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Data paper: Experimental data from a controlled feeding trial evaluating methane reduction and performance enhancement in crossbred male sheep

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ABSTRACT

This paper presents enteric emissions data, coupled with feed intake and biophysical measurements from 20 indoor-housed, castrated male sheep. Animals were fed either a control diet or supplemented with a novel enteric methane–suppressing feed additive (NuAdvent+) and were housed for 71 days within BioControl Controlling and Recording Feed Intake pens, providing continuous feed intake monitoring data for the duration of the trial. Methane and CO_2 measurements were also obtained for individual animals during this period, using GreenFeed Emissions Monitoring units. Blood variable measurements were obtained on day 71, alongside bodyweight and body-condition measurements taken periodically throughout. For all variables tested, differences between control and treatment groups were determined using a *t*-test. This high-resolution dataset thus offers a robust basis for evaluating methane mitigation strategies, validating and refining predictive models for methane emissions, and linking emissions with animal performance. The dataset can also contribute to national GHG inventories by providing detailed, region-specific data.

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Specifications table

Subject	Livestock Farming Systems
Specific subject area	Measurement of enteric emissions from sheep supplemented with a novel feed additive (NuAdvent+), alongside feed intake monitoring and biophysical measurements.
Type of data	Table
How data were acquired	- Methane and CO_2 emissions: GreenFeed Emission Monitoring (**GEM**) (C-Lock, South Dakota, USA) - Feed intake: BioControl Controlling and Recording Feed Intake (**CRFI**) (BioControl, CRFI, Rakkestad, Norway) - Bodyweight: DataMars Tru-Test® load bars (DataMars, Selkirk, UK) - Blood Parameters: VetScan HM5 Haematology Analyser (Zoetis, Leatherhead, UK) - Body condition and bodyweight: AgriWebb agricultural management software (AgriWebb, New South Wales, Australia)
Data format	Filtered data

(*continued on next page*)

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Parameters for data collection	Sheep were group-housed in slatted-floor pens of 4–6 animals for 71 days with continuous access to water and were fed via BioControl CRFI feed bins. Animals were individually allocated to a feed bin, accessible through a sliding vertical gate and triggered to open by each animal's EID ear tag. Each group of animals was allocated to a GreenFeed unit which supplied no more than pelleted feed when triggered by individual animal electronic identification (**EID**) tags, at a maximum of 320 g/day.
Description of data collection	Animals had continuous access to their individual BioControl feeding bins and GreenFeed unit allocated to their grouping pen – each of which automatically recorded data and uploaded the information to cloud-based software. Blood samples (to inform blood parameters) were taken from the jugular on day 71. Body Condition Scores (**BCSs**) were determined weekly on a scale of 1–5 through palpation by a single trained assessor, alongside live weight measured using a manual weigh-crate fitted with Tru-Test load bars. Both live weight and BCS were then subsequently recorded using AgriWebb agricultural management software.
Data source location	Institution: Rothamsted Research City/Town/Region: North Wyke, Okehampton, Devon Country: United Kingdom Latitude and longitude for collected samples/data: 50°46′10″N, 3°54′05″W
Data accessibility	Repository name: Rothamsted Research Data identification number: https://doi.org/10.23637/b6tiuymu
Related research article	Rivero, M.J., Khan, A.A., Akpensuen, T.T., Meo-filho, P., Pérez-Márquez, S., Jones, A. 2025. Evaluating the Efficacy of a Novel Multi-Component Feed Additive for Methane Mitigation and Performance Enhancement in Sheep. Ruminants 1–10. https://doi.org/10.3390/ruminants5020017

Value of the data

- This novel dataset provides 10 weeks of enteric methane and CO_2 emissions from sheep in the UK, alongside detailed feed intake, live weight, and blood parameter data. Collected with GreenFeed Emissions Monitoring and BioControl CRFI for automatic, continuous monitoring, the techniques used in this study ensure high-resolution data, comparable to methods used in other studies (O' Connor et al., 2024). Thus, this dataset offers a robust basis for evaluating methane mitigation strategies and linking emissions with animal performance.
- The data can benefit livestock and animal nutrition researchers, climate scientists, and veterinary specialists studying the impacts of dietary interventions. Agricultural technology developers, policymakers, and industry stakeholders can use the findings to inform methane mitigation strategies and evidence-based policy recommendations for sustainable farming practices. Furthermore, high–resolution individually allocated emissions data can also be used by producers to support changes to livestock breeding policies.
- The dataset can be used to validate and refine predictive models for methane emissions, particularly those incorporating dietary factors, supporting studies like the intercontinental database. It can also contribute to national GHG inventories (e.g., Scottish Government, Moxey and Thomson, 2021) by providing detailed, region-specific data for Tier 2 and Tier 3 accounting methods.

