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Rapeseed meal and urea as a protein source for growing bulls on alkali-treated straw-based feeding

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Abstract. Between the ages of 3 1/2 and 10 months, 12 bulls took part in an experiment in which 1) Tower rapeseed meal or 2) urea plus rapeseed meal was used as a protein source in a diet based on dry alkali-treated straw. In group 1 the rapeseed meal composed 32 % of a concentrate mixture also containing barley, oats, molassed beet pulp and minerals. The average daily consumption of rapeseed meal was 1.2 kg/animal and it contributed 58 % of the digestible crude protein supply. In group 2 urea composed 2 % of the concentrate mixture and the average daily consumption was 84 g/animal. In this group urea contributed about 38 % and rapeseed meal 20 % of the digestible crude protein supply. The palatability of the concentrate mixture was good in both groups. The average daily intake of alkalitreated straw was 2.3 kg/animal or 0.77 kg dry matter/100 live weight kg. Treated straw was the only roughage received by the animals from the age of 6 months. Up to that age the animals also received hay, on average 840 g per animal and day.

The average daily live weight gain in group 1 was 1072 g/animal and in group 2 it was 1111 g; the carcass weights in the respective groups were 169 kg and 176 kg, and the feed conversion rates were 4.08 f.u. and 4.16 f.u./kg live weight gain. The differences between the group were not significant ($P > 0.05$).

Almost all the animals showed pathological changes in their inner organs, which may mean that alkali-treated straw sounds not to be suitable as the only roughage source for growing bulls.

Introduction

The use of straw as the only source of roughage for growing bulls has been restricted by its low digestibility and high bulk. It has also been difficult to find an economical domestic source of valuable protein for straw-based feeding in countries like Finland, where cultivation is limited by the northern location. The development of methods for improving the energy value of straw and the production of new rapeseed varietes that are low in antinutritional substances and can be cultivated in Finnish conditions as well has now made it possible to start rearing bulls on straw-based feeding. In

Index words: rapeseed meal, urea, alkali-treated straw, growing bulls.

this experiment the feed consumption, growth rate and health of the animals were investigated in bulls receiving alkali straw and rapeseed meal and urea together with grain concentrates.

Experimental procedures

The experiment was performed with 12 growing male bulls, 10 Ayrshire and 2 Friesian, which were divided by age, live weight and breed into two comparable groups. The animals mean age at the beginning of the experiment was 110 days and their mean weight 140 kg.

The experiment lasted about 7 months, including an adaptation period of three weeks, in which the diet was gradually changed to that of the experimental regime. The experimental diets consisted of alkali-treated straw fed *ad libitum,* with hay during the first months of the experiment (Fig. 1), and a concentrate mixture consisting of barley, oats, molassed beet pulp and a commercial mineral mixture. As an additional source of protein, one group received rapeseed meal (RSM group) and the other group urea + rapeseed meal (UREA group Table 1).

The bulls were fed individually twice a day at a level which satisfied the energy and protein demands of animals growing at a rate of 1000 g/day (DAENICKE and ROHR 1974). They

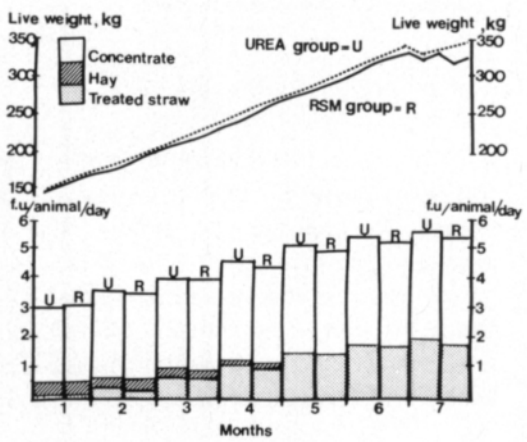

Fig. 1. Live weight gain and feed consumption in different groups.

Table 1. Average percentages of different components in the concentrate mixture during the experiment.

