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Can Nordic hemisphere macroalgae reduce emission of methane from ruminant livestock?

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Introduction

Methane (CH\textsubscript{4}) is a potent greenhouse gas (GHG) with 25 times more global warming potential than carbon dioxide (CO\textsubscript{2}) (Eickard et al., 2010; Jeyanathan et al., 2014). Emission of CH\textsubscript{4} from livestock contributes to climate change accounting for roughly 20% of global anthropogenic CH\textsubscript{4} emission (Beauchemin et al., 2008). Enteric CH\textsubscript{4} production also results in a significant energy loss to the animals which amounts to 2 to 12% of the gross energy intake (Martin et al., 2010; Benchaar and Greathead, 2011; Patra, 2012). Therefore, safe and effective enteric methane mitigation strategies will have a positive contribution to both the environment and animal productivity.

Hypothesis

Seaweed products can reduce enteric methane emission from ruminant livestock.

Materials and Methods

Intact, dried seaweed of the species Alaria esculenta (AE), Ascophyllum nodosum (AN), Saccharina latissima (SL), and a commercial seaweed mix (OceanFeed\textsuperscript{TM}, Ocean Harvest Technology, Millwood, Ireland), and purified seaweed extracts (Extract-I and -II) were incubated alone (except for extract-I and extract-II) or together with either sugar beet pulp or maize silage (basal feeds). The products and basal feeds were fermented anaerobically in bulked rumen fluid for 48 hours. The volume of gas produced was detected continuously by an automatic wireless pressure sensor in the Ankem\textsuperscript{TM} system (Ankom Technology, USA). Gas production is an indicator of microbial activity and therefore, digestion. Two of the three bottles per sample were fitted with gas tight bags (SKC, Flex Foil PLUS, USA) to collect all gases produced during in vitro fermentation to subsequently assess end-point methane using gas chromatography. Expected volumes for total gas and methane were calculated by adding the proportional gas produced per gram organic matter by the pure feeds or compounds in the mixes.

Results and Discussion

Intact seaweeds fermented with SBP or MS

- Pure MS and SBP produced large amount of gas but the pure seaweeds produced much less amounts. AN and OFS produced a negligible amount of gas while AE and SL showed moderate gas production (Figure 1).
- End-point methane production (Table 1) with AN existed more significant inhibition.

Extract-II affected neither total gas, methane production nor dry matter degradation.

Mau et al. (2016) reported that Saccharina can reduce methane production when included up to 25%. In vitro studies with maize showed reduced total gas production in response to both MF and in vitro production increased by 25% in response to both MF and dry matter degradation.

Conclusions

- AE, AN, OFS and SL reduced both total gas and methane production when fermented with SBP or MS without negatively affecting dry matter degradation.
- AE increased MS dry matter degradation while reducing total gas production and methane, suggesting that this seaweed has changed the profile of the short-chain fatty acids produced during fermentation.
- AE showed tendency for reducing total gas and methane production while increasing the dry matter degradation but extract-II lacked both attributes.
- Increasing doses of extract-I may have antimethanogenic activity.

References


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