



Animal welfare and society concerns finding the missing link



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ABSTRACT

Young adults in developed countries are distanced from agriculture and the meat industry needs to do a better job of communicating with them. A major welfare concern is slaughter without stunning. Other concerns, such as poor stunning or high levels of bruising, can be easily corrected by management who is committed to maintaining high standards. Another concern is biological system overload, occurring when animals are bred for more productivity. Researchers and industry need to determine optimum production levels instead of maximums. Retailers are major drivers of animal welfare standards enforcement and they respond to pressure from both activists and consumers.

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1. Introduction

The meat industry needs to be aware that young adults in their twenties are the first generation to grow up with both computers and mobile telephones. This changes the way they communicate. Social media enables people to network with each other. It is a relatively recent phenomenon, with Facebook being created in 2004, Twitter in 2006, and YouTube in 2005. Today most telephones are video cameras and pictures of animal abuses are more likely to get posted on the internet. All these electronic media are coupled with, the fact and many young adults in developed countries have little knowledge of where their food comes from. Candice Croney at Purdue University and her students conducted a survey and found that only 31% of young adults in the U.S. have ever visited a farm (Candice Croney, personal communication, 2014). A survey in the UK showed that 50% of young adults under age 23 could not link beef cattle with steak and 8% thought bacon came from wheat (Preece, 2014).

Young consumers do have a desire to connect with the origin of their food (Smith & Brower, 2012). The meat industry must start communicating more effectively with these affluent young adults. Their influence will extend beyond the developed world because they will write future legislation and policies that will have an effect on the entire world. In this paper, the author will summarize the most important animal

welfare issues and how different segments of the meat industry will be affected by them. In this broad overview, it will not be possible to do an in-depth review of all the issues. The goal of this paper is to highlight some of the most critical areas and provide references that will be useful to scientists who may not be familiar with the welfare issues.

2. Two types of animal welfare issues

There are two basic types of animal welfare issues. They are abuse or neglect of animals, caused by direct action by humans and welfare issues where either a process or equipment has to be changed to improve animal welfare.

2.1. Examples of abusive treatment or neglect

During the author's visits to hundreds of farms and slaughter houses in over twenty countries, the author has observed that animal abuse occurs in places that have either poor management supervision of employees or abusive methods have become a "normal" industry practice. Many of the undercover videos made in the U.S. show employees on either farms or packing plants abusing animals by beating, throwing, or kicking them. The problems shown on these videos were most likely due to poor management supervision of employees. There are also numerous videos from the developing world which show abusive handling. Correcting problems with abuse will require managers who are committed to stopping it. Neglect can also lead to serious

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welfare problems. Some examples of neglected health problems are advanced ocular neoplasia (cancer eye) in cattle or necrotic rectal prolapses in pigs. A survey done in the U.S. has shown that cattle producers are now doing a better job marketing cows before cancer eye becomes advanced (Nicholson et al., 2013). Another example of neglect is severely emaciated animals. Ahola et al. (2011) found that a higher percentage of dairy cows were marketed with very low body condition compared to beef cattle. Bruises are still major problems in some countries (Paranhos da Costa, Huertas, Strappini, & Callo, 2014). People will work to reduce bruises when they have to pay for the meat damage (Grandin, 1981). Many serious welfare problems that occur during transport, such as high death losses, injuries and bruises can be easily reduced by supervising transporters to stop rough handling, lower stocking densities on the vehicle and training drivers to reduce sudden stops and fast acceleration. There are extensive reviews of the literature on transport in Grandin (2014), Schwartzkopf-Genswein et al. (2012), and Appleby, Cussen, Garcias, Lambert, and Turner (2008).

2.2. Welfare problems that will require changes in equipment or procedures at the slaughter plant

These issues can be divided into two subcategories. They are problems that can be corrected by either repairing or a slight modification of existing equipment or procedures. The second type of problem will require major equipment changes.

2.2.1. Examples of minor changes

An example of a successful minor change is improving captive bolt stunning by better maintenance of the stunner (Grandin, 2002). Other examples are, use of electric prods to move cattle or pigs was reduced by employee training and adding lighting on a dark restrainer entrance to reduce balking and refusal to move (Grandin, 2001a). Training employees in livestock and poultry handling methods can also reduce bruises and carcass damage (Paranhos da Costa et al., 2014; Pilecco et al., 2013). Other examples of simple improvements are installing nonslip flooring in stun boxes, scheduling truck deliveries to reduce waiting times for unloading and installing a head holder to improve stunning accuracy (Paranhos da Costa et al., 2014). Head holders must be both well designed and operated correctly to reduce stress. Cattle that were forced unwillingly to enter a headholder, had higher cortisol levels compared to cattle stunned without using the headholder (Ewbank, Parker, & Mason, 1992). A study in Chile showed that the stun box door caused many bruises (Strappini et al., 2013). Simple modifications of control valves on a pneumatically powered door will reduce bruises by enabling the operator to have more precise control of downward movement of the door.