Groups	RSM	UREA
Barley	27.5	37
Oats	27.5	37
Molassed beet pulp	10	10
Rapeseed meal	32	11
Urea	—	2
Minerals	3	3
kg/f.u.	1.14	1.12
DCP, g/f.u.	171	170

f.u. = feed unit = 0.7 starch equivalent
DCP = digestible crude protein

were weighed on two days at the beginning of the experiment and once a week during the experiment. The quantities of grain and the protein sources were adjusted as the weights increased, using weight intervals of 20 kg.

The rapeseed meal used in the experiment was the Tower variety, in which the content of glucosinolates was only 0.2 % of dry matter and that of tannins 1.3 %.

The straw was mainly wheat straw. It was dry alkali-treated with a mobile machine (JF SP2000), in which the straw is chopped, and alkali solution added and mixed with the straw. The amount of NaOH added was 4.3 % of the dry matter of the straw. The unreacted base was determined by titration to pH 8 with 0.1 HCl. The residual NaOH averaged 0.96 % of the dry matter.

The chemical analyses of the feeds were made by standard procedures. The feeding values of the concentrates and hay were calculated from the digestibility coefficients obtained from NJF Tables (ANON. 1969, Table 2), but the value for the treated straw was calculated from the results of a digestibility trial performed with adult rams. The digestibility coefficients of the different constituents of the treated straw were as follows: organic matter 70 %, crude protein 20 %, crude fat 50 %, crude fibre 85 % and N-free extract 60 %. The value number used cal-

Table 2. The mean chemical composition and feeding value of the feeds.

	Rapeseed meal	Barley	Oats	Molassed beet pulp	Hay	Alkali-treated straw
Dry matter, %	87.1	89.0	88.8	87.8	86.2	78.5
% of DM						
Ash	8.0	2.8	3.1	9.4	6.6	10.1
Crude protein	40.2	12.9	13.7	13.3	8.5	4.5
Crude fat	2.2	2.4	6.2	0.5	2.0	0.8
Crude fibre	13.3	5.4	11.2	15.8	35.7	44.6
N-free extract	36.3	76.5	65.8	61.0	47.2	40.0
kg/f.u.	1.25	0.97	1.10	1.19	2.60	2.17
DCP, g/f.u.	363	83	104	91	92	20

culating the net energy value (fattening feed unit) was 63 (ANON. 1969).

Results and discussion

Feed intake and growth rate

The alkali treatment improved the feeding value of the straw. The amount needed for a feed unit was about 2.2 kg, or less than for hay (Table 2). The amount of untreated straw generally needed for a feed unit is 5.5—6.0 kg (ANON. 1969). On average the bulls consumed 2.3 kg (variation 1.8—3.1 kg) straw per day, or 0.77 kg DM/100 kg live weight. The contribution of straw to the total DM intake in the UREA and RSM groups was 34 and 33 %, respectively. The intake of treated straw varied widely between the animals. Similar intakes of alkali-treated straw have been obtained in other experiments with growing bulls (ARNASON 1980).

After 6 months of age, the treated straw was the only roughage given to the bulls. The daily intake of straw was then 4.3 kg/animal. Between the age of 3 and 6 months they also consumed hay, the average daily amount being 840 g/animal.

In the RSM group, the concentrate mixture contained 32 % rapeseed meal (Table 1). Although this proportion of rapeseed meal was about twice as high as is generally recommended (SYRJÄLÄ-QVIST et al. 1982) the palatability of the concentrate mixture was good. The daily amount of rapeseed meal consumed by the animals was 1.2 kg and this supplied about 58 % of their digestible crude protein.

In the UREA group, the mean consumption of rapeseed meal was 400 g per animal and day and that of urea 84 g/day, the maximal amounts of urea being 40 g/100 live weight kg. In this group the bulls received about 38 % of their digestible crude protein from urea and 20 % from rapeseed meal. The palatability of the concentrate mixture was good in this group also.

In the RSM group the roughage/concentrate ratio, calculated from the dry matter,

Table 3. Live weight gain, feed consumption and slaughter results.

