Effect of differently conserved herbage on chemical composition of forages and nitrogen turnover in dairy cows

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Introduction In forages derived from herbage high ruminal degradability of crude protein (CP) can result in poor nitrogen (N) utilisation by ruminal microbes and N losses to the environment. However, the mode of conservation can influence the CP fractions in forage and, thereby, the potential N utilisation by the animal. The objective of the present study was to determine the effect of three types of forage preservation on CP fractions and N turnover in dairy cows.

Material and Methods Herbage from a 34-d regrowth was harvested on 30th August 2016 from a ley mainly composed of *Lolium perenne*, *Trifolium repens* and *T. pratense*. After 24 h of wilting one third of the forage was baled without additives at a dry matter (DM) content of 56% (SI). A further third of the forage, after 26 h on the field, was put on the ventilation at an average DM content of 68% and dried to 88% DM (VH). The rest was harvested after 72 h drying on the field at 86% DM (FH). The three forage types were utilized in a replicated 3 × 3 Latin Square arrangement of treatments, to six multiparous Holstein cows. The experimental periods lasted 21 days and included a 14-day adaptation and a 7-day data collection period. The cows were fed for ad libitum intake either silage (SI), ventilated hay (VH) or field-dried hay (FH) and received 300 g/day of a mineral mix. During the collection periods cows received 95% of the intake of the adaptation period. During the data collection period, feed intake, milk yield and milk composition were recorded daily and excreta were completely collected. On day 2 and 5 of each collection period, ruminal fluid via stomach tube and blood were sampled. Non-protein N, buffer-soluble N and fibre-bound N were analysed according to Licitra *et al.* (1996) in the conserved forage. Subsequently, CP fractions A, B1, B2, B3 and C were calculated. These CP fractions are assumed to differ in rate and extent of ruminal degradability, with A being non-protein N, C being undegradable N and B1 to B3 being intermediate (Sniffen *et al.* 1992). Data were subjected to ANOVA using MIXED procedure of SAS 9.2 software (SAS Institute Inc., Cary, NC).

Results and Discussion The contents of CP (g/kg DM) and net energy for lactation (NEL, MJ/kg DM) were highest in SI (207; 5.9) followed by VH (187; 5.5) and FH (176; 5.4). All three forages were poor in energy and high in CP. The different CP fractions in the herbage and the three conserved forages are shown in Figure 1. The patterns of CP fractions for the respective treatments were similar to those described by Wyss (2018). The silage showed a very good quality. On average the pH was 5.5, with 27 g/kg DM lactic acid, 5 g/kg DM acetic acid and 1 g/kg DM butyric acid. The proportion of ammonia-N of total N amounted 4.5% and the silages attained 91 DLG-Points. Milk yield and milk components did not differ ($P>0.05$) among treatments. On average cows yielded 19.7 kg/day of milk with 4.93% fat and 3.79% protein. Cows receiving SI had a lower ($P<0.05$) DM intake (17.3 kg/d) than cows fed VH (19.2 kg/d), and cows fed FH (17.9 kg/d) were intermediate. According to Jans (1991) the DM intake of silage is often lower than DM intake of hay from the same plot and harvested at the same time. Daily N intake was greater ($P<0.05$) for VH cows compared to FH cows. The N intake of SI cows did not differ from the other cows. The N excreted with milk tended to be higher with VH (123 g/d) compared to FH (113 g/d; $P=0.08$) and SI (112 g/d; $P=0.07$).

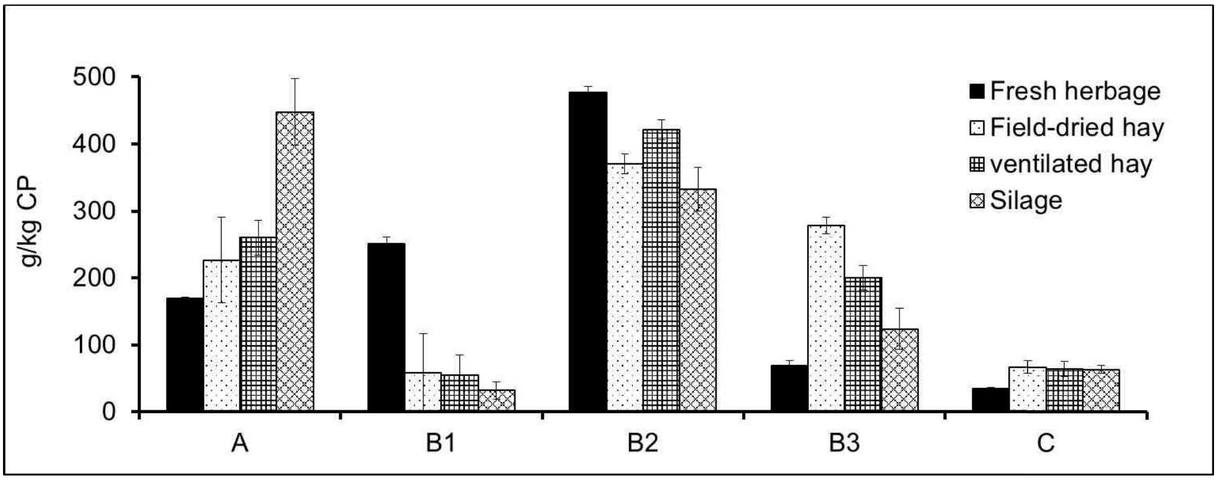

Fig. 1. Crude protein fractions in the fresh herbage and the conserved forage. CP, crude protein, A, B1, B2, B3, C, CP fractions according to Sniffen et al. (1992)

Faecal N excretion was similar (P>0.05) for all treatments (177 g/d) whereas urinary N excretion tended to be higher (P=0.06) for cows fed SI (307 g/d) compared to cows fed FH (251 g/d). Cows fed VH (295 g/d) were intermediate. Treatments had no effect (P>0.05) on the N balance which was negative (-27.2 g/d) for all cows. Presumably due to the deficit of energy the high CP quantity could not be used for the microbial synthesis in the rumen and the surplus of CP, which was degraded to ammonia had to be eliminated via the urine (Sutter 1998). Furthermore, the limitation of the intake during the collection period of 95% of the adaptation period could have influenced the N balance. Windisch et al. (1989) found a negative N balance, when the energy and protein supply was deficient. The proportion of faecal N (% of N intake) was lower (P<0.01) for cows fed SI (30.0) and VH (31.4) compared to cows fed FH (35.3). The proportion of urinary N (52.0% of N intake) did not differ among treatments. The milk urea contents were different (P<0.01). For SI, VH and FH the values amounted to 370, 351 and 306 mg/kg.

Conclusion Silage making had a greater impact on CP composition than haymaking. Especially the fraction A increased during the fermentation process. Feeding only forage derived from herbage in late lactation resulted in high urinary N losses and an N deficiency in dairy cows. The absolute excretion of urinary N was highest when cows were fed silage, which had more non-protein-N (fraction A) than the two other forages.

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