What is Affecting Housing Design and Other Management Practices - Economics or Animal Welfare?

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Abstract

Dairy producers are under considerable pressure to consider aspects of animal welfare in their daily management, as well as the design of their facilities. However, housing design and management decisions are often made for economic reasons with limited consideration for dairy cattle behavior and welfare. When designing lying areas, it is clear that cows like softer surfaces, for both lying down and for standing upon. Deep-bedded stalls work well for cow comfort but require maintenance. Lying space is often designed to encourage the cow to lie down in a specific location and to use the stall in such a way that feces and urine do not soil the stall. An adequate stall width and appropriate neck rail placement are two key parameters to consider when designing a comfortable lying space but may increase costs. The more restrictive we design stalls, the less attractive they become for the cow. The use of restrictive stall designs can help keep stalls clean, decreasing maintenance costs. Restrictive stall designs need to be accompanied by better flooring options, such as softer and drier, to avoid problems with hoof health. Genetic selection and other technical advances have significantly increased milk production per cow. However, this directed selection is also associated with reproductive difficulties, increased incidence of health problems, and a declining longevity. Broadening selection parameters to improve dairy cattle welfare may provide economic benefits and be more acceptable to the public in the long term.

Introduction

Dairy producers are under considerable pressure to consider aspects of animal welfare in their daily management, as well as the design of their facilities. Barn design and management can have considerable influence on the welfare of dairy cows (Cook et al., 2004; Zurbrigg et al., 2005). Housing for dairy cattle has been built 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. However, 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 herdmates for access to feed and lying space. In this paper, we review recent studies on the design of non-feeding areas and other management factors that affect the behavior and welfare of dairy cattle.

Assessing Cow Comfort

An important first step in designing housing that minimizes injuries or other health risks is to understand how to assess the welfare of a comfortable cow. Numerous indices and measures of cow comfort have been suggested (Cook et al., 2005; Rushen, 2001), including body condition score, cow cleanliness, lameness and injury, and health among others. Understanding animal behavior is a key indicator of dairy cattle comfort.

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A major advantage of using behavior as an indicator is that it can be measured non-invasively and without disturbing the cow.

Better Lying Surface

The surface provided for cows is one of the most important factors in designing a suitable lying area. Several researchers have measured stall usage, when the animals have no choice between surfaces, to assess how different bedding types affect behavior. For example, Haley et al. (2001) used a simple comparison between a space considered "high comfort" (a large box stall with mattresses) and a stall that represented "low comfort" (a tie stall with concrete flooring). They measured many behaviors, including lying, standing, and eating times, the number of times the cows stood up, and various leg positions during lying. Lying times were 4 hours longer and cows were more willing to stand up and change positions in the high-comfort housing. Cows also spent more time standing idle in the low-comfort stalls (Figure 1). This study demonstrates which behavioral measures are likely to change if a cow is uncomfortable, namely time spent lying and standing, and the number of times she is willing to stand up.

The surface provided to cows can have a significant impact on the occurrence of lesions and injuries. Weary and Taszkun (2000) found that cows on farms with mattresses (and little bedding) have more severe hock lesions than do cows on farms that use deep-bedded stalls (Figure 2). Similar results have now been reported in other research (e.g. Wechsler et al., 2000). Although many dairy professionals are aware of the risks of poorly bedded mattresses, too often this surface continues to be used. This occurs often for economic reasons, such as the cost of the bedding materials and/or labor.

Cows also clearly prefer lying surfaces with more bedding and spend more time lying down in well-bedded stalls. In a more recent experiment, the effect of the amount of bedding on the time spent lying and standing by cows housed in free stalls was examined (Tucker and Weary, 2004). Each stall was fitted with a geotextile mattress and bedded with 1 of 3 levels of kiln-dried sawdust (0, 2.2, and 15.4 lb). Cows spent 1.5 hours more time lying down in the heavily bedded stalls. In addition, cows spent less time standing with only the front legs in the stall when the mattresses were heavily bedded. These changes in both standing and lying behavior indicate that cows are hesitant to lie down on poorly bedded mattresses.

