Flooring Options to Minimize Lameness and Optimize Welfare

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Take Home Messages

- We must look at the flooring in dairy barns from the cow's point of view- what does she need to stay healthy and happy?
- Poor flooring in dairy barns reduces animal welfare by inhibiting normal locomotion by the cow, increasing risk of slipping and falling, and by increasing the chance of lameness
- To ensure optimum cow locomotion, flooring must be compressible and provide good traction. Concrete flooring is too hard
- Poorly maintained and poorly drained concrete flooring in free-stall barns is a major risk factor for hoof lesions and lameness
- The advantages of rubber flooring in reducing lameness have not been clearly shown

A lot of research has now shown that the type of flooring in dairy barns has a major impact on the health and welfare of the cows. Poor flooring is probably one of the major weaknesses with modern free-stall barns. The type of flooring on which cows walk when housed indoors has been found to affect their welfare in two main ways: either by impairing mobility, resulting in an increased risk of slipping and falling, or by increasing the risk of hoof disorders and lameness.

Effects of Flooring on Locomotion

For a heavy animal like a dairy cow, falling clearly can cause serious injury, and this must be avoided. To be comfortable when walking, a cow has to be able to walk at the speed that she wants to without fear of slipping or falling. Reduced cow mobility will reduce the efficiency of animal handling operations.

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Poor drainage and inadequate cleaning of floors is a common problem in modern free-stall barns. Slurry on floors reduces the traction of the flooring and clearly reduces cow mobility and the risk of injury. Cows avoid walking on passages covered with slurry (Phillips and Morris 2002) and slurry on the floor reduces walking speed (Phillips and Morris 2000, Rushen and de Passillé 2006) and increases the risk that the cow will slip or fall. Reduced walking speed by the cow increases the need for handlers to intervene to move the cows (Rushen and de Passillé 2006), which reduces the efficiency of animal handling operations. The effects of a lack of traction due to slurry are most obvious when the cows are starting to walk, turning corners or surmounting an obstacle (Rushen and de Passillé 2006). Adding non-slip material to the floor does not necessarily overcome these effects of slurry (Rushen and de Passillé 2006). Walking areas for cows need to be kept clean and free of slurry.

Concrete is the most common type of flooring found in modern free-stall barns but concrete does not provide the best walking surface for cows both because it is too hard (Rushen and de Passillé 2006) and because it often does not provide sufficient traction (van der Tol et al. 2005). This is shown by the cow walking at a lower speed and a greater risk of the cow falling and slipping. The most common method of dealing with this problem is to increase the friction of the surface of the concrete by grooving the concrete or by increasing the roughness of the surface in some way. However, increasing the roughness of the concrete floor may increase friction but may this may not be sufficient to increase walking speed (Phillips and Morris 2001). Furthermore, rough concrete flooring has greater abrasiveness, which leads to uneven wear of hooves with the result that the softer parts of the claw may end up carrying more weight of the cow than the harder outer walls (Telezhenko et al. 2008). This may result in greater pressure on the hoof increasing the risk of hoof damage (Franck and De Belie 2006, Franck et al. 2008).

Another way that concrete floors can be given more traction is to add a high-friction non-slip covering to the floor. This has been shown to increase walking speed and reduce the chance of slipping (Rushen and de Passillé et al. 2006). However, better results can be achieved by using a softer rubber floor, which increases walking speed and stride length, and generally improves the gait of the cows (Telezhenko and Bergsten 2005, Rushen and de Passillé 2006, Flower et al. 2007).

In fact, the softness or compressibility of the floor may be preferable to increasing the friction of the surface of the floor. Increasing the compressibility of the flooring reduces the risk of slipping more than does increasing the surface friction (Rushen and de Passillé 2006). Reducing the hardness of the floor is also likely to result in less compression of the claw as the cow walks (Schmid et al. 2008). Softer rubber flooring is a particular advantage for lame

cows (Telezhenko and Bergsten 2005, Flower et al. 2007). However, rubber floors can be slippery if too hard or if they do not have sufficient surface friction.

Slatted floors are one way of reducing the amount of wet manure on the floor, and some research shows that this results in cows having drier hooves. However, slatted concrete floors are not ideal from the cow's perspective. Cows have been found to walk more slowly and with shorter strides on slatted concrete floors compared to solid concrete floors (Telezhenko and Bergsten 2005), and slatted floors can result in higher pressures on the claw (Hinterhofer et al. 2006). Placing a rubber cover over the slats can improve the cows' use of slatted floors (Tucker et al. 2006).

