INVESTIGATIONS ON FODDER QUALITY OF FORAGE RAPE

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INTRODUCTION

In the present project the influence of glucosinolates and several other constituents in the green matter of different forage rape genotypes on the acceptance by grazing sheep, the quantitative feed intake as well as the health condition of the animals were investigated. For this exploration feeding experiments and a grazing trial respectively were carried out.

MATERIALS and METHODS

In the feeding experiments two cultivars of forage rape, the O-cultivar 'Liragrün' and OO-cv. 'Liratop', were sown at three times to obtain fodder in comparable quality for the experiments which lasted more than 100 days. Samples were taken twice for every growing period. For analyses of glucosinolates (GSL) and some other components affecting quality components. Feed intake and weight gain of sheep were recorded daily. To simulate the practical conditions in ruminant feeding, hay and a mineral mixture were additionally fed to the animals.
For **the grazing trial** 6 rape genotypes were cultivated on 2.5 x 7.0 m plots with 4 replications in four separated randomized blocks. The grazing trial started in June and the sheep were rotated weekly within the four blocks. At the beginning of each grazing period samples for analysis of fodder quality were taken and the leaf:stem-ratio was determined at the same time.
Dry matter (DM), crude protein (CP) and crude fibre (CF) were analyzed by LUFA*-methods (Naumann and Bassler, 1983). GSL content was determined by a method developed by Demes et al. (1988). For nitrate content the method of Balks and Reekers (1960) was used and feeding energy was measured following the method of Menke and Steingass (1987). The selection behaviour of grazing sheep was determined by visuale valuation and by the "yield-difference-method" (Zobelt, 1990).
Weight gains of the animals and some blood parameters were checked weekly. At the end of the experiment the sheep were slaughtered and the thyroid gland diameters were measured.

RESULTS

The glucosinolate content of the fodder rape used in the feeding experiment are presented in table 1. There is a clear difference between cvs. 'Liragrün' and 'Liratop' at all sampling dates. The results also show a strong influence of

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the physiological state of the plant and the climatic conditions of the growing period on total GSL-content and the part of the alkenyle- and indole-fractions.

Tab. 1: Total GSL-content, alkenyle- und indole-fractions of forage rape cultivars 'Liragrün' and 'Liratop' in three growing periods

grow. period	cv. 'Liragrün' total GSL-cont. µmol/g DM	parts in % alk.- GSLs	ind.- GSLs	cv. 'Liratop' total GSL-cont. µmol/g DM	parts in % alk.- GSLs	ind.- GSLs
feeding trial A						
1.	14.5 15.3	59 68	41 32	7.2 6.1	16 28	84 72
2.	13.3 14.8	59 44	41 56	5.6 9.7	25 3	75 97
3.	22.7 22.5	61 54	29 46	8.6 7.2	12 8	88 92
LDS 5% (cv./date) =				2.29	1.21	1.41
feeding trial B						
1.	22.6 16.8	81 82	19 18	1.4 2.6	50 54	50 46
2.	24.7 28.6	81 88	19 12	6.0 6.1	50 33	50 67
3.	53.1 41.6	84 78	16 22	8.8 12.1	57 57	43 43
LDS 5% (cv./date) =				0.95	0.73	0.26

As shown in table 1 the total GSL-content in the green matter of cv. 'Liragrün' in feeding experiment A was 2- to 3-fold (maximum 10-fold in B) in comparison with that of cv. 'Liratop'. These differences are mainly caused by the alkenyle-GSLs of the two cultivars whereas the indole-fraction is nearly identical. This unequal ratio of the two GSL-fractions in the two cultivars must be an important criterion with regard to the taste of the cultivars. It is known (Fenwick et al., 1983), that mainly the metabolites of the alkenyle-GSLs are reponsible for the bitter and sharp taste of rape and other cruciferous crops.
Further parameters which may affect the quality of forage rape are presented in table 2.