2.2.2. Examples of major changes

The second subcategory will be much more expensive to remedy because equipment or animal housing on the farm will require major changes and renovations. Some examples are switching a pork farm from individual sow gestation stalls to group housing or replacing small battery cages for laying hens with either cage free or furnished cage systems. There will be a further discussion of these housing systems in the sections on pigs and laying hens.

3. How do animal welfare issues affect different segments of the meat industry?

3.1. Packers

Compared to farms, welfare issues at slaughter plants are easier and less expensive to remedy. People always ask if animals know they are going to slaughter. Cortisol data collected both on the farm during restraint in a headgate and in the abattoir, indicate that stress levels are

similar in both places (Grandin, 1997; Mitchell, Hattingh, & Ganhao, 1988). Cattle and pigs that become agitated shortly before slaughter have higher lactate and reduced meat quality (Edwards et al., 2010; Gruber et al., 2010).

Surveys done by Grandin (2000, 2005) and Gallo, Teuber, Cartes, Uribe, & Grandin (2003) showed that the use of numerical scoring could be used to document how simple changes improved stunning and animal handling. The scoring system is described in Grandin (1998, 2010a). Some of the simple changes implemented to prevent return to sensibility in pigs were monitoring electric stunner placement and improved bleeding (Grandin, 2001a). Other simple changes that help prevent return to sensibility is chest sticking of cattle after captive bolt stunning and replacing head only electric stunning with head and heart stunning (Vogel, Badtram, Claus, Grandin, Turpin, Weyker, & Voogd, 2011; von Wenzlawowicz, von Holleben, & Eser, 2012). People manage the things they measure. Measurement is essential because it enables management to determine if procedures are improving or getting worse. In a survey of over 40 U.S. beef plants who were maintaining relatively high standards, the average percentage of cattle rendered insensible with a single captive bolt shot was 97%, the percentage vocalizing (bellow or moo) in stunning area was 2% and the percentage moved with an electric prod was 15% on fed cattle, and 29% on cows and mature bulls (Grandin, 2002, 2005). A plant in Mexico scored over 8000 cattle and the scores were 51% rendered insensible with a single shot, 10% vocalization and 80% moved with an electric prod (Miranda de la Lama et al., 2012). The author commends plant management for obtaining extensive baseline data, but now they need to work to greatly improve their scores.

3.1.1. Slaughter without stunning

The most controversial area from a welfare standpoint is religious slaughter where preslaughter stunning is not used (Anil, 2012). Many Muslim religious authorities will allow preslaughter stunning (Nakyinsige et al., 2013). The use of properly done preslaughter stunning eliminates welfare issues associated with religious slaughter without stunning. Stunning would make religious slaughter similar to conventional slaughter. However, many orthodox Jewish rabbis and some Muslims require a conscious animal that is slaughtered without either precut or immediate post cut stunning. It is beyond the scope of this paper to discuss whether or not slaughter without stunning should be banned.

There are two separate welfare issues when slaughter without stunning is being evaluated. They are the method used to hold and restrain the animal and painfulness of the throat cut. In some countries, highly stressful methods of restraint are used, such as suspending large cattle by one leg, shackling, and dragging, and leg clamping boxes. Undercover videos have been posted online of shackling and dragging, which illustrate severe animal welfare problems. Suspending an animal by one back leg is more stressful than upright restraint (Westervelt, Kinsman, Prince, & Giger, 1976). For large cattle, the two main methods of restraint that can be used to replace shackling and dragging or shackling and hoisting are: an upright restraint box where the animal is held in a standing position or a pen that rolls the animal onto its back. Dunn (1990) found that inverting cattle for over 90 s was more stressful than upright restraint. Vocalization is a useful measure for detecting welfare problems associated with electric prod use or excessive pressure exerted by restraint devices and headholders (Grandin, 2001b; Munoz, Strappini, & Gallo, 2012). Vocalization in cattle during restraint and handling is associated with physiological measures of stress (Dunn, 1990; Hemsworth et al., 2011). In a well-designed and properly operated upright restrainer used for kosher slaughter without stunning, the percentage of cattle that vocalized in the box was under 5% (Grandin, 2005, 2012). In poorly designed systems where excessive pressure was applied, the percentage of cattle that vocalized was 25% and 32% (Bourquet, Deiss, Tannugi, & Terlouw, 2011; Grandin, 1998). Loosening a head restraint so it applied less pressure to a steer's neck reduced the percentage of cattle that vocalized from 23% to 0% (Grandin, 2001b).

Upright restraint boxes had a lower percentage of cattle vocalizing compared to inverted restraint (Velarde et al., 2014) but struggling was greater in the upright box (Velarde et al., 2014). They did not differentiate between struggling that occurred either before or after loss of the ability to stand. Struggling is not a welfare issue after the animal loses the ability to stand and has become unconscious.

