall acceptability of enhanced or non-enhanced chops (Table 8).

The sole negative effect of Paylean in this experiment was observed in the number of animals lost during the marketing process. While no control pigs were condemned, 2 Paylean barrows were condemned at the packing plant and 3 gilts were dead on arrival. Past experience with the product suggests that Paylean pigs may be more susceptible to stress during shipping.

At the end of the day, the final decision on the use of Paylean will depend on relative economics and will vary substantially among farms. Considering typical farms, we might suggest a benefit in the range of \$2 to \$3 per pig sold. However, the range of benefits among farms could be substantial.

Furthermore, if losses in transit are not controlled, the economic advantage afforded by the use of Paylean will be lost.

In conclusion, the addition of RAC at the rate of 5 mg/kg to the diet of finishing pigs for an average of the last 26 days before marketing increased growth rate and feed conversion by about 13% each, to greatly reduce the number of tail-end pigs (from 7.5% to 0.75%), to reduce backfat by about 1 mm and to increase loin thickness by about 2.5 mm. The use of Paylean may increase DOAs, so producers using this product must apply greater care in the handling of pigs during loading, transport and unloading at the packing plant. While 5 mg RAC/ kg reduced tenderness slightly, as determined by both mechanical and taste panel evaluation, there was no impact on overall acceptability of the final pork product. The economic benefit accruing from the use of Paylean will depend on the circumstances of individual farms.

Table 1. Ingredient composition of experimental diets (% as fed) ¹

Ingredient	Control	Paylean
Wheat	50.000	48.000
Barley	33.725	31.120
Soybean Meal	12.893	16.623
Limestone	0.807	0.800
Dicalcium Phosphate	0.463	0.681
Salt	0.500	0.500
PSC Mineral Premix ²	0.400	0.450
PSC Vitamin Premix ³	0.400	0.450
Lysine HCl	0.075	0.236
dl-Methionine	-	0.053
l-Threonine	-	0.099
Canola oil	0.738	0.738
Paylean ⁴	-	0.025
Nutrients, calculated		
DE, Kcal/kg	3,300	3,300
Nutrients, analyzed		
Lysine total, %	0.84	1.09
Ca, %	0.58	0.63
P, total %	0.48	0.51
Ractopamine, mg/kg	undetected	4.9

¹ Diets were formulated to be similar to typical commercial diets, except that the % total lysine was increased from 0.75 to 1.00 % in the Paylean diet to accommodate the expected increased lean growth. Other essential AA, formulated according to the ideal protein ratio with lysine, increased accordingly.

² Provided per kg of mixed feed: Zn, 80 mg as zinc sulphate; Fe, 64 mg as ferrous sulphate; Cu, 50 mg as copper sulphate; Mn, 20 mg as manganous sulphate; I, 0.40 mg as calcium iodate; Se, 0.08 mg as sodium selenite.

³ Provided per kg of mixed feed; vitamin A, 6,600 IU; vitamin D₃, 660 IU; vitamin E, 32 IU; menadione sodium bisulfite complex, 3.2 mg; thiamine, 0.8 mg; riboflavin, 4 mg; d-pantothenic acid, 12 mg; niacin, 28 mg; vitamin B₁₂, 0.02 mg; d-biotin, 0.16 mg; folic acid, 1.6 mg.

⁴ Provided per kg of mixed feed; ractopamine hydrochloride 5 mg.

Table 2. Effect of Paylean on animal numbers.

	Control	5 ppm Ractopamine	S.E.M.	Trt	P values	
					Gender	Trt x gender
No. pigs started ¹						
Males	136	136				
Females	131	128				
<i>Total</i>	<i>267</i>	<i>264</i>				
No. pigs shipped ²						
Males	135	135				
Females	130	126				
<i>Total</i>	<i>265</i>	<i>261</i>				
Days on test ³						
Males	28.3	25.3				
Females	32.1	27.6				
<i>Total</i>	<i>30.1</i>	<i>26.5</i>	<i>1.78</i>	<i>0.001</i>	<i>.0001</i>	<i>0.23</i>
Tail-enders ⁴						
Males	2	0				
Females	18	2				
<i>Average</i>	<i>20</i>	<i>2</i>				

¹ Started on test diets when the average weight of the room was 85 kg.

² All pigs were shipped after the 6 wks on test, difference between pigs started and shipped is pigs removed from test during the experimental period (described in results).

³ Target was for pigs to be fed ractopamine for an average of 25 days.

⁴ Number of pigs not reaching the minimum live shipping weight of 116 kg, within the available 6 week experimental period.

