The effect of supplementing cereal straws with urea, *Trifolium* hay and *noug* meal on feed intake and liveweight gain of growing crossbred heifers

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Summary

DIFFERENT COMBINATIONS of *urea,* Trifolium *hay and noug meal were individually fed to growing crossbred heifers as supplements to diets based on teff or wheat straw. The rations given were isonitrogenous, and crushed maize was added to ensure that energy was not limiting. The aim of the experiment was to compare the supplements as sources of dietary nitrogen (N).*

Total dry matter (DM) intake increased when noug *was included in the rations and deceased when urea was fed.* Trifolium *hay increased the intake of rations based on wheat straw but did not have any effect on the intake of teff-based rations. Weight gains increased when* Trifolium *hay was included in the rations. The addition of urea to rations that did not contain* noug *increased the rate of weight gain, and this was further increased when* noug *was added. All differences were significant at P<0.05.*

The results of the study indicate that acceptable rates of weight gain can be obtained in growing dairy heifers by feeding rations based on cereal crop residues supplemented with small quantities of maize and urea, and protein from a legume or oilseed meal.

Introduction

Grazing animals in the Ethiopian highlands are subject to widely varying levels of nutrition, and during the dry season a large proportion of their diet is made up of cereal crop residues. These are high in lignocellulosic complexes and consequently of low digestibility, and as a result they are consumed in only limited quantities by ruminants. Cereal crop residues are often less than 50% digestible, and intake is usually 50 g/kg $LW^{0.75}$ or less (Mosi and Butterworth, 1985).

However, supplementation with protein or non-protein nitrogen (NPN) can increase both digestibility and intake of the complete diet. Clovers endemic to the Ethiopian highlands, such as *Trifolium tembense,* have been used in this way (Mosi and Butterworth, 1985), as has the residue of the oilseed *noug (Guizotia abyssinica)* after extraction (Butterworth and Mosi, 1985). Grown as an alternative to arable crops, clovers have the additional advantage of improving soil fertility through N fixation.

The objective of the work described in this article was to compare the effects of *noug* meal, *Trifolium tembense* hay and urea, fed in different combinations as supplements to wheat or teff straws, on feed intake and growth rate of crossbred heifers.

Materials and methods

The study was carried out at ILCA headquarters in Shola, Addis Ababa, at an altitude of 2380 m. Rainfall during the 4 years prior to the experiment averaged 900 mm per annum.

Thirty-six 1- to 2-year-old Holstein x Zebu heifers were used in the experiment. They had an average liveweight of 203 kg at the beginning of the experiment and were divided into 12 groups according to weight and age. The groups were randomly allocated one of 12 diets based on wheat or teff straw fed *ad libitum* and supplemented with different combinations of urea, *Trifolium* hay and *noug* meal. All rations were formulated so as to be isonitrogenous at 1.2% N. However, due to variations in the animals' consumption of the straw, which was offered *ad libitum,* the mean N content of supplemented rations was 1.21 ± 0.08% N (7.55 ± 0.52% CP). Urea was sprinkled on the straw, which was then stored in polythene bags for approximately 16 hours before feeding. Supplements were given as a separate meal which was completely consumed before straw was offered *ad libitum.*

As the main aim of the experiment was to evaluate the supplements as sources of N, it was undesirable for energy to be limiting. Each ration was therefore supplemented with enough crushed maize grain to satisfy energy requirements for a daily weight gain of 250 g (Agricultural Research Council, 1980). Fresh water and a complete mineral lick were always available, and bone meal and anhydrous sodium sulphate were added to the feed daily.

The amounts of feed offered and refused were recorded daily, and samples were analysed using methods described in AOAC (1980) and Goering and van Soest (1970). Experimental animals were assigned at random to individual feeding pens. A standardisation period of 14 days was followed by an experimental period of 98 days. Animals were weighed every 14 days and rectal palpation was carried out to monitor ovarian activity.

Results and discussion

The chemical composition of the various feeds used is given in Table 1. Except for *noug* meal, which was relatively low in N, the values shown are similar to those found by Mosi and Butterworth (1985) and Butterworth and Mosi (1985).

Table 1. *Composition of feeds expressed as percentage of dry matter*.

	Tef straw	Wheat straw	*Trifolium* hay	*Noug* meal	Maize grain	Urea
Organic matter	92.1	93.2	89.5	89.5	98.1	–
Nitrogen	0.86	0.74	2.5	4.5	1.7	45
NDF	73.5	72.2	44.4	31.1	15.9	–
Hemicellulose	29.3	17.9	7.8	5.7	11.3	–
ADF	44.2	54.3	36.6	25.4	4.6	–
Cellulose	40.0	48.4	31.8	20.1	3.6	–
Lignin	4.2	5.9	4.8	5.3	1.0	–
Ash	7.9	6.8	10.5	10.5	1.9	–

Daily consumption of individual feed components in the different rations is given in Tables 2 and 3. Although there were substantial differences in the intake of straw among the different diets, they were not significant. This was to be expected in view of the similarity in the NDF content of the two straws (Mertens, 1973).

