

Welfare of cattle during slaughter and the prevention of nonambulatory (downer) cattle

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I am often asked whether cattle know they are going to die at a slaughter plant. Most people assume that animals experience things the same way we do. Early in my career, I answered this question by observing cattle being moved through chutes at a feedlot for vaccinations and then on that same day watching cattle being moved up the chute at a slaughter plant. I observed that their behavior was the same in both places. If they knew they were going to die, they would become more agitated at the slaughter plant. Improving handling and keeping animals calm by using behavioral principles will help improve cattle welfare during slaughter.

The things that scare cattle are not the same things that scare us. Little details that people do not notice frighten cattle. A paper cup dropped in the entrance of the chute will make cattle balk and turn back. Bright contrasts of light and dark or a small swinging chain on a gate will often make cattle stop. They are also reluctant to enter dark places. Adding a light at the entrance of a restrainer often makes it possible to greatly reduce the use of electric prods, because the cattle become willing to enter.¹

Remove Distractions and Reduce Noise

At 1 plant, the employees had done extensive experimentation with lighting to improve cattle movement into the stunning box. Ninety-six percent of cattle walked into the box without being touched. Prior to changes in lighting, an electric prod was required to move animals that constantly balked and backed up.

It is impossible to have good animal welfare if cattle are constantly balking and refusing to move. Sometimes something as simple as moving a ceiling lamp will improve animal movement, because sparkling reflections on a wet floor often disappear when a lamp is moved. It is necessary to get into the chute at a cow's level to identify things that might scare cattle. Air drafts blowing in the faces of approaching cattle will also cause balking and refusal to move. Loud noises from equipment, such as air hissing, should be eliminated. Further information on eliminating distractions that impede animal movement can be found in other papers I've written.^{1,3}

Rapid movement is another thing that can agitate cattle. Cattle with nervous excitable temperaments were more likely to flinch and become highly agitated when they were exposed to the sound of a ringman yipping and quickly swinging his arm at an auction.⁴ The sound of people yelling and screaming is stressful and aversive to cattle, and shouting at cattle is highly aversive.⁵ Canadian researchers found that the sound of people yelling and whistling raised animals' heart rates more than the sound of a gate slamming.⁵ I have

observed that plants where cattle or pigs are walking quietly up the chute have quiet people moving the animals. There is no yelling or whistling. Cattle that remain calm are easier to move and less likely to balk at small distractions. Cattle should be moved in small groups, and the crowd pen that leads to the single file chute should be only half full.

Recognizing the Importance of Behavior

One of my biggest frustrations has been getting people to fully recognize that using behavioral principles is more humane and efficient than using force. If an animal balks and refuses to move, we should find and remove the thing that it is afraid of instead of prodding it harder with an electric prod.

There are now 25 center track conveyor restrainers that I have designed in use in beef slaughter plants.^{3,6,7} In 5 (20%) plants, the welding shop or equipment installers removed parts from the system that served important behavioral functions. Cattle behavior is greatly influenced by what cattle can see. The welders could not understand why extra metal sheeting was needed to prevent incoming cattle from seeing that the restrainer was mounted 10 ft (3 m) above the floor. They thought they were doing the plant a favor by removing the extra metal. When the false floor was removed, most animals had to be prodded with an electric prod to induce them to enter the restrainer. When I reinstalled it, 95% of cattle entered when tapped on the rump. Ruminants perceive depth and respond to the visual cliff effect.⁸ The false floor provided the visual illusion of a solid floor to walk on.

Recently, I visited the 25th restrainer system to replace the false floor and another metal shield that prevented cattle from seeing out until they were fully restrained. The plant manager called me because the new system worked poorly and cattle were constantly balking and refusing to enter. A few pieces of metal that control what the cattle see are the difference between a system in which cattle stay calm and a system where they become agitated. In 4 plants, extending a metal cover that had been shortened by the welding shop resulted in calm cattle that rode the conveyor quietly. Extending this cover prevented cattle from seeing out until their back feet were completely off the entrance ramp. Even when the welding shop personnel read my papers, they often did not believe that some extra metal sheeting could make such a difference. People need to learn that use of behavioral principles improves efficiency and animal welfare.