Tab. 2: Further quality parameters of forage rape cvs. 'Liragrün' and 'Liratop' (average of 6 samplings)

growing period / parameter	cv. 'Liragrün' 1	2	3	cv. 'Liratop' 1	2	3
feeding trial A						
crude fibre (%DM)	20.7	17.7	14.7	21.6	19.3	15.4
crude protein cont. (%DM)	11.8	12.5	21.3	11.9	13.4	21.9
nitrate content (%DM)	0.1	0.1	2.1	0.1	0.3	2.8
feeding energy (MJ/kgDM)	5.8	6.1	5.5	5.8	5.9	5.3
feeding trial B						
crude fibre (%DM)	21.6	19.3	15.4	16.9	18.1	14.4
crude protein cont. (%DM)	11.1	15.3	21.1	11.1	14.9	20.4
nitrate content (%DM)	0.1	0.2	1.6	0.1	0.4	1.4
feeding energy (MJ/kgDM)	6.8	6.4	5.9	6.6	6.2	5.9

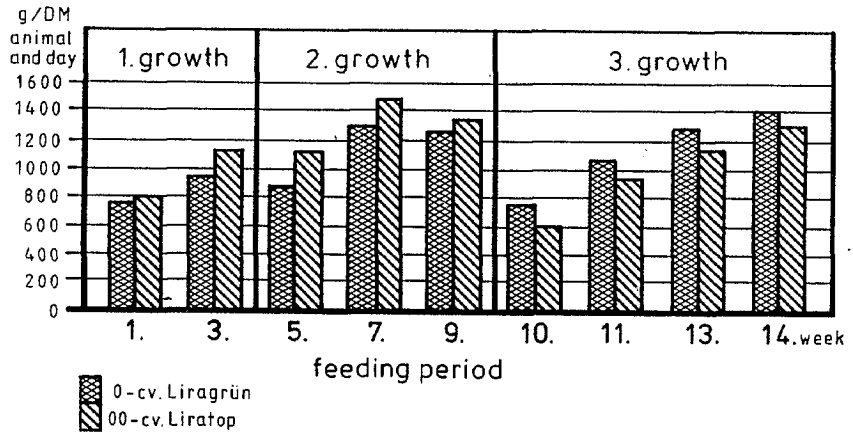

Fig. 1: Feed intake of sheep at 3 growing periods of cvs. 'Liragrün' and 'Liratop'

The intake of fodder rape by sheep varies between 0.8 and 1.3 kg DM per animal and day and is in agreement with observations by Helm (1980). Changes between the fodder grown in the three growing periods were always time accompanied by a reduction in the fodder intake followed by a period of normal consumption.

The reduction the fodder intake may also be caused by other constituents than GLSs alone. A high crude protein content on the one hand and a low content of dry matter and crude fibre on the other hand could be a reason for this behaviour of the animals. In some cases the nitrate content exceeded by far the limit for ruminants of about 1% calculated on dry matter base. The cv. 'Liratop' reached a nitrate content of 3.8% (DM) and 'Liragrün' up to 5.1% (DM). The fact, that no intoxication through nitrate was observed could be due to the high energy content of fodder rape (tab. 2)
Goiterogenic effects of the forage rape feeding are indicated in the thyroid gland diameters presented in fig. 2. But no relationship was found between the enlargement of the thyroid glands and the increase in weight of the sheep.

