EFFECT OF RACTOPAMINE FEEDING LEVEL ON GROWTH PERFORMANCE, CARCASS COMPOSITION, FATTY ACID PROFILE, AND LOIN QUALITY MEASUREMENTS

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Objectives

The focus of this experiment was to determine the effect of ractopamine (RAC) and feeding level on growth performance as well as its subsequent effects on carcass composition, fatty acid profile of the clear plate and belly, and loin quality measurements.

Methodology

Barrows (n = 75) and gilts (n = 75) were randomly allotted to one of three dietary treatments resulting in a randomized complete block design with location as a blocking factor and the pen as the experimental unit for growth performance, backfat depth, muscle depth, and hot carcass weight. The dietary treatments (as-fed basis) were: 1) Control diet containing no RAC; 2) RAC fed at 5 ppm; and 3) RAC fed at 10 ppm. Pigs, within a gender, were randomly assigned to treatment (5 pigs per pen and 10 pens per treatment). All diets were formulated to contain 1.2% lysine and fed for a five-week period. Pigs were acclimated for 5 days prior to initiation of treatments. Feed allocation was recorded on a daily basis. Pigs were weighed and feed was weighed back when diets were changed, in order to calculate average daily gain (ADG), average daily feed intake (ADFI), and feed efficiency (G:F) by feeding period. At the end of the 33 d feeding period, backfat depth and loin eye area (LEA) were measured on all pigs using real-time ultrasound (Aloka 500; Corometrics Medical Systems, Wallingford, CT). Two pigs were randomly selected per pen at allotment and blood samples were obtained from the jugular vein at d 0, 7, 14, 21, 27, and 33. Pigs were not fasted before blood samples were obtained. Plasma was obtained by centrifugation (1600 x g) of blood samples at 5ºC for 30 min. Plasma was stored at -20ºC until analysis of urea nitrogen concentrations.

At the conclusion of the five week period all pigs were tattooed for slaughter and the two pigs closest to the average pen weight were identified for subsequent carcass and muscle quality evaluation. At the time of slaughter hot carcass weight and Fat-o-Meter measures of fat depth and muscle depth were collected. Percent carcass yield was

calculated using off-test weight and HCW. Fat was sampled from the clear plate of 60 carcasses and they were broken into three parts; ham with foot on, loin and belly, and shoulder, placed into combos and transported by truck to the University of Illinois for dissection and muscle quality evaluation. Taste panels were conducted utilizing a 15 cm anchored, unstructured line scale for tenderness, juiciness, and off-flavor. Warner-Bratzler shear force value is the average of 4 cores per chop.

Statistical analyses of the data were performed using the GLM procedure of SAS (SAS Inst. Inc., Cary, NC). Dietary treatment, gender, and interaction were examined to determine their effects on growth and carcass characteristics. Sequence of measurement was included as a covariate for the analysis of Minolta Color and session was included as a fixed effect for taste panel measures. Pen was the experimental unit for growth performance, hot carcass weight, fat depth muscle depth, loin area, and fatty acid composition. Animal was considered the experimental unit for carcass composition and muscle quality data.

Results & Discussion

Pigs fed RAC displayed greater ($P < 0.05$) live weights each week with the exception of initial body weights at allotment when compared to control pigs as can be seen in Table 1. They also had increased ($P < 0.05$) average daily gains (ADG) over the course of the 5-week study while average daily feed intake (FI) did not differ ($P > 0.05$) (Table 2). Hot carcass weight (HCW) dressing percent (percent yield) increased ($P < 0.05$) with the addition of RAC while loin eye area was significantly larger ($P < 0.05$) only at the 5ppm level (Table 3). Fat depth over the loin did not differ between treatments while loin depth was greatest ($P < 0.05$) for the 5 ppm level, followed by the 10 ppm, and lastly the control treatment.