These differences in stall comfort may also account for a second important health problem; cows housed on mattresses also have a higher incidence of clinical lameness (24%) than those housed in deep-bedded sand stalls (11%; Cook et al., 2004). The lying surface can also affect udder health, and many studies have now shown the advantages to cows of using sand or other inorganic bedding as a way of reducing the growth of bacteria associated with environmental mastitis (e.g., Zdanowicz et al., 2004). In a recent study that compared sand bedding with straw bedding, sand stalls were advantageous for cow cleanliness and health, with hock lesions and claw diseases healing more quickly (Norring et al., 2008).

Making the decision to provide a well-bedded surface is just the first step in achieving a reasonable level of cow comfort – this surface must also be properly maintained. Drissler et al., (2005) found that if sand levels are not maintained, there is an associated decline in the stall use by cows. Sand levels in deep-bedded stalls decrease over a 10-day period, with the deepest part at the center of the stall. Lying time by cows also declines as the stall empties: every inch decline decreased lying time by about half an hour per day. Contact with concrete while lying down may explain lower lying times in deep-bedded stalls with less sand, and this concrete also affects leg health. Lesions on the point of the

hock are common in deep-bedded stalls (Mowbray et al., 2003), likely due to contact with the concrete curb when stalls are not well maintained.

Stall Configuration

Most indoor housing provides more than just a lying surface for the cows. Typically, the space is designed to encourage the cow to lie down in a specific location and to use the stall in such a way that feces and urine do not soil the stall. Unfortunately, most attempts to constrain how and where the cow lies down also reduces cow comfort.

New constructions and renovations often fail to provide appropriate space. Several experiments demonstrate how stall size and configuration affect standing and lying times. For example, in one study on the effect of stall width on cow behavior (Tucker et al., 2004), cows were provided with access to free stalls measuring 42, 46, or 50 inches between partitions. Cows spent an additional 42 minutes/day lying in the widest stalls, likely because they had less contact with the partitions in these larger stalls. Cows also spent more time standing with all 4 legs in the wider stalls, reducing the time they spent standing partially (i.e. perching) or fully on the concrete flooring available elsewhere in the barn.

In addition to stall width, neck-rail placement is important for managing standing behavior. Both the height of the neck rail and its distance from the curb affect standing (Tucker et al., 2005); more restrictive neck-rail placements (lower and closer to the rear of the stall) prevents cows from standing in fully in the stall, again increasing the time cows spend on concrete flooring elsewhere in the barn. The neck-rail is designed to 'index' the cow in the stall while she is standing, but the brisket board achieves this function while cows are lying down. Unfortunately, brisket boards also discourage stall use – cows spend 1.2 hours/day less time lying down when stalls have a brisket board compared to when using stalls without this barrier (Tucker et al., 2006b). Designing lying areas to encourage stall use has obvious economic implications. Obviously, wider stalls will cause increased construction cost. Increased occupancy of free stalls is also likely to increase the amount of fecal matter in the stall. Thus, well-used stalls require more stall maintenance, potentially increasing labor costs.

Standing Surfaces

According to popular thinking, when cows are not in the parlor, they should be eating or lying down. Unfortunately, no one seems to have explained this to the cows; a number of studies have found that even when cows have access to well-designed stalls, they spend only about 12 hours/day lying down. Cows spend the other 12 hours/day on their feet, and we need to take this into account in designing suitable housing.

In most barns, the surface for standing outside of the stall is wet concrete – a known risk factor for hoof health (e.g., Borderas et al., 2004). Cows can use the stall as a refuge, providing a dry, softer surface for standing. However, this increases the likelihood that cows will urinate and defecate in stall. The common response by barn designers has been to make the stalls more restrictive (as described above), forcing cows back into the concrete alley and explaining, in part, why lameness is now the most prevalent and costly health problem for cows housed in freestall barns. With our current barn designs, we are stuck with 2 bad choices: use restrictive stalls that keep the stall surface cleaner but force cows back onto the wet concrete, or use more open designs and increase frequency of stall maintenance. An alternative approach may be improving the standing surface elsewhere in the barn, such as in front of the feeding area.

