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J ANIM SCI 2011, 89:1219-1228.

doi: 10.2527/jas.2010-3589 originally published online January 7, 2011

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ANIMAL BEHAVIOR AND WELL-BEING SYMPOSIUM: Farm animal welfare assurance: Science and application¹

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ABSTRACT: Public and consumer pressure for assurances that farm animals are raised humanely has led to a range of private and public animal welfare standards, and for methods to assess compliance with these standards. The standards usually claim to be science based, but even though researchers have developed measures of animal welfare and have tested the effects of housing and management variables on welfare within controlled laboratory settings, there are challenges in extending this research to develop on-site animal welfare standards. The standards need to be validated against a definition of welfare that has broad support and which is amenable to scientific investigation. Ensuring that such standards acknowledge scientific uncertainty is also challenging, and balanced input from all scientific disciplines dealing with animal welfare is needed.

Agencies providing animal welfare audit services need to integrate these scientific standards and legal requirements into successful programs that effectively measure and objectively report compliance. On-farm assessment of animal welfare requires a combination of animal-based measures to assess the actual state of welfare and resource-based measures to identify risk factors. We illustrate this by referring to a method of assessing welfare in broiler flocks. Compliance with animal welfare standards requires buy-in from all stakeholders, and this will be best achieved by a process of inclusion in the development of pragmatic assessment methods and the development of audit programs verifying the conditions and continuous improvement of farm animal welfare.

Key words: animal-based measure, animal welfare, assessment, standard, verification

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J. Anim. Sci. 2011. 89:1219–1228
doi:10.2527/jas.2010-3589

INTRODUCTION

The focus of agricultural policy in many countries is increasingly on quality rather than quantity, and livestock production will be more and more constrained by public concerns regarding farm animal welfare (Thornton, 2010). Consumers expect their animal-derived food to be produced with respect for the welfare of the animals, and this has resulted in a variety of private and public standards meant to assure the public and consumers that farm animals have received the proper

treatment (Veissier et al., 2008; Webster, 2009). Fraser (2006) provides an excellent overview of the different options for animal welfare standards and assurance programs.

Pressure from the voting public can result in legislation that defines what are unacceptable animal husbandry practices and housing methods. This is probably the most visible (and, by some, feared) consequence of the increased concern about animal welfare (Croney and Millman, 2007). However, legislation does not provide the final answer to ensure good farm animal welfare. First, legislation can be very time consuming to introduce and enact (e.g., Appleby, 2003). Second, government legislation is not always comprehensive and tends to focus on issues of great public concern, such as the housing of laying hens, and seeks to establish only minimal acceptable standards. Finally, government legislation can vary greatly from jurisdiction to jurisdiction as a result of political decisions. For example, in the United States, most farm animal welfare regulations are state based, rather than being present in all states, and they may even differ from state to state.

¹Based on presentations at the Animal Behavior and Well-Being Symposium titled “Animal Welfare Assurance: Science and Application” at the Joint Annual Meeting, July 11 to 15, 2010, Denver, CO. The symposium was sponsored, in part, by the Association for Assessment and Accreditation of Laboratory Animal Care International (AAALAC) and EAAP (European Federation of Animal Science), with publication sponsored by the American Society of Animal Science and the *Journal of Animal Science*.

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Received October 8, 2010.

Accepted December 24, 2010.

A case in point is the difference between the Michigan legislation, which includes a resource-based minimum space allowance of 1 ft² (929 cm²) per egg-laying hen (Michigan Public Act 117, State of Michigan, 2009), vs. a California citizen initiative (Proposition 2, State of California, 2008), which adopts a performance-based outcome, with no specified minimum space allowance.

Animal welfare will be of increasing importance to international trade and, in an effort to harmonize the legislation and standards of different countries, the World Organization for Animal Health (OIE, 2008) began to develop animal welfare guidelines that could be used to govern international trade in animal products. Having standards governing animal welfare has proved beneficial in helping developing countries trade in animal products (Bowles et al., 2005).

