Current issues in animal welfare - what must be done and how do we improve?

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Summary

Concern about the welfare of dairy cattle is nothing new; producers and veterinarians have always been concerned about the condition of animals in their care and have tried to ensure that they are healthy and well nourished. Although good welfare has traditionally been viewed by farmers and veterinarians to be seen as good health and production there is a growing acceptance that concerns such as pain and distress and the ability to engage in highly motivated behaviors is also of importance. In this proceedings chapter we discuss the concept of animal welfare from three different perspectives: biological functioning, affective state and natural behavior. Drawing largely on the research undertaken by our students we provide examples of how science can help provide solutions to welfare concerns that address each of these concepts. Animal welfare science addresses all three types of concern by identifying problems in production systems and developing solutions to these problems. The best solutions are win-win, improving the lives of cattle and the people that work with them.

Introduction

Concern about the welfare of dairy cattle is nothing new; producers and veterinarians have always been concerned about the condition of animals in their care and have tried to ensure that they are healthy and well nourished (von Keyserlingk et al., 2009). In the tradition of good animal husbandry, good welfare can be seen largely as maintaining production and the absence illness or injury. However, more recent interest in farm animal welfare stems more from concerns about pain or distress that the animals might experience, and concerns that animals are kept under "unnatural" conditions, with limited space and often a limited ability to engage in social interactions and other natural behaviors. Our first objective is to describe a conceptual framework for these different types of animal welfare concern (reviewed in more detail by Fraser, 2008), using examples from dairy production systems. Over the past decade we have seen a tremendous increase in scientific research on the welfare of cattle. Although research alone cannot tell us which types of concerns are most important, it can and has provided solutions to a number of issues. Our second objective is to provide examples of how science can help provide solutions to welfare concerns (these and other examples are reviewed in Rushen et al., 2008).

Animal welfare: a conceptual overview

Animal welfare includes three types if concern: 1) is the animal functioning well (biological functioning), 2) is the animal feeling well (affective state), and 3) is the animal able to live a reasonably natural life (natural living; Fraser et al., 1997). Farm animal care givers are naturally concerned about the first category; addressing issues such as disease, injury, poor growth rates and reproductive problems, issues that are good for the animal and ultimately also vital in terms of the economic viability of the farm enterprise. However, people are also concerned with the affective state of the animal, and focus upon whether the animals are suffering from unpleasant feelings such as pain, fear or hunger. For some people (including many producers and consumers of organic products), a key concern is whether the animal is able to live a relatively natural life (Fraser and Weary, 2004). For example, is the calf kept with the cow and do cows have access to pasture?

These different types of concern about animal welfare can and do overlap. A lactating dairy cow unable to seek shade on a hot day (natural living), will likely feel uncomfortably hot (affective state), and may show signs of hyperthermia and ultimately reduced milk production (biological functioning). In such cases, research directed at any or all the levels can help address the welfare problem. In other cases, overlap may be less obvious or the different concerns may even be in conflict. For example, group housing of dairy calves allows them to engage in natural social interactions, but when poorly managed can lead to increased incidence of certain diseases or aggressive interactions. Different people can thus reach opposite conclusions about the relative advantages of different housing systems by favoring different welfare indicators (see Fraser, 2003 for case study). Clearly the best solutions will be those that address all three concerns, for example, by creating group-housing systems for calves that avoid competition, allow for social contact and maintains healthy calves. In this way, the three types of concerns can be considered as a checklist with researchers working to identify and solve the various welfare issues. Below we review a few examples of recent work showing how science can be used to address dairy cattle welfare issues from the perspective of biological functioning, natural living and affective states.

Biological functioning

Problems in biological functioning, such as disease and injury, are clearly a welfare concern. For example, lameness is now widely regarded as a major welfare problem for dairy cows and in recent years has received considerable attention in the scientific literature. Compounding the problem is that producers find it difficult to identify animals at the early stages of lameness, likely because dairy cows remain stoic unless injuries are relatively severe (Whay et al., 2003).

Current research is developing improved gait scoring system that can be used to identify cows that are becoming lame. Better scoring systems will require improved knowledge of cows' gait, and this can be derived from computer-assisted kinematic techniques that obtain precise measures of gait and how this changes with different types of hoof injuries

(Flower et al. 2005). Our group uses a gait scoring system based on several specific gait features (e.g. asymmetric steps, tracking up etc.), and these scores have proven sensitive in identifying cows with sole ulcers (Flower and Weary, 2006), pain reduction following use of local anesthetic (Rushen et al., 2007) or non-steroidal anti-inflammatory drug (Flower et al. 2008), and the advantages of softer walking surfaces for lame cows (Flower et al., 2007). Improved training in lameness detection, can serve to recognize which cows will benefit from treatment, and perhaps more importantly identify management and environmental factors to reduce the risk of cows becoming lame.

