**Application**

Understanding how supplementing dairy cows with an *Ascophyllum nodosum* extract via a water delivery system affects intake, milk production and nitrogen excretion can help optimize nutrient utilization and reduce environmental nitrogen losses in dairy systems.

**Introduction**

Nitrogen (N) losses from dairy production contribute to environmental pollution through nitrates in groundwater and emissions of ammonia and nitrous oxide into the atmosphere (Lahart et al., 2021). Ascophyllum nodosum (ASC) can reduce N degradation and ammonia-N accumulation *in vitro* by limiting ruminal proteolysis and N degradability (Wang et al., 2008, Belanche et al., 2016). However, limited research exists on the *in vivo* effects of ASC on N excretion and milk production (Antaya et al., 2019), while no studies have explored the use of extracted bioactive compounds from ASC administered to dairy cows. Furthermore, delivering an extract via a water-based delivery system offers a novel and more consistent and targeted approach, useful for pasture-based systems such as those common in Ireland. This study aimed to evaluate the effect of administering an ASC extract through a water-based delivery system on feed intake, milk production and total N excretion.

**Materials and Methods**

Nine multiparous Holstein Friesian dairy cows (*Bos taurus*) from the Spring calving dairy herd at UCD Lyons Farm were used in a replicated 3 × 3 Latin Square (*n* = 9). Cows were balanced for parity (3 ± 0.87), days in milk (179 ± 27), milk solids yield (2.03 ± 0.41 kg/d), and body condition score (3.03 ± 0.20). Cows were then randomly assigned to one of three dietary treatments: partial mixed ration diet (PMR) with no ASC extract (**Control**), or PMR with ASC extract at either 61.5 g DM/d (**Low**) or 125.3 g DM/d (**High**). The PMR comprised of grass silage and soybean meal, with 3.54 kg/d of concentrate supplemented during milking.

Each 21-d period included 13 days of dietary acclimatization in a free-stall barn, followed by 8 days in metabolism stalls for environmental acclimatization and sampling. Seaweed extracts were administered via individual water troughs using a controlled water system. The PMR was offered twice daily using a Keenan diet feeder. Cows were milked twice daily, with milk samples collected for milk composition analysis. To facilitate the separate collection of urine and faeces, cows were fitted with harnesses, and daily samples of urine and faeces were collected for chemical analysis. Data were analysed using the MIXED procedure of SAS® studio. The model included the fixed effects of treatment, period and their interaction while pre-experimental body weight was included as a covariate.

**Results**

There was no effect of treatment on water or dry matter intake (*P* > 0.05). Cows offered the High treatment had greater yields of milk, fat, protein, milk solids and energy corrected milk relative to both the Control and Low treatment cows (*P* < 0.05). There was no effect on milk composition parameters (*P* > 0.05). There was an increase in milk N excretion, partitioning and nitrogen utilization efficiency (NUE) for cows offered the High treatment relative to both the Control and Low treatment cows (*P* < 0.05). Urinary N excretion and partitioning was greater for cows offered the Low treatment in comparison to both the Control and High treatment cows (*P* < 0.05). Treatment did not impact faecal N excreted or partitioned (P > 0.05).

**Table 1.** The effect of *Ascophyllum nodosum* extract on water and feed intake, milk production, and milk composition parameters.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Treatments1 |  | *P*-value |
|  | Control | Low | High | SEM | Treatment | Period | Interaction2 |
| Drinking water intake (L/d) | 87.8 | 86.4 | 86.9 | 3.15 | 0.862 | 0.011 | 0.186 |
| Total DMI3 (kg/d) | 20.7 | 20.5 | 20.9 | 0.37 | 0.376 | 0.001 | NS |
| Milk production (kg/d) |  |  |  |  |  |  |  |
| Milk yield | 19.94a | 19.91a | 20.83b | 0.734 | 0.047 | <0.001 | NS |
| Fat | 1.20a | 1.16a | 1.25b | 0.059 | 0.001 | 0.002 | NS |
| Protein | 0.82a | 0.83a | 0.87b | 0.033 | 0.003 | 0.017 | 0.174 |
| Lactose | 0.90 | 0.90 | 0.94 | 0.030 | 0.076 | <0.001 | 0.215 |
| Milk solids | 2.04a | 2.00a | 2.13b | 0.093 | 0.005 | 0.007 | NS |
| Energy corrected milk | 27.5a | 27.5a | 29.3b | 1.28 | 0.002 | 0.002 | NS |
| Milk composition (%) |  |  |  |  |  |  |  |
| Fat | 5.99 | 5.86 | 5.79 | 0.155 | 0.430 | 0.012 | NS |
| Protein | 4.13 | 4.15 | 4.17 | 0.037 | 0.306 | <0.001 | NS |
| Lactose | 4.50 | 4.51 | 4.50 | 0.040 | 0.644 | NS | NS |

a-b Within a row, means with different superscripts differ (P < 0.05).

1Control = 0 g/kg DM of ASC extract; Low = 2.93 g/kg DM of ASC extract; High = 5.88 g/kg DM of ASC extract.

2Treatment x Period; 3Dry matter intake.

**Table 2.** The effect of *Ascophyllum nodosum* extract on nitrogen excretion.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Treatments1 |  | *P*-value |
|  | Control | Low | High | SEM | Treatment | Period | Interaction2 |
| Intake (kg/d) |  |  |  |  |  |  |  |
| Feed N | 0.598 | 0.590 | 0.597 | 0.0110 | 0.524 | <0.001 | NS |
| N output (kg/d) |  |  |  |  |  |  |  |
| Milk | 0.129a | 0.129a | 0.136b | 0.0052 | 0.005 | 0.019 | 0.139 |
| Faeces | 0.162 | 0.158 | 0.168 | 0.0046 | 0.093 | NS | NS |
| Urine | 0.199a | 0.229b | 0.198a | 0.0059 | 0.005 | NS | 0.078 |
| N partitioning |  |  |  |  |  |  |  |
| Milk | 0.219a | 0.219a | 0.228b | 0.0076 | 0.044 | NS | NS |
| Faeces | 0.272 | 0.268 | 0.281 | 0.0066 | 0.165 | 0.027 | NS |
| Urine | 0.345a | 0.381b | 0.334a | 0.0100 | 0.013 | 0.034 | 0.100 |
| NUE3 (%) | 21.72a | 21.81a | 22.66b | 0.752 | 0.035 | 0.161 | NS |

a-b Within a row, means with different superscripts differ (P < 0.05).

1Control = 0 g/kg DM of ASC extract; Low = 2.93 g/kg DM of ASC extract; High = 5.88 g/kg DM of ASC extract.

2Treatment x Period; 3Nitrogen utilization efficiency

**Conclusions**

Including an *Ascophyllum nodosum* extract through a water system to mid-late lactation dairy cows did not impact water or dry matter intake. Milk production parameters and NUE were improved for cows offered the High treatment while urinary N excretion was increased for cows offered the Low treatment.

**References**

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