In addition to these government-led initiatives, private standards for animal welfare that reflect consumer concerns are likely to have an important role in governing the food chain (Fulponi, 2006). Food retailers have been developing animal welfare standards that their suppliers must meet (Mench, 2008; Veissier et al., 2008), and farming organizations have their own animal welfare standards, which tend to focus on issues that are of importance to farmers, be noncompetitive, retain current industry practices, and avoid changes that have a large economic impact on farmers. However, consumers often complain that they have difficulty in finding adequate information on the animal welfare standards applied in producing food (Eurobarometer, 2007). Labeling regimens, which assure consumers that certain animal welfare standards have been complied with, can have an important role in providing consumers with information about how farm animals are raised, and their use appears to be on the increase worldwide (Veissier et al., 2008; Webster, 2009). Such animal welfare labeling schemes often aim at a greater than minimum level of welfare.

One issue concerns the extent to which private standards may complement or conflict with legislation. One excellent example in which legal requirements have been interwoven into private standards is the guidelines of the American Meat Institute Foundation (2010), in which federal regulations regarding animal transport, slaughter, and handling practices have been clearly identified among the voluntary science-based standards and interleaved with the audit measurements used to assess compliance with the standards.

Successful integration of best animal care practices into the farming community begins with a set of well-researched, scientifically and ethically valid, and practical set of standards that meet the approval of producers and the expectations of the public, and it ends with the accurate characterization and reporting of on-farm compliance. To achieve this, a collaborative effort between the livestock industry and government is needed to set national welfare standards and oversight processes. Edge and Barnett (2009) provide an example of this collaboration from Australia.

In this article, we consider some of the issues that arise when developing animal welfare standards for farm animals that are based on science and in verifying compliance with these standards. We discuss the problem of scientific uncertainty and the interaction between policy and science, especially in developing a consensus definition of animal welfare, and the practical difficulties of assessing compliance with science-based standards; we then consider the relative advantages of using animal-based rather than resource-based standards.

SCIENCE-BASED STANDARDS

Interaction of Science and Policy

The majority of animal welfare standards claim to be based on science as a way of enhancing their credibility, but even when animal welfare standards are based on science, there are limits to the role that scientific information will play in the final state of these standards. When the issue is not particularly controversial and where there is little scientific uncertainty, the results of scientific research can be the most important factor in affecting the standard. For example, research has shown that it is essential for newborn calves to receive an adequate quantity of colostrum to protect against disease until the immune system of the calf is fully functional (reviewed in Rushen et al., 2008). Furthermore, we have sufficient information to give fairly precise recommendations on how much colostrum to give and the optimal time to give it. Thus, several standards for the welfare of cattle include such recommendations in their standards or guidelines (e.g., Dairy Farmers of Canada, 2009).

Where there is controversy or scientific uncertainty, or where the standard touches an area of great public concern or one that can have a major impact on the industry, the standard will reflect a strong influence of policy decisions, and we should not expect that science will necessarily override these policy considerations. In particular, it is important to separate scientific issues from ethical ones (Croney and Millman, 2007). Although research may result in clear answers regarding the impact of any given practice on the welfare of the animals, it cannot answer the question of whether the practice is acceptable; this is an ethical, not a scientific, question. Regarding the dehorning and tail docking of dairy cattle, for example, during the last few decades, dairy farmers in some countries began to dock the tails of dairy cows, partly because of the belief that this would help improve cleanliness and reduce mastitis. Research has shown that this procedure can have a negative effect on animal welfare, especially through increased fly problems, and that it does nothing to improve cleanliness or udder health (Rushen et al., 2008; von Keyserlingk et al., 2009), and many welfare standards now disallow tail docking (e.g., Dairy Farmers of Canada, 2009). However, dehorning of calves is also a painful procedure, and this is generally considered

acceptable, albeit usually with the requirement that some pain control be used when calves are dehorned (e.g., Dairy Farmers of Canada, 2009). The difference between tail docking and dehorning is that dehorning is considered necessary to protect the animals and handlers from the dangers of being gored, whereas there is no countervailing advantage to the welfare of the animal with docking the tail. Thus, the acceptability of the procedure depends as much on ethical decisions as on scientific evidence.

In general, an interaction is likely to exist between scientific research and the policy decisions of the bodies making the standards. This can be seen in the history of the European legislation on the housing of laying hens (Appleby, 2003), in which the initial decisions to ban conventional battery cages appeared to be at least partly a policy decision (in the case of Switzerland, after a referendum), and which was modified later by some countries to allow enriched cages. Enriched cages appear to offer some of the health benefits of cages but still allow the hens to perform the behaviors that have been identified as the most important to them.

