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Abstract
Eighty-one boneless pork loins were used to determine the influence of pH on quality characteristics. With increasing loin pH, instrumental values for L* (lightness) and b* (yellowness) of loins and chops decreased, and cooking losses of chops before 0 d and after 1 d of retail display also decreased. The pH had no effects on package losses or Warner-Bratzler shear force values of chops. Center loin chops (0 d and 1 d) had higher ratios of reflectance than blade and sirloin chops. Sirloin chops had higher ratio of reflectance than blade chops. Center loin chops had lower package losses than blade and sirloin chops. Blade chops had lower (more tender) WBS values than center loin and sirloin chops. Measuring loin pH can predict instrumental color (L*and b*) values as well as cooking losses.; Swine Day, Manhattan, KS, November 16, 2000

Keywords
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EFFECTS OF pH AND LOCATION WITHIN A LOIN ON PORK QUALITY

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Summary

Eighty-one boneless pork loins were used to determine the influence of pH on quality characteristics. With increasing loin pH, instrumental values for L* (lightness) and b* (yellowness) of loins and chops decreased, and cooking losses of chops before 0 d and after 1 d of retail display also decreased. The pH had no effects on package losses or Warner-Bratzler shear force values of chops. Center loin chops (0 d and 1 d) had higher ratios of reflectance than blade and sirloin chops. Sirloin chops had higher ratio of reflectance than blade chops. Center loin chops had lower package losses than blade and sirloin chops. Blade chops had lower (more tender) WBS values than center loin and sirloin chops. Measuring loin pH can predict instrumental color (L*and b*) values as well as cooking losses.

(Key Words: Pork Chops, pH, Quality.)

Introduction

Meat color is one of the most important visual characteristic sought by consumers as an indicator of a freshness and wholesomeness. It has been stated that the extent of a meat product's shelf life depends on its quality characteristics, mainly color. Products with adequate color will give the appearance of an acceptable product, thus leading to faster retail sales. In addition to color, another major quality characteristic is the amount of moisture loss during fabricating, packaging, and processing. Meat is sold on a weight basis, so it is essential to select products that have a high water-holding capacity and will maintain a constant weight through various processes. Meat color and water-holding capacity often are related to ultimate pH of meat and quite often are utilized by packers as indicators of muscle quality in pork. Therefore, it is essential to have an understanding of the relationship between muscle color and water-holding capacity and meat pH.

Procedures

Eighty-one boneless pork loins were obtained from a commercial packing facility utilizing pH as a selection criterion. A pH probe designed specifically for Farmland Industries (Cypress, Lawrence, KS) was inserted on the bone side, 10 in. from the anterior end of the pork loin. Spectral data for the ratio of reflectance %R630/%R580 and CIE Lab color readings were taken over the bone surface at the blade (6 -7th rib), center (last rib), and sirloin (5-6th lumbar) locations using a HunterLab Miniscan (Hunter and Associates, Reston, VA.) with a 10° observer and Illuminate C. Loins were then placed into vacuum bags (CRYOVAC, Duncan, SC) and vacuum packaged (Target 4 Torr, Model 14EL, CRYOVAC). After packaging, loins were passed through a shrink tunnel (198° to 202°F) and aged for 14 d at 31°F in Farmland's warehouse. Loins then were transported to Kansas State University, where they were stored for 30 d at 31°F. At 44-d postmortem, loins were weighed, removed from the vacuum bags, and were allowed to bloom for 15 min at 32°F prior to cutting into 1-in. chops.

Chops at 4, 11, and 19 in., anterior to posterior, were used to determine Warner-Bratzler shear (WBS) force; package, cooking, and total moisture losses; and instrumental color. These locations represent the blade, center, and sirloin sections of a loin. Shear-force chops were weighed, covered with polyvinyl chloride (PVC) wrap in 2S Styrofoam trays, and weighed again. Spectral data for the ratio of reflectance %R630/% R580 and CIE Lab color readings were taken immediately (0 d) taken on each chop before being placed into an open-top retail display case for 24 h at 32°F under continuous 1614 lux lighting from Phillips Deluxe Warm White fluorescent lights (40 watt). Each chop was scanned at two locations (lateral and medial), and values were averaged. After 24 h, instrumental color readings (1 d) were taken, and each chop was weighed.

