Lame Cow

Dairy cows' locomotion comfort and claw lesions in loose-housing systems - associations with flooring, claw conformation, lameness and behaviour.

Project leader was Professor Christer Bergsten (christer.bergsten@slu.se), Department of Animal Environment and Health (presently Biosystems and Technology), SLU. The studies were a collaboration between seven SLU researchers.

This was a part of the big international Lamecow project, where SLU team participated in Workpackage 7 "Flooring Systems". The aim of the Lamecow project was to develop and test possible improvements of floors and their management and interaction with claws of dairy cattle in order to obtain the highest possible requirement for animal wellbeing and performance by reducing lameness and claw disorders. Furthermore, the aim was to give recommendations for the provision of better environments for cow locomotion, health and animal well-being in dairy systems.

"Flooring system" team, from the left: Madeleine Magnusson, Evgenij Telezhenko, Jan Hultgren, Christer Nilsson, Michael Ventorp, Christer Bergsten

Project description:
Loose-housing systems for dairy cows are strongly recommended by the government and the dairy associations in order to provide cows' possibilities to perform natural behaviour. However, the risk for lameness and claw lesions is significantly higher for dairy cows in loose housing systems than for cows tied in stalls (Bergsten and Herlin 1996, Manske et al., 2002).

Lameness, defined as a clinical, pathologic disturbance in locomotion, might be an important behavioural indicator of pain and thus of reduced animal welfare (Whay et al., 1997). In a British study, the incidence of clinical lameness in loose-housed dairy cows was 55% and sole ulcers and white line abscesses were the most common lesions, contributing to 28% and 22% of the treatments, respectively (Clarkson et al., 1996). In a recent Swedish study, 44% of 5000 examined cows had sole and white-line haemorrhages, the initial stage of these two clinical disorders; 10% of the cows had sole ulcers and 5% were lame (Manske et al., 2002). The causes of hoof lesions are generally complex, with several metabolic and traumatic
components. Their prevalence is also influenced by several management factors (Bergsten, 1994).

The most important part of dairy housing in its influence on cattle locomotion is flooring (Phillips, 1993). Concrete is used for most walkways in cattle houses because it is relatively durable, resistant to water and has acceptable hygienic characteristics. However such features of concrete as hardness, abrasiveness and slipperiness give rise to a number of foot injuries (Bergsten and Frank, 1996).

Concrete slatted floors may cause reduced locomotion activity (Zeeb, 1983), contusion of the sole and exungulation (Kirchner and Boxberger, 1987). In addition, an inadequate floor surface can alter the cows behaviour and may reduce cow welfare (Benz et al., 2002). The choice of flooring is much discussed, but there is little empirical basis for objective assessment of floor influence on cow locomotion, claw conformation and health.

The objective of the present project was to study short-term and long-term effects of floor surfaces with varying hardness, structure and hygiene in loose housing systems on dairy cows locomotor apparatus. The studies were focused on questions related to animal environment, wellbeing and health, with special emphasis on locomotion comfort, lameness and claw diseases. Furthermore, the development of abnormal claw shape, which is more prone to be diseased, were studied in depth. The study included development of new methods to establish changes of gait, loading and lesion development over time. The results were used to draw up recommendations for optimal floor surfaces and preventive measures such as correct care and claw trimming in relation to trimming routines, animal behaviour and different floor conditions.

**Project parts**

1. **Objective assessment of different floors influence on cow locomotion (trackway analysis)**

2. **Cows' preferences for different floorings**

3. **Studying factors (with special reference to floor) affecting between-within claw weight distribution (pressure measurement analysis)**

4. **Influence of different management systems on claw conformation and health (long-term studies)**

**References**


Kirchner, M. and Boxberger, J., 1987. Loading of the claws and the consequences for the
The project is terminated.

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Lame Cow – part 1

1. Objective assessment of different floors influence on cow locomotion (trackway analysis)

What can prove the suitability of the flooring for cow walking better than cow walking itself?

However, existing subjective methods for evaluation of cow locomotion usually only categorise animals as sound or lame and are strongly influenced by the skill and perception of the observer. The quantitative assessment of locomotion as a rule involves using very expensive techniques and sophisticated procedures.

But there is a locomotion analysis in which we don't need video recordings, moreover we do not need even existence of the animals themselves but only the product of their locomotion - trackways. Actually, nobody could see how dinosaurs moved but analysis of their trackways makes it possible to recreate pictures of their active life.

The aim of the present study was to investigate immediate changes in the cow's gait while walking on solid and slatted concrete floors by objective measurements of trackways.

