THE INFLUENCE OF GENOTYPE, SEX, AND DIETARY LYSINE ON CARCASS QUALITY CHARACTERISTICS OF 230 AND 280 LB FINISHING PIGS[1]

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Summary

When pigs were fed to 230 lb, high-lean genotype loin eyes had less visual marbling and a higher saturation index (more vivid or intense color) than medium-lean genotype loin eyes. Loin eye chops from high-lean gilts had greater cooking losses and Warner-Bratzler shear values (mechanically tougher) than those from high-lean barrows and medium-lean barrows and gilts. When pigs were fed to 280 lb, medium-lean genotype loin eyes had a lighter color visually and indicated by Hunter L* values, more marbling, less firmness, more moisture exudate, and a higher chop thaw loss than high-lean loin eyes. Barrow loin eyes had more marbling and less thaw loss than gilt loin eyes. Loin eye chops from high-lean barrows had higher Warner-Bratzler shear values than high-lean gilts and medium-lean barrows and gilts. Dietary lysine levels had minimal effects on carcass quality for pigs fed to either 230 or 280 lb.

(Key Words: Pork Quality, Lysine, Sex, Genotypes.)

Introduction

The swine industry has experienced increased market premiums for lean carcasses and discounts for fat, less efficient hogs. Research has suggested that carcass composition can be influenced by genotype, gender, and dietary lysine. Selection for decreased backfat and improved feed efficiency has resulted in pigs with increased lean gain potential. However, selection pressure for increased leanness only may have negative effects on carcass quality. Therefore, the objective of this experiment was to determine the interrelationship between genotype, sex, and dietary lysine and effects on carcass quality characteristics in finishing pigs fed to 230 and 280 lb.

Procedures

Diets, growth performance, and carcass characteristics for the pigs used in this study are described in previous papers in this Report of Progress. One hundred sixteen pigs were used in a 2 × 2 × 2 factorial arrangement. Genetic comparisons were made between pigs previously characterized as having either high or medium lean-gain potential. Within genotype, barrows and gilts were fed separately (three pigs per pen) two dietary lysine regimens. Pigs were fed either a diet containing .90 or .70% dietary lysine until the mean weight of pigs in a pen equaled or exceeded 230 lb. One pig from each pen was then randomly selected and slaughtered. The remaining two pigs were fed diets that were decreased from .90 and .70% to .75 and .55% dietary lysine, respectively. These pigs were then slaughtered when their mean weight reached or exceeded 280 lb.

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At 24 hr postmortem, carcass data were collected. During fabrication, the 10th rib loin eye cut surface was evaluated for quality characteristics. Visual color, marbling, and firmness were assessed using a scale of 1 to 5 with 1 = white, traces, or very soft and watery and 5 = dark red, abundant, or very firm and dry, respectively. At 15 min after ribbing, circular 5.5 cm diameter Whatman No. 2 filter papers were placed for approximately 1 second on posterior cut surfaces of loins laid horizontally on tables. The difference between dry and moist weights was recorded as the weight of moisture exudate. Hunter L*, a*, b* values were measured using a Minolta CR-200 Chromometer. Saturation index and hue angle were calculated using the equations of $(a^{*2} + b^{*2})^{1/2}$ and arc tangent (b*/a*), respectively. Hunter L*, a*, and b*, saturation index, and hue angle were used as objective measures of lightness, redness, yellowness, color vividness or intensity, and red to orange. Muscle pH was determined on approximately 2 g samples using a Fisher Accument model 620 pH meter. At approximately 28 hr postmortem, 3 in. of boneless loin eye muscle was frozen at −4°F for future analysis. One-in. chops were cut, weighed, and thawed at 35°F for 18 hr. Chops were then weighed and cooked to an internal temperature of 160°F, surfaces were blotted, and chops were reweighed. Six 1/2 in. cores were sheared through the center using an Universal Instron machine to determine Warner-Bratzler shear values or muscle tenderness.

Results and Discussion

For carcasses from pigs fed to 230 lb (Table 1), high-lean genotype loin eyes had ($P<.05$) less visual marbling, higher Hunter a* values (more red), higher Hunter b* values (more yellow), and higher saturation indices (more vivid or intense) than medium-lean genotype loin eyes. In a genotype × lysine interaction ($P<.05$), loin eyes from high-lean genotype pigs fed lower (.70%) lysine and medium-lean genotype fed higher lysine (.90%) had significantly ($P<.05$) higher pH's than loin eyes from medium-lean pigs fed higher lysine levels. However, all pH means were in the normal range of 5.4 to 5.5. In a genotype × sex interaction ($P<.05$), medium-lean barrows had ($P<.05$) loin eyes with greater hue angles (more orange on a red to orange scale) than loin eyes from high-lean gilts. Loin eyes from high-lean barrows and medium-lean gilts had intermediate hue angles. Loin eye chops from high-lean gilts had ($P<.05$) greater cooking losses, combined thaw and cooking losses, and Warner-Bratzler shear values (were tougher) than chops from high-lean barrows. Medium-lean gilts and barrows had loin chops with intermediate cooking losses, combined thaw and cooking losses, and Warner-Bratzler shear values.

