An assessment of young cattle behaviour and welfare in a virtual fencing system

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Abstract

Virtual fencing is a novel technology which uses a combination of audio and electrical stimuli to contain grazing livestock within a GPS boundary. There are however some concerns around the use of such a technology and its potential effects on the behaviour and welfare of animals. To investigate this, 64 dairy-origin calves were assigned to one of two treatments in a randomised complete block design, with 4 groups of 8 calves per treatment. The two treatments were virtual fencing (VF) and electric fencing (EF). The experimental period lasted 31 days in total, consisting of a 10 day training period and a 21 day grazing period. Welfare and behaviour of the animals was measured using faecal cortisol metabolites, activity pedometers, and behavioural recordings. Virtual fence data denoting the number of audio and electrical stimuli delivered for each animal were also recorded. Results show that there was no significant difference in animal welfare and behaviour between EF and VF in the current study. Additionally, there was no significant difference in daily liveweight gain between treatments. In the VF animals the rate of electric pulses declined after an initial learning period however there was a significant degree of variation in the rate of learning between animals. Virtual fencing could therefore offer an alternative to physical fencing for grazing young cattle without negatively impacting animal behaviour or welfare. The individual animal variation in VF systems however warrants further study.

Introduction

Virtual fencing is a system which enables livestock to be contained without the presence of a physical fence, instead using a virtual boundary which is set using GPS. The technology typically comprises a mobile phone application through which the user maps the virtual boundary, and a neck collar device on the animal which produces an audio cue when the animal approaches the boundary. If the animal breaches the boundary it receives an electric pulses from the collar. This signal pattern harnesses the associative learning capabilities of the animals so that they can avoid receiving an electrical pulse by learning to stop or turn away from the virtual boundary when the audio tone is emitted (Campbell et al., 2020). Thus, the system is developed as ethical and welfare-friendly with controllable and predictable cues for the animals (Lee et al., 2018). This technology has the potential to allow continuous animal monitoring, improve livestock management, reduce labor, and exclude animals from environmentally sensitive areas or otherwise challenging terrain (Campbell et al., 2020). There is however a basic requirement for new technologies in the animal sector that they at least maintain or lead to an improvement in animal welfare. In the case of virtual fencing, a small number of studies have looked at this to date with Campbell et al. (2019) and Hamidi et al. (2022) reporting no negative effects on welfare. The potential implications for animal welfare are not fully understood and so necessitates the assessment of stress and welfare in various species and age class of livestock, and also in various grazing scenarios and environments. The objective of this study therefore was to determine the effect of virtual fencing on the behaviour and welfare of young grazing cattle in an intensive grazing set up.

Methods

The study was conducted from May to September 2022 at the Agri-Food and Biosciences Institute (AFBI), Hillsborough, Northern Ireland. Sixty-four dairy-origin calves were assigned to one of two treatments in a randomised complete block design, with 4 groups of 8 calves per treatment. The two treatments were virtual fencing (VF) and electric fencing (EF). The experiment was conducted in two cohorts, with cohort 2 commencing immediately after cohort 1. Prior to the experimental period commencing the VF groups were fitted with Nofence collars (® Nofence AS, Batnfjordsøra Norway) and IceTag accelerometers (Ice-robotics Ltd, Edinburgh, Scotland). The experimental period for each cohort lasted 31 days in total, consisting of a 10-day training period and a 21-day grazing period. On days 1 to 10 both treatment groups were trained using a single electric and virtual fence line in their respective paddocks, with a solid barbed wire fencing making up the remaining three sides. From day 11 until day 25 three of the four sides of the grazing area were either electric of virtual fence, and from day 26 to 31 animals were fenced entirely in a four-sided virtual or electric area.

Welfare and behaviour of the animals was measured using faecal cortisol metabolites, activity accelerometers (IceTag), and behavioural recordings. Faecal samples were simultaneously collected from all animals once weekly and frozen (−18 °C) within 1 hour after sampling. Later faecal cortisol metabolites (FCMs) were extracted from the (defrosted) faeces and analysed using an 11-oxoaetiocholanolone enzyme immunoassay (EIA). This EIA measures 11,17-dioxoandrostanes, a group of cortisol metabolites (Palme and Möstl, 1997) and was used to determine stress levels of each animal sampled. Virtual fence data denoting the number of audio and electrical stimuli delivered for each animal were also recorded as well as weekly liveweight of the animals.

Results and Discussion

Results from the current study suggest that there was no significant difference between virtual and electric fencing on animal welfare. Faecal cortisol metabolite analysis showed no significant difference between VF (33.51ng/g) and EF (33.94 ng/g), indicating that stress levels were similar in both fencing treatments. There was no significant difference in IceTag accelerometer data, with standing time similar for VF (665 mins/day) and EF (687 mins/day), lying time (VF: 775 mins/day and EF: 753 mins/day), and steps per day (VF: 2609 and EF: 2136). Mean bodyweight was not significantly different between VF (224.3 kg) and EF (223.8 kg) at the end of the study. In terms of audio and electrical stimuli delivery, there was a significant degree of variation observed between animals, particularly in audio stimuli, and would suggest that further explore the causes of this variation.

Conclusion

Findings from this study demonstrate that virtual fencing does not negatively impact cattle welfare or performance in comparison to conventional electric fencing. This adds valuable knowledge to the growing body of literature which suggests that virtual fencing is a welfare-friendly technology for containing grazing animals.

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