DAIRY COW WELFARE IN AUTOMATIC MILKING SYSTEMS

Melissa F. Elischer, M.S.
Extension Educator, 4-H Dairy Youth Programs
Michigan State University Extension
Anthony Hall, Room 1287H
474 S. Shaw Ln.
East Lansing, MI 48824

INTRODUCTION

With any housing or feeding system employed for dairy cattle, careful consideration should be made to both the individual’s and herd’s well-being. Providing optimal welfare for dairy cows is a multifaceted and challenging task. Factors such as good herd management, adequate barn environment, automated milking system (AMS) management, social dynamics of the herd, and human-animal interactions are just a few items that impact the overall welfare of the animal (Wiktorsson and Sørensen, 2004). Production decisions must balance what is feasible for the individuals managing the dairy as well as what is best for the animals. Although it should not be a determining factor in husbandry decisions, public attitude and perception regarding the dairy industry cannot be ignored and have the potential to influence laws and regulations.

Understanding the human values and attitudes that impact how one evaluates animal welfare is an equally challenging task. Animal welfare is an animal issue, but it is also a value-laden human concept that runs along a continuum from extremists in both animal agriculture and animal rights, and all concepts in between. A holistic framework for understanding animal welfare and the specific contributions and drawbacks of an AMS to dairy cow welfare will be discussed.

WHAT IS ANIMAL WELFARE?

Debates regarding the human use of animals and animal welfare have been recorded since the sixth century B.C.E. in Greece, but it was not until the twentieth century that science was invited to these conversations to help with reforms and regulations on animal use (Fraser, 2008). Indeed, the concepts at the center of the debate and the supporting arguments have changed over time, but the central issue has remained the same: the proper treatment of animals (Fraser, 2008). Different approaches have been used to offer solutions to these concerns, including ethical debates and scientific research. Neither approach is more valid or important than the other, but each offers differing insights into a complex topic.

Historically, and even in the modern day, the topic of animal ethics has been approached primarily philosophically rather than scientifically. In ancient Greece, philosophers focused on justice; for example, does the human concept of justice apply to animals and if so, how (Fraser, 2008)? During the English Enlightenment, the discussion of animal ethics was focused on human morality and virtue in that cruelty toward animals was a reflection on how humans would in turn act cruelly toward other humans (Fraser, 2008). In the twentieth century, there was a shift away from a human-focused, largely philosophical argument to an animal-centered question based on quality of life (Fraser, 2008). This is where science was brought to the table in an attempt to quantify and objectively assess animal welfare (Duncan & Fraser, 1997). Even with a
Keeping the philosophy and science in mind, how does one then define animal welfare? The World Organization for Animal Health (OIE) maintains a scientific approach and defines it as:

...how an animal is coping with the conditions in which it lives. An animal is in a good state of welfare if (as indicated by scientific evidence) it is healthy, comfortable, well nourished, safe, able to express innate behavior, and if it is not suffering from unpleasant states such as pain, fear, and distress. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter/killing. Animal welfare refers to the state of the animal; the treatment that an animal receives is covered by other terms such as animal care, animal husbandry, and humane treatment (World Organization for Animal Health (OIE), 2015).

The American Veterinary Medical Association (AVMA) uses the OIE’s definition, but expands it to include philosophical concepts, stating:

Ensuring animal welfare is a human responsibility that includes consideration for all aspects of animal well-being, including proper housing, management, nutrition, disease prevention and treatment, responsible care, humane handling, and, when necessary, humane euthanasia. There are numerous perspectives on animal welfare that are influenced by a person's values and experiences. There are also various means of measuring animal welfare, including (but not limited to) health, productivity, behavior, and physiological responses (American Veterinary Medical Association (AVMA), 2015).

If these definitions are simplified and combined, the final result is as follows: “Animal welfare is the state of well-being brought about by meeting the physical, environmental, nutritional, behavioral, and social needs of the animal or groups of animals under the care, supervision, or influence of people” (Pajor, personal communication, August 8, 2007).

This definition incorporates not only meeting the physical needs, health, and hygiene of an animal, but it also takes the psychological and mental health of the animal into account, as well as the human-value aspect of animal welfare. Considering all the needs of an animal and the best care possible to meet those needs is very important in maintaining a high level of overall welfare. These needs have been listed formally by the Brambell Committee (1965) in the Five Freedoms. A framework to understand the three most common approaches to the human-value aspect of animal welfare has been presented by Fraser and colleagues (1997) in the Three Circles Model. Both of these important resources will be discussed in further detail.

**THE FIVE FREEDOMS**

The Five Freedoms (Brambell, 1965) are an animal-centered list providing a “common sense animal care guide” that can be extended to any species. The details of how these Freedoms
are met will vary greatly based on the individual(s) and situation(s) they are applied. The Freedoms are as follows:

1. **Freedom from Hunger and Thirst** by ready access to fresh water and a diet to maintain full health and vigor.
2. **Freedom from Discomfort** by providing an appropriate environment including shelter and a comfortable resting space.
3. **Freedom from Pain, Injury, or Disease** by prevention or rapid diagnosis and treatment.
4. **Freedom to Express Normal Behaviors** by providing sufficient space, proper facilities, and company of the animal’s own kind.
5. **Freedom from Fear and Distress** by ensuring conditions and treatment which avoid mental suffering.

