Good Pig Handling Improves Pork Quality

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Observations and interviews in sixteen pork slaughter plants in Europe, United States, Canada, and Mexico indicated that good handling procedures will reduce PSE, bloodsplash and death losses. In five plants the author worked intensively to (1) redesign handling facilities to improve pig movement, (2) stop rough handling and greatly limit electric prod usage, and (3) schedule trucks to avoid slaughtering pigs immediately after arrival. These changes reduced visually assessed PSE, bloodsplash, petechial hemorrhages, and death losses. Excitement shortly before stunning can increase the incidence of PSE in stress resistant pigs (Barton-Bade, 1985). Calkins et al (1980) found that elimination of electric prods reduced bloodsplash. The prods in the plant Calkins surveyed were connected to a transformer and the current passed through the animal's feet to ground. Reducing the voltage in this type of prod from 60 to 16 volts reduced the rate of broken aitch bones in another plant. A battery operated prod may be less damaging because the current passes between two points which are close together. A report from a third plant indicated that eliminating battery operated prods in the stockyards reduced both PSE and petechial hemorrhages.

At four plants, PSE levels determined visually the next day, were reduced by the author's presence at the stunning race. While the pig handlers were being watched they handled the pigs more carefully, and reduced electric prod usage. Observations in two other plants illustrated the beneficial effects of careful quiet handling. At the first plant, rough handlers were replaced with two new people who had no previous experience with pig handling. The new handlers were taught to be gentle and to seldom use a prod. PSE levels have been consistently lower with the new handlers. At the other plant the regular pig driver in the stockyard went on vacation. This man had a reputation for being rough. While he was gone the death loss dropped significantly.

At one plant the author worked with them on an intensive meat quality improvement program. The program included (1) gentle handling, (2) a rest period of at least two hours prior to stunning, (3) showering pigs during hot weather, (4) shorter stunning to stick interval, and (5) improved chilling practices. These procedures reduced bloodsplash and death losses. Pork unsuitable for export to Japan dropped from a high of 60 to 80% to 45 to 55%. The incidence of meat which was watery and soft, dropped from 15 to 20% to 10 to 15%. The percentages of watery soft pork fluctuated greatly depending on the weather. When the plant management made a maximum effort to reduce PSE, watery soft pork levels were 2 to 5% during the winter. In the spring and summer, levels increased to 10 to 20% when the temperatures fluctuated.

Resting pigs two to four hours before stunning reduced PSE in four different slaughter plants. Slaughtering pigs immediately after arrival had a very detrimental effect on meat quality in one plant. Previous research has shown that a short rest, (Malmfors, 1982) and showering will reduce PSE (Smulders et al, 1983). A short stunning to sticking interval will reduce bloodsplash (Burson et al, 1983), van der Wal, 1978). It is likely that the main benefit of a short rest is to allow a pig to settle down and lower its body temperature. Sayre et al (1963) found that high environmental temperatures shortly before slaughter increased PSE in Hampshires and Poland Chinas but the meat of Chester Whites remained firm. Voogd and Carr (1982) report that in Landrace sired crossbred pigs scaulded carcasses were softer and had lower water binding capacity compared to skinned carcasses.

Discrepancies Between Studies

The differences between pig breeds and genetic lines may account for many of the discrepancies between different studies on the variables which cause PSE. In Halothane negative pigs the susceptibility to PSE can vary between individuals (Lawrie, 1979). Monin and Sellier (1985) state that stress resistant Hampshire pigs have poor quality due to a low ultimate pH. In traditional PSE the pH falls rapidly. Discrepancies between studies may also be able to be explained by dietary factors such as a selenium deficiency or differences in muscle fiber types. The two types of muscle fibers respond differently to the physical exertion of fighting and stress due to an injection of adrenalin (Lacourt and Tarrant, 1985).

Improper use of statistics may also account for discrepancies between studies. Meat quality data is highly variable and it is difficult to get positive results with small sample sizes. One well known effect of stress is to increase variability of performance (Curtis, 1981). I have read papers on meat quality where the averages were not significantly different but the variance between the two treatments was significantly different. The conclusion that the experimental treatment had no effect was wrong. Standard error of the mean should be included on all meat quality research data so that readers can see the variability in the data. The location of measurements for meat quality can affect results. Fiber optic probe measurements can vary greatly depending on the location of the measurement on the longissimus dorsi (Lundstrom and Malmfors, 1985 and P. Barton-Gade, personal communication).