Communicating Scientific Uncertainty

An element of uncertainty always exists when estimating the magnitude of the various threats to animal welfare (Croney and Millman, 2007). In providing scientific information to policy makers or other groups that are developing welfare standards, it is incumbent on us to communicate honestly and effectively about the degree of scientific uncertainty that does exist. The European Food Safety Authority has developed the most formalized approach to providing independent scientific advice on matters relating to the health and welfare of animals (Ribo and Serratos, 2009). Its process involves identifying and characterizing the major hazards for animal welfare and estimating the magnitude of the impact on the animal. Its scientific opinions contain qualitative uncertainty scores in an attempt to communicate to policy makers the degree of uncertainty involved.

Unfortunately, uncertainty about the impact of any threat to an animal involves quite profound issues concerning the scientific knowledge of animal welfare. Usually the degree of uncertainty is less when research has assessed short-term or acute threats to animal welfare. For example, research has been fairly consistent in showing that dehorning of cattle is painful and that a combination of local anesthetics and longer lasting analgesics is needed (reviewed in Rushen et al., 2008; von Keyserlingk et al., 2009). However, it has been a far more difficult task for science to show the disadvantages of complex housing systems that have long-lasting, chronic effects on animal welfare. Reviews that have been done illustrate how difficult it is to show clearly that one type of housing system is better, in all respects, than another (e.g., Fraser, 2003; Blokhuis et al., 2007; Rushen et al., 2008). For example, a current debate is whether furnished cages or noncage systems

provide the best alternative to battery cages for laying hens (Rodenburg et al., 2008). One source of scientific uncertainty is that different studies comparing housing systems may produce different results because the details of the housing systems or the management may overshadow any differences between the housing systems per se. For example, this is apparent in studies that have compared the prevalence of *Salmonella* in housing systems for laying hens (Van Hoorebeke et al., 2010). Another source of scientific uncertainty is that differing housing or management systems have both disadvantages and advantages for animal welfare. One comprehensive study showed that laying hens in non-cage systems make better use of the resources available, appear less fearful, and have stronger bones than hens in furnished cages (Rodenburg et al., 2008). In contrast, the latter have decreased mortality rates and typically are exposed to better air quality (Rodenburg et al., 2008). However, it is difficult to draw clear conclusions about which system is better for the overall welfare of the birds unless we can rank the different advantages and disadvantages on a single scale.

Unfortunately, one of the greatest unresolved issues in research on animal welfare is how to weight the relative importance of the different threats to animal welfare, such as health vs. behavioral restriction, and this is the largest source of scientific uncertainty (Rushen and de Passillé, 2009). We suggest that this will not be resolved until we have a scientific concept of how the different components of welfare relate to the overall welfare of the animal. In such cases, different scientists can reach different conclusions about the relative advantages of different housing systems by favoring different welfare indicators. For example, there are differences between veterinarians and ethologists in their views on the relative effects of different calf housing methods on animal welfare (Bracke et al., 2008).

However, despite these occasional disagreements, considerable consensus can be achieved on what constitutes good or poor welfare by using formalized methods such as the Delphi technique (e.g., Whay et al., 2003; Hegelund and Sørensen, 2007). The results show that scientists with experience in animal welfare are capable of integrating a variety of information about animal health, housing, and management to achieve a fair consensus on the level of welfare on the farm. However, bodies providing scientific advice to policy makers need to be multidisciplinary and include veterinarians, ethologists, physiologists, and nutritionists.

A Consensus Definition of Animal Welfare

To assess the validity of the different welfare standards in addressing the concerns of stakeholders, we need to understand the main concerns. Three broad types of concerns are typically raised about the effects of modern farming systems on animal welfare (Fraser et al., 1997). Is the animal healthy and producing well? Is the animal happy, or is it suffering from pain or

Table 1. An operational definition of animal welfare developed in the Welfare Quality project (Welfare Quality, 2009)

Principle	No.	Welfare criterion	Example of potential measures
Good feeding	1	Absence of prolonged hunger	BCS
	2	Absence of prolonged thirst	Access to water
Good housing	3	Comfort around resting	Frequencies of different lying positions, standing up and lying down behavior
	4	Thermal comfort	Panting, shivering
Good health	5	Ease of movement	Slipping or falling, possibility of exercise
	6	Absence of injuries	Clinical scoring of integument, carcass damage, lameness
	7	Absence of disease	Enteric problems, downgrades at slaughter
	8	Absence of pain induced by management procedures	Evidence of routine mutilations such as tail docking and dehorning, stunning effectiveness at slaughter
Appropriate behavior	9	Expression of social behaviors	Social licking, aggression
	10	Expression of other behaviors	Play, abnormal behavior
	11	Good human-animal relationship	Approach or avoidance tests
	12	Positive emotional state	Novel object test

undesirable emotions, such as fear? Is the animal able to perform its normal behavior and live a reasonably natural life? Thus, animal welfare is a multidimensional concept comprising both physical and mental aspects, and a consensus definition would need to address all its components.

