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Modelling the nitrogen excretion of dairy cows in Austria

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Abstract

The Austrian data for the N excretion of dairy and suckler cows have been recalculated following the guidelines of the European Commission. It was assumed that the feeding of the dairy cows is mainly practiced considering the actual requirements for energy and protein (GfE 2001). The relatively low crude protein content of forage from mountainous meadows and pastures as a consequence of extensive grassland management is finally the main reason for the low N input via feed stuff and therefore the low N excretion level of livestock in Austria.

Keywords: N excretion, crude protein, forage quality, forage intake, milk urea content.

Introduction

On most of the Austrian grassland and dairy farms both home-grown forage from grassland and farm manure are the main natural nutrient resources. On the other hand the use of external inputs like concentrates and mineral fertilisers is very low compared to intensive production areas in Europe (Taube and Poetsch, 2001). Discussing the nutrient excretion of livestock, these specific circumstances have to be taken into consideration.

Materials and methods

Principally, the calculation of nitrogen excretion of dairy and suckler cows in Austria follows the guidelines of the European Commission (2002). It was assumed that the feeding of the dairy cows in Austria is mainly practiced according to requirements. This seems justified since there is an extensive advisory service established. As feeding standards, the "Recommendations for the Supply of Energy and Nutrients of Cows and Heifers" of the German Society of Nutrition Physiology were used (GfE, 2001). The DMI has been calculated using the feed intake prediction equation of Gruber et al. (2001). Forage quality data from different and representative grassland types in Austria were taken into account for the excretion calculations (Poetsch, 2005).

Results and discussion

To reach realistic results when modelling in milk production, it is necessary to account for the stage of lactation and the dry period since nutrient requirements and therefore feed intake are changing during lactation and dry period as a consequence of variable nutrient outputs (milk and foetus). As a consequence of these facts, in the present model the calculations were performed for every week of lactation and dry period. The results presented in Table 1 and 2 are therefore means of 52 weeks each.

Table 1: Ration composition, feed intake of the cows, energy and protein concentration of the total ration (average between winter and summer feeding period)

	forage composition				feed intake (per day)			concentration	
yield per lactation	fresh grass % DM	grass silage % DM	hay % DM	maize silage % DM	forage kg DMI	concentrate kg DMI	total kg DMI	NEL content MJ/kg DM	CP content % DM
3,000[1]	50.0	35.0	15.0	0.0	13.87	0.42	14.29	5.62	11.9
4,000[1]	50.0	35.0	15.0	0.0	14.04	0.92	14.95	5.70	12.0
5,000[1]	45.0	30.0	15.0	10.0	13.83	1.77	15.60	5.88	12.3
6,000[1]	43.8	30.0	15.0	11.3	13.77	2.78	16.55	6.03	12.7
7,000[2]	37.5	35.0	15.0	12.5	14.33	3.34	17.67	6.10	12.9
8,000[2]	31.3	40.0	15.0	13.8	14.22	4.42	18.64	6.25	13.2
9,000[2]	25.0	45.0	15.0	15.0	14.13	5.49	19.61	6.39	13.6
10,000[2]	18.8	50.0	15.0	16.3	14.03	6.54	20.57	6.51	13.9

[1] Milk yield: 3000, 4000, 5000, 6000 kg: Simmental, 700 kg live weight, 4.18 % milk fat, 3.44 % milk protein

[2] Milk yield: 7000, 8000, 9000, 10000 kg: Holstein, 640 kg live weight, 4.15 % milk fat, 3.28 % milk protein

[3] 3000 and 4000 kg milk yield represent suckler and nurse cows, respectively (ZAR, 2003)

In Figure 1 one example is given to illustrate how feed intake, concentrate level and the respective protein content of the ration are reduced during progress of lactation.