Meat Quality Survey in One Slaughter Plant

Method - The management at one slaughter plant in northeast North America kept careful records on the incidence of visually assessed PSE, petechial hemorrhages (salt and pepper speckle), and broken backs during the months of February, May, June and July of 1984. A high percentage of the pigs had Landrace breeding and they were susceptible to petechial hemorrhages. The slaughter floor was located on the third floor and the pigs had to walk up a long ramp. The survey was conducted to determine if improved procedures would have a beneficial effect on meat quality.

Groups of 200 or more pigs from the same farm of origin, if possible, were assigned to one of two treatments on each day data was recorded. This procedure was repeated 2 to 4 times each week during February, May, June and the first half of July. Data on broken backs, petechial hemorrhages and visually assessed PSE was collected on 32 groups. Additional groups had data collected for broken backs and petechial hemorrhages.

Control Treatment - Overnight rest in the lairage on the first floor and 5 to 15 minutes of rest prior to stunning on the third floor. Electric stunning time 4 to 6 seconds. Electric prods wired to a transformer were used to drive the pigs into the restrainer conveyor for stunning. The electrical current from the prod grounded out through the pig's feet.

Special Treatment - Overnight rest at the top of the ramp on the third floor prior to stunning. Stunning time 3 to 4 seconds and no electric prods were used.

High voltage head to back stunning was used on all the pigs in the survey. The stunner was set at 450 volts and 1.25 amps. All pigs were held in a restrainer conveyor. Petechial hemorrhages and broken backs were assessed visually after the pig carcasses were split. Carcasses were examined for petechial hemorrhages in the fat and on the membranes surrounding the longissimus dorsi (loin) by separating the fat from the muscle with a knife. PSE was assessed visually the next day in chilled loins by a grader blind to experimental treatment.

Results - The special treatment pigs had significantly fewer broken backs 4.41% compared to 8.83% (Table I). This result can probably be attributed to the difference in stunning time. Within the special treatment pigs, animals with longer stunning times had more broken backs. The special treatment pigs also had significantly lower levels of petechial hemorrhages (Table II). Stunning time differences within the special or control treatment had no statistically significant effect on petechial hemorrhages. The improvement in the special treatment group can probably be attributed to the elimination of electric prods or increased rest. The special treatment pigs also had significantly lower levels of PSE (Table III). Table IV illustrates that there is no relationship between the incidence of PSE and the incidence of petechial hemorrhages.

Discussion - It was not possible to look at stunning time and PSE. The improvement in the special treatment group can probably be attributed to the increased rest and the elimination of prods. An experiment conducted at another North American plant indicated that a short rest at the top of the ramp was most beneficial to reduce PSE. This plant also had their slaughter room located on the third floor and the pigs had to walk up a long ramp. Pigs from the same farm of origin were divided into three groups. Group 1 - slaughtered shortly after arrival, no rest after climbing the big ramp. Group 2 - rest overnight in lairage on the first floor, 2 1/2 hours of rest at the top of the big ramp prior to stunning. Group 3 - Rest overnight in the lairage, no rest after climbing the big ramp. Group 2 which had 2 1/2 hours of rest after climbing the ramp had less visually assessed PSE. PSE was increased in pigs which were slaughtered immediately after the physical exertion of climbing the ramp.

The data for both PSE and petechial hemorrhages was extremely variable. Weather appeared to be a major factor in increasing the variability of the data. The range for petechial hemorrhages varied from 4% to 36% for special treatment pigs and 15% to 40% for the controls. PSE ranged from 1% to 33% in special treatment pigs and 2% to 32% for controls. The large number of pigs in the survey made it possible to demonstrate that differences in handling significantly affected the incidence of PSE.

During the survey petechial hemorrhages doubled when one side of the conveyor restrainer broke. The stationary side of the restrainer rubbed and stretched the skin of the pigs. mechanical stretcing of the tissues was probably responsible for the increased petechial hemorrhages. Stretching the skin shortly before stunning will increase petechial hemorrhages in sheep (Gilbert and Devine, 1982).

Observations in many slaughter plants indicate that some groups of pigs are more excitable than others. Excitable pigs are more difficult to drive and more prodding is often required to keep a high speed line supplied with pigs. It is possible that excitable pigs may be more likely to have meat quality problems. Excitability in pigs is determined by both genetic and environmental factors. Recent research by Grandin et al (1986) indicates that providing pigs raised in confinement with suspended rubber hoses to chew on during fattening and a person entering the pen once a week reduced excitability. Two observers blind to experimental treatment rated control animals as more excitable and easily startled. Control pens were never entered by people for 60 days.