The definition of animal welfare that has the widest degree of acceptance is that based on the “Five Freedoms” (Webster, 2001). This definition is best understood as a guideline showing the direction that should be taken to improve welfare, rather than stating that animals must have “freedom” to have good welfare (as it is often misunderstood). The World Animal Health Organization (OIE), which has 159 signatory countries, has adopted a similar approach and defines an animal as having good animal welfare if it is “healthy, comfortable, well nourished, safe, able to express innate behavior, and . . . is not suffering from unpleasant states such as pain, fear, and distress” (OIE, 2008). This definition overlaps with the Five Freedoms to a considerable degree. More recently, the Welfare Quality project (Blokhuis et al., 2010), a collaboration between 41 institutes across Europe with collaborators in other regions, has developed an operational definition (Table 1) that overlaps considerably with the Five freedoms and the OIE definition, but which specifies the particular indicators that could be used to assess each component of welfare. One empirical study has found that this definition is broadly accepted by the community at large (Tuytens et al., 2010). These overlapping definitions represent the closest we have to a consensus definition of animal welfare and can be used to assess the extent to which various standards do address animal welfare in its entirety.

However, the Five Freedoms and the OIE welfare definitions continue to trouble some scientists because of the reference to “suffering” and “innate” or “natural” behavior. The question is whether these are these amenable to scientific investigation. The extent to which animals suffer as a result of the way we house

or handle them is of central importance to the general public (Duncan, 2006), but a commonly voiced (although dated) criticism is that this is beyond the reach of science. Many recent publications show that understanding animal consciousness is now widely accepted to be amenable to scientific investigation (e.g., Dawkins, 2008; Mendl et al., 2009). Considerable progress has been made in understanding and measuring pain in farm animals (Weary et al., 2006), and researchers are developing techniques to examine a broader range of emotional and mood states of animals (Mendl et al., 2009). Thus, most scientists now accept, in principle, that animals have feelings and emotions and that these can be investigated scientifically. There is no scientific reason not to include reference to emotional suffering in a definition of animal welfare.

The possibility that animal welfare is reduced because animals cannot perform behavior that they normally would perform is one of the enduring concerns the public has about the welfare of animals in modern husbandry systems. However, problems with the concept of natural behavior have been discussed many times (Špinka, 2006). Briefly, there is no reason to think that an animal will inevitably suffer simply because it does not perform all the behavior patterns shown by its wild ancestors. Indeed, allowing animals to perform some natural behaviors, such as aggressive behaviors or infanticide, may lead to reductions in animal welfare. Furthermore, a multitude of detailed studies on different species have revealed how much artificial selection has altered the behavior of domestic animals (Jensen, 2006), so we are uncertain about how much of the behavioral repertoire of their wild ancestors domestic animals have retained. Despite these criticisms, the longevity and the ubiquity of the concept of “natural behavior” indicates that it does capture some of the disquiet that modern farming systems provoke in many people. Thus, scientists have tended to avoid the question of whether any behavior is “natural” or “innate” and instead have translated the notion of natural behavior into questions about behav-

ioral need and behavioral motivation, which are more amenable to scientific investigation. Many scientific approaches have now been developed to assess the importance to animal welfare of being able to express various behaviors (Croney and Millman, 2007; Jensen and Pedersen, 2008). Again, there is no scientific reason why definitions of welfare should not deal with behavioral issues, even though questions remain regarding which behaviors are the most important for animal welfare.

Management-Based vs. Animal-Based Standards

The criteria underlying animal welfare standards are conventionally divided into resource-based, which describe the environment of the animal (otherwise called input-based, engineering, or design criteria), and animal-based, which describe the actual state of the animal (otherwise known as outcome-based; Mench, 2003; Webster, 2009). Existing assurance schemes tend to assess welfare by using resource-based measures based on an examination of the provision of housing or resources, partly because they are often easier to audit (Mench, 2003). A potential advantage of well-chosen resource-based criteria is that these should prevent welfare problems from occurring. Furthermore, resource-based criteria serve to identify the risk factors or hazards that can threaten animal welfare. However, to use resource-based criteria with any confidence, we need scientific research that shows fairly unequivocally that any given housing or management practice is indeed a hazard leading to reduced welfare, which is sometimes lacking (Rushen and de Passillé, 2009). One study of commercial animal welfare standards that relies strongly on resource-based criteria has thrown some doubt on their effectiveness in promoting animal welfare (Main et al., 2003).