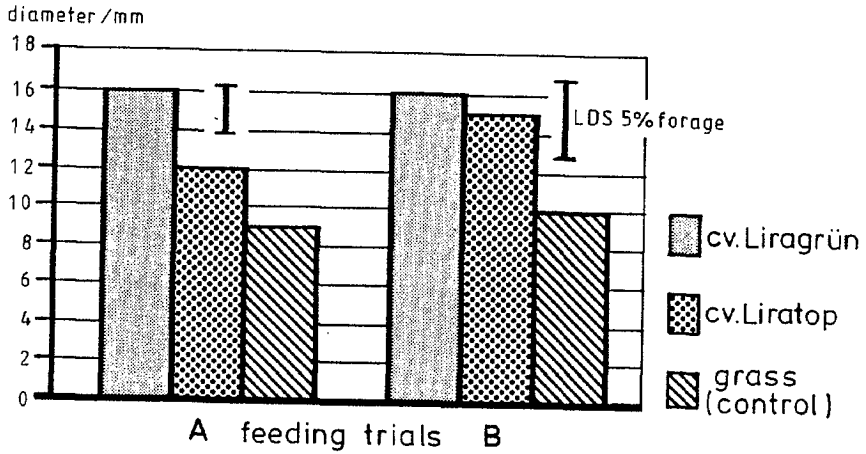

Fig. 2: The influence of different feedstuffs on thyroid gland diameter of sheep

The rape genotypes used in the grazing trial show significant differences in the total GSL-content as well as in the ratio of alkenyle:indole GSLs (fig. 3). During development of the plants a positive correlation between the increasing dry matter and the total GSL-content was found in accordance with the results published by MacFarlane (1988).
In contrast to the results of the feeding experiments there was a close relationship, i.e. a significant negative correlation between the GSL-content of genotypes and the acceptance by the animals which, in this case, were free to choose among all cultivars and genotypes grown in the trial. The correlation coefficients differ among the grazing periods as is shown in table 3.
In all of the 4 grazing periods the OO-genotypes were clearly better accepted by the sheep, and the feed intake, calculated by the "difference-method" (Zobelt, 1990), was significantly higher in comparison with the O-genotypes. The difference between the two groups of forage rape is demonstrated in figure 3.

Table 3: Correlations between total GSL-content and acceptance of the genotypes

grazing period	GSL-content/genotype
A	-0.79***
B	-0.94***
C	-0.92***
D	-0.57**

*** α= 0.001
** α= 0.01

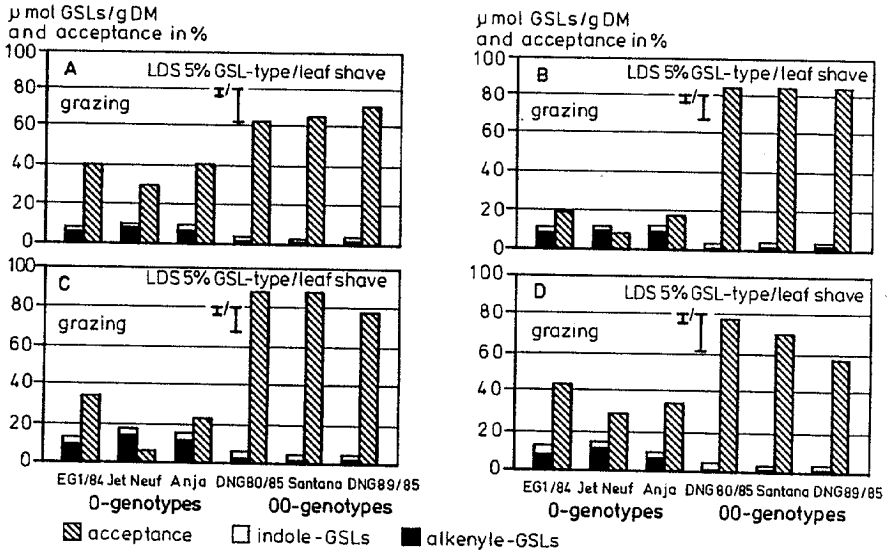

Fig. 3: Acceptance of forage rape genotypes with different GSL-content by sheep

CONCLUSION

Forage rape is a valuable crop with a comparativ nutrient and energy concentration. The amounts of these components in the plant depended on time of the year rather than on cultivars or breeding lines. Lack of crude fibre and a surplus of crude protein as well as nitrate accumulation, which occur especially in autumn, may be limiting factors in the use of forage rape in ruminant feeding.
Regarding glucosinolate content and pattern in vegetative tissue the difference between 0- and 00-types was evident. However, in addition to the influence of genotype a clear dependence on the physical state of the plants and the climatic conditions of the year were recognized.

During the feeding trials no relatioship between glucosinolate content and feed intake, weight gains or health condition were found, although cv. 'Liragrün' showed significantly higher glucosinolate content than cv. 'Liratop'.
In grazing experiments with six cultivars and breeding lines of forage rape the sheep undoubtly preferred genotypes with lower glucosinolate content in the vegetative tissue. A proportion of leaves up to 60% leaf/stem ratio seemed to be not very important. Only the 0-type 'DNG 89/85' showed a lower proportion of leaves (40%-50%) at some grazing dates, and at these dates significantly higher grazing residues were as observed compared with the other 00-types.

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