Welfare for slaughter without stunning can be improved by restraining an animal in a less stressful manner (Grandin, 1992), but there are still serious welfare questions about pain or distress from the throat cut. Some of the major problems are aspiration of blood into the trachea (Gregory, von Wenzlawowicz & von Hollenben, 2008) and sealing off of the arteries which results in prolonged sensibility (Gregory, von Wenzlawowicz, et al., 2008). An undercover video posted online shows a fully conscious veal calf with prolonged sensibility (Humane Society of the U.S., 2014). Changes in cutting technique can reduce the above problems. Gregory, von Wenzlawowicz, Von Hollenben, Fielding, and Gibson (2012) states that cutting close to the C1 (cervical 1) position may cut sensory nerves and reduce aversive sensations from aspiration of blood. Good technique can reduce the time required for an animal to lose sensibility and collapse. When skillful technique is used, over 90% of the cattle will collapse within 30 s (Grandin, 2010a; Gregory, Fielding, von Wenzlawowicz, & von Hollenben, 2010). Cattle require more time to lose sensibility compared to sheep (Blackmore, 1984; Daly, Kallweit, & Ellendorf, 1988; Newhook & Blackmore, 1982). This may be due to differences in anatomy. Baldwin and Bell (1963) and Baldwin and Bell (1963). Therefore, cattle may have greater welfare issues than sheep. Gibson, Johnson, Murrell, Hulls, and Mitchinson (2009) and Gibson, Johnson, Murrell, Chambers, and Stafford (2009) reported that cutting 109–170 kg calves with a 24.5 cm long knife resulted in pain similar to dehorning. The knife had been sharpened on a grinder and may have been too short to completely span the neck. Grandin (1994) observed that waving a hand in the face of a steer provoked a larger behavioral reaction than a kosher cut with the special long razor sharp knife that had been sharpened with a whetstone. This observation was made in a plant where highly skilled technique was used. The author has also observed that a few cattle can remain fully sensible and for several minutes, retain the ability to walk. Length of the knife is another factor that needs study. If the knife is too short, the tip may gouge the wound. The author has observed many instances of sloppy religious slaughter technique and overall animal welfare would be improved with stunning.

3.2. Researchers

Researchers need to understand that there is a difference between a method or a procedure that is suited for use in a research laboratory setting and the need for simpler procedures for use by meat packers and producers. The European Welfare Quality Assessment (Welfare Quality Network, 2009) protocols for use on farms are a good example of a system that is an excellent research tool with many welfare measures, but it is too complex and time consuming for routine use by commercial auditors and producers. In this system, multiple animal welfare outcome measurements, such as body condition score and lameness are combined with behavioral measurements such as the presence of stereotypies and fearful behaviors. It contains many good assessment tools but it needs to be simplified for commercial use (Andreassen, Sandoe, & Forkman, 2014). The trend in animal welfare assessment is to move away from input resource based requirements such as specifications on equipment design, to animal based outcome based measures (Hewson, 2003; Velarde & Dalmau, 2012). Welfare Quality also includes Qualitative Behavior Assessments based on assessing emotionally in animals (Andreassen, Wemelsfelder, Sander, & Forkman, 2013; Rutherford, Donald, Lawrence, & Wemelsfelder, 2012).

After the Welfare Quality Assessment is conducted, a single welfare score is determined. A study conducted in the U.S. with dairy cows showed that the three variables of poor body condition score, lameness

and a shortage of waterers were the factors most related to poor welfare (de Vries et al., 2013). The scoring system is not transparent and is difficult to understand (Andreassen et al., 2014). There are some serious problems with taking all the multiple variables measured in the Welfare Quality Audit and aggregating them into a single welfare score. de Vries et al. (2013) found that this system enabled a dairy with 47% lame cows to achieve an acceptable welfare rating and a herd with 25% lame cows to be rated enhanced welfare. Lameness causes long-term pain and is one of the most serious dairy welfare problems (Flowers, dePassille, Weary, Sanderson, & Rushen, 2007; Rushen, Pombourcq, & de Passille, 2006). The author believes that a better approach is to have certain critical points where an acceptable score is required on all of them. A high percentage of lame cows are not acceptable regardless of the scores on other welfare measures (Grandin, 2010a,b). For a minimum acceptable level of welfare during slaughter, the American Meat Institute scoring system has five critical points (core criteria). They are the effectiveness of stunning with a single application, insensibility, vocalization during handling and restraint, falling down during handling and electric prod use (Grandin, 1998, 2010a). It is the author's opinion that to pass a welfare audit, a farm must receive an acceptable score on all of the following critical points: air quality in indoor facilities, animal stocking density, coat/feather condition, lameness, injuries, body condition, animal cleanliness, and low levels of abnormal behavior. A failing score on any one of the above critical points would be an automatic failure. To identify definite animal welfare problems such as a high percentage of lame animals, missed captive bolt stuns, injuries and obviously sick animals, is easier than determining if an animal's welfare is truly positive. One reason why the Welfare Quality System became so complicated is that it is measuring both positive and negative animal welfare.

3.2.1. Research priorities at the slaughter plant

The main priority for animal welfare at a meat plant is to avoid either animal abuse or obvious pain and suffering. Slaughter without stunning is another high priority area. Captive bolt and electrical stunning of cattle, pigs, and sheep have a solid scientific basis that they induce instantaneous insensibility (AVMA, 2013; Blackmore, 1985; Croft, 1952; Daly & Whittington, 1989; Daly et al., 1988; Lambooij, 1982). Penetrating captive bolt is more effective than non-penetrating captive bolt (Zulkifi et al., 2013). Researchers need to explain to people concerned about welfare that even though captive bolt and electrical stunning trigger a release of stress hormones (Shaw & Tume, 1992; Van der Wal, 1978) this does not affect welfare because the animal is insensible when the release occurs.

