Partial substitution of concentrates by maize silage in rations for organic dairy cows and its influence on performance and utilization efficiency

M. Velik, R. Baumung and W.F. Knaus

Abstract - The aim of the present study was to investigate the influence of partial substitution of purchased concentrates with maize silage on feed intake, energy and nutrient supply, milk production and feed utilization efficiency in organic dairy cows. In the experiment, two winter rations were compared. In the experimental group (E) 2/3 of average herd concentrate intake were replaced by maize silage. In group E total dry matter, protein und energy intake was significantly lower than in the control group (C) (16.3 and 17.8 kg, 99 and 110 MJ NEL, 2170 and 2460 g crude protein, respectively). Milk yield decreased in group E by 1.7 kg, which was not statistically significant. Ruminal nitrogen balance and dietary protein to energy ratio was significantly lower in group E as compared to group C (-8 and 22 g, 21 and 24 g/MJ NEL, respectively). The diet for group E had no effect on milk composition, except milk urea content, which was in tendency lower in group E (15 and 17 mg 100ml⁻¹). Estimated milk yield from forage was considerably higher in group E (15.9 vs 13.5 kg). Efficiency of nitrogen (N) utilization was tendencially higher in group E.

INTRODUCTION

On organic dairy farms, purchased concentrates are one of the main sources of external inputs. This must be viewed critically in many respects: availability and costs of organically produced concentrates, maximum forage utilization, intact nutrient cycles and farm gate nutrient balances. Therefore, maximum milk yield from forage and restricted concentrate use appear to be important goals in organic farming (Nicholas et al., 2004). Maximal milk yield from forage requires an optimal microbial protein synthesis and therefore a synchronised ruminal energy and protein supply. Ruminal protein degradation occurs more rapidly in grass silages than carbohydrate degradation (Sniffen et al., 1992). Tamminga (1996) and Castillo et al. (2000) suggested that imbalances can be decreased by supplementing with low protein roughages such as maize silage, which is high in rapidly degradable carbohydrates and low in protein.

The aim of the present study was to investigate the influence of partial substitution of purchased concentrates with home grown maize silage on feed intake, energy and nutrient supply, milk performance and feed efficiency.

MATERIALS AND METHODS

The experiment was conducted on an organic farm in the province of Salzburg/Austria during the winter feeding period with 20 Holstein Friesian dairy cows, housed in a cubicle housing system with Calan gates for individual feeding.

In the experiment two rations were compared. Therefore, the cows averaging 140 ± 82 days in milk were divided into two groups, a control (C) and an experimental (E) group. Cows were fed grass-clover silage ad libitum in the morning and evening and hay at noon. Concentrates were fed individually to each cow according to milk yield via an automatic feeding station. In group E, 2/3 of average concentrate intake per cow were replaced by 2.6 kg maize silage dry matter and fed in two equal portions before offering grass-clover silage. The experiment lasted for 12 weeks.

Individual forage intake was recorded during three five-day recording periods. Concentrate intake was recorded daily during the experiment. Cows were weighed once during each recording period. Milk yields were recorded automatically at each milking. Representative samples of milk, feeds and feed refusals were collected and analysed. Data were analysed using the MIXED procedure of the SAS program.

RESULTS AND DISCUSSION

Least square means, residual standard deviation (s) and probabilities (P) concerning feed and nutrient intake, milk yield and utilization efficiencies are shown in Table 1.

Content of net energy lactation (NEL) per kilogram (kg) dry matter was 6.1 MJ for both diets, crude protein (CP) content was 130 g for diet E and 145 g for diet C, resulting in a significantly lower dietary CP to NEL ratio and ruminal nitrogen balance (RNB) in group E.

Although there was a tendency towards increased forage intake in group E, total feed intake was significantly reduced by 8 % compared to group C, indicating that maize silage was not consumed additionally, but replaced part of grass-clover silage raw materials.
intake. In addition, intake of NEL and utilisable crude protein in the duodenum (uCP) were significantly reduced compared to group C.

In general, cows fed with diet E produced 1.7 kg less energy corrected milk (ECM), although this difference was not statistically significant (P=0.38). In group C one additional kg ECM required 1.3 kg concentrate intake and suboptimal ruminal protein intake in group E might be the result of both, lower concentrate supply (Gruber et al., 2005).

The results indicate that protein supply might have been suboptimal in the maize silage group. Possible solutions could be the production of grass-clover silages with slightly higher protein contents or the use of home grown protein concentrates.

CONCLUSIONS

The authors gratefully thank the Austrian Ministry of Agriculture and Forestry, Environment and Water Management, Land Salzburg and Bio Austria for funding the project.

REFERENCES