Groups	RSM	UREA
Initial live weight, kg	140	141
Final live weight, kg	347	356
Live weight gain, g/day	1072	1111
DM supply, kg/day	5.4	5.5
Energy supply, f.u./day	4.4	4.5
DCP supply, g/day	583	582
DCP, g/f.u.	132	134
Feed conversion rate, f.u./kg gain	4.16	4.08
Carcass weight, kg	169	176
Dressing, %	48.9	49.4

was 39/61 and in the UREA group it was 40/60. This can regarded as reaching the optimal level (McCULLOUGH 1969).

The live weight gain was even and similar in the two groups; it was somewhat higher in the UREA group, but the difference was not significant ($P > 0.05$) (Fig. 1, Table 3). The feed conversion rate was also similar in the two groups, or on average 4.1 f.u./kg live weight gain.

Slaughter results and the health of the animals

By the age of 10 months all the animals had reached a carcass weight of at least 160 kg. In the RSM group it varied from 161 to 183 kg and in the UREA group from 163 to 181 kg. The dressing % in both groups averaged 49 %.

After slaughter, irritation of the mucous membrane of the small intestine was noted in all the animals; one animal had a liver abscess and there were three cases of inflammation of the kidneys. It has been reported from Norway that bulls fed on 4.7 kg DM (= 69 % of total DM) of dry alkali-treated straw had heavier kidneys than bulls fed on untreated straw. In addition, after 12 weeks of feeding treated straw diarrhoea occurred and growth was retarded (ARNASON 1980). According to our results, dry alkali-treated straw cannot be fed *ad libitum* as the only roughage for growing bulls.

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SELOSTUS

Rapsirouhe ja urea kasvavan lihanaudan valkuaisen lähteenä lipeäolkiruokinnalla

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Koe tehtiin 12 mullilla ikävälillä 3 1/2—10 kk. Valkuaisen lähteenä oli toisessa ryhmässä Tower rapsirouhe ja toisessa urea + rapsirouhe. Rapsirouheen osuus edellisessä ryhmässä oli 32 % väkirehuseoksessa, joka sisälsi myös ohraa, kauraa ja melassileikettä. Rapsirouheen saantimäärät olivat keskimäärin 1.2 kg/eläin/pv ja se korvasi noin 58 % eläimen saamasta sulavasta raakavalkuaisesta. Ureaa sisältävässä ryhmässä ureaa oli 2 % väkirehuseoksessa ja keskimääräinen annostus 84 g/eläin/pv. Urea korvasi noin 38 % sulavasta raakavalkuaisesta. Rapsirouhetta eläimet saivat tässä ryhmässä keskimäärin 400 g/eläin/pv eli 20 % sulavasta raakavalkuaisesta. Väkirehuseoksen maittavuus oli molemmissa ryhmissä hyvä.

Lipeäolkea eläimet söivät keskimäärin 2.3 kg/pv eli 0.77 kg kuiva-ainetta/100 elopainokiloa. Eläinten välillä oli yksilöllisiä eroja oljen syönnissä. Heinää mullit saivat puolen vuoden ikään asti keskimäärin 840 g/eläin/pv, mutta tämän jälkeen lipeäolki oli ainoana karkearehuna.

Eläinten kasvu oli tasaista eikä ryhmien välillä ollut merkitseviä eroja, joskin ureaa saaneet eläimet kasvoivat hieman paremmin kuin rapsiryhmän eläimet, keskimääräisten päiväkasvujen ollessa vastaavasti 1111 g ja 1072 g sekä teuraspainojen 10 kk:n iässä 176 kg ja 169 kg. Rehua kului molemmissa ryhmissä keskimäärin 4.1 ry/lisäkasvukilo.

Kaikilla eläimillä oli ohutsuolen limakalvo ärtynyt. Yhdellä eläimellä oli mätäpesäke maksassa ja kolmella munuaistulehdus. Tämä antaa aiheen epäillä lipeäoljen soveltuvuutta ainoaksi karkearehuksi.