RESEARCH REPORT
PORK QUALITY

Title: Effect of Downers on Pork Quality - **NPB# 02-107**

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Abstract: Four commercial packing facilities in the Midwest were utilized to characterize the impact of downer pigs on meat quality and the impact of respiratory health on downer pigs. Lungs of downer pigs were evaluated for pneumonia using a 3-point scale for lung lesions (1 = no lung lesions and 3 = extreme lung lesions) and pH was measured at approximately 45-min post mortem on 246 carcasses before entering the cooler. At approximately 24 h post-mortem, subjective loin color scores, marbling, muscle firmness, carcass muscle conformation, gender, objective loin color and ultimate pH was determined on 229 carcasses. Muscle conformation scores averaged from 2.10 in plant A to 1.98 in plant D with an overall average of 2.14. Average 45 min pH measurements ranged from 6.42 in plant A to 6.22 in plant C with an overall average of 6.32. Lung score values averaged 1.67 overall and ranged from 1.56 in plant A to 1.98 in plant D. All plants had a larger percentage of barrows that were classified as downers compared to gilts. Subjective color averaged from 3.55 in plant C to 4.00 in plant B and had an overall average of 3.75. Overall average marbling scores were 2.72 and ranged from 2.07 in plant A to 3.29 in plant B. Overall muscle firmness average was 3.16 and ranged from 2.80 in plant A to 3.75 in plant B. Overall average Minolta L* values were 45.72 and ranged from 43.81 in plant B to 46.60 in plant C. Overall average final pH values were 6.00 and ranged from 5.90 in plant D to 6.20 in plant A. Drip loss averaged from 1.42% in plant B to 2.37% in plant C with an overall average of 1.91%. Downer animals tended to produce pork that was dark in color, exhibited a relatively high ulitmate pH and low drip loss with virtually no relationship between downer animals and lung score value.

Key words: Swine, Downers, Pork Quality

Introduction: Animals that are slows, unable to walk under their own power or exhibit one or more of these signs, open mouth breathing, red patches on skin or muscle twiching, are classified as downer pigs. Downer pigs are a problem in all plants across the United States. Approximately 0.5 to 1.0% of pigs are considered slows, subjects, or downers in commercial plants and thus posing a problem of economic consequence for the producer and the processing plant. There are discounts for producers and increased labor costs for the processing plant. Assuming 1% downers and 100 million pigs slaughtered annually, approximately one million pigs are involved per year. Discounts of $10 to $15 per head are not uncommon, thus, the costs associated with this problem exceeds 10 million dollars per year for producers. This value does not include potential impacts on meat quality.

Preliminary trials with downer animals suggest that stress during handling results in acute acidosis (Bertol et al., 2002a; Bertol et al., 2002b; Hamilton, 2002; Ivers et al., 2002a; Ivers et al., 2002b; Hambrecht et al., 2003). This condition can result in blood pH reductions of 0.5 pH units and body temperature increase of 1 to 2.5□C (Hamilton, 2002). Depending on the time prior to slaughter, this condition may lead to either PSE or DFD muscle. Neither of these conditions are desirable and will have a negative effect on the value of the carcass.

Objectives: The objectives of this study is to characterize the impact of downer pigs on meat quality and the impact of respiratory health on downer animals.

Materials and Methods: Four commercial packing facilities in the Midwest participated in the project. Pigs were monitored from the time of unloading from the truck through the movement process to the restrainer. Pigs that were classified as downers were identified by using unique tattoo numbers and transported to the subject pen. Pigs were held in the subject pen until they were cleared for slaughter by a USDA inspector. Downer pigs from packing plants A, B and D were stunned via an electrical stunner and filtered in the slaughter line throughout the course of the 8 to 10 h shift. Downer pigs from packing plant C were stunned via a captive bolt stunner and filtered in the slaughter line twice during the 8 h shift. The 246 downer carcasses were identified by tieing a string to the front foot after the scald/dehairing process for ease of tracking through the dressing procedure. The lungs were evaluated on the viscera table for pneumonia using a 3-point scale for lung lesions (1= no lung lesions and 3= extreme lung lesions). A pH measurement was taken just prior to the carcass entering the chill cooler, approximately 45 min postmortem, with the SFK star probe (SFK Technologies, Cedar Rapids, IA). Seventeen carcasses were not able to be identified for the 24 h postmortem measurements. At approximately 24 h postmortem, subjective loin color (NPPC, 1999), marbling (NPPC, 1999), muscle firmness (NPPC, 1991) and carcass conformation (NPPC, 1999) were evaluated and gender was recorded. Objective loin eye color was characterized using the Minolta CR-300 (Minolta Camera Co., Japan, illuminant D65 and 0° observer) at approximately 24 h. An ultimate pH measurement was taken with the SFK star probe at approximately 24 h post-mortem.