Poorly designed and managed facilities cause injuries and increase the risk of health problems including lameness and transition cow disease, arguably two of the most serious welfare challenges facing the dairy industry (see von Keyserlingk et al. 2009). Producers spend millions of dollars building indoor housing for dairy cattle, with the aim of providing a comfortable environment for their animals - one that ensures adequate rest, protection from climatic extremes, and free access to an appropriate, well-balanced diet. Despite these laudable aims, housing systems do not always function well from the perspective of the cow – poorly designed and maintained facilities can cause injuries, increase the risk of disease, and increase competition among herd mates for access to feed and lying space.

Our aim is to provide science based solutions that can facilitate better designs and improvements in management that will prevent some of these problems. Our work has generally evaluated housing systems from the cow's perspective by asking how the housing affects cow health (e.g. by reducing the risk of hock injuries; Barrientos et al., 2013), what housing the cow prefers (Fregonesi et al., 2007; Fregonesi et al., 2009), and how the housing affects behavior (e.g. by reducing competition and increasing feeding time; Huzzey et al. 2006).

Variation in lameness rates can be explained in part by how the facilities are designed and managed, but these factors vary greatly among regions due to differences in tradition, barn builders, and availability of materials such as bedding. This means that the factors associated with lameness also vary among regions. For example, in recent analyses we have found major differences in factors associated with lameness in freestall facilities between the northeastern (NE) – US versus California (Chapinal et al., 2013). In the NE – US, where many farms used mats or mattress with just a little sawdust bedding, the risk of lameness reduced by half for farms using deep bedding and for farms that provided some access to pasture during the dry period. In CA, all farms used deep-bedded stalls (typically with dry manure bedding) and almost all farms provided outdoor access (typically to a well bedded dirt lot). Under these conditions, rates of lameness were much lower than in the NE – US. Rates of lameness were lowest on farms where stalls were kept clean (i.e. not contaminated with feces) and on farms that used rubber in the alley to the milking parlour.

Unlike lameness, hock lesions are obvious to anyone who cares to look. Indeed, it is pretty hard to avoid noticing hock lesions when you are standing at hock level in the milking parlour. But even though we can see these lesions they remain common on many

farms. Again, we found that prevalence varied among regions, from 42% in British Columbia, to 56% in California, to 81% in NE – US (von Keyserlingk et al., 2012). And again, the good news is that within each region some farms had very low rates suggesting that others could learn from these most successful producers.

One of the greatest challenges is to translate science into practice. Our recent work on benchmarking lameness shows promise as a possible vehicle to promote the adoption of best practices that result in improved dairy cattle welfare (von Keyserlingk et al., 2012; Chapinal et al., in press). In summary, across regions, farms that use well-maintained, deep-bedded stalls have lower risk of lameness and lower rates of hock injuries. Benchmarking programs that provide famers the relevant data from their farms and other farms in their region can motivate farmers to change practices resulting in improved welfare. Farmers can use this data, together with the recommendations described here and elsewhere, to develop formulate tailor-made solutions to problems with lameness and leg injuries.

Affective state

Measures of biological functioning, like disease and growth, can normally be characterized scientifically with little disagreement. The same cannot always be said for measures of how animals feel. Developing validated measures of animal affect remains one of the most interesting and challenging problems in animal welfare science. Painful procedures remain part of the everyday business of dairy farming, but new scientific studies are showing ways that this pain can be reduced or avoided. Considerable research has shown that all methods of dehorning and disbudding cause pain to calves (reviewed by Stafford and Mellor, 2005) but recent research has also shown that hot iron dehorning an result in negative judgment bias argued to reflect low mood in calves (Neave et al., 2013; Daros et al., 2014).