Conclusions - The survey indicated that changing procedures improved meat quality. Further studies need to be conducted to separate out the variables of stunning time, rest and prods. Informal observations and the results of this survey incidate that when plant management makes a strong commitment to improve pig handling methods, meat quality will improve. Significant improvements can be made by simple changes such as (1) elimination of rough handling, (2) reducing or eliminating electric prod usage, and (3) scheduling trucks to allow pigs a short rest period to settle down and cool off and avoiding excessive physical exertion and excitement shortly before stunning.

REFERENCES

Barton-Gade, P. 1985. Developments in the pre-slaughter handling of slaughter animals. Proceedings European Meeting of Meat Research Workers. Paper 1:1 pp. 1-6. Albena, Bulgaria.

Burson, D.E. 1983. Effects of stunning method and time interval from stunning to exsanguination on bloodsplash in pork. J. Anim. Sci. 57: 918-921.

Calkins et al. 1980. Incidence of bloodsplashed hams from hogs subjected to certain antemortem handling methods. J. Anim. Sci. 50:15, Suppl. 1 (Abstract).

Curtis, S.E. 1981. Environmental management in animal agriculture, Iowa State University Press, Ames, Iowa.

Gilbert, K.V. and Devine, C.E. 1982. Effect of electrical stunning method on petechial hemorrhages and on blood pressure of lambs, Meat Sci. 7:197-207.

Grandin, T. et al. 1986. Richness of pig's environment affects handling in chute. J. Anim. Sci., Supl. 1 64: In Press (Abstract).

Lacourt, A.; and Tarrant, P.V. 1985. Glycogen depletion patterns in myofibres of cattle during stress. Meat Sci. 15:85-100

Lawrie, R. A. 1979. Meat Science, Third Edition, Oxford, England, Pergamon Press.

Lundstrom, K. and Malmfors, G. 1985. Variation in light scattering and water holding capacity along porcine longissimus dorsi muscle. Meat Sci. 15:203.

Malmfors, G. 1982. Studies on some factors affecting pig meat quality. Proceedings European Meeting of Meat Research Workers, pp. 21-23, Madrid, Spain.

Monin, G. and Sellier, P. 1985. Pork of low technological quality with a normal rate of muscle pH fall in the immediate post-mortem period: The case of the Hampshire breed. Meat Sci. 13:49-63.

Sayre, R.N. et al. 1963. J. Food Sci. 28:292.

Smulders, F.J.M. et al. 1983. Pre-stunning treatment during lairage and pork quality. In: Eikelenboom G. ed. Stunning of animals for slaughter. Dordvecht, The Netherlands. Martinus Nijhoff, pp. 90:95.

van der Wal, P.G. 1978. Chemical and physiological aspects of pig stunning in relation to meat quality, a review. Meat Sci. 2:19-30.

Voogd, E.C. and Carr, T.R. 1982. Slaughter factors which affect meat quality. University of Illinois. Swine Research Reports, Champaign-Urbana, Illinois.

Table I

BROKEN BACKS

	Special Treatment		Control Treatment	
	N = 15 groups	N = 41 groups	N = 15 groups	N = 38 groups
Stun time	3 sec.	3-4 sec.	4-5 sec.	4-6 sec.
	3.19%[a] ± 0.48	4.85%[b] ± 0.34	7.70% ± 1.19	9.37% ± 0.63
Mean 56 groups	4.41%[c] ± 0.31		Mean 53 groups	8.83%[d] ± 0.59
Mean balanced for stun time	4.02%		Mean balanced for stun time	8.54%

Means with subscript a and b (P< .05) significantly different

Means with subscript c and d (P<.001)

Table II

PETECHIAL HEMORRHAGES (SPECKLE)

	Special Treatment		Control Treatment	
	N = 18 groups	N = 41 groups	N = 15 groups	N = 60 groups
Stun time	3 sec.	3-4 sec.	4-5 sec.	4-6 sec.
	13.23% ± 1.23	11.53% ± 1.24	25.52% ± 1.94	22.82% ± 0.87
Mean 56 groups	12.02%[c] ± 0.94		Mean 75 groups	24.15%[d] ± 0.71
Mean balanced for stun time	12.38%		Mean balanced for stun time	24.17%

Means with subscript c and d (P<.001) significantly different

Table III

VISUALLY ASSESSED PSE IN LOINS

	Special Treatment	Control Treatment
	N = 32 groups	N = 32 groups
Mean	$18.26\%^a \pm 0.57$	$15.00\%^b \pm 0.82$
	P<.001	

Table IV

RELATIONSHIP BETWEEN PSE AND HEMORRHAGES

Percent with both PSE and hemorrhages	Percent with PSE only and no hemorrhages
N = 24 groups	N = 24 groups
$10.07\% \pm 1.42$	$10.18\% \pm 1.77$

No significant differences