

Relationships between contents of fatty acids and forage quality compounds in forbs

Anjo Elgersma¹, Karen Søgaard² and Søren Krogh Jensen²

¹Independent scientist



EGF conference, Alghero, Italy, May 2017

Outline

- Introduction
- Materials and methods
- Results: fatty acids (FA), vitamins, quality
- Discussion and future ideas

Introduction

- Lack of agronomic data on forbs in grasslands
- Aim of this presentation:
 - A: Differences among species
 - B: Relationships between traits within each species
 - C: Patterns of similarity across species (groups)
- Discussing potential benefits of forbs in terms of product quality

Materials and Methods

Dataset available in Denmark

- Establishment in 2008
- Pure stands of 7 dicots: 4 forbs and 3 legumes
- Standard perennial ryegrass- white clover mixture
- Replicated plots
- Harvests in 2009 and 2010
- Four cuts per year: late May, early July, mid August, mid-late October

Forb species



Plantago lanceolata, Ribwort plantain



Cichorium intybus, Chicory



Forb species, continued



Sanguisorba minor,
Salad burnet



Carum carvi,
Caraway

Legume species



Melilotus officinalis,
Yellow sweet clover



Lotus corniculatus,
Birdsfoot trefoil



Medicago sativa,
Lucerne (alfalfa)

Analyses

- DM yield
- Quality parameters (NDF, CP, Ash, IVOMD)
- Vitamins
 - -tocopherol (vit. E)
 - -carotene (pro-vit. A)
- Fatty acids (FA)

- Mixed model: Species, Cut, S x C; Year random

Quality compounds in the various species

- Chicory: highest **ash** content
- Ribwort plantain and lucerne: most **NDF**
- Birdsfoot trefoil: most **fatty acids**
- Legumes and grass-clover: highest **protein** content
- Forbs (salad burnet): most **other compounds**

More data and figures: see Elgersma A., Søegaard K., Jensen S.K.. 2014. Herbage dry matter production and forage quality of three legumes and four non-legume forbs in single-species stands. *Grass and Forage Science*, 69, 705-716

Fat-soluble vitamins in the various species

- Lucerne and yellow sweet clover had lower vitamin contents than G/C-mixture
- Salad burnet and ribwort plantain had higher -tocopherol contents than mixture
- Caraway, ribwort plantain, and birdsfoot trefoil were highest in -carotene

More data and figures: see Elgersma A., Søegaard K., Jensen S.K.. 2013. Fatty acids, -tocopherol, -carotene and lutein contents in forage legumes, forbs and a grass-clover mixture. *Journal of Agricultural and Food Chemistry*, 61, 11913-11920

Fatty acids in the various species

- Plantain, chicory and lucerne lowest FA
- Birdsfoot trefoil highest FA and C18:3 (ALA)
- The n-6:n-3 ratio was highest in Caraway and lowest in Birdsfoot trefoil
- Large variation between species

More data and figures: see Elgersma A., Søegaard K., Jensen S.K.. 2015. Interrelations between -tocopherol, -carotene, lutein, protein and fiber in forage legumes, non-leguminous forbs and a grass-clover mixture as affected by harvest date. *J. Agric. Food Chem.* 63, 406-414

Summary overall species differences

- **A: Differences among species for each trait**
- Various forbs outperformed the standard grass-clover mixture for -tocopherol content
- Some forbs had high fatty acid contents and/or a very distinct FA profile

Environmental variation: season and year

Do species differ in seasonal fluctuation and in their relations with other traits?

Effect of season

- Generally highest quality in October (cut 4):
 - high N, low NDF, high vitamin and FA contents, high n-3 FA proportion
- Second highest values in May (cut 1)
- Associated with vegetative growth stage
 - High leaf:stem ratio
- Lowest quality trait values in July (cut 2)
- Trends comparable among species

Relationships between FA other traits (summary)

•B: Relationships between traits within each species

- A positive relation between FA and contents of N and vitamins
- A negative relation between FA and contents of NDF and yield

Summary trends in interrelationships with FA

●C: Patterns of similarity across species (groups)

- Much similarity in patterns of relations between contents of C18:3 (ALA) and other traits across species.
- With C18:3, more relations than with total FA

Implications

- Here, a 4-cut silage system was applied to single stands
- Management practices aiming for herbage with high protein and low fiber contents at the moment of harvest, would also increase contents of
 - FA
 - C18:3 (ALA)
 - -carotene

Discussion

- Potential for the forage-feed-food chain?
- Is there scope for more biodiverse grassland mixtures on commercial farms?
- Could forbs be fed as a supplement?

Further work

- Questions to be solved:
 - Agronomic issues (yield, seasonal growth pattern, harvestability)
 - Intake, effects on animal production and animal health
 - Transfer of plant compounds to animal product
 - Effects on product shelf life and consumer health
 - Marketing; traceability

Acknowledgements

EU COST Action FA0802 Feed for Health

for granting short-term scientific missions to Denmark

EGF organisation

for the opportunity to present this paper today

Aarhus University, Faculty of Agricultural Science in Foulum, Denmark

for their hospitality and for providing the data