Shear-force chops were cooked to an internal temperature of 160°F in a Blogdett dual-air-flow oven (DFG-201, G.S., Blodgett Co., Inc., Burlington, VT). Temperature was monitored using thermocouples attached to a Doric Minitrend 205 temperature recorder (Emmerson Electric S.A., Doric Div., San Diego, CA). Chops then were cooled at room temperature for 1 h and weighed. They were chilled 24 h at 38°F before six 0.5-in. cores were taken parallel to the muscle fibers and sheared perpendicular to the muscle fibers using a WBS attachment connected to an Universal Instron testing machine (Model 4201, Instron, Canton, MA). Package and cooking losses were calculated by the equations [(initial wt.-aged wt.)/initial wt.] and [(raw wt. -cooked wt.)/raw wt.], respectively. Total moisture loss was calculated by the equation [1-((1-purge, %) × (1- package loss, %) × (1-cooking loss, %))].

Results and Discussion

No differences (P>.05) were observed in plant measurements for CIE a* (measures of redness) or ratio of reflectance values (Table 1). Chops CIE L* values decreased (became darker) with increased loin pH. Chops at lower pH (<5.5) had higher (P<.05) L* values (lighter in color) than chops with intermediate pHs (5.6 to 5.9) and high pHs (6.0 to >6.2). However, chops with intermediate pH had higher (P<.05) L* values than chops with high pH. In addition, values for CIE b* (an indicator of yellowness) decreased with increased loin pH. Chops with low pHs (<5.5 and 5.6) had higher (P<.05) b* values than chops with a higher pHs (5.8 to >6.2). The differences in b* values became less with increased loin pH.

Quality characteristics of shear-force chops are reported as pH means in Table 1. Similar to plant measurements, CIE L* and b* values of shear-force (0 d) chops decreased with increased loin pH. Chops with a pH of <5.5 had higher (P<.05) L* values than chops with pHs of 5.7 to >6.2. However, chops with a pH of 5.7 had higher (P<.05) L* values than chops with a pH of >6.2. Moreover, chops with a pH of 5.5 had higher (P<.05) b* values than chops with pHs of 5.8 to >6.2. However, chops with a pH of 5.8 had higher (P<.05) b* values than chops with a pH of >6.2. The ratio of reflectance (measures oxymyoglobin content) seemed to increased with increasing loin pH. Chops with a pH of 5.5 had a lower (P<.05) ratio of reflectance than chops with a pH of 6.1.

After 24 h storage (1 d) in an open-top retail display case, CIE Lab color reading were taken on shear force chops and presented as pH means (Table 1). Similar to 0-d color readings, 1-d L* values decreased with increased loin pH. Chops with low pHs (<5.5 and 5.5) had higher (P<.05) L* values than chops with higher pHs (5.7 to >6.2). However, chops with pHs of 5.7 to 5.9 had higher (P<.05) L* values than chops with a pH of >6.2. No general trend was observed between pH and a* values. However, chops with a pH of <5.5 had lower (P< .05) a* values (less red) than chops with higher pHs (6.0 to >6.2). Chops with pH of 5.5 had lower (P<.05) a* values than chops with pH of 5.8. In addition, b* values decreased with increased loin pH. Chops with lower pHs (<5.5 and 5.5) had higher (P<.05) b* values (more yellow) than chops with higher pHs (6.0 to >6.2). Moreover, chops with a pH of 5.8 had higher (P<.05) b* values than chops with a pH of >6.2.

