Sensory Characteristics of Loins from Pigs Fed Glycerol and Ractopamine HCl During the Last 28 Days of Finishing[1,2]

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Summary

Sensory characteristics were evaluated on a total of 80 loins from pigs fed diets containing glycerol, ractopamine HCl (RAC), and a combination of glycerol and RAC during the last 28 d prior to harvest. A total of 1,054 pigs were blocked by weight and randomly allotted to 1 of 4 dietary treatments with 10 replications per treatment. Pigs were fed corn-soybean meal-based diets. Dietary treatments were arranged in a 2 × 2 factorial design with main effects of glycerol (0% or 5%) and RAC (0 or 6.75 g/ton). Pork loins from 1 randomly selected barrow and gilt from each pen were used for sensory analysis. There were no glycerol × RAC interactions or main treatment effects for cooking loss or Warner-Bratzler shear force (WBSF). Additionally, there were no glycerol × RAC interactions or main treatment effects for the sensory traits including myofibrillar tenderness, overall tenderness, pork flavor intensity, or off-flavor intensity. There was a glycerol × RAC interaction ($P < 0.01$) for the sensory trait of connective tissue amount. The interaction was a result of increased connective tissue amounts when glycerol was added to the diet without RAC but numerically decreased amounts when glycerol was fed in combination with RAC. In conclusion, feeding dietary glycerol or RAC singularly or in combination for 28 d prior to slaughter did not influence sensory characteristics of center-cut pork loin chops.

Key words: glycerol, ractopamine HCl, sensory analysis

Introduction

Ractopamine HCl (RAC; Paylean, Elanco Animal Health, Indianapolis, IN) is a widely used feed additive fed to finishing pigs prior to marketing to improve growth rate, F/G, yield, loin depth, and fat-free lean index. However, pigs fed RAC have been shown to have increased levels of polyunsaturated fatty acids and increased iodine value in carcass fat. Increased concentrations of polyunsaturated fatty acids lower fat stability, which can result in development of off-flavors.

Legislation and energy mandates have supported rapid expansion of renewable biofuel production in the United States. The Energy Independence and Security Act of 2007 increased the minimum level of renewable fuels, previously set by the Renewable

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Fuels Standard of 2005, to be produced and consumed by the United States to 136 billion liters by 2022. Crude glycerol is the primary coproduct from biodiesel production. There are currently 176 biodiesel production facilities operating in the United States producing more than 9.88 billion liters of biodiesel. This level of production will produce approximately 7.81×10^8 kg of crude glycerol. Crude glycerol has been shown to have a minimal impact on growth performance and carcass characteristics, but Mourot et al. (1994[6]) reported an increase in the saturation of carcass fat from pigs fed crude glycerol. Little is known about the effect of crude glycerol on loin sensory characteristics.

The potential increase in availability of glycerol as a feedstuff for swine along with the common practice of feeding RAC to finishing pigs warrants evaluation of these ingredients in combination and their effect on loin sensory characteristics. Therefore, the objective of this trial was to evaluate the effect of dietary glycerol and RAC on cooking loss, Warner-Bratzler Shear Force (WBSF), and sensory traits.

Procedures

Procedures used in these experiments were approved by the Kansas State University Institutional Animal Care and Use Committee and Institutional Review Board. The experiment was conducted at a commercial research facility in southwestern Minnesota. The facility had a totally slatted floor, and each pen was equipped with a 4-hole dry self-feeder and a cup waterer. The facility was a double-curtain-sided deep-pit barn. The experiment was conducted in the winter of 2008.

A total of 1,054 barrows and gilts (PIC 337 × 1050, initially 207.8 lb) were used in the 28-d study. Pigs were randomly allotted and blocked to 1 of 4 dietary treatments with 10 pens per treatment. Each pen contained 25 to 27 barrows and gilts.

Pigs were fed corn-soybean meal-based experimental diets (Table 1) in meal form. Dietary treatments were arranged in a 2 × 2 factorial design with main effects of glycerol (0% or 5%) and RAC (0 or 6.75 g/ton). Glycerol from a soybean biodiesel production facility (Minnesota Soybean Processors, Brewster, MN) was used in the trial. All experimental diets were formulated to maintain a constant standardized ileal digestible lysine:ME ratio within treatments that included or did not include RAC. For glycerol, the NRC (1998[7]) ME value of corn (1,551 kcal/lb) was used in diet formulation.

The pigs in this study were marketed in 2 different groups. First, on d 14, the barn was "topped" similar to normal marketing procedures in most commercial production operations. The 4 heaviest pigs from all pens were visually selected, removed, and marketed. The remaining pigs in the barn were marketed at the conclusion of the study (d 28).