Some of the Freedoms are easier to assess and provide for, but that should in no way inhibit striving to meet all of these identified needs. Maintaining animals under human care, especially production animals such as dairy cattle, will lead to compromising some of these conditions from a “wild” state. For example, dairy cattle have evolved and been selected from pasture dwelling bovines. In many modern dairies in the United States, providing pasture access as the main source of feed and housing for dairy cattle is not very common (although this management strategy is gaining popularity in New Zealand, Australia, and parts of Europe), but this does not mean cattle welfare is necessarily impaired. Instead, it means that the Freedoms are met in a different way with proper management strategies, such as: soft, clean, comfortable lying spaces; non-slip flooring that may be cushioned in high traffic areas or locations where cattle spend a long time standing; protection from predators and environmental elements in proper housing; or access to a well-balanced total mixed ration (TMR) for the correct stage of lactation. Meeting Freedoms 4 and 5 can seem more challenging than the first three, but when taking a moment to consider how this would look in a modern dairy, the challenge begins to dissipate. Cattle are still housed in herds, not in isolation, an important step for satisfying normal behaviors and preventing fear. Maintaining a normal schedule and consistent, low-stress handling methods will also go a long way to improve welfare and meet these Freedoms, especially number five.

**THE THREE CIRCLES MODEL**

The Three Circles Model was introduced by Fraser and colleagues (1997) as a method of recognizing the human values that underlie this topic even when conducting scientific research. As stated previously, ethical concerns are what brought science into animal welfare to better evaluate quality of life. This model addresses three common, overlapping schools of thought used to understand animal welfare. No single circle is more important than another, nor is any one isolated from the other two. This model provides a lens for examining one’s own biases when addressing animal welfare concerns, as well as the means to understand outside perspectives. The model can be best represented through the following Venn diagram with circles numbered purely to ease discussion:
1. **Basic Health and Functioning**: This lens looks at animal welfare in terms of the physical fitness of the animal. Is the animal growing and reproducing well? Does the animal have the food, water, and shelter necessary to exist? This circle ties back to Freedom 1 (hunger and thirst), Freedom 2 (discomfort), and Freedom 3 (pain, injury, and disease). Traditionally, many producers and veterinarians evaluate welfare through this lens.

2. **Natural Living**: The second lens states that animals should be able to lead reasonably natural lives with natural elements an important factor in their environment (Fraser, 2008). The specific “nature” of animals should be respected and accommodated for, meaning that providing care for animals does not fit under a “one size fits all” approach. Often philosophers and social critics use this lens of welfare evaluation. Freedom 4 (expression of natural behavior) aligns with this circle.

3. **Affective States**: Using the term “feelings” can be problematic when discussing the subjective experiences of an animal’s existence and it also does not encompass all the states an animal may experience. Concerns of both pleasant (e.g., “happiness”, “pleasure”, etc.) and unpleasant (e.g., “pain”, “suffering”, etc.) states fall in this circle (Fraser, 2008). Some of these conditions may be termed “emotions”, but this word is still not enough to cover states such as hunger or thirst which have both a physical and mental component. Freedom 5 (fear and distress) directly connects to this lens; however, all the Freedoms can be discussed in this light because they can all relate to a subjective experience for an animal.

With a functional definition of animal welfare at hand, combined with using the Five Freedoms and Three Circles Model as the evaluation framework, a discussion can take place regarding the impacts of milking cows with automatic milking systems (AMS).
AMS TECHNOLOGY AND IMPACT

AMS were first commercially available in the Netherlands in 1992 and were intended to decrease human labor necessary to run a dairy farm (Bijl et al., 2007). Since this time, the number of dairies milking and managing a herd with an AMS has grown to over 8,000 as reported at the end of 2009, with the majority (>90%) located in northwestern Europe (de Koning, 2010). Although invented largely to assist with and ease human labor, there are numerous benefits to dairy cattle milked in this way.

An AMS, when functioning properly, provides the cow with a consistent milking routine, performs proper teat stimulation and for the correct duration of time, and often delivers a rationed concentrate during milking (Svennersten-Sjaunja and Petterson, 2008). Rasmussen and colleagues (1990) demonstrated the importance of a consistent, predictable milking routine in their experiment where the results indicated an increase in milk production when variation during the milking procedure was kept to a minimum in the parlor. An AMS also offers unique opportunities for cattle in that producers would have the ability to create a custom milking schedule for each cow so each animal could be milked at a different frequency or have a different interval between milkings (Svennersten-Sjaunja and Petterson, 2008). This flexibility in the milking schedule is an important benefit to the AMS, but it must be managed properly to ensure the robot is operating as efficiently as possible to meet individual cow variations in milking intervals, yield, and duration, as well as the economic goals of the producer, such as the revenue of the AMS (André et al., 2010). An AMS allows cows a greater opportunity to set their own milking schedule, and quite often increases in milking frequency and production are observed in the absence of detectable metabolic or behavioral distress in dairy cows. Additionally, an AMS is able to milk each quarter separately, reducing the risk of overmilking and causing damage to teat ends, helping to maintain high udder health (Hopster et al., 2002).