Table 3. The effect of Paylean on the overall growth performance

	Control	5 ppm Ractopamine	S.E.M.	P values ¹		
				Trt	Gender	Trt x gender
No. pigs started						
Males	136	136				
Females	131	128				
Average	267	264				
No. pigs shipped						
Males	135	135				
Females	130	126				
Average	265	261				
Initial wt., kg						
Males	86.7	85.7				
Females	85.6	86.3				
Average	86.1	86.0	1.49	0.94	0.82	0.13
Final wt., kg						
Males	118.9	118.5				
Females	117.9	117.8				
Average	118.4	118.1	0.28	0.51	0.04	0.65
Overall ADG, kg/d						
Males	1.14	1.30				
Females	1.01	1.15				
Average	1.08	1.22	0.03	0.001	0.001	0.80
Overall ADFI, kg/d						
Males	3.62	3.60				
Females	3.13	3.14				
Average	3.37	3.36	0.05	0.98	0.001	0.87
Overall FCE³						
Males	0.32	0.36				
Females	0.32	0.36				
Average	0.32	0.36	0.01	0.001	0.33	0.89
Kg feed/pig started						
Males	101.6	90.6				
Females	99.8	86.1				
Average	100.7	89.2				

¹ Model included the effects of treatment, gender and the treatment by gender interaction. Room (n=2) was considered random. Pen (n=32) was the experimental unit.

² Based on individual (not pen) data.

³ FCE: feed conversion efficiency (gain/feed).

Table 4. The effect of Paylean on average weekly growth rate according to the week of shipping

Week Shipped	Trt	n = ¹	Week on Test					
			1	2	3	4	5	6
1	C	3	1.43					
	T	4	1.68					
2	C	14	1.31	1.33				
	T	31	1.41	1.56				
3	C	52	1.22	1.14	1.13			
	T	64	1.34	1.43	1.25			
4	C	70	1.19	1.11	1.03	1.10		
	T	91	1.30	1.30	1.15	1.15		
5	C	84	1.17	1.05	1.07	0.99	1.12	
	T	62	1.08	1.32	1.08	0.99	1.03	
6	C	44	1.00	0.95	0.91	0.86	0.99	0.89
	T	9	1.15	1.12	0.93	0.81	0.91	1.07

¹ Number of pigs shipped within that week. For example in the second group of animals shipped, 14 pigs were shipped from the control group, they gain 1.33 kg/d the week before shipping, and 1.31 kg/d the first week on test.

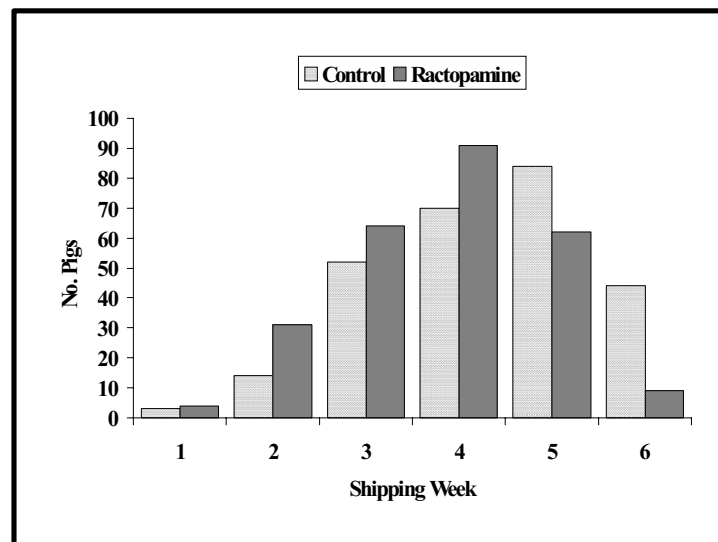


Figure 1. Effect of 5 mg ractopamine per kg on the number of pigs shipped by week

Table 5. The effect of Paylean on carcass quality.

	Control	5 ppm Ractopamine	S.E.M .	P values ¹		
				Trt	Gender	Trt x Gender
Dressed wt., kg						
Males	94.22	94.06				
Females	94.46	94.74				
<i>Total</i>	<i>94.34</i>	<i>94.40</i>	<i>0.28</i>	<i>0.89</i>	<i>0.26</i>	<i>0.58</i>
Dressing percent, %						
Males	79.2	79.4				
Females	80.2	80.4				
<i>Total</i>	<i>79.7</i>	<i>79.9</i>	<i>0.15</i>	<i>0.29</i>	<i>0.001</i>	<i>0.81</i>
Backfat thickness, mm						
Males	20.32	18.48				
Females	15.83	15.64				
<i>Average</i>	<i>18.08</i>	<i>17.06</i>	<i>0.36</i>	<i>0.02</i>	<i>0.001</i>	<i>0.06</i>
Loin thickness, mm						
Males	67.06	69.74				
Females	69.45	71.83				
<i>Average</i>	<i>68.26</i>	<i>70.79</i>	<i>0.87</i>	<i>0.001</i>	<i>0.002</i>	<i>0.83</i>
Lean yield, %						
Males	59.23	61.07				
Females	62.27	62.47				
<i>Average</i>	<i>60.75</i>	<i>61.77</i>	<i>0.20</i>	<i>0.001</i>	<i>0.001</i>	<i>0.008</i>
Carcass index						
Males	108.57	110.15				
Females	111.34	110.99				
<i>Total</i>	<i>109.96</i>	<i>110.57</i>	<i>0.23</i>	<i>0.06</i>	<i>0.001</i>	<i>0.005</i>
Carcass premium, \$						
Males	2.14	1.85				
Females	1.14	0.84				
<i>Total</i>	<i>1.64</i>	<i>1.34</i>	<i>0.26</i>	<i>0.06</i>	<i>0.001</i>	<i>0.96</i>
Carcass value, \$						
Males	118.30	119.35				
Females	119.24	118.82				
<i>Total</i>	<i>118.77</i>	<i>119.08</i>	<i>2.71</i>	<i>0.76</i>	<i>0.84</i>	<i>0.48</i>

¹ Model included the effects of treatment, gender and the treatment by gender interaction. Room (n=2) was considered random. Pen (n=32) was the experimental unit.