It is now also becoming clear that use of local anesthetic alone does not fully mitigate this pain. For example, local anesthetic does not provide adequate post-operative pain relief. Lidocaine is effective for 2 to 3 h after administration and treated calves actually experience higher plasma cortisol levels than untreated animals after the local anesthetic loses its effectiveness (Stafford and Mellor, 2005). However, the use of non-steroidal anti-inflammatory drugs, in addition to a local anesthetic, can keep plasma cortisol and behavioral responses close to baseline levels in the hours that follow disbudding and dehorning. A second consideration is that animals respond to both the pain of the procedure and to the physical restraint. Calves dehorned using a local anesthetic still require restraint, and calves must also be restrained while the local anesthetic is administered. The use of a sedative (such as xylazine) can essentially eliminate calf responses to the administration of the local anesthetic and the need for physical restraint during the administration of the local anesthetic and during dehorning (Grøndahl-Nielsen et al., 1999). Thus a combination of sedative, local anesthetic and a non-steroidal anti-inflammatory drug reduces the response to pain during dehorning and in the hours that follow. Unfortunately, such a combination of treatments may not be practical for farmers

and may itself have drawbacks for the animal. For example, an effective local block requires repeated injections and additional restraint.

One common alternative to hot-iron dehorning is using caustic paste to cause a chemical burn. This method of dehorning is still painful for the calves (Morisse et al., 1995), but the pain appears easier to control. Calves treated only with the sedative xylazine showed no immediate response to application of the paste, and little response in the hours that followed (Vickers et al., 2005). Moreover, caustic paste dehorning combined with a sedative actually resulted in less pain to calves than dehorning with a hot iron combined with both a sedative and a local anesthetic. This example shows how methods of pain treatment can be developed that are effective and practical for use on farm.

In this section we have focused on pain, in part because the science is clear but also because there is considerable social consensus regarding the ethics of intentionally causing (or failing to prevent) pain to animals. However, we urge readers not to focus only on pain; other affective states may be equally or more important to many cattle, including negative states like fear associated with poor handling practices and facilities and perhaps also positive affect associated by cows suckling their calf or grazing on pasture. The ability to perform these types of natural behavior are also considered important in their own right, as we turn to in the next section.

Natural living

For some, the natural living criteria may seem clear – simply allowing animals to live as naturally as possible. We see this approach as naïve; some natural conditions such as exposure to climatic extremes, disease, parasite infections and predator attacks cannot be seen as good for the animals. Thus the welfare benefits of providing more natural living must be assessed through the lens of the first two criteria. We use the example of more natural feeding systems for calves to illustrate how research can be used to determine if access to more natural environments also provides benefits to the animals in terms of biological functioning and affective state.

Traditionally calves are fed milk twice daily at 10% body weight, but calves often fail to gain weight during the first weeks of life (Hammon et al. 2002). When provided the opportunity, calves consume considerably more than 10% of their body weight (de Passillé and Rushen, 2006). Calves grow much more rapidly when allowed to suckle from the dam (Flower and Weary, 2003), but this biological functioning benefit does to not require keeping the cow and calf together. Simply feeding more milk allows for much higher weight gains, better feed conversion, and reduced age at first breeding (Jasper and Weary 2002; Diaz et al. 2001; Shamay et al., 2005). A better understanding of the calf's natural behavior and preferences, and how allowing this behavior this can benefit calf growth, is helping to revolutionized calf feeding practices.

The milk feeding practices also affect calf hunger. Calves vocalize when hungry and this vocal response, even in the first days after separation from the cow, can be much reduced or eliminated by providing more milk or colostrum (Thomas et al., 2001). Calves that are

fed restricted amounts of milk from an automated calf feeder typically visit the feeder more than 20 times a day even when they only receive milk on 2 of these visits. Increasing the milk ration much reduces the frequency of these 'non-nutritive' visits (Jensen 2006; De Paula Vieira et al. 2008). This reduction benefits the other calves using the feeder by reducing feeder occupancy and competition for feeder access. Thus allowing more natural feeding behavior reduces hunger and in this case also improves the efficiency of the feeding system facilitating group housing of calves.

The benefits in terms of improved growth and reduced hunger can be achieved by proving the calves more milk. Nipple feeding is clearly more natural but does this provide other benefits for the calf or the producer? Calves allowed to suck on a teat during or after a meal show higher concentrations of cholecystokinin and insulin (de Passillé et al., 1993) and a greater degree of relaxation after the meal (Veissier et al., 2002). Group-housed milk-fed calves will sometimes suck each other (i.e. cross sucking), but this cross-sucking can be much reduced or eliminated if calves consume their milk ration via free access to a teat (de Passillé, 2001), likely because the sucking behavior per se, rather than the ingestion of milk, is responsible for reducing sucking motivation (de Passillé, 2001). Thus nipple feeding also facilitates group housing, saving labor for producers (Kung et al., 2001) and perhaps providing other benefits to the calves.

For the past decades, common wisdom among North American dairy experts was that calves should be housed individually, in separate pens or hutches. This practice was considered to maximize performance and minimize the risk of disease. Individual housing also helps avoid behavioural problems such as competition and cross-sucking.