Effect of Welfare Audits

Over the years I have observed that excessive use of electric prods or other bad practices can sometimes become normal because a plant has no standard of comparison. In 1996, I surveyed 10 beef plants for the USDA.⁹ Only 3 beef plants were able to stun 95% or

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more cattle on the first attempt, and only 1 plant stunned 100% correctly. One plant hung a fully conscious live animal on the bleed rail. I was appalled at the abusive practices that occurred in 2 of these plants. At 1 plant, employees paralyzed bulls with an electric prod even though they knew I was doing a survey for the USDA. Bad practices had become normal. In every plant, electric prods were used on a high percentage of cattle.

In 1999, the McDonald's Corporation audited 41 US beef plants on stunning and handling practices. I audited 27 of these plants and trained the McDonald's auditors. There was great improvement in beef stunning in 1999, compared with the results of the 1996 USDA survey.^{9,10} The percentages of cattle stunned with 1 shot from a captive bolt stunner were: 100% at five (12%) plants, 99% at 10 (24%) plants, 98 to 95% at 22 (54%) plants, 94 to 90% at 2 (5%) plants, and < 90% at 2 (5%) plants. All cattle where the first shot missed were immediately restunned prior to skinning or limb removal. In 1 (2%) beef plant, a sensible animal was hung on the bleed rail. Nineteen pork plants were audited. Ninety percent (17) rendered 100% of pigs completely insensible. Two (10%) plants had 1 and 5% of pigs, respectively, that showed possible signs of returning to sensibility on the bleed rail. The signs observed were blinking and righting reflexes. All animals were insensible prior to scalding or skinning. The behavior of the employees in many plants had improved now that a major customer was auditing handling and stunning. When a large plant was removed from the approved supplier list, the industry realized that they had to take animal welfare seriously. During 2000, handling and stunning has further improved in most plants. Several plants with problems improved after being temporarily suspended from the approved McDonald's supplier list. Major meat-buying customers such as restaurants and supermarkets can bring about great improvements in animal welfare.¹⁰

I observed that electric prods in many plants had been replaced by other driving aids such as flags, plastic bags, and plastic paddle sticks. It is important to get electric prods out of people's hands as their primary driving tool. If an animal balks and refuses to move, the electric prod can be used, but it should be put back down after the stubborn animal is moved. In plants that have worked to remove all the distractions discussed previously, it was easy to move 95 to 100% of cattle without an electric prod. During 2000, 20 of 27 (74%) beef plants had eliminated electric prods in the crowd pen that leads to the single file chute, and 19 (71%) used an electric prod on only 0 to 5% of cattle to move them into the stunning box or restrainer. Half of the pork plants had eliminated electric prods in the crowd pen, and electric prod use in the single chute was reduced. There were also improvements in the attitude of the handlers when yelling was stopped and the electric prod was no longer the primary driving tool. Now, instead of yelling, a handler would touch a steer in the rump, saying "come on boy." Removing electric prods from people's hands helped foster a more caring attitude toward animals.

Line Speed Problems

In a few plants, there are still some problems with high line speeds that overload stunner operators.

When an operator is overloaded, the percent of cattle or pigs that are stunned correctly will decrease. I have observed this problem in cattle and pork plants. Operator overload develops within a narrow range of speeds. When overload develops, the operator's performance will suddenly drop. An increase in only 10 to 15 pigs or cattle/h may be all it takes to overload a particular system. The maximum speed at which a particular plant will operate properly is a function of equipment design and staffing level. For example, my data indicate that a beef plant operating at 330 cattle/h with a single overloaded operator stunned only 85% of cattle correctly with 1 shot from a captive bolt stunner. When additional ergonomic handles were attached to the heavy pneumatic stunner, 1 stunner operator was able to stun 97% of cattle with the first shot. In this plant, all cattle in which the first shot missed were immediately restunned and rendered insensible before hanging on the rail. Sometimes a small design change will remove operator overload. In other plants, the line will have to be slowed down.

Animal Welfare and Stunning

A complete review of all stunning methods is beyond the scope of this presentation, but scientific research clearly shows that captive bolt and electrical stunning methods will instantly render animals insensible and unconscious. There have been several reviews of this research.¹¹⁻¹⁵ Stunning equipment must be properly maintained and used correctly to be effective.