In one study, cows were given the choice of standing on concrete or softer surfaces, and cows

spent the majority of their time standing on the softer flooring (Tucker et al., 2006a). In this study and in an earlier experiment (Fregonesi et al., 2004), standing times increased when cows had access to a rubber standing surface in front of the feeder. These effects on standing times are only modest, so the development of new standing surfaces remains an important area for future work.

Increased Milk Production Per Cow

Milk production per cow has increased dramatically, from approximately 5,000 lb/cow in 1950 to almost 19,000 lb/cow now. This increase was achieved through numerous technological and scientific developments. One of the most important was the improvement in genetic selection for production characteristics that was facilitated by the development of artificial insemination techniques. Intensive or continuous selection for a single trait can result in numerous reproductive, neurological, and behavioral problems, which are commonly referred to as production diseases. Cows selected for high production efficiency show numerous undesirable correlated effects (Rauw et al., 1998). High levels of milk yield are associated with increased health problems, declining fertility , and higher rates of culling (Rauw et al., 1998). High milk yield has been identified as a risk factor for numerous health problems, including digestive problems, lameness, skin and skeletal problems, retained placentas, udder edema, and mastitis (Fleischer et al., 2001; Fourichon et al., 2001). Laminitis resulting in lameness, the most common welfare concern on high producing farms, has been linked to selection for increased milk production (Greenough and Weaver, 1997). Although selection for milk production has had significant economic advantages, developing new breeding programs that improve dairy cow welfare by improving fitness and an ability to tolerate metabolic stress may be prudent (Oltenacu and Algers, 2005), especially in light of the public's increasing interest in the production practices used by animal agriculture.

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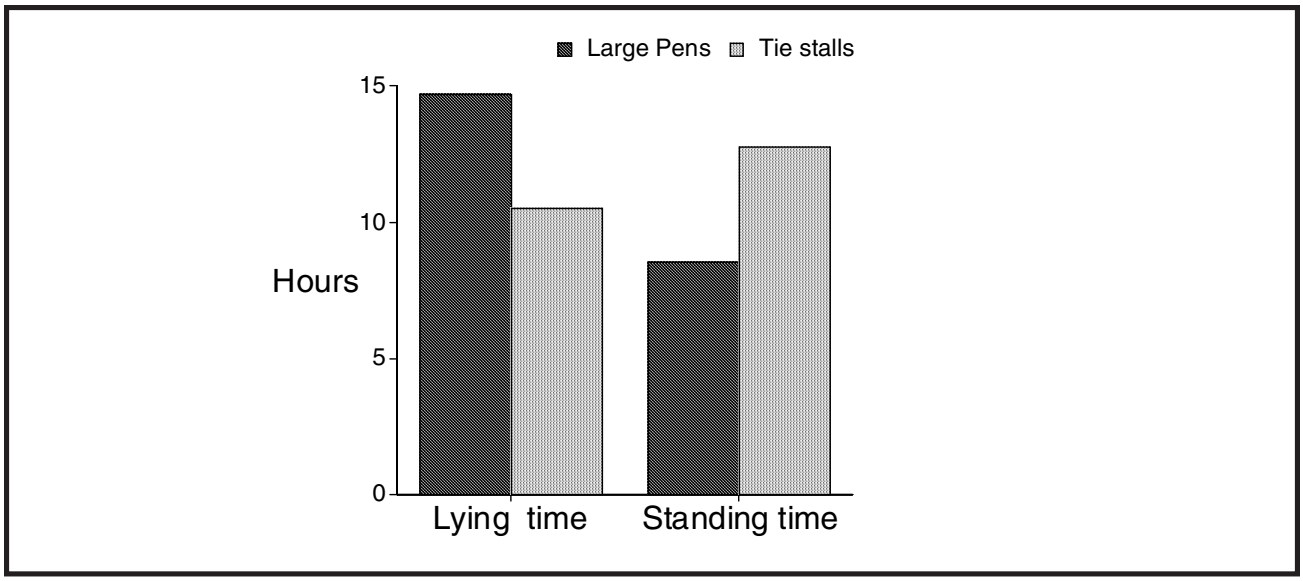

Figure 1. Cows spent more time lying and less time standing in large pens bedded with mattresses (high comfort) than in concrete tie-stalls (low comfort) (Haley et al., 2001).

