EFFECT OF PIG AGE AT MARKET WEIGHT AND MAGNESIUM SUPPLEMENTATION THROUGH DRINKING WATER ON PORK QUALITY

B. Frederick, E. van Heugten, and M.T. See
North Carolina State University, Department of Animal Science

Summary
Thirty-two pigs were used to determine the effect of age of pig and magnesium supplementation through drinking water on fresh and stored pork quality. Two groups were identified as fast or slow growers, 153 or 180 ± 0.4 days of age at 108 ± 0.6 kg BW. Pigs were harvested on the same day and pork quality measurements were conducted. The age of pig at market weight had no effect on display fluid loss, purge loss, or lipid oxidation of loins or hams. However, hams from older pigs had less surface exudate than younger pigs. Furthermore, loins and hams from older pigs were darker and hams tended to be redder during display storage than those from younger pigs. Although, magnesium supplementation did not affect pork quality characteristics, pork from older pigs were darker and tended to be redder than from younger pigs.

Introduction
Pigs are often harvested at a constant bodyweight to maintain uniformity of pork products and maximize profits. However, the variation of bodyweight within a pen is often too great to market the entire pen of pigs at one time to accomplish the aforementioned goals. Therefore, multiple marketing from a particular group or pen is required to accomplish these goals. Morrow et al. (2002) reported that increased frequency of feed withdrawal and/or increased age at marketing within a pen had a negative effect on several pork quality characteristics. However, the results do not indicate whether the effect on pork quality was caused by frequency of feed withdrawal or age of the pigs when marketed.

Short-term supplemental dietary Mg has been reported to decrease water loss (D'Souza et al. 1998, 1999, 2000; Hemann et al., 2000) and improve color of pork (D'Souza et al., 1998, 2000). Furthermore, dietary Mg potentially decreases lipid oxidation of stored pork (Apple et al., 2001). Most of the recent nutritional approaches to improve pork quality have focused on supplementation through feed delivery. This practice is difficult to implement for such a brief period of time (2 days) because of feed deliver systems currently established. The implementation of this feeding scheme is further complicated by multiple marketings within pens. Therefore, developing a water soluble approach to improve pork quality would simplify delivery by ensuring proper timing of supplementation.

Therefore, the objective of this study was to determine if the age of pigs has a negative effect on pork quality and if magnesium supplementation through drinking water could negate those effects.

Materials and Methods
A total of 32 pigs (108 ± 0.6 kg BW) were used to determine the effect of age of pigs and Mg
supplementation through drinking water on pork quality. Our goal was to select two groups of pigs of similar market weight, but groups were intended to differ by approximately 30 days of age. Two initial groups of 50 pigs, approximately 28 kg BW, were selected from two farrowing groups 30 d apart. The initial groups of pigs were fed the same grower and finishing feed during the appropriate weight ranges to meet or exceed nutrient requirements of each phase of growth. Sixteen pigs were selected from each of the two initial groups of 50. Thus, 16 slow growing pigs were selected from the older initial group, representing pigs that reached market weight at 180 d of age and 16 pigs were selected from the younger initial group, which reached market weight at 150 d of age.

The 32 pigs selected for this study were placed into 2.03 m by 0.74 m individual pens and provided with free access to water via a nipple waterer. Pigs were fed 2.7 kg of feed (0.12% Mg) per day for a 7 d adjustment period. After the adjustment period, pigs were allotted by sex and weight to water supplemented with 900 mg of Mg/L of drinking water for 0 or 2 d prior to slaughter. Plastic water containers (23 L capacity) were filled daily with 15 L of water containing appropriate Mg concentrations. Water containers were suspended from the ceiling and gravimetrically (approximately 600 ml/min) emptied into a galvanized pipe leading to an Arato® nipple. Daily water disappearance volumes were determined by weight.

On the third day (08:00) of magnesium supplementation all pigs were transported 110 km to a commercial abattoir. After approximately 2 h and 30 min of lairage, pigs were electrically stunned, scalded, and eviscerated. Hot carcass weights were collected prior to refrigeration to determine carcass yield. The temperature and pH of the loin were measured between the 10th and 11th rib at 45 min post-mortem using a Sentron® pH meter.

At 24 h post-mortem the entire right loin and ham were removed and transported 60 km to a commercial meat fabrication facility. The Longissimus dorsi and Semimembranosus muscles were removed from the loin and ham. One loin and ham chop was used to determine surface exudates and Minolta L* (lightness), a* (redness), and b* (yellowness) at 15 min and 45 min after the initial cut, respectively. Initial surface exudate, a predictor of drip loss, was determined by placing a single, 45 mm filter paper for approximately 5 s on a chop 15 min after fabrication. The filter paper was reweighed and initial exudate was expressed as weight gained by the filter paper. These chops were also used to determine display fluid loss and color at 2, 4, 6, and 8 d and lipid oxidation as measured by thiobarbituric acid reactive substances (TBARS) at 8 d of storage. An additional chop from each muscle was vacuum-packed until TBARS analysis could be performed. A third chop was used to determine dry matter and Mg concentration. The fourth and final chop was used for lipid oxidation after 4 d of display storage. The remaining posterior loin section was deboned, closely trimmed, and cut into two equal sections for vacuum-packed storage for 25 and 50 d to determine the effects of Mg on stored meat quality.