Unfortunately, however, CO₂-induced stunning is not instantaneous, and there has been controversy within the scientific community over whether animals adversely react to CO₂ gas. Some studies¹⁶⁻¹⁹ reveal evidence of aversion; others do not. My own observations lead me to believe that some pigs can be anesthetized peacefully with CO₂, whereas others frantically attempt escape when they first smell the gas (genetic factors appears to influence the reaction).¹⁷ For example, purebred Yorkshire pigs are anesthetized peacefully, whereas other strains become agitated.¹⁶⁻¹⁸ For Landrace Large White cross pigs, breathing either 60 or 90% CO₂ was less aversive than a shock from an electric prod.²⁰ Carbon dioxide causes highly variable reactions in humans.²¹⁻²³ It is my opinion that CO₂ is suitable for some types of pigs but causes problems with other types. In particular, CO₂ experiments should be conducted using stress-susceptible pigs. The potential of other gases, such as argon, for use in stunning is also worthy of investigation, but the cost may be prohibitive.

Assessing Insensibility

Recently, TV newscasts showed undercover video taken in different plants. This video showed a live animal hung on the rail in 1 plant and reflexes that were mistakenly thought to indicate fully conscious animals in 2 others. People need to learn how to assess insensibility. An insensible animal will often have limb reflexes. A properly stunned animal will have wide open eyes, a floppy head, no righting reflex, a limp flaccid tongue, no blinking, and no eye reflexes in response to touch.^{11,12} When hung on the rail, the back should be straight. Electrical and captive bolt stunning create spasms immediately after stunning, so it is best to assess insensibility after these spasms cease. The only

exceptions to this recommendation are pigs stunned with an electric stunner where the amperage setting is too low. These pigs may blink immediately after stunning, because the stunning current was not sufficient to induce a grand mal seizure, which is required to induce insensibility. Market weight pigs stunned with the correct setting of 1.25 A should be assessed after bleeding to make sure they do not recover.

Continuous Auditing is Essential

The McDonald's audit uses American Meat Institute Guidelines.⁹ Continuous auditing by plant management is required to maintain handling quality. It is just like microbiologic testing for food safety. You manage things that you measure. Continuous monitoring and measurement is required to maintain a high standard. Handling has a tendency to become rough and careless unless continuous monitoring is done. Even when financial losses are documented, such as increased pale soft exudative pork or more bruises in cattle, handling practices will deteriorate unless auditing is done on a regular basis. My objective scoring system for handling and stunning at slaughter plants is simple so that it can be easily implemented.⁹ It was essential to identify important critical control points but not have too many things to measure. The variables measured are: 1) percentage of animals stunned correctly on the first attempt, 2) percentage of animals insensible on the bleed rail, 3) percentage of cattle that vocalize (moo or bellow) during movement through the chute and restrainer, 4) percentage of animals for which an electric prod is used, and 5) percentage of animals that slip or 6) percentage that fall.²⁴ A minimum of 100 animals are scored in large beef and pork plants, and 50 animals are scored in small plants with a line speed of < 100 head/h.

To keep the auditing process simple, each variable is scored on a yes or no basis for each bovid or for each stunning cycle in pigs. For example, vocalized—yes or no, use of electric prod—yes or no. Attempting to determine the intensity of cattle or pig vocalization is not practical under commercial conditions.

Vocalizing Animals are Stressed

Vocalization in cattle (moos or bellows) and pigs (squeals) are correlated with physiologic measures of stress.²⁵⁻²⁸ Vocalization scoring is a simple way to identify problems with excessive electric prod use or other problems with equipment, handling, or stunning. In 99% of cattle, vocalization was associated with an obvious aversive event such as missed stuns, slipping, falling, electric prod use, or excessive pressure from a restraint device.^{9,29} Isolating a single bovid in a stunning box or race for too long will also cause it to vocalize. Beef plants with careful quiet handling practices and minimal electric prod use will have \leq 3% of cattle vocalizing. Plants where cattle constantly balk and refuse to enter a stunning box or restrainer will have high vocalization percentages ranging from 7 to 17%, because an electric prod was required to move them.¹⁰ In 1 plant, a light installed on a dark restrainer entrance caused an 8% vocalization percentage to drop to 0%, because electric prod use was reduced. Installing a false floor in a conveyor restrainer to eliminate the visual cliff effect resulted in vocalization percentage dropping from 9 to 0% in 1 plant and 17 to 2%

in another plant. In a fourth plant, excessive pressure exerted by a hydraulic head restraint caused 23% of cattle to vocalize. When pressure was reduced, the percentage of cattle that vocalized was reduced to zero.