A more apparent trend for the ratio of reflectance was observed on shear-force chops after 24 h of display. Chops with a pH of <5.5 had the lowest ratio of reflectance, and the ratio increased with increasing loin pH. Chops with pH of <5.5 had a lower (P<.05) ratio of reflectance than chops with pHs of 5.7 to >6.2. However, chops with a pH of 5.7 had a lower (P<.05) ratio of reflectance than chops with pHs of 6.0 and 6.1.

Cookery characteristics of shear-force chops are reported as pH means in Table 1.

No differences (P>.05) were observed for WBS and percentage of package losses. However, differences (P<.05) in cooking losses were observed. Chops with low pH (<5.5) had the highest cooking losses, and losses decreased with increased loin pH. Shear force chops with lower pHs (<5.5 and 5.5) had higher (P<.05) cooking losses than chops with higher pHs (5.8 to >6.2). However, chops with a pH of 5.8 had higher (P<.05) cooking losses than chops with a pH of >6.2.

Plant instrumental color values by location within the loin are shown in Table 2. No differences (P>.05) were observed for CIE a* or ratio of reflectance values. The center loin section had higher (P<.05) L* values than the blade or sirloin sections. The blade section had a higher (P<.05) b* value than the center loin section.

Quality differences (P<.05) were found by location for shear force chops stored in an open-top retail case for 0 d and 1 d (Table 2). Blade chops had higher (P<.05) 0-d and 1-d L* values than center loin and sirloin chops. However, sirloin chops had higher (P<.05) 0-d and 1-d L* values than the center loin chops. Center loin chops had higher (P<.05) 0-d and 1-d a* values than blade and sirloin chops. Blade chops had higher (P<.05) 0-d and 1-d b* values than the center loin and sirloin chops. In addition, center loin chops had higher (P<.05) 0-d ratio of reflectance than blade and sirloin chops. However, center loin chops had a higher (P<.05) 1-d ratio of reflectance than blade and sirloin chops. In addition, sirloin chops had a higher (P<.05) ratio of reflectance than blade chops.

Cookery traits and WBS values are represented as location means and shown on Table 2. No differences (P>.05) were found for cooking losses. However, center loin chops had lower (P<.05) package losses than chops from than blade and sirloin regions. Blade chops had lower (P<.05; more tender) WBS values than center and sirloin chops.

This study suggests that pork quality characteristics vary with pH and chop location within a loin. Therefore, muscle pH can be a useful predictor of pork loin quality to produce a consistent product for consumers.

Table 1. Influence of Loin pH on Instrumental Color, Warner-Bratzler Shear Force, and Cookery Traits