Controlled atmosphere stunning does not induce instantaneous insensibility, but in many cases, animal handling is improved for both pigs and poultry. In group CO₂ systems for pigs, electric prods can be eliminated. Inversion of poultry on the shackle line for electrical stunning is stressful (Bedonova et al., 2007). Systems where the transport containers containing the live birds are moved through a chamber have the advantage of eliminating stressful preslaughter handling. It is beyond the scope of this article to review all the literature on controlled atmospheric stunning. Two commercially available systems where live chickens are stunned in the transport containers that the author believes maintain an acceptable level of welfare are either a gradual rise of CO₂ levels or low air pressure (Gerritzen, Reimert, Hindle, Verhoeven, & Veerkamp, 2013; McKeegan, Sandercock, & Gerretzen, 2013). The author suggests that to assess welfare, an outcome measure of the behavioral reactions of birds or pigs before loss of posture and the ability to stand should be used. When animals lose the ability to stand they are insensible and unconscious (AVMA, 2013; Benson et al., 2012). It is the author's opinion that welfare is severely compromised if an animal exhibits escape behavior and attempts to climb or jump out of the container. It is the author's opinion that some gasping or head shaking may be acceptable as a trade off because pre-slaughter stressful handling is eliminated.

3.3. Retailers

Retailers have been major drivers of improving animal welfare both on the farm and in the slaughter plant. When activists put pressure on retailers they react by strengthening their standards. The author had the opportunity to work with McDonalds Corporation, Wendy's International, and Burger King on implementing welfare auditing of beef and pork slaughter plants. Use of the numerical scoring system resulted in great improvements (Grandin, 2000). Retailers need welfare evaluation systems that are easy for assessors and auditors to understand. In the U.S., the PAACO auditor training program is conducted in a day and a half workshop with two harvest plant visits. Retailers also need clearly worded guidelines to avoid lawsuits from suppliers who are removed from their approved supplier list. Retailers are most likely to implement an auditing system that has a strong third party independent audit. Third party audits are conducted by an independent auditing company.

3.3.1. Change in retailer attitudes about animal welfare

The author observed that the attitudes of corporate level managers of a restaurant company changed after they saw serious welfare issues such as an emaciated dairy cow or poor stunning. After visits to farms and slaughter plants, the welfare issue switched from being an abstract concept to something real that demanded management attention and action. It was no longer an abstract nuisance that was delegated to either the legal or public relations department. The executives were now motivated to use their economic power to make improvements. Retailers often react to really bad undercover videos or an emergency such as a food poisoning incident by making their specifications more strict. Since the early 1990s, a series of food safety recalls in the U.S. and a succession of undercover welfare videos have motivated both retailers and government regulators to strengthen oversight. Implementing animal welfare audits at slaughter plants is much easier compared to doing farm audits because there are fewer meat plants than farms. To keep costs reasonable, the same auditors often conduct both food safety and welfare audits. Both retailers and various certification groups have their own audit and welfare certification schemes. Some of the most common ones are the RSPCA, Animal Welfare Institute, Humane Certified, Whole Foods GAP, and Tesco Foods. These private standards exceed the standards of the OIE.

3.4. Consumers

Consumers fall into two groups: the high-end consumers who buy natural, organic, and high welfare meats, and regular consumers who are more price sensitive. These two groups are both important market sectors. Wealthy consumers in developed countries are often willing to pay for high end welfare verified products. European consumers were more likely to be willing to pay where they had high trust in an animal friendly brand. Lower income consumers will often buy the cheapest product and the demand for meat is growing around the world. Consumers often become more concerned about animal welfare after a shocking undercover video is released. In the U.S. food safety is the highest concern.

3.5. Animal activists

Since the 1970s, the author has worked with both animal activist groups and the meat industry. In the 1970s and 1980s, animal activists were focused on reforming and improving the meat industry. Some animal activist groups in the 1970s and 1980s funded research to improve both slaughter methods and farming practices (Belanger, Prince, & Westerevelt, 1976; Vitello & Hoyt, 2012). The author has observed that individuals in activist groups who have worked hands-on with either farm animals or pets in animal shelters, often have more moderate views compared to individuals who have always operated from an

office. Some of the new younger generation of animal activists are vegans who never use animal products. Today the agenda of some groups has switched from reforming the meat industry to working to eliminate it. In college, younger activists may have taken many courses in the philosophy of animal rights and animal law. Their activism is shaped by abstract ideas instead of knowledge from the field. Many law schools now teach animal law and twenty years ago, these courses did not exist. Meat scientists and industry stakeholders need to work to communicate with the public. The author has observed that many young students believe everything on activist websites. The meat industry must be more transparent and explain everything they do.