For carcasses from pigs fed to 280 lb (Table 2), high-lean genotype loin eyes were visually more reddish pink in color and firmer, but had less marbling ($P<.05$). Also, high-lean genotype loin eyes had ($P<.05$) a higher pH, less moisture exudate, lower Hunter L* values (darker), and smaller hue angles (more red on a red to orange scale) than medium-lean genotype loin eyes. Barrow loin eyes had ($P<.05$) more marbling and less thaw loss than gilt loin eyes. In a genotype × sex interaction ($P<.05$), high-genotype barrow loin eyes had ($P<.05$) higher Warner-Bratzler shear values (were tougher) than high-lean gilt, medium-lean barrow, and medium-lean gilt loin eyes. For pigs fed to either 230 or 280 lb, high-lean genotype loin eyes had less visual marbling than medium-lean loin eyes.

At 230 lb, high-lean loin eyes, compared with medium-lean loin eyes, objectively had a more vivid or saturated color resulting from more red and more yellow measurements. This could be partially explained by less marbling and less dilution of lean color. Chops from high-lean gilts were mechanically tougher than chops from high-lean barrows and medium-lean barrows and gilts partially because of a higher cooking loss.

For pigs fed to 280 lb, medium-lean loin eyes were lighter both visually and objectively, were less firm, and had more moisture exudate thaw loss partially because of a lower pH and binding of water by protein. At 280 lb, barrow loin eyes had more marbling and less thaw loss than gilt loin eyes. However, high-lean barrow chops were tougher than high-lean gilt and medium-lean barrow and gilt chops.

Table 1. The Effects of Genotype, Sex, and Dietary Lysine on Carcass Quality Characteristics of Pigs Fed to 230 lb

	Genotype		Sex		Dietary lysine, %		
Item	High (H)	Medium (M)	Barrows (B)	Gilts (G)	.90	.70	CV
USDA grade	1.3[m]	1.7[n]	1.8[k]	1.2[l]	1.5	1.5	44.6
Percent muscle	52.6	52.5	50.9[k]	54.3[l]	52.5	52.7	4.4
Visual color[a]	2.9	2.7	2.8	2.8	2.8	2.8	18.4
Marbling[a]	2.2[m]	2.9[n]	2.7	2.4	2.4	2.8	28.2
Firmness[a]	3.5	3.6	3.7	3.4	3.5	3.6	31.0
Moisture exudate, mg[b]	152.6	129.3	125.3	156.6	142.5	139.4	58.5
Hunter L*[c]	53.1	53.9	54.0	53.0	53.4	53.6	7.6
Hunter a*[d]	10.7[k]	8.6[l]	9.3	10.1	9.4	9.9	18.0
Hunter b*[e]	7.7[m]	6.5[n]	7.0	7.2	7.0	7.2	24.9
Saturation index[f]	13.2[k]	10.8[l]	11.7	12.4	11.8	12.3	19.9
Hue angle[g]	35.2[o]	36.8[o]	36.9[o]	35.1[o]	36.5	35.6	8.4
pH at 24 hr	5.5[p]	5.4[p]	5.5	5.4	5.5[p]	5.4[p]	2.2
Thaw loss, %[h]	2.9	3.1	2.7	3.3	2.9	3.1	40.1
Cook loss, %[i]	24.5[q]	24.5[q]	23.5[q]	25.5[q]	24.8	24.2	19.3
Total loss, %[j]	26.7[r]	26.8[r]	25.6[r]	27.9[r]	27.0	26.5	17.5
Warner Bratzler Shear, lb	10.1[s]	8.8[s]	9.2[s]	9.7[s]	9.7	9.0	13.3