At the end of the experiment, pigs from each pen were individually tattooed with pen number and shipped to the JBS Swift & Company processing plant (Worthington, MN). After harvest, chilling, and fabrication, whole loins were collected from 1 barrow and 1 gilt randomly chosen from each pen from the d-28 marketing group for loin

[6] Mourot, J., A. Aumaitre, A. Mounier, P. Peiniau, and A. C. Fracois. 1994. Nutritional and physiological effects of dietary glycerol in the growing pig: Consequences on fatty tissues and post mortem muscular parameters. Livest. Prod. Sci. 38:237-244.

[7] NRC. 1998. Nutrient Requirements of Swine. 10th ed. Natl. Acad. Press, Washington, DC.

quality evaluation. After the loins were identified and packaged, they were transported to the Kansas State University Meat Laboratory and stored at 32°F to 38°F. Loins were fabricated into 1-in. chops 10 d postmortem. Five center-cut loin chops were individually vacuum packaged and frozen (-40°F) for determination of cooking loss, WBSF, and sensory characteristics. Chops were removed from the freezer and thawed in a refrigerator (32°F to 38°F) overnight. To determine cooking loss, the chops were first weighed to determine initial weight and then cooked to an internal temperature of 104°F, turned, and cooked to a final internal temperature of 158°F in a dual-airflow convection gas oven (Blodgett, model DFC-102 CH3, G.S. Blodgett Co., Burlington, VT). Chops were monitored with copper-constantan thermocouples placed in the approximate geometric center of each chop and attached to a Doric temperature recorder (Model 205, Vas Engineering, San Francisco, CA). Following a 30-min cooling period, chops were re-weighed to determine cooking loss percentages. The chops were then chilled at 32°F to 38°F overnight, and six 0.5-in. cores were removed parallel to the muscle fiber direction. Each core was sheared once perpendicular to the direction of the muscle fibers with the Warner-Bratzler V-shaped blunt blade (G-R Manufacturing Co., Manhattan, KS) attached to an Instron Universal Testing Machine (model 4201, Instron Corp., Canton, MA) with a 50-kg compression load cell and a crosshead speed of 250 mm/min. Peak shear force values were recorded.

To determine sensory characteristics, the chops were removed from the package, cooked to an internal temperature of 104°F, turned, and cooked to a final internal temperature of 158°F in a dual-airflow convection gas oven. Cooked chops were then cut into 1-in. × 0.5-in. × 0.5-in. samples. Samples were kept warm in blue enamel double boiler pans with warm water in the bottom portion. Eight trained panelists were given 2 cubes of each chop to evaluate sensory characteristics. Each panelist conducted sensory analysis on a warm-up chop and a chop from each treatment during each session. Sensory characteristics evaluated include myofibrillar tenderness, juiciness, pork flavor intensity, connective tissue, overall tenderness, and off-flavor intensity.

Data were analyzed as a randomized complete block design by using the PROC MIXED procedure of SAS (SAS Inst., Inc., Cary, NC) with pen as the experimental unit. Main effects and interactions between pigs fed crude glycerol and RAC were tested. Statistical significance was set at $P < 0.05$ for all statistical tests.

Results and Discussion

The control and treatment means for cooking loss, WBSF, myofibrillar tenderness, connective tissue amount, overall tenderness, juiciness, pork flavor intensity, and off-flavor intensity are reported in Table 2. For cooking loss and WBSF, there were no glycerol × RAC interactions or main treatment effects. Additionally, there were no glycerol × RAC interactions or treatment differences for the sensory traits of myofibrillar tenderness, overall tenderness, pork flavor intensity, or off-flavor intensity. However, there was a glycerol × RAC interaction ($P < 0.01$) for connective tissue level. The interaction was a result of increased connective tissue amounts when glycerol was added to the diet without RAC but numerically decreased amounts when glycerol was fed in combination with RAC. We have no explanation for this unexpected interaction because we would not expect an increase in connective tissue without a decrease in tenderness, which was not observed.

In other research evaluating RAC and loin quality, Fernández-Dueñas et al. (2008[8]) reported that inclusion of RAC did not affect the loin quality traits of cooking loss, tenderness, juiciness, and flavor. However, Carr et al. (2005a[9], 2005b[10]) reported an increase in WBSF and a decrease in sensory tenderness scores for loins from pigs fed RAC.

In conclusion, our results indicate that feeding pigs crude glycerol or RAC did not influence loin sensory characteristics.

[8] Fernández-Dueñas, D. M., A. J. Myers, S. M. Scramlin, C. W. Parks, S. N. Carr, J. Killefer, and F. K. McKeith. 2008. Carcass, meat quality, and sensory characteristics of heavy body weight pigs fed ractopamine hydrochloride (Paylean). J. Anim. Sci. 86:3544-3550.