4. Welfare issues on the farm for all species

The aim of this next section is to briefly overview some of the major animal welfare issues on the farm. This will be useful to meat scientists, who may not be familiar with the most important issues. For all species, there is a huge concern about painful practices such as dehorning cattle, castration, beak trimming of laying hens and tail docking of pigs and dairy cattle. Since the mid-2000s there have been many research studies to find practical methods to provide pain relief for castration of calves and piglets (Coetzee, 2013). Another area of concern for both animal and human welfare is air quality standards for intensively raised animals in enclosed buildings. The Welfare Quality Network (2009) has a dust standard but it is not required for all species of intensively raised animals. Weaner pigs grow faster in an environment with low ammonia and dust levels (Lee et al., 2005). Air quality standards are important for basic welfare because poor air quality contributes to a variety of health problems such as eye problems, lung pathology, and lower weight gain (Kristensen & Wathes, 2000). For all species, handling and transport of animals must be supervised to prevent rough treatment. Animals with obvious health problems must either be immediately treated or euthanized. Dead animals should be promptly removed. This is basic husbandry but unfortunately the above problems keep showing up on activist's videos. For all species, animals must be regularly assessed for obvious welfare problems such as poor body condition (too thin), lameness, hide/feather condition, cleanliness, injuries, bruises, death loss percentages, sickness, and abnormal behavior. Methods used to euthanize sick animals are another cause of major concern (AVMA, 2013).

4.1. Beef cattle

Many beef cattle around the world live outside and spend either all or part of their life on pasture. They have fewer welfare issues compared to more intensively raised animals. Painful procedures such as dehorning and castration are a major issue. The use of polled (hornless) cattle would eliminate dehorning. Angus cattle are naturally polled and the beef breeds now have good polled genetic lines. In Europe and Asia, fattening bulls are left intact, and in North American, South America, and Australia, steers (castrated males) are fattened. For extensively raised cattle, there is a need to have practical methods to reduce pain that can be applied at the same time the animal is castrated. An anesthetic gel developed in Australia may be a practical method of pain relief (Lomax & Windsor, 2013). Other methods such as NSAID pain relievers, such as Meloxicam, given at the time of castration are less effective than medications given before the surgery (Coetzee, 2013). Researchers need to develop practical methods that would be easy for farmers and ranchers to use. Epidurals and IV injections are not practical for farmers and controlled substance medications with human abuse potential should also be avoided.

In some countries, cattle are hot iron branded to prevent theft. Freeze branding is less painful than hot iron branding (Lay et al., 1992). On an extensive ranch, freeze branding is not practical because a large tank of liquid nitrogen is used up after 20 cattle are branded. In North America, another major welfare issue is failure to wean and vaccinate calves before they are shipped from the ranch of origin.

Prewaning and vaccinating calves 30 to 45 days will reduce health problems at the feedlot (Urban-Chimiel & Grooms, 2012). This poor practice continues because producers often get the same price at the auction for unvaccinated calves as they do for vaccinated calves. Since they are not held accountable for sickness at the feedlot there is no financial incentive to reduce it.

In feedlots two of the biggest welfare issues are mud and heat stress. Cattle in the U.S. are being grown to heavier weights. Black Angus cattle had improved weight gain and less panting when they were given access to shade (Gaughan et al., 2010). Panting scoring can be used to access heat stress (Mader, Davis, & Brown-Brandl, 2005). Open mouth breathing is a sign of severe heat stress (Mader et al., 2005). Cattle that are heavily soiled with mud or manure may have lower weight gain and more pathogen contamination (Blagojevic, Antic, Ducic, & Buncic, 2012; Hauge, Nafstad, Rotterud, & Nesbakken, 2012).

Rough, poor handling practices are another major welfare issue. In the U.S. handling of cattle, arriving at feedlots has improved. Woiwode and Grandin (2014) found that during cattle handling in the squeeze chute for vaccinations, the percentage of cattle falling down was under 1%, vocalization 1.3% of the cattle, and electric prod use 5.5% of the cattle. There is still a big need to improve truck driver behavior. A recent survey of handling by truck drivers showed over use of electric prods (Nicholson et al., 2013). Drivers loading cattle outside of business hours are often poorly supervised compared to personnel vaccinating incoming cattle. South American studies have shown that training handlers reduces bruises (Paranhos da Costa et al., 2014).

Until recently, lameness was seldom a major problem in beef cattle. The author has observed problems with fattened feedlot cattle arriving at slaughter plants with sore feet and stiff muscles. This is likely due to a combination of feeding high doses of beta agonists such as ractopamine or zilpaterol and handling stress (Grandin, 2010b). Pigs fed ractopamine are more susceptible to stress if they are handled roughly (James et al., 2013). These substances can also increase death losses in cattle (Longeragan et al., 2014; Montgomery et al., 2009), increase heat stress in sheep (Macia-Cruz et al., 2010), and cause hoof cracking and aggression in pigs (Poletto, Rostagio, Richert, & Marchant-Forde, 2009; Poletto et al., 2010). Pigs fed high doses of ractopamine were also slower and more difficult to move (Marchant-Forde, Lay, Pajor, Richert, & Schinckel, 2003). In developing countries, lameness problems have also been observed in fattening bulls and cattle housed on concrete with no bedding. Bedding pens can help prevent lameness.