Data description

The data for 20 indoor-housed castrated male sheep are available at https://doi.org/10.23637/b6tiuymu. Data are stored in multiple.csv files dependant on data type and are described below.

- Column_units_and_descriptors.csv: A detailed description of the units used within each column of all files, and a brief description to aid interpretation of data.
- Blood.csv: Raw values for 20 blood parameters analysed at the end of the experimental period, with blood samples analysed using a VetScan HM5 Haematology Analyser. Presented alongside individual identifiers for each of the 20 experimental animals.
- CH4DM.csv: Daily intake data (basal and GreenFeed pellets), dry matter intake, and methane emissions per kg dry matter intake. Presented alongside individual identifiers for each of the 20 experimental animals.
- Emissions_individual_datapoints.csv: Data relating to individual animal's visits to the GreenFeed units, including visit start and end times, duration, and carbon dioxide and methane emissions.
- GHG_emissions.csv: Summary live weight and emission measurements per animal.
- Weight_and_BCS.csv: Live weight and body condition score of the 20 animals. Measurements were taken on a weekly basis for 8 weeks of the experimental period.

Experimental design, materials and methods

Animals

A total of 24 healthy crossbred (Suffolk × North Country Mule) castrated male sheep were initially selected from Rothamsted Research's North Wyke Farm flock and allocated into experimental groups pre-trial. Animals were balanced by live weight (52 ± 3.7 kg), body condition score (3.03 ± 0.19) and age (14.8 ± 0.16 months) and then randomly assigned to treatment or control groups. Due to equipment failure, two animals from each experimental group were removed during phase one of the trial (acclimatisation), and thus phase two (experimental phase) consisted of 20 animals.

Feeding

For a period of 71 days (including a 30-day acclimatisation period), animals were offered a diet based on grass pellets formulated from permanent pasture ryegrass, containing 16% crude protein. Feed was provided on an *ad libitum* basis, with uneaten material removed and replaced each day. In the treatment groups, the grass pellets were supplemented with NuAdvent+ which contained, as a percentage of DM, 3.2% CP, 1.02% WSC, and 83.1% ash. As the inter-animal variation in live weight at the start of the trial was considered negligible, the quantity of supplement administered was not

altered between animals, and was instead supplied at a consistent daily rate of 20 g per animal. Using a calibrated container, the supplement was administered in powder form directly onto the feed, broadcast evenly across the entire surface of the supplied grass pellets to ensure a sufficient quantity of supplement was ingested by each animal. This dosage was determined according to manufacturer guidance (Cloudagri®), as no peer-reviewed dosing data were available at the time. Cloudagri® conducts routine quality assurance testing on raw ingredients to monitor for undesirable compounds, following a risk-based approach that is reviewed annually and adheres to both Belgian and European regulatory frameworks, under the supervision of the Belgian Federal Agency for the Safety of the Food Chain. To ensure consistent intake, the supplement was manually mixed into individual feed bins each day, with care taken to distribute the additive evenly across the daily ration.

Biophysical measurements

Live weight (**LW**) and BCS (on a scale of 1–5, as described by Russel et al., 1969) were recorded weekly throughout the study. LW was measured using a manual weigh crate equipped with Tru-Test® load bars, while physical BCS assessments, whereby the animals were palpated, were conducted by a trained evaluator. All data were subsequently logged and managed using AgriWebb farm management software (AgriWebb, Surry Hills, New South Wales, Australia). At the conclusion of the trial, blood samples were collected via jugular venepuncture using EDTA-treated vacutainer tubes, with a maximum of 10 mL drawn per animal. Sampling occurred during morning hours, and blood was immediately analysed using a VetScan HM5 Haematology Analyser (Zoetis, Leatherhead, UK), generating complete blood counts across 20 parameters.

