Seaweed: future use as feed and to inhibit enteric methane emission

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Introduction: New and refined techniques have been developed for cultivation of marine plant biomass (macroalgae, also called seaweed), and the future production potential is expected to exceed that of terrestrial plants by 10-fold or more. Macroalgae species are categorized into brown, green and red macroalgae, which contain carbohydrate and protein fractions that are distinctly different from those of terrestrial plants. Within these three main categories, it is possible to find species that have sufficiently high protein contents and organic matter digestibility to make them interesting as alternative, new protein feeds for ruminant livestock – provided they can be marketed at competitive prices in the future.

At the moment, the most interesting feature of macroalgae in relation to livestock feeding is due to the contents of a wide range of bioactive compounds, not found in terrestrial plants. An Australian seaweed species, *Asparagopsis taxiformis*, produces bromofom, which can almost completely block the formation of methane (CH4) associated with anaerobic fermentation of feed in the forestomachs of ruminants. Unfortunately, bromoform is in itself a greenhouse gas and unwanted in the human food chain.

Hypothesis and aim of studies: We hypothesize that seaweed species adapted to marine waters in the Northern hemisphere have developed distinct bioactive compounds with anti-methanogenic properties, which will be safe to use as feed additives for ruminants.

Methodology: As part of the project Macro Algae Biorefinery 4 (financed by the Innovation Foundation Denmark), investigations were undertaken to establish whether macroalgae cultivated in the Northern hemisphere and purified carbohydrate fractions (alginate and fucoidan) from such macroalgae can inhibit enteric methane formation. Intact, dried *Alaria esculenta*, *Ascophyllum nodosum*, *Saccharina latissima*, and a commercial seaweed mix (OceanFeedTM Swine, Ocean Harvest Technology, Milltown, Ireland) as well as purified alginate and fucoidan extracts were incubated alone (except for the purified extracts) or together with either sugar beet pulp or maize silage under anaerobic conditions in buffered rumen fluid for 48 hours. Amount of gas produced was detected continuously by a pressure sensor system, total amount of produced gas was collected and then analyzed for content of CH4 by gas chromatography.

Results: Pure macroalgae products had low rumen degradability compared to the basal feeds. Addition of macroalgae to the basal feeds reduced total gas and methane production to a varying extent depending on the species, but this was not associated with a depression of fermentability (rumen degradability) of the basal feed(s). The anti-methanogenic effect of the seaweeds could partly be mimicked by alginate, whereas fucoidan did not have anti-methanogenic properties.

Conclusion: All of the tested macroalgae species and the purified alginate extract reduced methane formation with *Ascophyllum nodosum* being the most efficient with an average reduction of 21% without a negative effect on dry matter degradability of the basal feeds.