**Application**

This study evaluated local brewers’ spent grains and field beans as alternative proteins to soyabean meal, comparing concentrate-based and a pasture-based diets. While the pasture diet lowered methane emissions per kg intake, it reduced growth rates, raising environmental and cost concerns.

**Introduction**

Using sustainable feed proteins in livestock diets can enhance performance and nutrient use while reducing reliance on high-carbon-footprint proteins like soyabean (Pexas et al., 2023). Local proteins in the UK, such as brewers’ spent grains and field beans, can reduce costs and minimise carbon footprint of transport. Furthermore, pasture-based beef production can reduce feed costs, support local economies, and preserve biodiversity (Boval and Dixon, 2012; Fraser et al., 2022). These systems are favoured by consumers because of the perceived improved animal welfare and nutritional composition of animal-derived foods (Klopatek et al., 2022). The present study examined the impact of substituting soyabean meal with brewers’ spent grains or field beans on beef performance and enteric methane (**CH4**) emissions; also comparing the concentrate-based diets with a fresh-cut ryegrass diet without concentrate supplementation.

**Materials and Methods**

Thirty-two Aberdeen Angus×Holstein beef cattle (16 steers, 16 heifers), were grouped and randomly assigned to one of four experimental diets, balanced for age and weight. Three groups received total mixed rations with grass and maize silages, but with soya-based (**SB**), brewers' spent grains-based (**BSG**), or field beans-based (**BNS**) concentrates; while a fourth group was fed fresh-cut ryegrass only (**GRA**). Weekly feed intake was calculated from daily feed offered and refusals. Measurements of body weights (**BW**), BW change (**BWc**), and feed efficiency were recorded, along with preserved feed samples for proximate analysis. Furthermore, CH4 emissions were recorded daily by automated head chamber system (GreenFeed; C-Lock, Inc., Rapid City, SD). While on GreenFeed, animals had access to concentrate feed as bait, which made up 7.9–8.7 % of total dry matter (**DM**) across the different diets. Data were analysed using general linear models (SPSS 29.0; Armonk, NY, USA) with treatment, week, sex, and their interactions as fixed factors; animal ID nested within treatment as random factor; with week being the repeated effect. Where necessary, Fisher's Least Significant Difference test (*P* < 0.05) was used for pairwise mean comparisons.

**Results**

DM intake (**DMI**;kg/day) was higher for SB (9.78; *P* = 0.002) compared with BSG (8.50) and GRA (8.60), and organic matter intake (**OMI**;kg/day) was higher (*P* < 0.001) for SB (9.44) and BNS (9.58) compared with GRA (7.91). GRA had higher (*P* < 0.001) NDF (5.25 vs 4.16, 4.04, and 3.94 kg/day for GRA vs SB, BSG, and BNS, respectively) and ADF intakes (3.33 vs 2.60, 2.36, and 2.37 for GRA vs SB, BSG, and BNS, respectively). Crude fat intake (kg/day) was higher (*P* < 0.001) for BSG (0.35) compared with SB (0.24), BNS (0.23), and GRA (0.18). Starch intake (kg/day) was higher (*P* < 0.001) for BNS (2.58) compared with SB (2.07) and BSG (1.72), and water-soluble carbohydrate intake (kg/day) for GRA (0.61; *P* < 0.001) compared with SB (0.28), BSG (0.16), and BNS (0.24). BWc was higher (*P* < 0.001) for the concentrate-fed animals compared with GRA (1.42, 1.36, 1.58, and 0.72 kg/day for SB, BSG, BNS, and GRA, respectively). GRA had lower CH4 yield (19.6 g/kg DMI and 22.3 g/kg OMI; *P* < 0.001 and *P* = 0.006, respectively) compared with SB (24.1 and 25.4 g/kg DMI and OMI, respectively), BSG (26.4 and 27.5 g/kg DMI and OMI, respectively), and BNS (22.5 and 23.4 g/kg DMI and OMI, respectively). CH4/BW (g/kg) was higher (*P* = 0.011) for SB (0.50) and BNS (0.46) compared with GRA (0.39). Steers had higher (*P* < 0.001) nutrient intakes and BWc (1.72 vs 0.81 kg/day; *P* < 0.001), and lower CH4/DMI (21.9 vs 24.4 g/kg; *P* = 0.019) and CH4/OMI (22.9 vs 26.3 g/kg; *P* = 0.002) than heifers.

**Conclusions**

The study shows that high-quality protein diets with less fibre and more starch, like soya and field beans, enhance growth and nutrient use, while more fibrous diets like ryegrass reduce growth rates but also CH4 emissions. The lower CH4 yield could be attributed to the reduced availability of fermentable carbohydrates in fresh-cut ryegrass. The significant sex effect complies with Owens and Gardner (2000) who found that steers typically have higher feed intakes and growth than heifers. Brewers’ spent grains and field beans can replace an equivalent amount of soyabeans in the diet without impacting productivity or CH4 emissions. High-fibre pasture-based diets can be more cost-effective and reduce CH4 yields but there is an environmental and economic trade-off as they also reduce growth rates.

**References**

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