Fig. 1. BioControl CRFI. Sheep were housed within BioControl 'Controlling and Recording Feed Intake' (CRFI) pens throughout the acclimatisation and experimental periods. Animals were allocated to an exclusive Biocontrol feeder (green bin pictured), access to which was granted by vertical sliding feed gates, controlled by animal–specific individual electronic identification ear-tags.

Feed intake measurement via biocontrol system

Animals were housed in BioControl CRFI pens (BioControl, Rakkestad, Norway), with each individual measuring 3 m^2 (Fig. 1). During the 30-day acclimatisation phase, sheep were paired within pens to prevent social isolation and facilitate training on their individual BioControl feeders, which were accessed using EID-activated gates. During this period, four of the BioControl panels malfunctioned, reducing the number of operational automatic feeders to 20 for the main experimental phase (10 animals per treatment group). Consequently, two sheep from each treatment group were withdrawn, leaving 20 animals in total. For the subsequent six-week experimental period, sheep were grouped into four mixed mobs (two groups of six and two groups of four; Fig. 2). Each group included an equal number of treatment and control animals and had access to a single GEM system (C-Lock, Rapid City, USA). Despite the group housing arrangement, each animal continued to access its individually allocated CRFI feeder. Feed intake was recorded continuously and automatically via the CRFI system, along with detailed feeding behaviour metrics including visit frequency, timing, duration, intake per visit, and eating rate. Grass pellet samples were collected and oven-dried to determine DM content.

Enteric methane emissions measurement via greenfeed system

Methane (CH_4) emissions were monitored daily throughout the experimental phase using GEM systems (Tedeschi et al., 2022), with one GEM unit located in each of the four grouping pens. These systems function by measuring CH_4 output during visits, whereby animals voluntarily inserted their heads into the shrouded intake area, triggering recognition of their individual electronic identification tags. Upon tag detection, the GEM dispensed a small quantity of concentrated feed pellets to attract and retain the animal for sampling (Hammond et al., 2016). Methane produced through eructation during feeding was then captured and quantified. Each animal was allowed a maximum of eight sampling sessions per day. During a given session, animals received up to five feed drops, with 8 g of pellets per drop dispensed at 35-second intervals, and thus a total maximum daily allowance of 320 g per animal. Following an initial training period, animals consistently interacted with

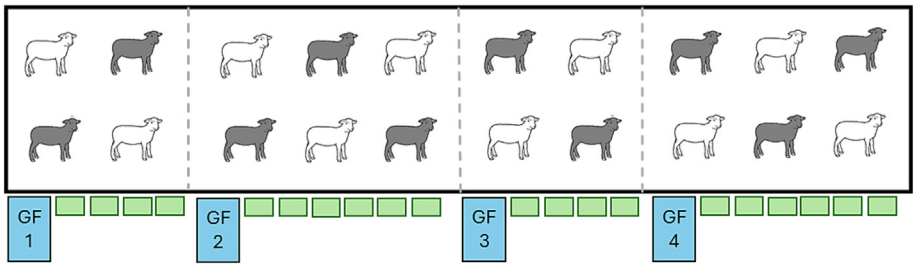

Fig. 2. Experimental animal arrangement. For the experimental period, 20 sheep were arranged into four groups, two of four and two of six, each group containing an equal number of treatment animals (shown in grey) and control animals (shown in white). Each animal had access to an individually allocated feed bin and each penned group had access to a GreenFeed unit.

the GEM units, averaging 240 ± 75 s per visit. The daily intake of pellets from the GEM units was recorded for each individual and included in overall DMI calculations. A representative pellet sample was oven-dried to determine dry matter content for accurate DMI estimation.

Peer Review Summary

Peer Review Summary for this article (https://doi.org/10.1016/j.anopes.2025.100115) can be found at the foot of the online page, in Appendix A.

Ethics approval

Prior to commencement, the research protocol of this study was reviewed and approved by Rothamsted Research's Animal Welfare Ethical Review Body (AWERB) in accordance with the Animal Scientific Procedures Act (1986).

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) did not use any AI and AI-assisted technologies.

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Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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