In conclusion, concrete flooring is too hard and often does not provide sufficient traction when cows are walking. This increases the chance of slipping and falling and reduces the time that the cows are willing to stand and walk compared to soft, high-friction rubber floors. To optimize cow mobility, flooring needs to have some degree of compressibility as well as providing good traction.

■ Effects of Flooring on Lameness

Lameness among dairy cows is widely recognized as one of the most serious (and costly) animal welfare issues for lactating dairy cows. To control lameness on a farm, many aspects of housing and management must be maintained correctly. Risk factors are many and include high-grain feeding, uncomfortable stalls, poor management of transition cows, and genetic selection for high milk yields, rather than conformation. However, the type of flooring in barns can have a large effect on the incidence of lameness on a farm.

A number of epidemiological surveys have found associations between the type of flooring and the occurrence of various hoof disorders or lameness. In table 1, we have summarized the most important of these findings. The flooring in dairy barns can affect the incidence of lameness in two main ways. Poor drainage and wet, dirty floors increase the risk of infectious forms of lameness such as digital dermatitis and increase the risk of hoof wear, since the horn of the hoof is softer. Floors that are too hard increase the risk of hoof lesions, such as sole ulcers or sole haemorrhages, which are associated with disruption of the growth of the horn of the hoof or claw.

Table 1. Results of epidemiological studies of the effect of flooring on hoof lesions or lameness

Reference	Farms	Type of floor	Comparison	Variable	Effect noted
Faye and Lescouret 1989	80	Concrete	Earth	All hoof diseases	Prevalence 19.8% on concrete versus 2.9% on earth
Frankena et al. 1992	123	Concrete slats	Straw yards	Sole haemorrhages	Prevalence: 44.6% on concrete versus 4.6% on straw
Wells et al. 1999	4516	Floor always wet	Floor usually dry	Incidence of digital dermatitis >5%	Farms with wet flooring more likely to have high incidence (54% vs 29%)
Somers et al. 2003	47	Slatted concrete	Straw yards	Sole hemorrhage, sole ulcer, white line separation	Lower prevalence in straw yards
Somers et al. 2005a	47	Solid concrete	Slatted concrete	Digital dermatitis	Risk was 1.19 on solid versus 1 on slatted
Somers et al. 2005b	46	Solid concrete	Slatted concrete	Interdigital dermatitis and Heel horn erosion	Risk was 1.26 on solid versus 1.00 on slatted
Cramer 2007	41	Concrete (solid, smooth or grooved)	Rubber	Hoof lesions	No effect of floor type
Frankena et al 2008	12	Straw yards	Solid concrete Slatted concrete Grooved concrete	Prevalence of lameness	Straw yards = 1% Solid concrete = 20.1% Slatted concrete = 27.4% Grooved concrete = 40.6

Concrete floors have been associated with an increased occurrence of hoof lesions due to claw horn disruption (e.g. sole haemorrhages, sole ulcers, white line disorders) compared to straw yards (Frankena et al. 1992, 2008, Somers et al. 2003), or earthen floors (Katsoulos and Christodoupoulus 2008), while one study (Faye and Lescourret 1989) found an increased occurrence of all hoof disorders on concrete floors compared to earth floors.

Whether the concrete floor is slatted or solid does not seem to affect the occurrence of claw horn disruption (Somers et al. 2003). Grooved concrete has been associated with a higher prevalence of lameness than smooth or slatted concrete (Frankena et al. 2008). However, the particular physical properties of the concrete floor are of importance: lameness is more common when concrete flooring is smooth or slippery (Faull et al. 1996, Dembele et al. 2006). The occurrence of hoof lesions is affected by how well the concrete flooring is maintained: Bell (2004) found that the number of large imperfections in the floor (i.e., large cracks or holes in the concrete) could account for 15% of the difference in the number of cows with lesions in the hind lateral claws among dairy farms in the Fraser Valley of BC.

Hoof lesions associated with infection such as digital dermatitis, interdigital dermatitis and heel horn erosion appear to be associated with wet flooring (Wells et al. 1999) or with the accumulation of feces and urine on the floor since their occurrence is lower on slatted floors than solid floors and lower when a scraper is used on slatted floors (Somers et al. 2005a, Somers et al. 2005b). Borderas et al. (2004) found that claws exposed to moisture became softer and that softer horn was associated with increased heel horn erosion. Concrete flooring itself is not necessarily a risk factor for digital dermatitis but grooved concrete is associated with a greater occurrence compared to textured, smooth or slatted concrete (Wells et al. 1999).

