

Quality and vitamins in forage herb and legume species

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Introduction

Grasslands provide an important part of the feed used by domestic and wild ruminants. Fresh herbage is an important natural source of vitamins in ruminant diets. Concentrations of vitamins in plants depend on factors such as regrowth stage, temperature and day length, N fertilisation and leaf proportion in the harvested herbage. Most studies on vitamin concentrations in forages have been carried out with agronomical important grass species such as perennial ryegrass and legume species such as white clover, but hardly with other grassland forage species. As data of dicotyledonous species grown in a sward are scarce, yield, quality and vitamin contents in a number of herb (hereafter referred to as forb) and legume species were compared to a grass-clover mixture to get an insight into species differences.

Methods

The experiment was established in spring 2008 in Foulum, Aarhus University, in the central part of Jutland, Denmark (93 °E, 563 °N). Pure stands with each of 4 forb species, i.e., salad burnet (*Sanguisorba minor*), caraway (*Carum carvi*), chicory (*Cichorium intybus*), and ribwort plantain (*Plantago lanceolata*) and 3 legume species, i.e., yellow sweet clover (*Melilotus officinalis*), lucerne (*Medicago sativa*), and birdsfoot trefoil (*Lotus corniculatus*) were sown, plus a commercial mixture (85% *Lolium perenne* + 15% *Trifolium repens*). Net plot size was 1.5 m x 9 m. Swards were cut with a forage harvester on 29 May, 9 July, 21 August and 23 October 2009 and 31 May, 13 July, 19 August and 21 October 2010. After cutting, samples of the harvested herbage were taken to determine yield, quality parameters (ash, neutral detergent fibre (NDF), acid detergent fibre (ADF), acid detergent lignin (ADL) and *in vitro* organic matter digestibility (IVOMD)) and vitamin concentrations (α -tocopherol and β -carotene) (Elgersma *et al.* 2012, 2013). The experimental design was a randomized complete block with two replications. There were eight 'species' (the seven legume and forb species plus the mixture) and four harvests per year. Analysis of variance procedures were applied using the MIXED procedures of SAS. Yield and vitamin concentrations were evaluated with a model that included fixed main effects of species, harvest date and their interaction. All tests of significance

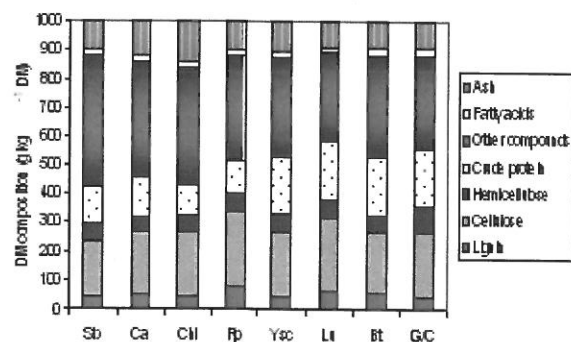


Figure 1. Concentrations of quality compounds in salad burnet (Sb), caraway (Ca), chicory (Ch), ribwort plantain (Rp), yellow sweet clover (Ysc), Lucerne (Lu), birdsfoot trefoil (Bt) and grass-clover (G/C).

were made at the 0.05 level of probability.

Results

All parameters showed significant differences ($P < 0.001$) among the species.

Yields ranged from 3.9 to 15.4 t DM/ha/year and were lower in yellow sweet clover, salad burnet and caraway than in lucerne and the grass-clover mixture. The grass/clover mixture had the highest *in vitro* organic matter digestibility. Ribwort plantain and lucerne had the highest concentrations of NDF, ADF and ADL. Birdsfoot trefoil had low NDF and ADF concentrations but a high ADL concentration and thus a high lignification of the cell wall, as well as a low ash content. The highest ash concentration was found in chicory. The crude protein concentration was highest in the three legume species and in the grass/clover mixture, and lowest in chicory and plantain. The concentration of 'other compounds' including water-soluble carbohydrates was significantly higher in salad burnet than in all other species; it was also higher in chicory and caraway than in the legume species and the mixture (Fig. 1). Alpha-tocopherol concentrations averaged over the season ranged from 21 to 85 mg/kg DM and were lowest in lucerne and yellow sweet clover and highest in plantain and salad burnet. Beta-carotene concentrations ranged from 26 to 61 mg/kg DM and were lowest in lucerne and highest in plantain, caraway and birdsfoot trefoil (Fig. 2).

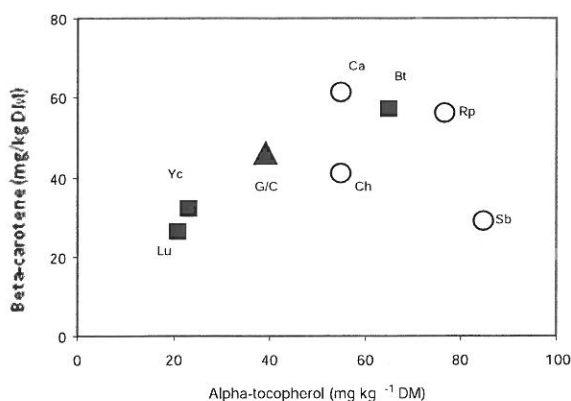


Figure 2. Concentrations of α -tocopherol and β -carotene of forbs (\circ), legumes (\blacksquare) and a perennial ryegrass – white clover mixture (\blacktriangle), averaged across 4 harvests and 2 years.

Discussion

Lucerne and the grass-clover mixture outperformed most forbs in terms of yield but the yield of chicory, plantain and birdsfoot trefoil was not different from that of the grass-clover mixture, confirming our hypothesis that the yield of some dicotyledonous species can equal that of grass-clover. Various dicots had a relatively high nutritive value (the legumes had a high protein content, salad burnet had a low NDF content and a high proportion of other compounds including water-soluble carbohydrates) and could enhance

the nutritional profile of mixed species pastures. Other compounds may play a role in animal nutrition and animal products. More research is needed to identify the various compounds and their functions. The high vitamin concentrations of some forbs as found in this study might offer perspectives for naturally improved milk vitamin composition and could improve sensory properties and physical characteristics of animal-derived products (Moloney *et al.* 2008). These benefits may encourage adoption of these species by farmers, but must from a management viewpoint be balanced against the lack of persistence of most forbs.

Acknowledgements

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References

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