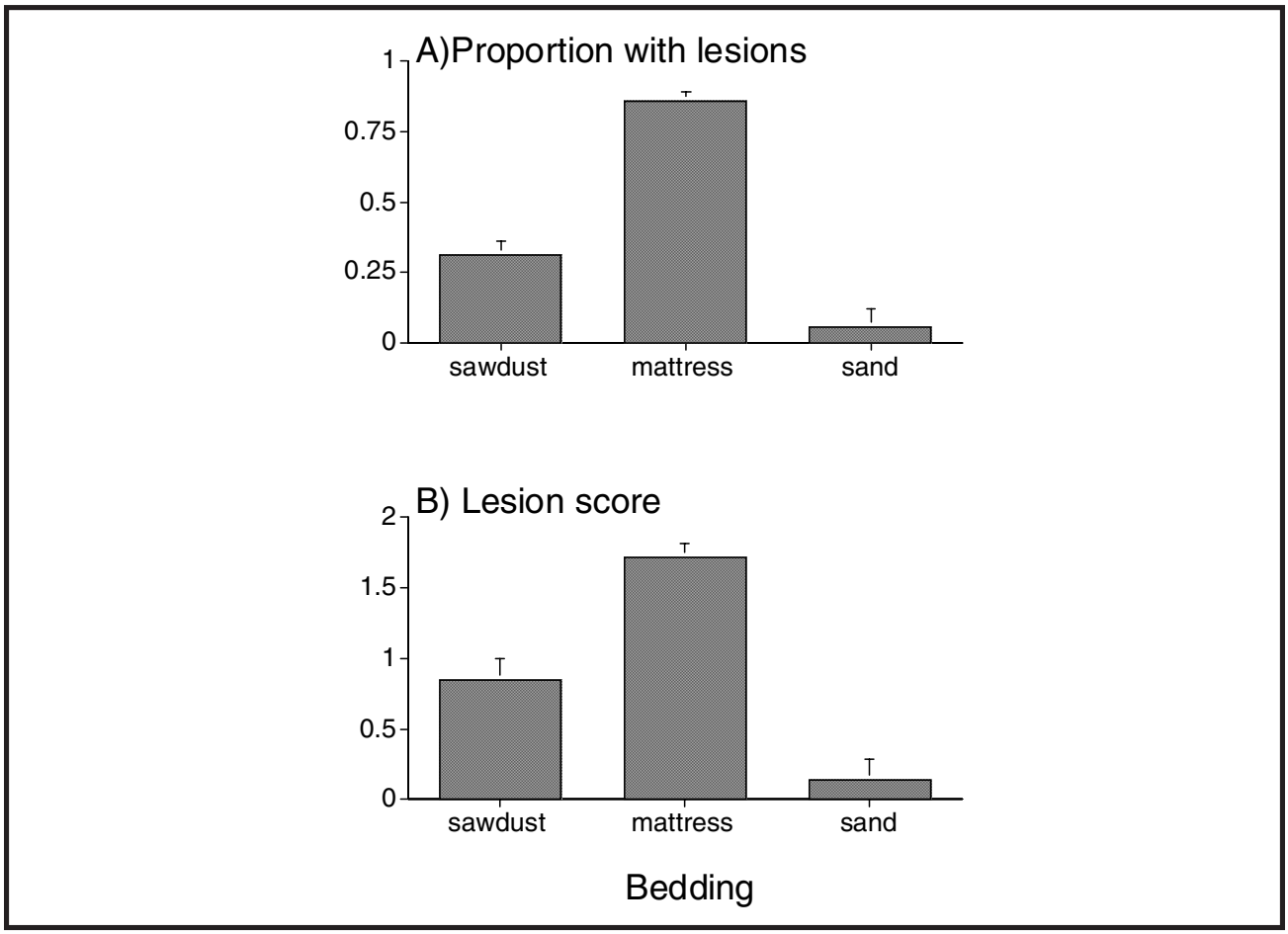

Figure 2. Cows on geotextile mattress are more likely to have lesions (A) and these lesions are more severe (B). Data shown are for the lateral surface of the tarsal joint, the area where lesions are most common (Weary and Taszkun, 2000).