The new calf-feeding methods described above work well for individually housed calves, but also facilitate group housing. Group housing provides more space for calves and allows for social interactions. For the past decades, common wisdom among North American dairy experts was that calves should be housed individually, in separate pens or hutches. This practice was considered to maximize performance and minimize the risk of disease. Individual housing also helps avoid behavioural problems such as competition and cross-sucking.

The new calf-feeding methods described above work well for individually housed calves, but also facilitate group housing. Group housing provides more space for calves and allows for social interactions. Research and practical experience show that group rearing of calves can result in considerable benefits through reduced labour requirements for cleaning pens and feeding. Calves are social animals that need exercise and keeping dairy calves in groups may provide a number of advantages to both producers and their calves. Successful adoption of group housing will mean avoiding problems such as increased disease and competition. Recent research provides some insights into how these risks can be minimized.

We evaluated the behaviour and growth rates of calves housed in pairs versus individually (Chua et al., 2002); calves gained weight steadily regardless of treatments. Interestingly, during the week of weaning (approximately 5 weeks of age), pair-housed

calves continued to gain weight normally but the individually housed calves experienced a slight growth check. There were no differences between groups in the amounts of milk, starter or hay consumed, or in the incidence of scouring or other diseases. Aggressive behaviour and cross-sucking were almost never observed (less than 0.2% of time).

In a more recent study, De Paula Vieira et al. (2010) found that calves housed in pairs vocalized less during weaning than did individually housed calves. The results of this study also illustrated some longer-term costs to housing calves individually. When all calves were eventually introduced to a group pen after weaning calves that had previously been single housed took on average 50 h to begin feeding, in comparison to just 9 h for the pair-reared calves. Calves are also able to learn a simple colour discrimination task, and then re-learn the task when the colour treatments were reversed. However, despite the speed of learning for the simple discrimination task being similar for individually housed and pair-housed calves, the pair-housed calves are able to adapt more easily when the training stimuli are reversed. Together, the results of these studies suggest that individual housing of dairy calves can result in measurable learning deficits. Social housing for calves may result in animals that are more flexible in their responses to changes in management and housing (de Paula Vieira et al., 2012; Gillard, et al., 2013).

Successful group rearing requires appropriate management, including feeding method and group size. Large epidemiological surveys of U.S. and Swedish dairy farms found increased mortality and disease on farms keeping calves in large groups (more than 7 or 8) (Losinger and Heinrichs, 1997). Thus, small groups are likely a better alternative than large ones.

Calf immunity and the design and management of the housing systems, such as its cleanliness and ventilation, likely affect disease susceptibility more than group housing per se. Our work shows that housing young dairy calves in small groups is viable in terms of calf health, performance and behaviour. New research is now required on management strategies that will help prevent disease. For now, we encourage producers to consider keeping a closed herd (i.e. no new animals entering the herd), keeping groups small and physically separated from one another (e.g. in super hutches), and managing group pens in an all-in-all-out basis.

Calves in groups sometimes compete with pen mates. In one experiment using a simple teat-feeding system, we found that group-housed calves can displace one another from the milk teat many times each day if there are not enough teats (von Keyserlingk et al., 2004). However, giving each calf access to its own teat greatly reduced these displacements. This improved access to teats resulted in longer feeding times and increased milk intakes.

Other research has focused on how computerized feeding stations can be managed to reduce competition between calves. Increasing the daily milk allowance for calves from 5 to 8 litters per day reduced by half the number of times calves visited the feeder, reducing occupancy time and displacements from the feeder, and improving the efficient use of

this equipment (Jensen and Holm, 2003; de Paula Vieira et al. 2008; Sweeney et al., 2010). Our research shows that young calves can be introduced into a group with little disruption when they are trained to feed from the computerized feeding station prior to the introduction (O'Driscoll et al., 2006). Although the calves visited the feeder less frequently on the day of mixing, they were able to compensate by increasing both the duration and amount consumed per meal, and established their pre-mixing feeding pattern after just one day.

Conclusions

Many in the dairy industry may have assumed that animal welfare concerns can be met by working to ensure good health and productivity for the cows and calves in their care. We have argued above that good biological functioning is a necessary component of welfare, but this focus alone is not sufficient; affective states like pain or hunger, and concerns about naturalness are also important. Animal welfare science addresses all three types of concern by identifying problems in production systems and developing solutions to these problems. The best solutions are win-win, improving the lives of cattle and the people that work with them.

Acknowledgements

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