Application:

The dietary provision of brown macroalga has the potential to reduce enteric methane (CH4) expelled from ruminants. The mechanism for reducing methane (CH4) may be due to phenolic compounds, specifically phlorotannins found exclusively in brown seaweeds.

Introduction:

Several macroalga (seaweed) species have been assessed in-vitro for their effects on rumen fermentation and subsequent CH4 mitigation. The red seaweed Asparagopsis taxiformis has been shown to reduce CH4 by up to 80% in-vivo1, however as an invasive species its cultivation in the UK is undesirable. As a result, native temperate species with differing modes of action are being investigated.

The brown species Ascophyllum nodosum (ASCO) yielded reductions of up to 10% when included at 8% dry matter (DM) in-vitro, whilst literature indicates that reductions could be greater with 15% being observed2. Other studies indicate that ASCO provision could improve rumen fermentation through supporting protein metabolism, reducing bloat and having anthelmintic activity3. However, there are limited studies investigating the effects of ASCO supplementation in-vivo, particularly in beef cattle. The aim of this study was to assess the impact of 4% DM ASCO provision in the diet on CH4 production, daily liveweight gain (DLWG), feed intake and carcass traits in finishing beef cattle. As ASCO has a high iodine content, 4% inclusion was chosen to ensure no negative effects on animal health.

Materials and methods:

Thirty-six finishing beef cattle of four breeds and two sexes were evaluated over a 100-day period. Cattle were allocated into two experimental groups ‘control’ (CON) and 4% DM (ASCO) balanced by liveweight, breed, sex and age. The cattle were housed in four pens (two pens of each sex) with nine animals per pen. A ration of 80:20 forage:concentrate was provided for the first 7 d of the study, 70:30 between 7- 14 d and remained on a 60:40 ration for the rest of the trial period. In the ASCO group, the forage portion was reduced by 4% DM to account for the ASCO provision.

Methane and hydrogen emissions were recorded using GreenFeed units (C-Lock Inc., Rapid City, SD, USA), which were placed in each pen for a two-week training period prior to starting the treatment diet and a minimum of 49 days in each pen during the study. Feed intake was recorded real-time using Biocontrol feed boxes (BioControl A/S, Rakkestad, Norway) and mean daily intake each week calculated. Liveweight and body condition scores (BCS) were recorded bi-weekly, with average daily gain (ADG) calculated through regression. Rumen fluid samples were collected post-slaughter and assessed for volatile fatty acid (VFA) via gas-chromatography analysis and ammonia (NH3) content according to the method of Chaney and Marbach4. The carcass weight and kill out % was recorded at slaughter and marbling and fat colour of the meat was visually assessed by a trained technician using Meat Livestock Australia standard assessment chips four days post slaughter. The VFA and NH3 data sets were assessed for homogeneity and normality before the completion of one-way ANOVA analysis with Bonferroni post-hoc tests using GraphPad Prism version 5.

Methane emissions were evaluated as CH4 production (g/day), CH4 yield (g CH4/kg DMI) and CH4 intensity (gCH4/g LWG) and predicted as a linear mixed model (using REML estimation method) in GenStat with fixed effects of age, breed, sex and treatment. Pen, animal nested in pen and GreenFeed unit were included as random effects.

Results:

No statistically significant differences were observed for DM intake (P>0.05), ADG kg/day (P>0.05) or BCS (P>0.05) across dietary treatments. The dietary inclusion of 4% DM ASCO had no significant effect on CH4 production (P>0.05), CH4 yield (P>0.05) or CH4 intensity (P>0.05). The ASCO treatment numerically improved mean marbling score, but no statistical significance was observed in this or other carcass traits. No statistically significant differences were observed for NH3 (P>0.05) or VFA (P>0.05) production across treatments.

Conclusion:

The in-vivo inclusion of 4% DM ASCO into a finishing beef cattle ration had no effect on animal performance or gas emission variables. Whilst the use of brown seaweeds is favourable in temperate climates, the economic viability for minimal CH4 reductions and negligible production effects suggests that research focus should remain on red species for CH4 mitigation in ruminants. However, the potential effects of meat from animals supplemented with ASCO on human health parameters warrant further investigation.

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