Resource-based assessment can fail to fully answer questions about animal welfare; consequently, there has been interest in developing animal-based methods that can be used to assess the actual state of welfare of the animals on a particular farm (Webster, 2009). Existing farm assurance standards sometimes ask animal-centered questions, and several European agricultural standards use welfare assessment tools that incorporate the judgment of inspectors regarding the severity of the animal welfare problems encountered. Examples of such assessment standards can be found in the GLOBALGAP Control Points and Compliance Criteria for cattle, sheep, pigs, and poultry (<http://www.globalgap.org>) and the Red Tractor Farm Assured Chicken Production Scheme (<http://www.assuredchicken.org.uk>). Within these standards, the majority of the requirements are resource based, but some clauses are close to being animal based. For example, the GLOBALGAP Control Points and Compliance Criteria program has clauses dealing with the occurrence of tail biting, flank biting, ear biting, or fighting in pigs and lameness in chickens.

The Welfare Quality project (Webster, 2009; Blokhuis et al., 2010) has been at the forefront in attempting to develop animal-based on-farm and slaughter welfare assessment systems to address the key areas of feeding, housing, health, disease, and behavior for pigs, poultry, and cattle that address multiple health and welfare criteria. These assessment schemes have been tested on a large number of farms across Europe.

Although there are obvious advantages in increasing the use of animal-based measures of welfare, there are also difficulties (Rushen and de Passillé, 2009). Real practical difficulties exist in being able to take the necessary measures on farm in a relatively short time. Pressure always exists to reduce costs by limiting the duration of the visit or the frequency of visits to farms, or the number of animals observed. Problems of time sampling are a real issue when using behavioral outcome measures. Many of the behaviors that we would like to use to assess welfare occur only for short periods and do not occur equally throughout the day. Therefore, a brief visit to a farm at a time chosen most often for the convenience of the auditor is unlikely to obtain a reliable measure of the occurrence of abnormal behaviors throughout the day. Our increasing ability to automate the recording of animal behavior is likely to aid the use of such behavioral measures in on-farm animal welfare monitoring schemes (Ito et al., 2009). Because of the difficulties inherent in taking behavioral measures during a short farm visit, animal-based welfare assessment schemes have somewhat overemphasized measures of health or injury, which, although undoubtedly important, do not fully cover all the welfare issues. Even with measures of illness or injury, considerable difficulties exist in obtaining accurate estimates of incidence, especially from the records of farmers. A recently developed animal welfare advisory tool for dairy calves (Vasseur et al., 2010) is primarily resource based because of the difficulties in obtaining reliable outcome-based measures of calf health from Canadian dairy farms. Again, our ability to take automated measures related to health, such as measures of body temperature to detect illness (Schaefer et al., 2007), measures of behavioral changes indicating illness (e.g., Borderas et al. 2009), or image analysis to detect lameness in broilers (Dawkins et al., 2009), will improve our ability to use such animal-based measures.

At present, it is unlikely that animal-based standards can completely replace resource-based standards. Given that both resource- and animal-based criteria have pros and cons, animal welfare assessments will require both criteria for the foreseeable future; indeed, experts tend to choose a mix of such criteria when developing animal welfare assessment schemes (Leach et al., 2008).

AUDITING COMPLIANCE

Once animal welfare standards have been developed, the next challenge is to assess the extent to which pro-

ducers, transporters, or slaughterhouses comply with these standards (Webster, 2009). Many private companies now offer animal welfare auditing services to agricultural producers and food retailers that require verification of the animal care practices used by their suppliers. These professional auditing enterprises often develop customized programs that employ procedures, protocols, and practices that ideally accurately measure and report compliance with animal welfare standards. Animal welfare audit enterprises must build audit programs that are trusted and accepted by both the community to be audited and the target social audience. Furthermore, to obtain social confidence in the audit enterprise, audit programs must incorporate the most current validated scientific measures while balancing socially articulated concerns and public legal mandates to secure farm animal welfare.

