**Application**

**Novel research using GreenFeed technology in a pasture-based sheep production system will generate data contributing to the national inventory, enabling more precise calculations of CH₄ emissions from sheep.**

**Introduction**

**The accurate measurement of methane (CH₄) emissions in grazing sheep is essential for improving the understanding of CH4 production patterns, generating data for national inventory calculations and identifying dietary strategies to mitigate emissions. This study evaluates CH4 emissions in sheep over a six-month period, from spring to autumn, using GreenFeed technology. The GreenFeed technology intermittently captures and quantifies eructated CH4 emissions during individual animal visits to the feeding station at pasture. GreenFeed proved effective for longitudinal CH4 monitoring, demonstrating its utility in capturing real-time, non-invasive emissions data in grazing systems, (Starsmore et al., 2024) however most of the work to date has focused on cattle or measuring animals indoors. The objective of this study was to profile CH4 output on nulliparous hoggets across the grazing season and to identify the effect of seasonal forage and animal live-weight variation on CH4 emissions in sheep.**

**Materials and Methods**

**This experiment was carried out over a six month period from March until August 2024. Forty nulliparous female sheep (20 Suffolk and 20 Texels), circa 12 months of age at commencement of the experiment, were monitored on a pasture-based diet. Daily CH4 emissions data were recorded during brief feed station visits, with individual measurements aggregated for analysis. Each animal was permitted a maximum of six visits per day to the GreenFeed system, with a minimum interval of two hours between consecutive visits to ensure temporal spacing and measurement independence. During each visit, animals received eight individual feed allocations, each consisting of 7.5 g of feed (dried grass pellet), dispensed at 30-second intervals to standardise feeding events. Additionally, weekly forage samples were collected from the grazing area throughout the study period. These samples were analysed for dry matter (DM) and nutritional composition. Animal live-weight was recorded monthly throughout the study. Two main CH4 output traits were investigated, namely CH4 expressed per day (g/day) and CH4 expressed per kg live-weight (g/kg LW). The effect of seasonal variation, forage quality parameters and breed on CH4 output were analysed using linear mixed models in PROC MIXED (SAS Inst. Inc., Cary, NC, USA).**

**Results**

**Across the six-month experimental period, the average CH4 output was 38.82 (SD = 7.46) g/day, with animals averaging 3.02 (SD = 1.16) visits to the machine per day. The repeatability of the animal’s individual CH4 output (g/day) was 88% across the experimental period. Methane output expressed as g/day differed by month (P<0.001; Figure 1) with the lowest CH4 output associated with March (31.58 g/day) and the highest reported in the months of June to August, which did not differ from each other. Methane output, expressed per kg live-weight also differed by month (P<0.001; Figure 1) with the lowest values recorded for the months of March, April and June, which did not differ from each other. Additionally, breed-specific differences in CH4 output (g/day) were identified, with Suffolk hoggets producing 39.47 (0.30) g/day, compared to the Texel hoggets producing on average 37.63 (0.30) g/day (P<0.001). However when CH4 was expressed per kg live-weight the two breeds did not differ from each other (P>0.05) suggesting that differences in live-weight accounted for the differences in CH4 output expressed in g/day between both breeds. Grass quality analysis identified monthly differences OMD (P<0.001), with the highest OMD levels associated with March and April, 858.94 g/kg.**

**Figure 1. Average monthly methane output (error bars represent one standard error above and below the mean methane output) expressed as CH4 g/day and CH4 g/kg live-weight.**

**Conclusions**

**Enhancing the understanding of enteric CH4 emissions from sheep in pasture-based systems is essential for refining Ireland’s greenhouse gas inventories and supporting targeted mitigation strategies for small ruminants in extensive grazing systems. This study highlights the temporal and breed-specific variability in CH4 emissions among nulliparous female sheep. CH4 output, both in absolute terms (g/day) and relative to live-weight, was influenced by seasonal factors, animal bodyweight and a change in grass nutritional composition. Breed differences were evident in absolute CH4 output but not when expressed per kg of live-weight, emphasising the role of animal size in CH4 emissions. The high repeatability 88%, associated with individual animal CH4 measurements indicates the consistency among the individuals in terms of CH4 output across the study period. Furthermore, CH4 expressed as g/day increased over the trial period, correlating with an increase in animal live-weight and a variation in grass OMD. This demonstrates the potential in improving sward quality to reduce CH4 output. These findings provide valuable insights into the dynamics of CH4 emissions, with implications for breed selection and seasonal management strategies in livestock farming.**

**References**

**STARSMORE, K., LAHART, B., VILLALOBOS-LOPEZ, N., EGAN, M., HERRON, J., BURKE, J. & SHALLOO, L. 2024. Residual methane emissions in grazing lactating dairy cows. *New Zealand Journal of Agricultural Research,* 67, 285-295.**