Ritual Slaughter

When ritual slaughter (Kosher, Jewish, or Halal Muslim) is being discussed, the variable of throat cutting without stunning must be separated from the variable of how the animal is restrained and handled prior to and during slaughter.¹¹ I have observed that the abusive and cruel restraint methods used in some ritual slaughter plants are a bigger issue than the ritual slaughter itself. In plants where live cattle were restrained for kosher slaughter by shackling and hoisting by 1 rear limb, they could be heard bellowing in the office and the parking lot. I estimate that the percentage of cattle vocalizing in some of these dreadful plants was almost 100%.

Restraint equipment that holds cattle in a comfortable upright position has been available for more than 40 years.^{11,30-32} There are also restraining boxes available that rotate an animal from a standing position onto its back. Rotating boxes are much better than shackling and hoisting live animals, but they are probably more stressful than the best upright restraint. Restraint equipment must be designed and operated correctly. Calm animals are easier to restrain. If cattle vocalize when they are restrained, it is likely that excessive pressure is being applied to their body. To minimize stress, ritual slaughter must be done immediately after the animal is restrained. During work on restraint systems at 4 different kosher slaughter plants, I developed 4 behavioral principles of restraint:

- 1) Block vision—The animal must see a lighted place to move into, but solid panels or curtains should be used to prevent it from seeing people.
- 2) Slow steady movement—Parts of an apparatus that press against an animal must move with slow steady movement. Sudden jerky motion scares.
- 3) Optimum pressure—A device must hold an animal tightly enough for it to feel held but not so tightly that it causes discomfort.
- 4) Do not trigger righting reflex—The device should hold an animal in a comfortable upright position. If the animal slips or feels unbalanced, it may struggle.

I estimate that 5 years ago only 10% of large cattle used for kosher meat in the United States were shackled and hoisted. Today the percentage of kosher cattle that are shackled and hoisted has increased. Since the world beef market was opened up, kosher beef from South American countries such as Uruguay is now entering the United States. Shackling and hoisting is commonly used in Uruguay. This year, I talked to an international beef buyer who was so appalled at the cruel treatment of cattle he observed in Uruguay that he refused to buy beef from plants that shackled and hoisted live cattle. The Israeli magazine *Ha'aretz* also has an article³³ about bad conditions in Uruguay.

Another problem area is the growing Halal market in the United States. Some of these plants are small locker type plants, and the Muslim slaughterers often have been given no training. Fortunately, most Muslim religious authorities will accept stunning. In New

Zealand cattle are electrically stunned for Halal slaughter, and I have observed Halal slaughter in Australia where cattle were stunned with an impact mushroom head nonpenetrating captive bolt. Stunning prior to Halal slaughter will improve animal welfare.

Preventing Dairy Cow Downers

The best way to improve the welfare of nonambulatory (downer) cattle is to prevent them. Selling old cows when they are still fit for transport and handling is the single most important way to prevent downers. I have observed that about 10% of dairies are responsible for 90% of downers. Breeding cattle with strong sound feet and limbs is essential. There are disturbing signs that some dairy cattle breeders are selecting for milk production at the expense of their cows.

The percentage of downer cattle has increased. An audit of 21 cow slaughter plants by Smith et al^{34,35} indicated that the percentage of nonambulatory dairy cows arriving at plants had increased. In 1999, 1.5% of arriving cows were nonambulatory, and in 1993, only 1.1% were nonambulatory.^{34,35}

In dairy and beef plants, the percentage of cows arriving with arthritic joints has tripled. In 1993, 4.7% of cull dairy cows had arthritic joints, and in 1999, the percentage increased to 14.5%.^{34,35} Lameness is increasing in dairy cows, and lame cows are more likely to become nonambulatory. Conformation of feet and limbs is heritable and will affect the incidence of lameness.^{36,37} Indiscriminate selection for milk production may reduce fitness, because milk production in dairy cows is more affected by genetic selection than improved management. A survey³⁸ conducted in Wisconsin and Minnesota indicated that 13.7 to 16.7% of all dairy cows were lame. A dairy veterinarian in Florida told me that, in his opinion, lameness was the number 1 health issue in the year 2000. John Webster from Oxford University estimates that during 1999, 21% of British dairy cows were lame.^b

Pushing young heifers into production too quickly can also contribute to increased lameness. Heifers that gain > 800 g/d have more hemorrhages in the soles of their feet. These hemorrhages indicate that a heifer's feet have been permanently damaged before the heifer has even reached maturity.³⁹

The percentage of dairy cows that are emaciated on their arrival at slaughter plants has increased by 20%, from 4.8% in 1993 to 5.4% in 1999.^{34,35} Cows that leave the dairy in an emaciated condition are more likely to fall down in trucks and become nonambulatory.