4.2. Dairy cattle

Lameness is a major issue in dairy cattle. Studies show that up to 24% of lactating dairy cows are clinically lame (Bennett, Barker, Main, Why, & Leach, 2014; Espejo, Endres, & Salter, 2006). On the best well managed dairies, 5% or less of the lactating cows are lame (Espejo et al., 2006). Lameness needs to be measured on a regular basis because dairy farmers may greatly underestimate the percentage of lame cows (Leach et al., 2010). Videos for scoring lameness can be found on Zinpro.com. The Welfare Quality Auditing Assessment uses a three-point scale (Welfare Quality Network, 2009). This may underestimate the percentage of lame cows. A simple four-point scale, which is easy to teach, is 0 = normal, 1 = walks with an obvious limp or abnormal gait, and keeps up with the herd when the herd is walking, 2 = Mobile but cannot keep up with the herd when the herd is walking, and 3 = Can barely move (Grandin, 2010b). Several studies using 4-point and 5-point scales show that lameness scoring has high inter observer reliability (d'Eath, 2012; Winckler & Willen, 2001). Scoring systems with more than five categories had poor interobserver reliability (d'Eath, 2012). The tendency for the cow to shift its weight can be used to assess lameness in cattle that are tied (Haley et al., 2014).

Body condition scoring is another important measure of dairy cow welfare. Lactating cows are more likely to become too thin, therefore body condition score percentages should be based on lactating cows.

Body condition scoring for Holstein dairy cows can be found in (Welfare Quality Network, 2009; Wildman, Jones, Wagner, & Boman, 1982). A rigorous training program and repeatability checks will improve accuracy (Vasseur, Gibbons, Rushen, & dePassille, 2013).

Other important measurements for assessment of dairy cow welfare are cleanliness scoring, udder condition, swollen hocks (legs) hoof lesions, and somatic cell count. The very best dairies will have significantly less swollen hocks (Fulwider et al., 2007).

4.2.1. Dairy calf welfare

Maintaining acceptable welfare standards for bull calves less than a week old is a major problem area in some dairies. Unless there is a market for bull calves, they may get neglected or slaughtered at one to three days of age for "bob veal." Handling young Holstein calves that are too weak to walk in a low stress manner is very difficult. In New Zealand, many dairy bull calves are raised as pasture raised bull beef, and in the U.S., many dairy bull calves are castrated and raised as either fed steers or large veal calves. The author has observed that dairy bull calves are most likely to be mistreated in areas where they have little economic value.

Unlike beef cattle, there are few polled options for Holsteins. Most dairy calves are dehorned. Performing the operation at a young age reduces stress. Since dairy calves are intensively housed, it is practical to use a local anesthesia. Both lidocaine anesthesia and a nonsteroidal anti-inflammatory drug are given. They are allowed to take effect before the horn bud is removed. Sutherland, Ballou, Davis, and Brooks (2013) has good protocols where lidocaine local anesthesia is combined with a NSAID analgesic, such as meloxicam.

4.3. Pigs

In the swine industry, the major welfare issues are euthanasia of baby pigs, castration, and sow gestation stalls. Sow gestation stalls, where sows live during pregnancy in a stall where she cannot turn around, is a degree of confinement that two-thirds of the American public find not acceptable. This is a situation where science is not going to provide all the answers to the public. Scientific studies show that sows produce well in both group housing and gestation stalls (Li & Gonyou, 2013; McGlone, 2013). Gestation stalls are being phased out in Europe and some major companies in the U.S. such as Smithfield Foods, are phasing them out. There are three basic types of group housing systems that can be used to replace gestation stalls. They are free access stalls where the sows can operate the rear gate, electronic sow feeders where each sow can access her feed with an electronic ear tag and small static groups.

The author is asked all the time, which system is better? All of these group housing systems can be made to work. If an existing gestation stall system has to be removed, small static groups, where a group of sows is never mixed with other sows may be a good choice. The expensive drop feeders that supply feed to the gestation stalls can be re-used. Electronic sow feeder systems are cheaper to build because less welded steel is required for pen fences, but computer skills are required to operate them. Free access stalls work well but they are more expensive due to extensive amounts of welded steel panels. All three systems will require more space in the building compared to gestation stalls (Hemsworth et al., 2013). A good review and descriptions of different group sow housing systems is in Spooler, Geudeke, Van der Peet-Schwering, and Soede (2009) and National Pork Board (2013). Producers must be careful to provide sufficient space in group housing (Hemsworth et al., 2013). Fighting may be a major problem in group housing. Some genetic lines of pigs are more aggressive (D'Eath, Roehe, et al., 2009) and the author has observed that some producers who use group housing have switched to less aggressive genetic lines of pigs.

Castrating screeching baby piglets is a procedure that will make a poor impression on the public when viewed on the internet. Genetic

selection of pigs so they do not secrete androsterone, is one approach to eliminate both boar taint and the need to castrate (Gregersen et al., 2012). Immunizing male pigs against the male hormone releasing factor is being successfully used in Brazil and other countries (Bradford & Mellencamp, 2013). The third alternative of growing pigs to lighter weights is not practical because the same labor is required to process a 100 kg pig and a 150 kg pig.