Although there are many benefits to using an AMS, careful considerations need to be taken during the transition to a robotic system. Udder health has been shown to decrease when training cows to use AMS that have previously been milked in a parlor (Hovinen and Pyörälä, 2011). During the first year of AMS use, Rasmussen and colleagues (2001) found an increased incidence of new mammary infections compared to previous years in traditional parlor systems. Elevated somatic cell count (SCC) levels slowly dropped after three months in the AMS system (Rasmussen et al., 2001). Kruij and colleagues (2002) found similar results, reporting consistently higher SCC in AMS milked cows compared to the same animals milked previously at either 2x or 3x a day in a conventional parlor. The authors speculated the mammary gland infections and resulting increased SCC may be due to the length of the milking interval, method of teat cleaning, or increased likelihood of the milk canal remaining open with AMS. The results of these studies suggest it is especially important to monitor mammary gland health with the introduction of a new milking method. As more and more aspects of dairy husbandry become automated, it is vital managers and herdsmen observe cows daily; no machine will ever completely replace the excellent, thoughtful care humans provide.

Cows in an AMS dairy have more opportunities to make choices and exhibit a greater degree of control over their environment due to the flexible milking schedule (Jacobs and Siegfroid, 2012). Other issues may arise with this increased freedom, such as social isolation.
during milking, that create new welfare challenges to the individual (Jacobs and Siegford, 2012). Hopster and colleagues (2002) compared the stress response between primiparous cows milked in an AMS and a conventional parlor and reported AMS cows having a lower heart rate and spending more time with heads inside a feed trough. Further, it was also reported the AMS cows had lower maximum concentrations of nonadrenaline and adrenaline during the milking process, but no differences were detected in the number of steps (used as an indicator of discomfort during milking) or mean oxytocin levels after teat stimulation (Hopster et al., 2002). Hopster and colleagues concluded that results indicated robotic milking was not any more stressful than traditional milking methods and did not seem to negatively impact the cow’s welfare.

Many AMS offer automated sensors that can monitor aspects of cow health that would be otherwise difficult to record around the clock and in great detail. Outputs from AMS sensors include production at every milking from each quarter, changes in milk production or feed intake, reproductive stage, udder health, and body weight (Spahr and Maltz, 1997). Some of these technologies have been validated and can provide very useful information (Elischer et al., 2013); however, they should not replace daily human observation of the herd, but should instead be used as a compliment. Milk quality can be assessed through color and electrical conductivity from each quarter, which is a task other milking systems cannot perform (Jacobs and Siegford, 2012).

Other studies have found indications of chronic stress or discomfort with an AMS; however, factors related to housing design, like cow traffic patterns or the AMS model, may be responsible for these results instead of the milking method. Although Hagen and colleagues (2005) reported no difference during the milking process, cardiovascular indicators of stress were recorded while cows housed in a forced-traffic AMS were lying down compared to cows milked in a herringbone parlor. These results suggest the design of the AMS environment and traffic system, not the milking process itself, had a negative impact on cow welfare (Hagen et al., 2005). Similar results were found by Gygax and colleagues (2008) when comparing two different AMS models - the DeLaval Voluntary Milking System VMS1 (DeLaval International AB, Tumba, Sweden) and Lely Astronaut1 (Lely Industries N.V., Maassluis, The Netherlands) - with an auto-tandem parlor. Researchers found cows in both AMS models displayed more restless behaviors and had higher resting heart rates than cattle in the auto-tandem system (Gygax et al., 2008). The herd milked in the DeLaval system demonstrated more of these negative effects, suggesting there is a difference between AMS models (Gygax et al., 2008). Potentially confounding these results, the traffic pattern of the DeLaval and Lely AMS differed: DeLaval was set up in a forced/guided traffic pattern, whereas the Lely AMS allowed for free cow movement (Gygax et al., 2008). This may have contributed to the higher levels of stress recorded in the DeLaval herd and would agree with the results of Hagen and colleagues (2005) that other environmental factors may be stressful and not necessarily the milking procedure itself.

CONCLUSIONS

Animal welfare is not a simple, black and white topic. It encompasses centuries of philosophical debate and human values, with the scientific study of this subject still relatively new. To fully understand and evaluate animal welfare one must take a holistic approach, looking at the physical and subjective states of an animal. In doing so, one must also be aware of
personal cognitive biases that may exist when deciding what questions to ask, which assessment methods to use, and how to interpret data. The Five Freedoms and Three Circle Model are excellent resources to employ when appraising animal welfare and discussing this value-laden topic with others. Using these resources, a discussion of the benefits and drawbacks of an AMS can be explored. AMS provide cows increased flexibility and control over their environment and schedule, as well as provide a consistent milking procedure. However, there still needs to be excellent human management of the equipment and herd in this type of dairy system to ensure animals remain healthy and use the AMS so cows may reap the benefits.

WORKS CITED