There are 2 factors that have probably contributed to decline in body condition: indiscriminate use of recombinant bovine somatotropin (rBST, also known as growth hormone) and genetic selection for increased milk production. Two studies^{40,41} indicate that giving cows rBST reduces body condition score; body condition decreases with increasing dose. Dairy managers who use rBST must carefully monitor body condition. A California truck driver who handles downer cows from dairies told me that dairies using rBST have more downers. It is my opinion that high milk prices contributed to the indiscriminate use of rBST in the late 1990s, but rBST used in moderation probably does not increase risk for nonambulatory cattle. I visited a well-managed 2,000-cow dairy that used

a slow release form of rBST given every 2 weeks. More than 99% of cows in that dairy were in good body condition.

There are other management factors that may contribute to dairy cows becoming nonambulatory. Many dairies in the West use bulls instead of artificial insemination. If body condition declines, a cow is more likely to be knocked down when the bull mounts. Health problems can also result in downer cows. Some cows with severe mastitis may become downers. Genetic selection for increased milk production is related to increased mastitis.^{42,43} Further research has revealed that selection based strictly on milk yield increases veterinary expenditures and cow health problems.⁴⁴

Poor management and facilities can also increase risk of downers. Nonslip flooring is essential to prevent cows' falling. Quiet careful handling can also help prevent falls. I have observed downer cows that arrived at a slaughter plant with swollen limbs because of careless hoof trimming. Paying hoof trimmers on a piecework basis may encourage better work. People who work with animals should be paid based on quality rather than the quantity of their work.

Beef Cattle Welfare

The incidence of downer beef cattle has declined, compared with dairy cows. The National Market Cow and Bull Audit indicated that the percentage of nonambulatory beef cows arriving at a slaughter plant was 1.0% in 1993 and 0.7% in 1999.^{34,35} Unfortunately, the incidence of arthritic joints and severely lame cows increased from 2.9% in 1993 to 11.9% in 1999.^{34,35} This indicates that producers may be putting less emphasis on selecting cows for sound feet and limbs. For dairy and beef cattle, selection for sound feet and limbs will prevent many cows from becoming downers. Selection strictly for productivity is likely to be detrimental to animal welfare.

I have observed that some beef cattle with European continental genetics are more excitable than cattle raised 20 years ago. They are more likely to balk at the distractions that were discussed previously and to become agitated during handling. Cattle with excitable temperaments are more likely to panic when suddenly confronted with new experiences. Feedlots and slaughter plants have reported difficulties handling beef cattle that have originated from ranches where they were only handled on horseback. When people on foot attempted to move them, they became highly agitated. Beef cattle should be acclimated to vehicles, people on foot, and people on horseback before they leave a ranch. This will make handling easier and less stressful at feedlots and packing plants.

Accountability and Monitoring

Systems that hold people accountable for losses will help prevent downers and meat quality losses such as bruises or dark cutters. In 1 study,^c cattle sold by live weight, where the slaughter plant pays for bruises, had twice as many bruises, compared with loads of cattle sold by carcass weight. When producers had to pay for bruises, they handled cattle more carefully.

Computerized systems can be used to monitor quality of handling. Technology is available to instrument a squeeze chute to record how hard cattle hit the headgate.⁴⁵ Cattle that are handled quietly will walk in

and out of a squeeze chute. In an Australian study,⁴⁶ a radar system used for catching speeders on the highway was used for recording the speed of cattle exiting the squeeze chute.

Cattle that remain calm during handling in squeeze chutes will have better weight gain, fewer dark cutters, and more tender meat.⁴⁷ Cattle that run quickly out of the squeeze chute gain less weight. Good handling practices will improve animal welfare and meat quality and prevent injuries that can cause an animal to become nonambulatory.

Conclusions

To maintain an acceptable level of animal welfare in slaughter plants, management must continually measure and audit handling practices and stunning. People manage what they measure. It is also essential that small distractions that make cattle balk and refuse to move be removed from chutes. Good handling is impossible if cattle constantly balk and back up. Supermarkets and restaurants can greatly improve animal welfare by using their economic influence to maintain adequate standards.

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