

Comparison of nutrient and mineral content of herbage from pasture and fresh indoor feeding

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Abstract

Grazing and/or indoor feeding of fresh herbage are common feeding systems for dairy cows in Switzerland. In the framework of an on-farm dairy production system comparison, the nutrient and mineral content of herbage from pastures and for fresh indoor feeding were regularly analysed during two growing periods. Nutrient contents (crude protein (CP), acid detergent fibre (ADF), neutral detergent fibre (NDF), ethanol soluble carbohydrates (ESC)) were analysed by Near-infrared reflectance spectroscopy (NIRS) and the minerals calcium (Ca), phosphorus (P), magnesium (Mg), potassium (K), sodium (Na), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) determined using an inductively coupled plasma optical emission spectrometer. Due to the different utilisation, herbage for fresh indoor feeding contained lower proportion of grasses (60 vs 70%) and herbs (6 vs 9%) but a higher content of legumes (34 vs 21%). The nutrient content was more variable throughout the growing period in the herbage for fresh indoor feeding. The differences in species composition and the generally lower growth stage resulted in significantly higher CP and lower ADF contents of the pasture herbage. Herbage for fresh indoor feeding showed higher contents of Ca and lower contents of P and Zn. The Mg content was similar and increased from spring to summer. The data demonstrates that herbage for fresh indoor feeding represents a valuable source of nutrients and minerals. Its contents, however, may fluctuate more strongly during the growing period as compared to herbage from pastures.

Keywords: herbage, grazing, indoor feeding, mineral content

Introduction

Grazing and/or indoor feeding of fresh herbage are very common feeding strategies for dairy cows in Switzerland. In this traditional system, easily accessible fields located close to the farm buildings are used for grazing while the herbage of more remote fields is harvested daily and fed fresh in the barn. This system allows the cows to be supplied with fresh herbage during the entire growing period. Due to climatic and other factors influencing plant growth and development, nutrient and mineral content of herbage may fluctuate strongly during the growing period. This can be of specific importance for fresh herbage for indoor feeding, which is cut on successive days with progressive developmental stages and which may differ in species composition as compared to herbage used for grazing. In the framework of an on-farm dairy production system comparison, the nutrient and mineral contents of herbage for indoor feeding were regularly analysed throughout the growing period and compared to the contents of herbage from pastures from a full grazing system.

Materials and methods

The system comparison (Reidy *et al.*, 2017) was conducted on the experimental farm of the Vocational Education and Training Centre for Nature and Nutrition in Hohenrain (620 m above sea level). In 2014 and 2015 from spring to autumn, herbage samples were taken directly from the pasture (full grazing) or in the barn from herbage (fresh indoor feeding). Samples were dried at 105 °C to determine dry matter (DM) content and at 55 °C for 24 h for nutrient and mineral content analysis. Prior to analysis, samples were ground using a mill (Brabender, Duisburg, Germany) equipped with a 1.0 mm sieve. Nutrient

contents (crude protein (CP), neutral detergent fibre (NDF), acid detergent fibre (ADF), sugar) were analysed by NIRS. Dry ashed samples were solubilised in nitric acid 65% and their content of calcium (Ca), phosphorus (P), magnesium (Mg), potassium (K), sodium (Na), copper (Cu), iron (Fe), manganese (Mn) and zinc (Zn) were analysed using an inductively coupled plasma optical emission spectrometer (ICP-OES, Optima 7300 DV, Perkin-Elmer, Schwerzenbach, Switzerland). Data were analysed using analysis of variance (Systat 13).

Results and discussion

Due to the different utilisation (cutting vs grazing), the herbage for fresh indoor feeding contained lower proportions of grasses (60 vs 70%, mainly ryegrass) and herbs (6 vs 9%) but a higher content of legumes (34% white and red clover vs 21% white clover only) than the herbage from the pastures. Despite the lower legume proportions, the CP content of the herbage from the pastures was significantly higher and both ADF and NDF contents were lower (Table 1). This might be related to the generally younger growth stage of the pasture herbage. From spring to autumn, an increase in the CP content was observed that was especially pronounced for the herbage from pastures (Figure 1). The highest ADF contents were found during summer for fresh herbage fed indoors. Crude protein and ADF contents varied considerably during the growing period and were much more pronounced for the herbage for fresh indoor feeding.

The Ca contents of the herbage for fresh indoor feeding were higher than from pasture herbage (Table 1). The highest values were found during summer (Figure 1). Lower contents were found for P, K and Zn in herbage for fresh indoor feeding. The contents increased from spring to autumn (Figure 1). The Mg contents were similar in the two different herbages and increased from spring to summer (Figure 1). Sodium, Cu and Mn contents were similar for the two herbages. Important variations were found for the Fe contents (Table 1). In comparison to the study of Schlegel *et al.* (2016), the values for herbage of the same botanical composition were similar for Ca, K and Cu, but higher for Na and Fe and lower for Mg, Mn and Zn.

Table 1. Nutrient and mineral content of herbage from pasture and fresh indoor feeding.