Feeding RAC had no effects ($P > 0.10$) on fatty acid profile and calculated IV of belly fat, but had an effect ($P < 0.05$) on linoleic acid in clearplate fat. The percentage of linoleic acid in clearplate fat from pigs fed 10 ppm RAC (18.6) was on average 7% higher (17.4) than pigs fed control diet and 5 ppm RAC. This resulted in a 3% increase in IV, 8% increase in polyunsaturated fatty acid and 8.5% decrease in the ratio of monounsaturated to polyunsaturated fatty acids from pigs consuming 10 ppm RAC compared to pigs consuming control and 5 ppm RAC diets. No significant difference ($P > 0.05$) was detected between pigs fed control diet and 5 ppm RAC concerning any fatty acid measurements (Tables 4 and 5).

Carcass cutting yields, expressed as a % of HCW, revealed minimal differences between control diet and pigs fed RAC. The tenderloin was increased ($P < 0.05$) as a % of HCW by the addition of RAC to the diet, but no other significant differences were noted (Table 6). Loin Quality measurements (Table 7) were not affected by feeding RAC with the exception of Minolta a* which was lowered by both levels of RAC and b* with was lower for 10 ppm ($P < 0.05$). Trained sensory panel and Warner-Bratzler shear force also did not reveal any significant differences between treatments ($P > 0.05$).

Conclusions

The addition of RAC to the diet resulted in a favorable growth response yielding heavier carcasses ultimately resulting in more lean pork than the control diet. There was however, no major difference in percent yield of lean cuts from the carcass. Feeding 10 ppm of RAC increased the enrichment of linoleic acid in clearplate fat, but there was no overall effect of RAC on the fatty acid profile of belly fat of finishing pigs and thus should be no effect on belly fat quality.

Tables and Figures

Table 1. Effect of ractopamine feeding level on BW and growth performance by week.

	Control	5 ppm	10 ppm	SEM
Pens, n	10	10	10	--
Pigs, n	50	50	50	--
Initial BW, kg	76.2	76.7	77.0	0.30
Week 1, 7 d				
Pigs, n	50	50	50	--
BW at 7 d, kg	81.7 [b]	83.0 [a]	83.5 [a]	0.40
ADG, kg	0.79	0.90	0.94	0.06
Feed Intake, kg	2.56	2.71	2.73	0.06
G:F	0.31	0.33	0.35	0.02
Week 2, 7 d				
Pigs, n	49	50	50	--
BW at 14 d, kg	89.3 [b]	92.0 [a]	91.9 [a]	.60
ADG, kg	1.09 [b]	1.29 [a]	1.20 [a,b]	0.06
Feed Intake, kg	3.00	3.10	3.08	0.07
G:F	0.36	0.42	0.39	0.02
Week 3, 7 d				
Pigs, n	48	50	50	--
BW at 21 d, kg	96.9 [b]	99.9 [a]	100.3 [a]	0.70
ADG, kg	1.08	1.13	1.19	0.07
Feed Intake, kg	3.09	3.13	3.15	0.08
G:F	0.35	0.36	0.38	0.02
Week 4, 6 d				
Pigs, n	48	50	50	--
BW at 27 d, kg	103.7[b]	107.4[a]	107.7[a]	0.80
ADG, kg	1.14	1.25	1.24	0.05
Feed Intake, kg	3.08	3.19	3.27	0.08
G:F	0.37	0.39	0.38	0.02

Week 5, 6 d				
Pigs, n	48	50	50	--
BW at 33 d, kg	107.0 [b]	110.5 [a]	111.2 [a]	0.90
ADG, kg	0.56	0.52	0.59	0.07
Feed Intake, kg	3.15	3.20	3.28	0.09
G:F	0.18	0.16	0.18	0.02

[a, b] Within a row, means lacking a common superscript differ ($p < 0.05$)

Table 2. Effect of ractopamine feeding level on growth performance in finishing pigs by time period.