Auditing Animal Welfare Standards

A clear understanding of what it means to audit animal welfare is critical for public acceptance of these programs. The historic literature on the practice of auditing (Hayes et al., 2004) was developed largely by scholars from banking and business. The purpose of an audit can range from policing a business to adding credibility, to adjudication of claims against an enterprise, or a combination of all 3. In summary, the characteristics of an audit are internationally recognized as the following: an audit follows a structured, documented plan; is an independent, objective, and expert examination and evaluation of evidence; assesses the reliability and sufficiency of the information contained in the underlying records and other source data; and ascertains the degree of correspondence between the claims of management and established criteria by examining the physical evidence of documents, confirmation, inquiry, and observation. The goal, or objective, of the audit is to communicate the results to interested users and to express an informed and credible opinion in a written report (Hayes et al., 2004).

Animal welfare auditing programs must follow these internationally established practices. Different types of audits are currently used in farm animal welfare assurance programs. First, a self-audit is done by the producer or a designated employee, which serves largely to enable self-improvement in complying with the animal welfare standards. This type of auditing can be done by an external consultant (often called second-party auditing), who is less in danger of bias. A recently developed advisory tool to assess dairy calf welfare is an example of this type of audit (Vasseur et al., 2010). Third-party audits, on the other hand, entail the use of a trained external auditor who has no conflict of interest with the enterprise being audited. The absence of any conflict of interest plays a critical role in promoting the integrity of, and social confidence in, third-party audits. The goal of a third-party audit is to truthfully measure, document, and report on-farm compliance with

the animal welfare standard. The reporting structure is through the audit agency, which then reports back to the producer or the entity requesting or paying for the audit, or both, and the auditor may provide no direct feedback or recommendations to the producer. This distinguishes third-party audits from many of the on-farm assessment programs developed recently by animal industry groups, which more closely resemble self-audits. These often have as a goal helping producers adopt an animal care program to promote and maintain compliance with a set of standards, in preparation for the possible introduction of audits by food retailers or to meet legal requirements. The swine welfare assessment programs of the National Pork Board (2007) of the United States are examples. Consequently, the assessors provide direct feedback and recommendations to the producer before, during, and after the assessment.

The plethora of different animal welfare standards that have been developed and the lack of uniformity in animal welfare regulations present a significant challenge for auditing enterprises that wish to develop uniform audit protocols for each species under all conditions of housing. Integrating regulatory requirements into a science-based audit program can be particularly challenging because regulation is the end result of political negotiation and may conflict with the results of research (Croney and Millman, 2007; Swanson, 2008). Despite this, the regulations must take precedence over the science-based audit. Thus, significant customization of the audit protocol and instrument must occur for different standards and in different areas.

Animal Welfare Auditor Training

Well-articulated and scientifically supported animal welfare standards, audit procedures, and validated measures are essential, but no matter how airtight are the standards, procedures, and the audit instrument, an ill-trained auditor can sabotage the integrity of an audit and the reputation of the auditing enterprise. Training programs for professional animal welfare auditors are based on a comprehensive understanding of the standards, audit measures, legal mandates, and procedural requirements of conducting the audit and reporting the results. Government inspectors are trained in the specific legal requirements, procedures, and public expectations for oversight (Hayes et al., 2004). In North America, most audit procedures and auditor training specific to animal welfare have been internally developed by private audit firms and the animal industries, with only a few exceptions (Grandin, 2000; Mench, 2003). For example, the Professional Animal Auditor Certification Organization (<http://www.animalauditor.org>) was formed and specializes in the training and certification of animal welfare auditors.

Several important considerations must be addressed in any auditor training program. First, auditors must be trained to a high level of competence and must understand the criteria and measures that will be used to