	Loin pH									
Variables	<5.5	5.5	5.6	5.7	5.8	5.9	6.0	6.1	>6.2	SE
Plant Instrumental Color[x]										
L*	57.25^{d}	55.01^{cd}	54.37^{c}	53.16^{bc}	51.05^{ab}	52.77^{bc}	49.99^{a}	49.35^{a}	49.05^{a}	0.783
a*	8.53	7.33	7.34	8.04	7.85	6.67	7.10	7.25	7.11	0.535
b*	14.04^{d}	13.26^{cd}	13.10^{cd}	13.01^{bcd}	12.22^{ab}	11.70^{ab}	11.64^{a}	11.47^{a}	11.05^{a}	0.540
% R630/% R580	2.49	2.40	2.38	2.52	2.46	2.41	2.56	2.55	2.61	0.075
Shear Force Chop Color 0 d[y]										
L*	62.35^{d}	61.90^{d}	59.17^{cd}	57.11^{bc}	56.67^{bc}	56.13^{bc}	54.48^{ab}	54.13^{ab}	52.77^{a}	1.140
a*	12.11	11.43	13.03	12.77	12.06	11.51	11.42	12.21	11.27	0.882
b*	19.33^{de}	19.60^{e}	18.89^{cde}	18.68^{cde}	18.38^{bcd}	17.82^{abc}	17.35^{ab}	17.41^{ab}	17.21^{a}	0.376
% R630/% R580	2.66^{ab}	2.58^{a}	2.89^{abc}	3.01^{bc}	2.87^{abc}	2.90^{abc}	2.99^{abc}	3.13^{c}	2.97^{ab}	0.151
Shear Force Chop Color 1 d[z]										
L*	61.95^{e}	61.27^{e}	59.39^{de}	56.98^{cd}	55.65^{bc}	55.77^{bc}	53.75^{ab}	53.57^{ab}	52.38^{a}	1.000
a*	10.13^{a}	10.88^{ab}	11.80^{bc}	11.47^{abc}	12.78^{c}	11.65^{abc}	12.11^{bc}	12.38^{bc}	11.90^{bc}	0.527
b*	19.38^{cd}	19.47^{cd}	19.57^{d}	18.88^{abcd}	19.22^{bcd}	18.50^{abc}	18.37^{ab}	18.26^{ab}	17.99^{a}	0.337
% R630/% R580	2.38^{a}	2.51^{ab}	2.67^{abc}	2.75^{bcd}	2.98^{cde}	2.93^{cde}	3.13^{e}	3.21^{e}	3.07^{de}	0.337
Cookery Traits										
Package loss, %	4.16	4.05	3.96	4.20	3.82	3.92	3.92	4.00	4.12	0.324
Cooking loss, %	25.53^{d}	25.21^{d}	23.89^{cd}	23.50^{cd}	21.88^{bc}	20.03^{ab}	19.98^{ab}	19.03^{ab}	18.31^{a}	1.086
WBS, kg	3.09	3.21	2.69	2.09	2.56	2.39	3.04	2.68	2.75	0.417

[a,b,c,d,e]Means within a row with different superscript letter differ (P<.05).

[x]Lightness (L*), redness (a*), yellowness (b*), or indicator of the amount of oxymoglobin present (ratio of reflectance % R630/ % R580) measured on the loins in the packing plant.

[y]Instrumental color measurement taken on shear-force chops prior to storage in an open-top retail display case.

[z]Instrumental color measurements taken on shear-force chops after 24 h storage in an open-top retail display case.

Table 2. Influence of Loin Location on Quality Characteristics

	Location			
Variable	Blade	Center	Sirloin	SE
Plant Instrumental Color[x]				
L*	52.83	51.50[a]	53.00[b]	0.574
a*	7.49	7.33	7.60	0.314
b*	12.71[b]	12.00[a]	12.45[ab]	0.363
% R630/% R580	2.51	2.49	2.47	0.053
Instrumental Color 0 d[y]				
L*	59.52[c]	54.47[a]	57.57[b]	0.574
a*	11.61[a]	12.74[b]	11.59[a]	0.646
b*	18.63[b]	18.08[a]	18.18[a]	0.177
% R630/% R580	2.76[a]	3.09[b]	2.81[a]	0.076
Instrumental Color 1 d[z]				
L*	58.99[c]	54.21[a]	57.04[b]	0.548
a*	11.29[a]	12.47[b]	11.27[a]	0.213
b*	19.14[b]	18.60[a]	18.82[a]	0.135
% R 630/% R580	2.71[a]	3.04[c]	2.80[b]	0.135
Cookery Traits				
Package loss, %	4.23[b]	3.72[a]	4.1[b]	0.294
Cooking loss, %	22.62	21.91	21.35	0.698
WBS, kg	2.42[a]	2.88[b]	2.87[b]	0.168

[a,b,c]Means within a row with different superscript letter differ (P<.05).

[x]Lightness (L*), redness (a*), yellowness (b*), or indicator of the amount of oxymoglobin persent (ratio of reflectance %R 630/% R580) measured at the packing plant.

[y]Initial color measurement taken on shear-force chops prior to storage in an open-top retail display case.

[z]Color measurements taken on shear-force chops after 24 h storage in an open-top retail display case.