	Control	5 ppm	10 ppm	SEM
Pens, n	10	10	10	--
Week 1 to 2, 14 d				
Pigs, n	49	50	50	--
ADG, kg	0.94 [b]	1.09 [a]	1.07 [a]	0.04
Feed Intake, kg	2.78	2.91	2.90	0.06
G:F	0.34	0.38	0.37	0.01
Week 1 to 3, 21 d				
Pigs, n	48	50	50	--
ADG, kg	0.98[b]	1.10 [a]	1.11 [a]	0.03
Feed Intake, kg	2.88	2.98	2.98	0.06
G:F	0.35 [b]	0.37 [a]	0.37 [a]	0.01
Week 1 to 4, 27 d				
Pigs, n	48	50	50	--
ADG, kg	1.02 [b]	1.14 [a]	1.14 [a]	0.02
Feed Intake, kg	2.93	3.02	3.05	0.06
G:F	0.35 [b]	0.38 [a]	0.37 [a]	0.01
Week 1 to 5, 33 d				
Pigs, n	48	50	50	--
ADG, kg	0.93 [b]	1.02 [a]	1.04 [a]	0.03
Feed Intake, kg	2.97	3.06	3.09	0.07
G:F	0.32	0.34	0.34	0.01

[a, b] Within a row, means lacking a common superscript differ ($p < 0.05$)

Table 3. Effect of ractopamine feeding level on carcass weight and composition.

	Control	5 ppm	10 ppm	SEM
Pigs	48	50	50	--
Pens	10	10	10	--
RTU fat depth, mm	15.9	14.8	15.0	0.5
RTU loin area, cm^2	41.5 [b]	44.7 [a]	43.1 [a,b]	0.8
Pigs	45	46	46	--
Pens	10	10	10	--
Hot carcass wt., kg	78.9 [b]	83.2 [a]	83.8 [a]	0.7
Percent yield	73.8 [b]	75.3 [a]	75.4 [a]	0.4
FOM fat depth, mm	16.4	16.1	15.8	0.5
FOM loin depth, mm	55.8 [c]	61.1 [a]	58.5 [b]	0.9

[a, b] Within a row, means lacking a common superscript differ ($p < 0.05$)

Table 4. Effect of ractopamine feeding program on fatty acid profiles of porcine clear plate fat [1]

Fatty Acid (% weight)	Control	5 ppm	10 ppm	SEM
C14:0	1.65	1.65	1.70	0.05
C16:0	23.40	23.50	23.38	0.22
C16:1	2.97	2.92	3.01	0.06
C18:0[2]	11.14	10.75	10.41	0.21
C18:1t	0.52	0.50	0.52	0.02
C18:1c	38.06	37.79	37.19	0.36
C18:2[2]	17.24[a]	17.56[a]	18.54[b]	0.34
C18:3[2]	1.05	1.10	1.21	0.07
C20:1[2]	0.17	0.18	0.17	0.01
Other [4]	3.81	4.06	3.89	0.21
Iodine value[2,3]	68.74[a]	69.12[a]	70.72[b]	0.52
Saturated	36.18	35.90	35.46	0.26
Monounsaturated	41.55	41.21	40.72	0.35
Polyunsaturated[2]	18.41[a]	18.83[a]	19.93[b]	0.37
Mono/Poly ratio	2.27[a]	2.24[a]	2.06[b]	0.06
US/S ratio	1.67	1.68	1.72	0.02

[1] Each mean represents 10 pens with 2-3 pigs. Pen was used as the experimental unit in statistical analysis.

[a, b] Within a row, means lacking a common superscript differ ($p < 0.05$)

[2] Treatment by gender interaction ($p < 0.05$). See attached interaction graphs.

[3] Calculated as IV = C16:1(0.95)+C18:1(0.86)+C20:1(0.785)+C18:2(1.732)+C18:3(2.616).

[4] Other fatty acids (e.g., C10:0, C12:0, C20:3 and C20:4) of low concentration.