The pork industry needs to find an alternative to blunt force trauma for euthanasia of baby pigs because even when it is done correctly, it looks terrible on undercover videos. The American Veterinary Medical Association states that blunt force trauma is an approved method, but the industry needs to phase it out (AVMA, 2013). There is a new flat head captive bolt gun that works well for euthanizing baby pigs (Casey-Trott, Millman, Turner, Nykamp, & Widowski, 2013). Other methods are gas euthanasia in a box (Rault, McMunn, Marchant-Forde, & Lay, 2013; Sadler et al., 2014).

4.4. Laying hens

The biggest welfare issues for laying hens are small battery cages, beak trimming, forced molting by food restriction, and osteoporosis, which causes bone fractures. When the author was hired to work with McDonald's Corporation on laying hen welfare, she was shocked to observe hens stuffed into conventional battery cages so tightly that when they slept, they were on top of each other. McDonald's quickly implemented a standard to give the birds more space. This now enabled them all to sleep without being on top of each other. However, the hens were still living in a barren environment. There are two basic alternatives for replacing conventional battery cages. They are furnished enriched colony cages (Appleby et al., 2002) or cage free housing. Colony cages provide a partitioned nest box and perches to help maintain bone strength. They also have a scratch area and the ceiling of the cage is higher so the hens can walk in a natural upright posture. Performance is similar in furnished cages and conventional cages (Tactacan, Guenter, Lewis, Rodriguez-Lecompte, & House, 2009).

There is much controversy about cage free systems versus using the enriched colony cages. The two systems have different advantage and disadvantages (Laywel, 2004). Cage free aviary systems stocked at high densities have more dust and egg contamination compared to enriched colony cages (de Ren et al., 2005). Cage free systems work well when stocked at low densities, but may have dust problems when stocked at higher densities. New hybrid systems that combine features of both systems are now available. Cage free systems where hens can jump off of high perches also have more bone fractures compared to enriched colony cages (Lay et al., 2011). Osteoporosis, loss of plumage, and emaciation in laying hens are major problem regardless of the type of housing (Sherwin, Richards, & Nicol, 2010; Wilkins et al., 2011).

There are genetic differences in the frequency of feather pecking and it is related to high productivity. A hen that lays a lot of eggs has to eat more and researchers have discovered that feather pecking may have displaced foraging behavior (Dixon, Duncan, & Mason, 2008). Trimming beaks reduces damage from feather pecking but it is painful and may cause long-term pain (Gentle, Waddington, Hunter, & Jones, 1990). The infrared beam is a less stressful method for trimming beaks than using a hot blade (Dennis & Cheng, 2012; Gentle & McKeegan, 2007). Muir and Cheng (2013) and Cheng and Muir (2005) have used group selection to breed highly productive egg layers with reduced feather pecking. Another controversial practice that has been phased out in the U.S. and is forbidden in Europe is synchronizing molting by removing feed. Birds naturally lose their feathers each year and then grow new ones for the next egg laying cycle. More welfare friendly methods are feeding lower energy feed (Koelkebeck & Anderson, 2007).

4.5. Broiler chickens

Meat chickens grow extremely fast and when they are not managed properly they may have increased death losses. Lameness in market ready birds can be assessed with gait scoring (Garner, Falcone, Wakenell, Martin, & Mench, 2002). Other welfare problems that should be monitored are footpad lesions and birds soiled by dirty litter. The biggest welfare problem in the meat chicken industry is the welfare of broiler breeder hens (DeJong & Guemene, 2011). In order for broilers to grow fast, a large appetite and high feed intake is required. The breeder hens that produce the broilers have to be kept on a highly restricted diet to prevent them from becoming overweight (Mench, 2002). This creates problems with constant hunger because they are fed below half of below ad lib intake and this is an area that needs more research (D'Eath, Tolkamp, Kynazakis, & Lawrence, 2009). A modern broiler bird is one of the few animals that will eat until the gut is completely full. This is an example of a welfare issue caused by genetic selection. Handling during loading into transport containers is also a major issue. Careful handling will greatly reduce injuries such as broken wings and death losses.

4.6. Sheep

Some welfare issues unique to sheep are shearing and mulesing of the Australian Merino. When sheep are mulesed, a flap of skin is removed from the area around the anus. This procedure is done to prevent damage from maggots. Breeding sheep with less wrinkly skin could eliminate the need to perform mulesing. Sheep are the only livestock that have to be sheared. Due to declining markets for wool, hair sheep that do not require shearing are becoming more popular. Shearing is highly stressful for sheep.

5. Monitoring farm and transport problems at slaughter

There are many welfare issues that occur on the farm or during transport that can be easily monitored at the slaughter plant (Grandin, 2010b; James, Tokach, Goodband, Nelson, Dritz, Owen, Woodworth, & Sulabo, 2013; Velarde & Dalmau, 2012). Table 1 shows welfare and loss issues that can be monitored at slaughter. Long distance transport is another welfare issue (Appleby, Cussen, Garcias, Lambert, & Turner, 2008).