Due to the obvious problems associated with concrete floors, many producers have started using rubber flooring. While there are some obvious advantages for cow mobility in using soft, high-traction rubber floors (discussed in section 1), there is not yet enough evidence to say that their use reduces lameness, although there are some signs that this may be true. Unfortunately, few epidemiological studies on a large number of farms have examined the effects of covering concrete with rubber flooring. One study in Ontario (Cramer 2007) found no difference between farms with concrete and rubber floors in the occurrence of hoof lesions. However, while Katsoulos and Christodoupoulus (2008) found a much higher prevalence of claw horn disruption on concrete floors compared to straw yards, the prevalence was not higher when the concrete floor was covered with a layer of rubber or combined with some soil.

A number of smaller experimental studies have examined whether rubber flooring provides an advantage over concrete floors, with mixed results. No

studies have found a clear reduction in lesions associated with claw horn disruption such as sole haemorrhages, sole ulcers, white line separation or digital dermatitis (Vokey et al. 2001, Vanegas et al. 2006, Boyle et al. 2007). However, Vokey et al. (2001) did report some reduced lesion scores for cows that were both bedded on sand and with rubber floors compared to cows bedded with sand and with concrete floors. Furthermore, claw lesion scores tended to increase the most for cows with concrete floors and walking on concrete and increased the least for cows walking on rubber and with sand bedded stalls. Improvements in heel horn erosion have, however, been reported with rubber flooring (Vanegas et al. 2006, Boyle et al. 2007) probably because the reduced abrasiveness of rubber results in less horn wear (Vokey et al. 2001, Vanegas et al. 2006). Vanegas et al. (2006) found a reduced occurrence of lameness among cows (n=950 cows) with rubber flooring but this was not reported in a smaller experiment (n=120 cows) by Vokey et al. (2001).

In conclusion, claw lesions associated with bacterial infections (dermatitis and heel horn erosion) are increased when floors are wet or covered in slurry. Concrete floors are associated with increased lesions, when compared to straw yards or earthen floors, but differences in resting area may confound these results. Rubber flooring does not consistently reduce lesions due to claw horn disruption but reduces heel horn erosion and claw wear and may reduce the occurrence of lameness. Smooth and slippery concrete increases the occurrence of lameness and poorly maintained concrete increases the risk of hoof lesions.

■ Effects on Overall Activity

The type of flooring in the barn can influence the behaviour of cows in a number of ways but the relationship between these changes and the welfare of the cows is less clear. Cows clearly prefer to stand on a softer surface than concrete when eating (Tucker et al. 2006). Placing rubber flooring in front of feed bunks or in the feeding area does not increase time spent feeding or feed intake (Fregonesi et al. 2004, Tucker et al. 2006) but does increase the time spent standing in the feed area and reduces the time spent standing or lying in the lying stalls (Fregonesi et al. 2004, Tucker et al. 2006, Boyle et al. 2007, Ouweltjes 2008). The most likely explanation of this is that with concrete flooring cows are making more use of the lying stalls since concrete does not provide a sufficiently comfortable area for them to stand. Cows walk more when on rubber flooring compared to concrete flooring (Ouweltjes 2008, Platz et al. 2008) and make more visits to an automated milking system (Ouweltjes 2008). On rubber flooring, cows mount more frequently and are much less likely to slip when mounting (Platz et al. 2008).

Conclusions

- The type and quality of flooring can have a major impact on the welfare of cows in free-stall systems.
- Concrete flooring is too hard and does not provide sufficient traction when cows are walking. This increases the chance of slipping and falling and reduces the time that the cows are willing to stand and walk compared to soft, high-friction rubber floors.
- Compared to straw or earth floors, concrete floors increase the chance of lameness and hoof lesions, but this effect is not always reduced by covering the floor with rubber.
- Poorly maintained concrete floors increase the risk of hoof lesions.
- Concrete flooring that is poorly drained and covered with slurry increases the chance of cows slipping and falling and increases the risk of dermatitis and heel horn erosion.
- Slatted floors can help keep hooves dry and reduce dermatitis and heel horn erosion but can reduce the cows' mobility and may increase the pressure on cows' hooves.

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