Results and Discussion: Killfloor data by packing plant are found in Table 1. Muscle conformation average scores were consistent for all downer pigs ranging from 2.10 at Plant A to 1.98 at Plant D with an overall average of 2.14. More heavily muscled pigs are thought to be more suseptable to acute acidosis when undergoing a stress event

because of a greater total muscle mass compared to lighter muscled pigs. The pH measurement taken at approximately 45 min post mortem averaged ranging from 6.42 to 6.22 with an overall average of 6.32. Average lung score values were consistent for Plants A, B, and C with Plant D being slightly numerically higher with an overall average of 1.67. Evaluations were conducted at Plant D in the latter part of October. The seasonality of Plant D could explain the higher lung score value. Animals with a high lung score value were exhibiting signs of pneumonia or some other factor causing a decrease in lung capacity. This may impede their respiratory process and hinder their ability for the removal of carbon dioxide from their system when undergoing a stressful event such as transportation or handling. These events could then lead to acute acidosis causing the animal to become immobile and classified as a downer. All four plants had a numerically higher percentage of barrows that were classified as downers.

Meat quality characteristics are shown in Table 2. Subjective loin color from downer pigs averaged higher than 3.5 for all plants on the NPPC scale (1999) with an overall average of 3.75. Average marbling and firmness were more variable suggesting a variety of genetics and management practices being represented. Overall averages were 2.72 for marbling and 3.16 for firmness. Minolta L* average values from all plants were lower than 46.75 with an overall average of 45.72 which in addition to the subjective color score test indicates a darker color. Figure 1 shows the distribution of the downer pigs ultimate pH. Final pH values from downer pigs averaged 5.90 or higher and drip loss averaged 2.37% or less with an overall average of 6.00 and 1.91% respectively.

Several factors can influence ultimate pH. Decreasing muscle and liver glycogen prior to slaughter is assocoiated with improvements in pork quality. According to Bidner, (2003) environment, handling and slaughter practices can all contribute to ultimate pork quality. These factors can all be associated with stress on the animal. Stress is a factor that can decrease muscle glycogen. McVeigh et al. (1982) reported that muscle glycogen was decreased by 41 % when young bulls were stressed compared to the controls. Warriss (1982) and Wittmann (1994) both reported decreased muscle glycogen levels when pigs were subjected to the stress of feed withdrawal for a 48 h or 24 h time frame, respectively compared to the controls. Pigs that were observed fighting during the transportation and/or lairage process were reported to produce higher ultimate pH values in the *adductor* and *semimembranosus* compared to the controls (Warris and Brown, 1985). Downer pigs undergo a great deal of stress prior to slaughter. Depending upon how long before the animal is slaughtered, the animal could deplete its glycogen stores before slaughter. Therefore the animal would have a reduction in muscle glycogen which would likely cause a darker color, an increase in water-holding capacity and ultimate pH (Bidner, 2003).

A small percentage of animals exhibited pork that was very pale soft and exudative. It is the authors' opinion that this small percentage of pigs became downers during the final drive from the lairage pen to the stun line causing them to have a high short term stress just prior to slaughter. The short term stress could influence a number of physiological responses in the animal. One would be an increase in the pig's body temperature causing glycolysis and metabolism to occur at a faster rate than normal which would result in more lactate being produced and lower muscle pH (Hambrecht et al., 2003). Another possibility is this short term stress could activate all metabolic systems and cascade mechanisms resulting in a pH decline that occurs more rapidly

than normal causing an increase in protein denaturation. All responses can result in a final product that is of lower quality.

Lay Interpretation: Downer animals tended to produce pork that was dark in color, exhibited a relatively high ultimate pH and low drip loss with no relationship between downer animals and lung score value.