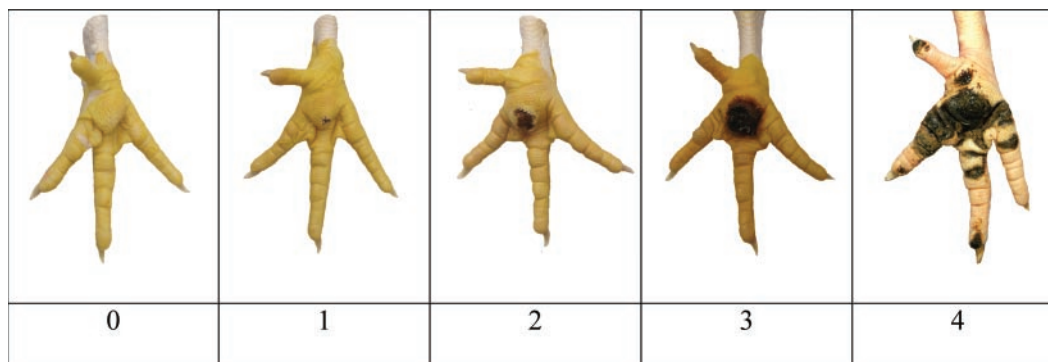


Figure 1. Scoring scale for pododermatitis (i.e., footpad disease) in broiler chickens. The feet of each bird are inspected and given a score based on the photograph they most closely resemble. The scores show an increase in the severity of pododermatitis and range from 0 (representing no evidence of pododermatitis) to 4 (representing severe pododermatitis). Based on the Welfare Quality Project (Welfare Quality, 2009). Photographs are from A. Butterworth (University of Bristol, North Somerset, UK). Color figure available in the online PDF.

determine compliance with the standard. This includes the scientific and practical basis for the standards, the measures, and the criteria. Auditors must be trained to conduct highly accurate and repeatable auditing and should understand the difference between resource-based and animal-based criteria because the methodology used to assess compliance for these types of criteria will differ. However, ease of use and interpretation by the auditor are important (Grandin, 2006), and this places limits on the types of animal-based measures that can be used. For example, a resource-based criterion, such as space allowance, with a specific quantitative requirement, such as inches (centimeters) or square feet (square meters) per animal, is relatively easy to measure reliably. In contrast, an animal-based measure may be difficult to assess in a highly repeatable and consistent way. Subsequently, we discuss one animal-based method of assessing the welfare of broilers.

Second, auditors must be fully versed in the regulations for the conditions and species they will be auditing. Correct interpretation of the legislation, a full understanding of the authoritative boundaries, and an understanding of how the regulation is integrated into the animal welfare standards is critical. Third, auditors should be certified for competency not only in the classroom, but also in the field. Shadow audits of newly trained auditors are essential before full certification. Continuing education must be a condition of periodic recertification, especially in the case of formal credentialing or employment by an audit enterprise. A listing of North American animal welfare audit and certification programs has been compiled by the USDA Animal Welfare Information Center (<http://awic.nal.usda.gov>).

Auditing animal welfare is challenging when there are 1) poorly written standards or laws that are ambiguous or that promote unreasonable or impractical expectations; 2) standards and measures that conflict; and 3) audit procedures and criteria that do not produce meaningful information relative to that standard or law, or worse, do not result in an overall improvement in animal welfare. These may thwart the intention

to promote best management practices through a third-party audit system.

A PRACTICAL EXAMPLE: ASSESSING FOOTPAD DERMATITIS IN BROILERS

Successful on-farm welfare assessment involves a combination of animal-based measures to assess the actual state of welfare of the animals and resource-based measures to identify risk factors. We illustrate this approach by describing a method of assessing welfare in broiler chicken flocks by assessing one cause of lameness (Welfare Quality, 2009). Footpad dermatitis, or pododermatitis, is a major welfare problem for broiler chickens, and inspection bodies in some European countries are now beginning to focus on footpad health as a marker for overall broiler welfare.

First, a protocol consisting of a standardized description of the methods to be used is developed. This includes a description of the animal-based measure. Footpad dermatitis is described as a contact dermatitis found on the skin of the foot, most commonly on the central pad, but sometimes also on the toes; the skin is turned dark by contact with litter, and deep skin lesions can result. A scoring scale is then provided (Figure 1) that allows an assessment of the severity of these lesions. The protocol must also describe the sampling strategy, for example, the number of birds to be scored and the best locations for selecting the birds. In the example used, at least 100 broiler chickens per flock are assessed: 10 birds taken from 10 areas of the house, including 2 areas located near drinkers, 2 areas located near feeders, 3 areas located near a wall, and 3 areas located away from drinkers and feeders.

As stated above, the assessors must be adequately trained so that they are familiar with the measure, and they must be repeatable and reliable in their application of it. In this example, the assessors are trained through classroom sessions, on-farm visits, and examinations of photographs. The inspectors are required to be assessed during the training course until they develop uniform scoring. Assessors are asked to carry out a validation or

reference audit periodically to check that they continue to score in a repeatable way.

