**Chemical composition and in vitro gas production evaluation of brown and red sub-Antarctic macroalgae as feed for ruminants**

**Application:** The inclusion of seaweeds in ruminant diets could potentially play a viable role in ruminant diets as a source of protein and energy.

**Introduction**: Macroalgae can be used for several purposes including, for instance, human consumption, soil fertilizers and animal feed, due to their diverse range of metabolites (de Freitas et al. 2020). The objective of this study was to evaluate different macroalgae found in the Chilean sub-Antarctic Region, in terms of their chemical composition and in vitro ruminal fermentation.

**Material and methods**:

Four algae (Lessonia flavicans, Gigartina skottbergii, Ulva lactuca and Macrocystis pyrifera) and one alfalfa sample were used. Chemical composition, in vitro gas production (Theodorou et al. 1994) and methane production were determined. In a first incubation, 0.800 g DM of each ingredient was used and incubated in triplicate at 39°C. The gas volume (ml gas/g DM) was recorded at 3, 6, 9, 12, 24, 36, 48, 72 and 96 hours using a pressure transducer (model 8804 HD). After the incubation period (96h), dry matter disappearance (DMD96h mg/100mg), relative gas production (RGP, ml gas 96h)/(mg/100mg DMD 96h) were determined. The concentration of short chain fatty acids (SCFA) according to Getachew et al. (2002) and the microbial biomass production (MBP) according to Blümmel et al. (1997). To determine CH4, 0.200 g DM sample of each ingredient was incubated in 100 mL glass syringes in triplicate in three incubation runs (Theodorou et al., 1994). Gas volume (mL gas/200 mg DM) and CH4 were measured after 4, 8, 12 and 24 h of fermentation. A completely randomized design and Tukey's test were used when significant differences between treatments were observed (P < 0.05).

**Results**: Table 1 shows the chemical composition of the macroalgae. OM content, (g/kg) was higher for alfalfa (P<0.0001), followed by G.skottsbergi. and lower for M.pyriphera, as for CP content (P<0.0001), it was higher for U.lactuca, followed by alfalfa hay and lower for G.skottsbergi. *In vitro* gas production (ml gas/ gDM) at 96h was lower (P<0.001) for G.skottsbergi, followed by M.pyriphera and L.flavicons, however G.skottsbergi and M.pyriphera show the highest DMD 96h (mg/100mg), being lower for U.lactuca. The four algae produced lower amounts of methane (ml CH4/ g DM) compared to alfalfa hay (P<0.0001), however, L.flavicons and M.pyriphera were the one that presented the lowest amounts in the hours evaluated.

Table 1. Chemical composition (g/kgDM), methane production (ml CH4/ g DM), and in vitro rumen gas kinetics (ml gas/ g DM) and fermentation profile of different macro alga as apotential use in ruminat diets.

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| --- | --- | --- | --- | --- | --- | --- | --- |
| Item | G.skottsbergi | M.pyriphera | L.flavicons | U.lactuca | Alfalfa hay | SEM | P-value |
| OM,g/kg | 744.63b | 561.97e | 693.77c | 641.92d | 899.13a | 0.638 | 0.0001 |
| CP,g/kg | 86.00e | 141.55c | 111.86d | 185.91a | 154.50b | 1.054 | 0.0001 |
| EE, g/kg | 17.68a | 3.00d | 1.65e | 14.34b | 8.57c | 0.188 | 0.0001 |
| ml gas/g DM |  |  |  |  |  |  |  |
| 6h | 4.44c | 7.78bc | 4.42c | 10.92b | 16.31a | 0.976 | 0.0001 |
| 12h | 6.82d | 12.45c | 10.87cd | 20.74b | 40.41a | 1.206 | 0.0001 |
| 24h | 11.55d | 14.68d | 25.13c | 33.42b | 73.66a | 1.621 | 0.0001 |
| 48h | 20.97d | 32.99cd | 41.18c | 58.56b | 102.28a | 3.142 | 0.0001 |
| 96h | 25.88d | 59.14c | 48.83c | 82.51b | 118.28a | 4.567 | 0.0001 |
| ml CH4 /g DM |  |  |  |  |  |  |  |
| 3h | 0.27b | 0.25b | 0.03b | 0.34b | 5.26a | 0.407 | 0.0001 |
| 6h | 0.21b | 0.21b | 0.03b | 0.30b | 7.39a | 1.486 | 0.0184 |
| 9h | 3.61b | 0.59c | 0.09c | 1.65b | 7.81a | 1.79 | 0.0522 |
| 12h | 0.61b | 0.62b | 0.15b | 1.13b | 6.77a | 0.513 | 0.0001 |
| 24h | 8.53b | 0.88b | 0.18b | 1.42b | 37.18a | 3.09 | 0.0001 |
| DMD,mg/100mg | 68.49a | 67.62a | 41.60b | 14.72c | 44.64b | 0.765 | 0.0001 |
| ME, Mj/kgDM | 7.89e | 11.27c | 10.28d | 15.07b | 16.02a | 0.101 | 0.0001 |
| MCP, mg/g | 679.80a | 669.81a | 404.98b | 132.48c | 413.95b | 7.226 | 0.0001 |
| SCFA | 0.05d | 0.06d | 0.10c | 0.14b | 0.32a | 0.007 | 0.0001 |
| N-NH3,mg/dI | 26.91a | 21.05b | 21.47b | 30.67a | 31.07a | 2.293 | 0.0258 |

**Conclusion:** The inclusion of U. lactuca suggests a viable alternative in diets for sheep, while G. skottsbergisi has a higher in vitro Dry matter digestibility, it has a lower nutritive value and fermentation at the rumen *in vitro* level. *In vivo* studies are suggested to evaluate its possible use in ruminant diets.

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