6. Biological system overload may be the big future welfare problem

In intensively housed broiler chickens, laying hens, pigs and dairy cows, there is increasing concern that pushing the animal to produce more meat, eggs, or milk will cause both increasing welfare problems and a decline of functionality (Rodenburg & Turner, 2012). As milk production in the dairy cow has increased fertility and the ability to rebreed and produce a calf has declined (Spencer, 2013). Digital adipose cushion in tissue in the hoof of Holstein dairy cows has decreased which has resulted in more hoof lesions (Oikonomou, Banos, Machado, Caixeta, & Bicalho, 2014). Green, Huxley, Banks, and Green (2014) reported that dairy cows that give more milk had thinner body condition. These two studies show that fat reserves in the body of high producing cows are reduced. In many large dairies a cow lasts for only two years of milk production. In layers, the rate of bone fractures due to osteoporosis is very high even when the hens are housed in good systems. In enriched furnished colony cages, hens had 36% keel bone fractures and in the aviary system with multi-level perches they had 80% (Wilkins et al., 2011). Keel fractures cause hens to experience pain (Nasr, Nicol, & Murrell, 2012). Fracture levels are so high that even in better housing the improvements are like comparing something that is atrocious to something that is poor. In the future, researchers and managers need to breed for optimal production instead of maximum production. In sheep, breeding for high productivity has lowered resistance to parasites (Greer, 2008).

Table 1
Welfare issues, losses and severe health problems that can be monitored at the slaughter plant.

All Species Measurements that are the same in all species	Specific measurements for each species				
	Dairy cows	Beef cattle	Pigs	Poultry	Sheep
Body condition Lameness	Swollen hocks and knees Udder condition	Liver abscesses in grain fed cattle Ocular neoplasia (cancer eye)	Shoulder lesions Vulva bites	Foot pad lesions all poultry Broken wings broilers from rough handling	Foot rot Fly strike
Cleanliness of hide or feathers	Cow not dried off before shipping	Pneumonia (monitor BRD)	PSS Porcine Stress Syndrome	Twisted legs in broilers	Mulesing
Injuries	Coat condition—no bald spots	Coat condition (no bald spots)	Difficult, slow moving ractopamine	Breast blisters (dirty litter)	Shearing injuries
Bruises	Docked tails	Sore footed on all four limbs from high dose beta agonist	Severe scratches from fighting	Feather condition	Wool blindness
Dead %			Blood lactate (handling stress in stunning chute)	Fractures in laying hens osteoporosis Hock Burn	Bruises from lifting sheep by the wool
Heat stress (panting)					
Non-ambulatory animals %					
External parasites					
Internal parasites					
Overloaded trucks					
Measures of handling					

Both producers and scientists may think that we have to keep increasing production to feed a growing population. The author fears that an over emphasis on production may lower disease resistance. A new disease, Porcine Epidemic Diarrhea, is killing many piglets and the virus is very virulent and it can survive in manure and feed for seven to twenty-eight days (National Pork Board, 2014; Sun et al., 2012). Dead piglets do not feed people. To genetically select for disease resistance may require a slight decrease in productivity. There is a possibility that breeding for high production has lowered disease resistance in pigs. Jiang, Xing, Xing, Jiang, and Zhou (2013) reported that highly productive commercial pigs were less resistant to PRRS (porcine respiratory and reproductive syndrome) than Chinese Dapulan pigs. The Chinese pigs are a traditional breed. The author suggests that instead of selecting for ever increasing productivity, researchers should strive for the optimum levels that combine reasonably high levels of productivity with disease resistance, acceptable animal welfare and a longer life for breeding animals.

7. How has the industry responded to consumer concerns?

Some good effective responses of the meat industry to communicate better with today's internet connected consumer was opening the Cargill plant in Colorado to the Oprah Winfrey TV Show and beef plant video tour with Temple Grandin (American Meat Institute, 2012). This video has had over 100,000 views. Chandler Keys, a lobbyist in Washington, D.C. states that consumers just want to know how things work. It is impossible to hide from undercover video because now every telephone is a video camera. A pro-active step that some U.S. and Canadian plants have done is video auditing by third party auditors. This prevents the problem of people acting good when they knew they are being watched. Another great example of showing the public what we do is the Fair Oaks Dairy and Pig Adventure in the U.S. These working farms are open for public tours. Consumers also need to learn that pre-slaughter stress levels are similar to on-farm handling (Grandin, 1997; Gruber et al., 2010).

Bad responses from the U.S. industry are so-called Ag Gag laws which make it a crime to take undercover video. This sends the wrong message to today's consumer. Agriculture has to look at everything it does and ask themselves, "Can I explain this to my guests from the city." I have worked over 40 years in this industry and I am proud of the improvements I helped achieve. We need to show it. Consumers do not like sudden surprises. U.S. consumer's rejection of finely textured beef, which is recovered from fat trimmings caused several large plants to close. A major problem with this issue was lack of listing the

recovered beef on the label. The meat industry needs to be transparent and explain and show everything we do. Many practices can be easily defended but some practices will have to be changed.

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