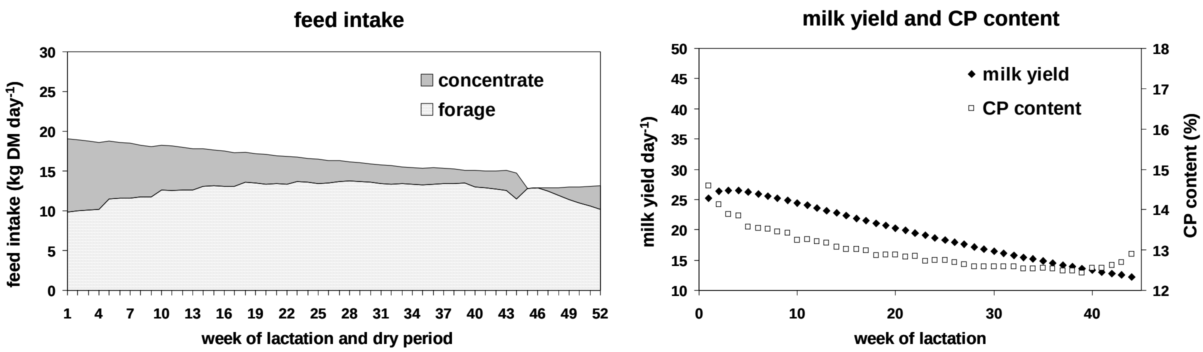

Figure 1: Production data for Simmental cows (6,000 kg milk yield)

Table 2: Calculation of N excretion of the cows (kg per year)

yield per lactation	DM intake	N diet	N milk	N calf	N weight gain cow	N products	N excretion	N gaseous losses	N manure
3,000[1,3]	5,216	98.9	16.2	0.9	1.1	18.2	80.8	8.1	72.7
4,000[1,3]	5,457	104.4	21.5	0.9	1.1	23.5	80.8	8.1	72.7
5,000[1]	5,694	112.5	26.9	0.9	1.1	28.9	83.6	8.4	75.2
6,000[1]	6,039	123.1	32.3	0.9	1.1	34.3	88.8	8.9	80.0
7,000[2]	6,448	133.0	35.9	0.9	1.0	37.8	95.2	9.5	85.7
8,000[2]	6,804	143.6	41.1	0.9	1.0	43.0	100.7	10.1	90.6
9,000[2]	7,158	155.7	46.2	0.9	1.0	48.1	107.6	10.8	96.8
10,000[2]	7,506	167.5	51.3	0.9	1.0	53.2	114.3	11.4	102.8

[1] Milk yield: 3000, 4000, 5000, 6000 kg: Simmental, 700 kg live weight, 4.18 % milk fat, 3.44 % milk protein

[2] Milk yield: 7000, 8000, 9000, 10000 kg: Holstein, 640 kg live weight, 4.15 % milk fat, 3.28 % milk protein

[3] 3000 and 4000 kg milk yield represent suckler and nurse cows, respectively (ZAR 2003)

Based on these assumptions the mean calculated N excretions of cows per year are presented in Table 2, dependent on milk yield. The N intake with diet increases from 99 to 168 kg per year and the corresponding N output with products (mainly milk) rises from 18 to 53 kg. This results in N excretions of 81 to 114 kg and – when gaseous losses from buildings, manure storage and grazing of 10 % are considered – in values of N in manure of 73 to 103 kg per cow and year. These excretion data are lower than assumed in several EC member states. One main reason is the low protein content of grassland forage ranging from 12 to 14 % due to the relatively extensive grassland management, as shown by the data of Poetsch (2005).

The other very important reason for low N excretion is the low milk yield level of Austrian dairy cows. The mean milk production in Austria is 5,432 kg per cow and year which is much lower compared to the milk production in Scandinavian and Western European countries. As described in Table 1, the protein content and hence the N excretion is considerably low at this level of milk production.

The milk urea content can be used as an indicator of the ruminal N balance and hence protein content of the diet (Kirchgessner et al. 1986, Verite et al. 1995, Steinwidder and Gruber 2000). The value of 20.8 mg milk urea has turned out to correspond to an optimal CP content of the ration, i.e. a ruminal N balance of zero (Steinwidder and Gruber, 2000). The statistical evaluation of the official milk recording and breeding organisation in Austria (ZAR, 2004) indicates that the average milk urea content is around 20 – 22 mg/100 ml in the relevant milk yield classes (3,000 – 7,000 kg milk).

Conclusions

Up to now the N excretion of dairy cows in Austria was calculated on the basis of 4,500 kg milk per year, which is about 1,000 kg lower than the actual average amount. In future different production levels, ranging from 3,000 kg (suckler cows) to 10,000 kg milk per cow and year, will be taken into account. This will strongly improve an environmental friendly use of farm manure, following the rules of good agricultural practice. Aiming at the reduction of N excretion to avoid negative impact on the environment, the compliance of actual energy and protein requirements has to be seen as a key point.

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