Locomotion comfort will be assessed by means of gait analysis on passageways with different flooring. Different concrete or soft-surface floors (rubber/PVC), solid or slatted floor elements, both commercial floors and prototypes will be studied. Together with standardised methods of subjective locomotion scoring, for the gait analysis an objective system of measurements of cow trackways will be used. The originally developed trackway measurement system allows to get such linear kinematic data as stride and step lengths, step angle, step abduction, overlap distance and length of diagonal support. The measurements of gait asymmetry can be calculated from the data.

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The trackway analysis will be used to determine indicators of walking comfort and discomfort under the field conditions on an experimental and commercial dairy farms with different flooring designs. The same method will also be used to investigate how the locomotion of dairy cows with different degree of lameness will be influenced by different floors.
Lame Cow – part 2

2. Cows' preferences for different floorings

Among the problems to design dairy stalls there are two features of major concern, namely: how to provide good welfare by means of less exposure to hard and unhygienic floors. Preference tests give us the indications of the environment from the animal perception and, even more important, hold out the possibility of enabling us to be objective about a concept of an ethological "need". Concrete remains to be the most "popular" floor material for passageways in loose housing buildings. Despite a number of negative characteristics as abrasiveness, slipperiness, hardness and inappropriate hygiene, and as consequence - increased risk for injuries and diseases, concrete is used as a floor material due to its low price and easiness to install. To test the cows' preferences between standard concrete floor and other kinds of covering such as rubber compounds and acid-resistant mastic asphalt will help to promote new flooring on the market and by this means provide better locomotion for the animals. Moreover maintenance behaviour (laying down, standing on the bed, standing on the passage and feeding) will be analysed in the housing systems with different floor design.

Free-choice tests will provide us with valuable information about suitability for walking on surfaces with different slip resistance, softness and other properties. Results of the preference test will give opportunity to consult the main users of the floors - animals themselves. Analysis of maintenance behaviour will reveal the possible flooring effect on occupation time of different areas at the stall.
3. Studying factors (with special reference to floor) affecting between-within claw weight distribution (pressure measurement analysis)

Measurement of the local pressure distribution on the sole surface of the claw can give information on functional characteristics of all structures in the claw for attenuation of pressure. The I-Scan system (Tekscan, Inc) will be used for the determination of force, contact area, contact pressure, centre of force, peak force, and peak contact pressure of the claw sole areas (wall, white line and sole) as well as differences in the parameters in medial and lateral claws. I-Scan is a complete system that is comprised of both hardware and software components. The hardware components collect pressure information from the sensor and make the data available to the system software. The software allows to view the collected pressure data, to record this information as a movie, and to review and analyse the data. The system has previously been used in laboratory research of cow claw pressure distribution. Claw measurements and claw lesions are recorded in all participating animals according to earlier used techniques. The claw pressure parameters will be assessed in cows under field conditions that are exposed for different flooring. The relationships between the forces that are applied to different regions of the claw's weight bearing surface will be evaluated in both healthy and diseased claws. The effects of age, parity, lactation stage and breed are evaluated.

The aim of analysis of pressure distribution on the claw sole is to provide better understanding of the interaction between claws and floor surface, and especially the development of asymmetric claws and claw horn lesions. Moreover, specific areas on the claw sole, which are more predisposed to injuries under different environmental conditions are identified to produce recommendations for functional claw trimming, taking into account the particular flooring.
In order to get a better understanding of causes of disturbed locomotion and lameness, the claws, which are the main locomotive part affected by diseases, should be scrutinised more scrupulously than other elements of locomotor apparatus. The claws are placed in the very close contact with environment and as a consequence get the most evident impact. The claws are quite sensitive to inadequate flooring conditions and response with different conformation deviations, physical and biomechanical alterations.

To investigate the effect of different flooring systems on the claw conformation and health the long-term experiment will be performed. The loose-housed dairy cows, in an experimental barn with identical management conditions will be divided into experimental and control groups to investigate effects of walkway surfaces with varying hardness, friction, structure and hygiene. Claw conformation characteristics along with growth and wear extents will be assessed by means of standardised methods. Sampling and evaluation of horn quality of wall, white line and sole will be made. Additionally sole concavity will be assessed using profile gauge. Using a high-resolution digital camera the foot is photographed from a palmar/plantar perspective. With a standardised scoring system, each foot is visually scored for lesions of the skin, heel, sole and white line first on the cow and later from the photo.

The study of the interaction between claw conformation and environment will reveal long-term effects of floor surfaces with varying hardness, structure and hygiene in loose housing systems on dairy cows claw health. Furthermore, development of abnormal claw shape, which is more prone to be diseased, will be studied in depth.