[9] Carr, S. N., D. J. Ivers, D. B. Anderson, D. J. Jones, D. H. Mowrey, M. B. England, J. Killefer, P. J. Rincker, and F. K. McKeith. 2005a. The effects of ractopamine hydrochloride on lean carcass yields and pork quality characteristics. J. Anim. Sci. 83:2886-2893.

[10] Carr, S. N., P. J. Rincker, J. Killefer, D. H. Baker, M. Ellis, and F. K. McKeith. 2005b. Effects of different cereal grains and ractopamine hydrochloride on performance, carcass characteristics, and fat quality in late-finishing pigs. J. Anim. Sci. 83:223-230.

Table 1. Diet composition (as-fed basis)[1]

	Ractopamine HCl, g/ton			
	0		6.75	
Ingredient, %	0% glycerol	5% glycerol	0% glycerol	5% glycerol
Corn	82.77	77.36	74.81	69.41
Soybean meal (46.5% CP)	15.24	15.64	23.19	23.59
Glycerol	---	5.00	---	5.00
Ractopamine HCl (9 g/lb)	---	---	0.04	0.04
Monocalcium P (21% P)	0.48	0.48	0.43	0.45
Limestone	0.90	0.90	0.88	0.85
Salt	0.35	0.35	0.35	0.35
Vitamin premix	0.04	0.04	0.04	0.04
Trace mineral premix	0.05	0.05	0.05	0.05
Phytase[2]	0.03	0.03	0.03	0.03
L-Lysine HCl	0.15	0.15	0.15	0.15
DL-methionine	---	---	0.02	0.02
L-threonine	0.01	0.01	0.03	0.03
Total	100.00	100.00	100.00	100.00
Calculated analysis				
SID[3] amino acids, %				
Lysine	0.70	0.70	0.90	0.90
Methionine:lysine	31	31	30	30
Met & Cys:lysine	65	63	61	59
Threonine:lysine	64	64	64	64
Tryptophan:lysine	19	19	19	19
SID lysine:ME, g/Mcal	2.09	2.09	2.69	2.69
ME, kcal/lb	1,521	1,521	1,520	1,520
Total lysine, %	0.79	0.79	1.01	1.01
CP, %	14.3	14.0	17.3	17.1
Ca, %	0.51	0.51	0.51	0.51
P, %	0.44	0.42	0.46	0.45
Available P, %[4]	0.22	0.22	0.22	0.22

[1] Fed from 208 to 259 lb.
[2] OptiPhos 2000 (Enzyvia LLC, Sheridan, IN) provided 227 phytase units of phytase per pound of diet.
[3] Standardized ileal digestible.
[4] Includes expected P release of .07% from added phytase.

Table 2. Influence of crude glycerol and ractopamine HCl on loin characteristics[1]

	Ractopamine HCl, g/ton					Probability, $P <$		
	0		6.75					
Item	0% glycerol	5% glycerol	0% glycerol	5% glycerol	SE	Ractopamine HCl × Glycerol	Ractopamine HCl	Glycerol
Cooking loss, %	25.63	24.65	25.20	24.13	0.66	0.95	0.47	0.13
Warner-Bratzler shear force, lb	8.71	8.40	8.09	8.64	0.24	0.41	0.74	0.81
Sensory traits								
Myofibrillar tenderness[2]	5.6	5.8	5.7	5.6	0.16	0.23	0.94	0.74
Connective tissue amount[3]	7.2	7.4	7.5	7.3	0.08	0.01	0.37	0.76
Overall tenderness[2]	5.8	6.1	6.1	5.9	0.15	0.15	0.89	0.73
Juiciness[4]	5.1	5.0	5.0	5.2	0.13	0.21	0.62	0.83
Pork flavor intensity[5]	5.4	5.3	5.3	5.4	0.09	0.09	0.64	0.86
Off-flavor intensity[3]	7.4	7.5	7.5	7.6	0.09	0.89	0.16	0.20

[1] A total of 80 loins were used in the experiment with 2 loins per pen and 10 pens per treatment. Values are the mean of 1 gilt and 1 barrow per pen (10 barrows and 10 gilts per treatment).
[2] 1 = extremely tough, 2 = very tough, 3 = moderately tough, 4 = slightly tough, 5 = slightly tender, 6 = moderately tender, 7 = very tender, 8 = extremely tender.
[3] 1 = abundant, 2 = moderately abundant, 3 = slightly abundant, 4 = moderate, 5 = slight, 6 = traces, 7 = practically none, 8 = none.
[4] 1 = extremely dry, 2 = very dry, 3 = moderately dry, 4 = slightly dry, 5 = slightly juicy, 6 = moderately juicy, 7 = very juicy, 8 = extremely juicy.
[5] 1 = extremely bland, 2 = very bland, 3 = moderately bland, 4 = slightly bland, 5 = slightly intense, 6 = moderately intense, 7 = very intense, 8 = extremely intense.