Using activity sensors to characterise behavioural rhythms

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With the rapid development of sensor technology it is easy and cost effective to collect monitoring data for behaviour in animals and humans. Therefore, new possibilities are appearing to develop early warning systems to detect health and welfare issues in livestock. However, despite intensive research, reliable and practical solutions are still scarce. One new opportunity is the analysis of behavioural rhythms. A way of understanding this rhythmic structure of behaviour is to study its circadian rhythm. A circadian rhythm could be any biological process that exhibits an endogenous oscillation of approximately 24 hours. Although these biological processes are endogenous, they need a so called 'zeitgeber' as a cue which could be for example light or temperature. To identify such rhythm, Scheibe *et al.* [1] developed a parameter called Degree of Functional Coupling (DFC) to characterize the synchrony between behavioural and environmental rhythms. Therefore, DFC expresses the percentage of cyclic behaviour that is harmonically synchronized with the environmental rhythms, over the 24 hour period. The DFCs can be used to identify welfare issues, with high DFCs in healthy animals and dropping DFCs due to a disturbance [2].

We used this method in sheep and housed cattle to investigate its potential usefulness for farming systems. For sheep, we further investigated how the DFCs for activity behaviour were expressed during the course of a year in extensively kept sheep in the West Highlands of Scotland. A flock of 24 ewes were used wearing three-way accelerometers (IceTag Pro, IceRobotics Ltd., Edinburgh, Scotland) integrated into a collar. DFCs were lower during the harsher winter season and individuals had a different DFC linked to animal performance and responses to weather changes. It was concluded that random regression models based on DFCs effectively identified between-individual variation. These findings create new opportunties for automated phenotyping.

Different parameters were tested for analysis on cattle, from activity to feeding behaviour. Activity was recorded with three-way accelerometer data loggers (IceTag Pro, IceRobotics Ltd., Edinburgh, Scotland) attached to the left hind leg. The feeding behaviour was collected by using an automated feeding system (RIC feed-weigh trough, Hokofarm Group, Marknesse, NL). The experimental design was 2 x 2 factorial comprising 40 crossbred Charolais and 40 purebred Luing assigned to one of two ad libitum diets, a mixed diet and a concentrate based diet. Steers fed with a concentrate based diet had lower activity DFC% and higher variation on its response than steers fed with a mixed diet. In addition, activity DFC% was even lower for Luing fed with concentrate, showing an interaction between breed and diet. In contrast, Luing fed with a mixed diet showed high consistency of activity DFC%. DFCs based on feeding can identify differnet responses compared to DFCs based on activity. Overall, we found that the method provides useful data for livestock farming.

References

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