[a]Scores of 1 to 5: 2 = gray, slight, or soft and watery; 3 = light pink, small or intermediate; 4 = reddish pink, moderate or firm.
[b]Moisture absorbed when placing a Whatman No. 2 filter paper on the loin eye cut surface.
[c]Measure of dark to light: a larger L* value represents a lighter color.
[d]Measure of redness: a larger a* value represents a more red color.
[e]Measure of yellowness: a larger b* value represents a more yellow color.
[f]Measure of vividness or intensity of the color: a larger index represents a more vivid color.
[g]Measure of red to orange: a larger angle represents a more orange and less red color.
[h]100 × (frozen chop wt − thawed chop wt)/frozen chop wt.
[i]100 × (thawed chop wt − cooked chop wt)/thawed chop wt.
[j]100 × (thawed chop wt − cooked chop wt)/frozen chop wt.
[kl]Means within genotype, sex, or dietary lysine level with different superscripts differ ($P<.01$).
[mn]Means within genotype, sex, or dietary lysine level with different superscripts differ ($P<.05$).
[o]Genotype × sex interaction ($P<.05$) for Hue angle − MB (38.9) > HG (35.5), HB (35.0) and MG (34.8), $P<.05$.
[p]Genotype × lysine interaction ($P<.05$) for pH at 24 hr − H .70 (5.5) and M .90 (5.5) > M .70 (5.4), $P<.05$; H .90 (5.4) intermediate.
[q]Genotype × sex interaction for cook loss, % − HG (27.4) > HB (21.4), $P<.05$; MB (25.4) and MG (23.6) intermediate.
[r]Genotype × sex interaction for total loss, % − HG (29.5) > HB (23.9), $P<.05$; MB (27.3) and MG (26.4) intermediate.
[s]Genotype × sex interaction ($P<.05$) for Warner-Bratzler shear, lb − HG (10.6) > HB (9.5), MB (9.0), and MG (8.6), $P<.05$.

Table 2. The Effects of Genotype, Sex, and Dietary Lysine on Carcass Quality Characteristics of Pigs Fed to 280 lb

	Genotype		Sex		Dietary lysine, %		
Item	High (H)	Medium (M)	Barrows (B)	Gilts (G)	.90/.75	.70/.55	CV
USDA grade	2.0^{m}	2.5^{n}	2.5^{k}	1.9^{l}	2.3	2.1	26.8
Percent muscle	51.4	50.8	49.9^{k}	52.3^{l}	50.7	51.4	3.7
Visual color[a]	3.1^{k}	2.7^{l}	3.0	2.8	3.0	2.9	9.7
Marbling[a]	2.6^{m}	2.9^{n}	3.0^{m}	2.6^{n}	2.7	2.8	18.4
Firmness[a]	3.9^{m}	3.5^{n}	3.9	3.5	3.8	3.7	15.0
Moisture exudate, mg[b]	129.8^{m}	161.0^{n}	131.0	160.0	136.0	154.8	30.0
Hunter L*[c]	50.7^{k}	54.0^{l}	52.0	52.7	52.1	52.6	4.9
Hunter a*[d]	9.6	9.1	9.0	9.8	9.5	9.3	14.9
Hunter b*[e]	6.4	7.0	6.4	7.0	6.7	6.7	17.5
Saturation index[f]	11.6	11.5	11.0	12.1	11.7	11.5	15.0
Hue angle[g]	33.3^{k}	37.1^{l}	35.1	35.3	35.2	35.2	7.6
pH at 24 hr	5.5^{m}	5.4^{n}	5.5	5.5	5.4	5.5	1.9
Thaw loss[h]	2.3^{k}	3.6^{l}	2.6^{k}	3.3^{l}	2.7	3.1	24.8
Cook loss[i]	22.0	21.4	21.5	21.9	23.0	20.3	15.4
Total loss[j]	23.8	24.2	23.5	24.4	25.1	22.8	13.5
Warner Bratzler Shear, lb	10.3	8.8	9.9	9.2	9.7	9.5	13.5

[a]Scores of 1 to 5: 2 = gray, slight, or soft and watery; 3 = light pink, small or intermediate; 4 = reddish pink, moderate or firm.
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[f]Measure of vividness or intensity of the color: a larger index represents a more vivid color.
[g]Measure of red to orange: a larger angle represents a more orange and less red color.
[h]100 × (frozen chop wt − thawed chop wt)/frozen chop wt.
[i]100 × (thawed chop wt − cooked chop wt)/thawed chop wt.
[j]100 × (thawed chop wt − cooked chop wt)/frozen chop wt.
[kl]Means within genotype, sex, or dietary lysine level with different superscripts differ ($P < .01$).
[mn]Means within genotype, sex, or dietary lysine level with different superscripts differ ($P < .05$).
[o]Genotype × sex interaction ($P < .05$) for Warner Bratzler shear, lb − HB (11.0) > HG (9.5), MB (8.8), and MG (9.0), $P < .05$.