Table 2. *Daily consumption of individual dietary constituents of teff-based diets*.

	T	T + U	T + NM	T + Trif.	T+Trif.+U	T+Trif. + NM	SD
Teff straw (kg)	3.79	3.31	4.26	3.35	3.39	3.85	±1.04
Maize grain (g)	498	515	337	337	351	353	±36
Trifolium hay (g)	–	–	–	500	501	452	±117
Noug meal (g)	–	–	412	–	–	434	±140
Urea (g)	–	21.4	–	–	9.2	–	± 2.5

T = teff straw; U = urea; NM = *noug* meal; Trif. = *Trifolium* hay.

Table 3. *Daily consumption of individual dietary constituents of wheat-based diets*.

	W	W+U	W+NM	W+Trif.	W+Trif.+U	W+Trif.+NM	SD ±
Wheat straw (kg)	3.00	2.69	3.79	3.30	2.84	3.74	1.12
Maize grain (g)	648	652	394	351	381	307	131
Trifolium hay (g)	–	–	–	629	496	428	66
Noug meal(g)	–	–	382	–	–	347	27
Urea (g)	–	24.5	–	–	9.2	–	2.2

W = wheat straw; for U, NM and Trif. see Table 2.

Table 4 gives the total consumption of dry matter. Analysis of variance of the pooled data showed that the intake of rations containing urea was significantly lower than that of rations without urea or with *noug* meal supplements. This may have been due to the fact that urea was fed at one time rather than throughout the day. The importance of efficient allocation of feed supplies over the 24-hour period has recently been emphasised by Sniffen and Robinson (1984), and it is evident that feeding strategy is particularly important when considering the supplementation of diets based on crop residues.

Table 4. *Pooled mean values of total DM intake (g/kg LW$^{0.75}$) by animals fed different combinations of cereal crop residues,* Trifolium *hay, urea and* noug *meal*.

	–Trif.	+Trif.	SE
Wheat straw	71.5a	79.5b	±1.75
Teff straw	81.5b	81.8b	±1.75
No urea or no *noug*	Urea	*Noug*	SE
72.2a	71.7a	86.8b	±1.51

Note: For each sub-table, means followed by the same letter are not significantly different (P<0.05).

There was a significant interaction between *Trifolium* hay and the straw fed. When no *Trifolium* hay was fed total DM intake was higher on teff-based diets than on wheat-based diets, but when*Trifolium* hay was included there were no significant differences in intake between the straws.

The increased DM intake associated with *noug* meal was consistent with the results obtained by Butterworth and Mosi (1985), which showed that supplementing cereal crop residues with *noug* meal increased both intake and digestibility of the diet when fed to sheep.

Pooled results for weight gains (g/day) are given in Table 5; no significant differences in growth rate could be attributed to straw type. The inclusion of *Trifolium* hay in the rations significantly (P<0.05) increased the daily rate of gain. This finding is consistent with the results obtained by Mosi and Butterworth (1985). Animals fed urea gained more weight than those fed rations containing straw and*Trifolium* hay only; the weight gain of animals fed *noug* meal was greater than that of those fed straw and *Trifolium* hay with or without urea (P<0.05).

Table 5. *Pooled mean values of weight gain (g/day) by animals fed different combinations of cereal crop residues,* Trifolium *hay, urea and* noug *meal*.

–Trif.	+ Trif.	SE	No urea or*noug*	Urea	*Noug*	S E
133a	227b	±25.2	72[a]	179[b]	289[c]	±30.8

Note: Means followed by the same letter are not significantly different (P<0.05).

Table 6 shows that the marked effect of *Trifolium* was not matched by any increase in ruminal ammonia concentration. Both urea and *noug* caused marked increases in ruminal ammonia levels, from 6–8 mg/ 100 ml to 10–12 mg/100 ml. Only in the case of *noug* was this associated with higher intake; weight gains of animals fed *noug*-supplemented diets were much higher than those of animals fed urea-supplemented diets.

Table 6. *Effect of diet on ruminal ammonia concentration (mg/100 ml)*.

Basal component[1]	Alone	With urea	With *noug*
Teff straw	8.5[2]	11.0	10.2
Teff straw + *Trifolium*	7.0	11.6	11.2
Wheat straw	5.5	12.3	10.6
Wheat straw + *Trifolium*	8.1	9.3	10.6

[1] All diets contained about 10% crushed maize.
[2] Each entry is a mean of three sampling times.

These results indicate that addition of either urea or *noug* meal increased the weight gain of animals fed straw with or without *Trifolium*. The increased DM intake associated with *Trifolium* hay and*noug* meal might be due either to their providing bypass protein or to their increasing the availability of amino acids, peptides or branched-chain fatty acids in the rumen, which in turn would increase the yield of rumen microbial protein (van Soest,1982). No significant treatment effects on ovarian function were observed.

Conclusions

Satisfactory growth rates were obtained in crossbred dairy heifers by feeding cereal crop residues supplemented with shall amounts of maize and urea and additional protein. The protein could be supplied in the form of either legumes grown in an alley-farming system or on fallow land, or locally available oilseed meals or similar protein concentrates.

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