The second step involves analyzing the risk factors present by using resource-based measures. This can be done by completing a farm questionnaire or standard inspection report, which provides a description of the farm, house, and flock. By combining this information with the recorded prevalence of footpad dermatitis (i.e., the animal-based measures), it is possible to identify the key risk factors. For example, a single company can measure the prevalence and severity of footpad dermatitis in different flocks within the company. By making comparisons between good and poor flocks, it is possible to identify the management, housing environment, feeding, medication, stockmanship, and genotype factors that differ between these farms. From farm experience in the United Kingdom, the main risk factors for lameness include the growth rate, the age of the birds at slaughter, the use of whole cereals in the diet, the type of feed, the quality of biosecurity measures, the litter condition (an important factor), and the genotype of the birds. The sex of the birds, amounts of feed restriction, lighting pattern and light intensity, amount of bird activity, and stocking density have also been found to influence the extent of footpad dermatitis and lameness (Kestin et al., 1999). If the company combines this knowledge of the risk factors with an investigation of the bacteriological pathologies linked with footpad dermatitis and identifies whether these bacteria originate in their hatchery, during the transportation, or through lapses in farm biosecurity, then improvement in footpad health potentially may be achieved by targeting and addressing the risk factors identified on each farm during this process.

The third and fourth steps are to inform and support management decisions to create improvements in welfare by reducing the incidence of dermatitis. The measures made on farm and at the slaughterhouse by trained assessors, and the information that is collected with both animal-based and resource-based measures can be used to promote and support management decisions and to give advice, which may reduce the incidence of dermatitis.

Once measures have been carried out on a farm, these can be used in a variety of ways. The first way is to take the raw scores for each measure as “benchmarking” or “initial position” scores, which tell the producer how he or she was performing at the beginning of the assessments and also allow a comparison with baseline values and with peers. The next step is to ascribe weights to these measures, to give impact factors for each measure with respect to animal welfare (Bracke et al., 2002). This type of weighting system is seen, for example, in the Austrian TierGerechtheits index (Bartussek, 1999). Weighted sums of scores appear intuitive, and the principle is usually readily understood by users.

The individual measures can be combined to give aggregate scores, which are considered meaningful and

credible by the producer and the consumer. However, the process of combining scores must not devalue the overall meaning of the assessment information, for example, by compensating a very poor score in one area with several moderately acceptable scores in other areas. If this occurs, then the power of discrimination can be lost and the credibility of the combined score is brought into doubt. Spoolder et al. (2003) indicated that when welfare scores are simply summated to give an overall score, a welfare disadvantage can be compensated for by several minor advantages, but this effect can be limited, or even eliminated, if minimal requirements are set below which specific scores cannot be permitted (Botreau et al., 2007). However, the best methods of weighting and combining scores are a continuing source of scientific uncertainty in welfare assessments (Rushen and de Passillé, 2009).

SUMMARY AND CONCLUSIONS

Research in animal welfare has progressed to the extent that we can now take reliable and valid measures of the presence on site of known risk factors or hazards and of the presence or absence of indicators of good or poor animal welfare. Despite these scientific advances, policy and ethical issues will always play a role in affecting which aspects of animal welfare we focus on in developing standards, and in deciding the level of animal welfare that we consider to be acceptable. Practical issues associated with the process of auditing compliance with standards also place limits on the extent to which actual practice approaches the ideal.

One of the most important developments has been in animal-based welfare standards that consider the actual welfare state of the animals. Despite the obvious value and attractiveness of using animal-based measures in welfare assessment, their practical use within existing assurance schemes is problematic in several ways. For example, are existing schemes able to assess animal-based measures in a repeatable and reliable way within the time scale of a routine assessment? Who will carry the cost of assessing animal-based measures? How will assessment of animal-based measures work in terms of periodicity and seasonality of assessment? That is, will the seasonal changes in production systems make interpretation of the findings difficult? Can the reduction of animal-based measures to a single farm-based score actually work? Animal-based measures conventionally assess poor welfare (e.g., attributable to lameness, skin lesions, hunger). Can they also be used to convey positive information to consumers about good welfare (Yeates and Main, 2008)? The tools being developed in animal-based measurement systems now under development are part of the trend toward the inclusion of assessment techniques that reflect what can be measured “on the animal.” It seems increasingly likely that some animal-based measures may find their way into farm assessment schemes and farm animal welfare legislation.

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