		Pasture		Indoor feeding		P-value		
		2014	2015	2014	2015	Herbage	Year	H × Y
CP	g kg ⁻¹	236	257	166	192	<0.01	<0.01	0.76
ADF	g kg ⁻¹	227	214	288	254	<0.01	<0.01	0.13
NDF	g kg ⁻¹	405	415	441	409	0.14	0.28	0.04
Sugar	g kg ⁻¹	101	91	93	108	0.47	0.66	0.03
Ash	g kg ⁻¹	113	115	114	112	0.83	0.86	0.62
Ca	g kg ⁻¹	5.8	6.6	9.2	10.5	<0.01	0.07	0.69
P	g kg ⁻¹	4.9	4.6	4.0	3.9	<0.01	0.12	0.34
Mg	g kg ⁻¹	1.9	2.2	2.2	2.2	0.21	0.24	0.36
K	g kg ⁻¹	39.2	37.1	34.7	31.1	<0.01	<0.01	0.44
Na	g kg ⁻¹	0.4	0.3	0.5	0.4	0.02	<0.01	0.99
Cu	mg kg ⁻¹	12	12	11	11	0.06	0.60	0.73
Fe	mg kg ⁻¹	365	263	619	162	0.47	0.01	0.09
Mn	mg kg ⁻¹	56	57	57	50	0.44	0.44	0.33
Zn	mg kg ⁻¹	33	37	26	28	<0.01	0.02	0.67

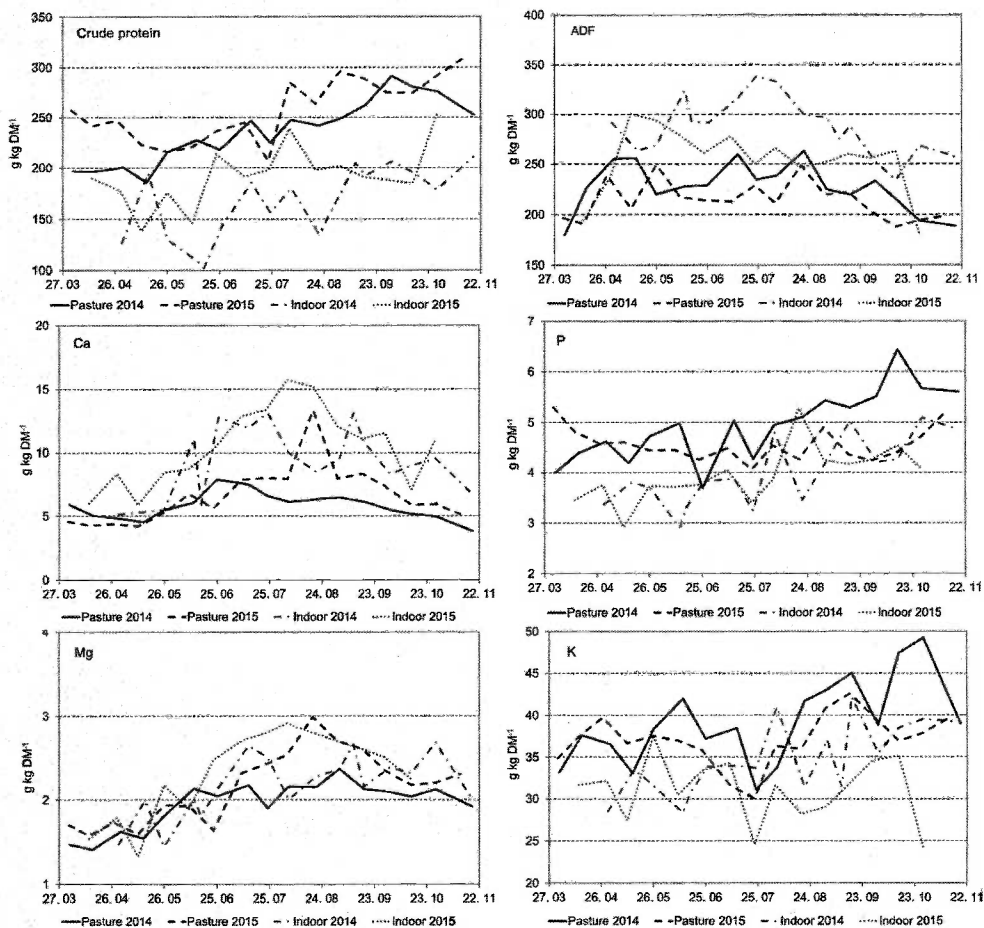


Figure 1. a-f: Crude protein, ADF, Ca, P, Mg and K contents during the two growing periods 2014 and 2015.

Conclusion

The results demonstrate that differences in species composition and more advanced growth stages of herbage for fresh indoor feeding result in lower CP and ADF contents as compared to herbage from pastures. Despite considerable seasonal fluctuations, which are more pronounced in herbage for fresh indoor feeding, Ca, P, K, Cu, Fe and Mn may cover the mineral requirements for dairy cows (Agroscope, 2017). Due to the lower content of Mg, Na and Zn, these minerals should be supplemented.

References

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