Table 6. Least square means for loin quality characteristics.

	Treatment				Gender			
	Control	RAC	SEM	<i>p</i>	F	M	SEM	<i>p</i>
Probe pH	5.74	5.74	0.09	0.93	5.78	5.69	0.09	0.08
Purge loss								
24hrs	4.77	4.28	0.78	0.35	3.67	5.38	0.78	0.00
48hrs	6.73	6.21	0.80	0.38	5.56	7.38	0.80	0.00
CIE color								
L*	54.47	54.13	0.65	0.62	53.49	55.11	0.65	0.03
a*	8.19	7.43	0.23	0.00	7.43	8.19	0.24	0.00
b*	13.93	13.10	0.13	0.00	13.24	13.78	0.13	0.01
Visual color score								
Canadian ^w	2.7	2.7	0.17	0.74	2.7	2.7	0.17	0.78
USA ^x	2.9	3.0	0.08	0.64	3.0	2.9	0.08	0.86
Japanese ^y	2.8	2.8	0.09	0.64	2.8	2.8	0.09	0.83
Marbling ^z	1.8	1.8	0.13	0.83	1.6	2.0	0.13	0.00

^wScale of 1 to 5; 1=extremely pale, 5=extremely dark

^xScale of 1 to 6; 1=pale pinkish gray to white, 6=dark purplish red

^yScale of 1 to 6; 1=light, 6=dark

^zMarbling scores correspond to estimated intramuscular lipid content.

Table 7. Effect of Paylean on Warner Bratzler Shear Force of non enhanced and enhanced loins.

	Not enhanced	Enhanced
Gender		
F	68.7	49.2
M	69.0	49.5
SEM	2.70	1.82
<i>p</i>	0.83	0.91
Treatment		
C	64.9	44.6
T	72.8	54.0
SEM	2.70	1.82
<i>p</i>	0.00	0.00

Table 8. Effect of Paylean on pork loin sensory attributes.

	Not enhanced loins							
	Treatment				Gender			
	C	T	SEM	<i>p</i>	F	M	SEM	<i>p</i>
Initial Tenderness ^w	5.6	5.2	0.16	<i>0.04</i>	5.3	5.6	0.16	<i>0.12</i>
Overall Tenderness	5.7	5.3	0.16	<i>0.05</i>	5.4	5.6	0.16	<i>0.16</i>
Percept. Connective Tissue ^x	5.8	5.7	0.23	<i>0.79</i>	5.6	5.9	0.23	<i>0.35</i>
Juiciness	5.2	5.2	0.17	<i>0.85</i>	5.2	5.3	0.17	<i>0.55</i>
Pork Flavour Intensity	5.2	4.9	0.13	<i>0.09</i>	4.9	5.1	0.13	<i>0.37</i>
Flavour Desirability	5.6	5.5	0.17	<i>0.67</i>	5.5	5.6	0.17	<i>0.57</i>
Overall Acceptability	5.6	5.3	0.16	<i>0.22</i>	5.4	5.6	0.16	<i>0.41</i>
	Enhanced loins							
	Treatment				Gender			
	C	T	SEM	<i>p</i>	F	M	SEM	<i>p</i>
Initial Tenderness	6.8	6.4	0.11	<i>0.04</i>	6.5	6.6	0.11	<i>0.56</i>
Overall Tenderness	6.8	6.5	0.10	<i>0.06</i>	6.6	6.7	0.10	<i>0.53</i>
Percept. Connective Tissue ^x	6.4	6.3	0.06	<i>0.20</i>	6.3	6.4	0.06	<i>0.32</i>
Juiciness	6.5	6.3	0.11	<i>0.33</i>	6.3	6.5	0.11	<i>0.18</i>
Pork Flavour Intensity	5.7	5.6	0.06	<i>0.43</i>	5.6	5.7	0.06	<i>0.23</i>
Flavour Desirability	6.2	6.2	0.07	<i>0.64</i>	6.2	6.2	0.07	<i>0.93</i>
Saltiness	5.3	5.2	0.14	<i>0.90</i>	5.2	5.3	0.14	<i>0.88</i>
Overall Acceptability	6.2	6.1	0.08	<i>0.29</i>	6.1	6.2	0.08	<i>0.54</i>

^wIntensity of sensory attributes was evaluated based on an 8-point scale (8=extremely tender, juicy, intense, none, none; 1=extremely tough, dry, bland, abundant, and intense).

^x Amount of perceptible connective tissue