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Table 1. Killfloor data by plant.

	Plant A	STD	Plant B	STD	Plant C	STD	Plant D	STD	Overall	STD
Number of animals	44		66		76		60		246	
Muscle conformation score[a]	2.10	0.44	2.10	0.43	2.15	0.39	1.98	0.65	2.14	0.42
45 min pH	6.42	0.25	6.38	0.28	6.22	0.33	6.25	0.24	6.32	0.29
Lung score[b]	1.56	0.70	1.57	0.69	1.60	0.68	1.98	0.65	1.67	0.70
Gilts, %	34.88		40.32		34.78		45.28		38.77	
Barrows, %	65.12		59.68		65.22		54.72		61.23	

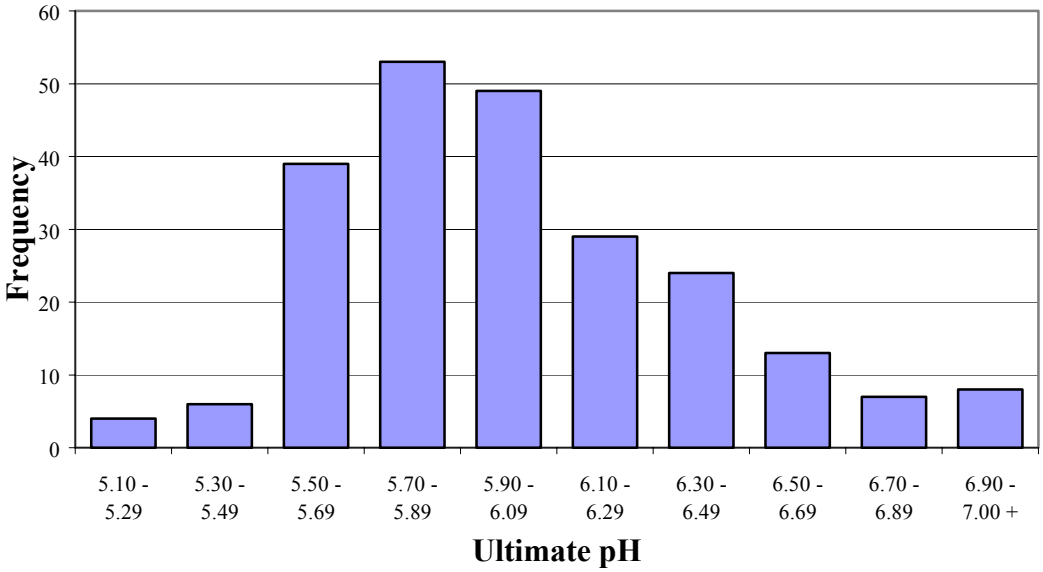
[a] NPPC, 1999 (1-3)
[b] 1-3 scale

Table 2. Quality characteristic measurements from downer pigs.

	Plant A	STD	Plant B	STD	Plant C	STD	Plant D	STD	Overall	STD
Color[a]	3.78	0.79	4.00	0.89	3.55	1.03	3.72	0.66	3.75	0.89
Marbling[b]	2.07	0.69	3.29	1.15	2.68	1.43	2.68	0.89	2.72	1.19
Firmness[c]	2.80	0.66	3.75	0.98	2.88	0.90	3.19	0.48	3.16	0.88
Minolta L*	46.05	4.15	43.81	4.22	46.60	6.18	46.31	3.41	45.72	4.89
Minolta a*	7.43	1.24	7.80	1.49	7.95	1.89	6.78	1.58	7.53	1.68
Minolta b*	2.54	1.07	3.20	1.37	3.69	2.00	3.18	1.11	3.21	1.56
Final pH	6.20	0.35	6.00	0.41	5.96	0.41	5.90	0.32	6.00	0.39
Drip loss, %	1.97	1.63	1.42	0.02	2.37	0.03	1.74	1.77	1.91	2.00

[a] NPPC, 1999 (1-6)
[b] NPPC, 1999 (1-10 represents % intramuscular fat)
[c] NPPC, 1991 (1-5)

Figure 1. Distribution of ultimate pH of downer pigs



Average pH = 6.00
StDev = 0.39