Chops designated for display storage were placed individually on an absorbent pad in a commercial Styrofoam® tray and wrapped with oxygen permeable film. Chops were stored under fluorescent lighting at 4°C for the appropriate time. After 2, 4, 6, and 8 d of storage the display muscle samples were removed from their package, placed on a paper towel, and reweighed for calculation of display fluid loss. Subsequently, Minolta color measurements were obtained. Chops were then returned to their original tray, rewrapped, and returned to refrigeration for further storage and measurements. Muscle samples designated for lipid oxidation determination after 4 and 8 d of storage were vacuum-packed until TBAR analysis could be performed.

The remaining posterior portion of the loin was cut into two equal portions. vacuum-packed, and
stored for 25 or 50 d at 4°C in the absence of light. After the appropriate storage time, the loin sections were removed from the package and reweighed to determine purge loss. Two loin chops were cut from the interior portion of the loin sections and designated for color determination or TBARS analysis. Minolta color was determined on one chop after a 45 min bloom period. The other chop was immediately vacuum-packed until TBAR analysis could be performed.

Data were analyzed by split-plot design with age as the main plot and magnesium supplementation as the subplot. Pigs were blocked by weight and the pig was the experimental unit. The presence of the Napole gene was used as a covariate because pigs were identified to have a greater than expected incidence of Napole gene.

Results and Discussion
Pigs classified as 150 or 180 days of age differed (P < 0.0001) by 27 ± 0.4 d. Live bodyweight and dressing percent was not affected by age or Mg supplementation. However, the average daily bodyweight gain of the younger and older pigs was 705 and 607 g of BW/d, respectively. The older pigs exhibited a greater loin pH (P < 0.05) than the younger pigs at 45 min post-mortem (6.37 vs. 6.23 ± 0.03, respectively). However, an interaction occurred between age and magnesium supplementation (P < 0.05) for loin and ham pH at 24 h post-mortem (Figures 1 and 2). The pH of the loin and ham of the younger pigs was greater with magnesium supplementation than without. However, the loin and ham pH of the older pigs was less with magnesium supplementation than without.

![Figure 1. Interaction of age of pig by magnesium supplementation on 24 h loin pH.](image)
Figure 2. Interaction of age of pig by magnesium supplementation on 24 h ham pH.

Initial exudate, a predictor of drip loss, of the loin was not significantly affected by age or magnesium supplementation. However, the initial exudate of the ham was reduced from 74.2 to 61.0 ± 6.3 mg as age increased from 150 to 180 (Figure 3). Display fluid loss of the ham and loin was not affected by age of the pigs or magnesium supplementation.

Figure 3. Effect of age of pig on surface exudate, a predictor of drip loss, of loin and ham. Exudate was measured by filter paper. A higher number indicates more fluid loss. The ham from older pigs had less surface exudate than younger pigs (P < 0.05).

The age of pigs did not affect initial loin lightness. However, loins from older pigs were darker in color (P < 0.05), as measured by Minolta L*, after 4 and 8 d of storage than younger pigs (Figure 4). Furthermore, the hams from older pigs tended to be darker after 0 and 4 d (P < 0.10) and were darker after 2, 6, and 8 d of display storage (P < 0.05) than younger pigs (Figure 5). Additionally, hams from older pigs tended to be redder, as measured by Minolta a*, after 4 and 8 d of storage than younger pigs (Figure 6, P < 0.10).
Figure 4. Effect of age of pig on lightness of loin chops during display storage. Higher Minolta L* values indicate meat is lighter in color. Loin chops from older pigs were darker at 4 d and 8 d of display storage ($P < 0.05$).

Figure 5. Effect of age of pig on lightness of ham chops during display storage. Higher Minolta L* values indicate meat is lighter in color. Ham chops from older pigs tended to be darker after 0 and 4 d of display storage ($P < 0.10$) and were darker at 8 d ($P < 0.05$).
Magnesium supplementation had no effect on loin or ham lightness or yellowness. However, loins from pigs provided Mg supplementation were redder (P < 0.05), as measured by Minolta a* (8.48 vs. 7.74 ± .22), after 6 d of display storage than without supplementation.

Purge loss and color of loins and hams stored for 25 or 50 d in vacuum-packed bags was not affected by age of pigs or magnesium supplementation. Furthermore, lipid oxidation during display or vacuum-packed storage was not affected by age or magnesium supplementation.

Pork color from older pigs was more desirable than younger pigs. Furthermore, pig age did not affect display fluid loss, purge loss, or lipid oxidation of loins or hams. These data do not concur with those reported by Morgan et al. (2002) in which age of pig at marketing and multiple feed withdrawals were confounded. Magnesium did not affect pork quality characteristics in the present study, which contradicts our previous results (Frederick et al., 2002) and may be explained by a longer lairage time of 2 h 30 min in the current experiment vs 45 min in the previous one.

Implications
Maximizing growth may negatively impact pork quality, irregardless of genetic mutations known to reduce quality, if pigs are harvested at a younger age. Although supplementation through drinking water is a convenient means of providing magnesium to market pigs and shown modest success to improve pork quality, the response to magnesium is not consistent. More research is required to establish a consistent response to magnesium.

References