Table 5. Effect of ractopamine feeding level on fatty acid profiles of porcine belly fat [1]

Fatty Acid (% weight)	Control	5 ppm	10 ppm	SEM
C14:0	1.65	1.71	1.76	0.06
C16:0[2]	23.03	23.43	22.93	0.33
C16:1	3.24	3.22	3.15	0.08
C18:0	10.18	10.42	10.19	0.23
C18:1t[2]	0.51	0.46	0.50	0.01
C18:1c	39.80	39.01	39.56	0.47
C18:2	16.80	16.43	17.09	0.41
C18:3ω6	0.72	0.73	0.75	0.03
C18:3ω9	0.17	0.17	0.17	0.01
Other[4]	3.91	4.43	3.89	0.25
Iodine value[2,3]	68.86	67.59	69.20	0.62
Saturated[2]	34.86	35.56	34.89	0.47
Monounsaturated	43.71	42.85	43.39	0.46
Polyunsaturated	17.52	17.16	17.84	0.43
Mono/Poly ratio	2.51	2.53	2.45	0.08
US/S ratio	1.76	1.69	1.76	0.02

[1] Each means represented 10 pens with 2-3 pigs. Pen was used as the experimental unit in statistical analysis.

[2] Treatment by gender interaction ($p < 0.05$). See attached interaction graphs.

[3] Calculated as IV = C16:1(0.95)+C18:1(0.86)+C20:1(0.785)+C18:2(1.732)+C18:3(2.616).

[4] Other fatty acids (e.g., C10:0, C12:0, C20:3 and C20:4) of low concentration.

Table 6. Effect of ractopamine feeding level on loin quality.

	Control	5 ppm	10 ppm	SEM
Pigs, n	20	20	20	--
Ultimate pH	5.57	5.60	5.62	0.02
Color score	3.4	3.3	3.4	0.10
Marbling score	2.2	2.0	2.2	0.10
Firmness score	3.2	3.2	3.4	0.10
Minolta L*	47.4	47.7	47.2	0.50
Minolta a*	6.0 [a]	5.2 [b]	4.8 [b]	0.30
Minolta b*	2.4 [a]	2.0 [ab]	1.7 [b]	0.20
Drip loss, %	2.6	2.5	2.4	0.20
Taste panel tenderness score	7.3	7.2	7.5	0.30
Taste panel juiciness score	7.6	7.1	6.8	0.30
Taste panel off-flavor score	0.09	0.01	0.02	0.03
Cooking loss, %	24.4 [ab]	21.3 [a]	24.5 [b]	1.10
Warner-Bratzler shear force, kg	3.1	3.1	3.5	0.20
Proximate analysis moisture, %	75.3	75.3	75.3	0.10
Proximate analysis fat, %	1.7	1.5	1.4	0.10

[a, b] Within a row, means lacking a common superscript differ ($p < 0.05$)

Table 7. Effect of ractopamine feeding level on ham, loin, and belly composition as a % of Hot Carcass Weight.

	Control	5 ppm	10 ppm	SEM
Pigs, n	18	18	18	--
Whole Ham, %	24.6	24.4	24.9	0.20
Skinned Ham, %	20.6	20.4	20.8	0.20
Inside, %	3.7	3.7	3.7	0.10
Outside, %	5.2	5.3	5.4	0.10
Knuckle, %	2.9	2.9	3.0	0.10
Lt Butt, %	0.57	0.6	0.66	0.03
Pigs, n	19	19	19	--
Whole Loin, %	27.2	27.4	27.3	0.30
Trimmed Loin, %	22	22.2	22.1	0.30
Canadian Back, %	7.2	7.5	7.5	0.10
Tenderloin, %	0.98 [b]	1.11 [a]	1.08 [a]	0.03
Sirloin, %	1.49	1.64	1.62	0.06
Pigs, n	19	19	19	--
Untrimmed Belly, %	15.2	15.5	15.6	0.2
Trimmed Belly, %	11.8	12.0	12.1	0.2
Spareribs, %	3.8	3.6	3.7	0.1
PA moisture (Belly), %	52.6	54.4	53.9	10
PA fat (Belly), %	30.7	27.8	28.4	1.3

[a, b] Within a row, means lacking a common superscript differ ($p < 0.05$)