Energy supplementation of straw-based diets: substitution of sugar beet pulp with Ca soaps. Performance trials with heifers and rumen degradability

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SUMMARY - The partial substitution, on an energy basis, of sugarbeet pulp with 0, 0.2, 0.4 or 0.6 kg of Ca-soaps did not significantly affect either the dry matter intake of straw (mean 4.1kg/d) or the growth rates of heifers, even if gains were modest at the 0.6kg/day level (508; 484; 484; 323 g/d). The Ca soaps did not appear to have any significant negative affects on rumen degradability or rumen liquid characteristics.

RESUME - "Complémentation énergétique des rations à base de pailles". La substitution partielle des pulpes de betteraves avec 0; 0,2; 0,4; 0,6 kg/j des savons de Ca n'a pas modifié de manière significative l'ingestion de la paille (en moyenne 4,1 kg/j on observe un effet négatif (508; 484; 484; 323 g/j). Les valeurs de disparition "in sacco" et les caractéristiques du jus de rumen semblent indiquer que l'apport d'acides gras sous forme de savons n'a pas d'effet négatif sur les fermentations microbiennes et sur les bactéries cellulolytiques en particulier.

Introduction

Sentitive value of straw is significantly affected by the type of concentrate feed used (1, 2, 4). Sugarbeet pulp, rich in highly digestible fibre, is considered to be better than cereals as it interferes less with rumen cellulolytic activity. However, sugar beet pulp could depress forage dry matter intake as it has a considerable bulk (3,5). The use of calcium soaps, which have an energy concentration twice that of cereals and beet pulp, could be a convenient alternative to these supplements.

This paper reports the results of wheat straw utilisation trials, with increasing ratios of calcium soaps partially replacing sugar beet pulp on an energy basis.

Material and methods

The first trial, which lasted 124 d, was conducted with 28 Simmental heifers (liveweight 432 ± 6kg) divided into 4 equal groups and housed in 4 open sheds on sawdust litter. The different treatments (table 1) consisted of ad-libitum wheat straw, sugarbeet pulp, Ca soaps, protein supplement and molasses. The quantities of beet pulp (3.27; 2.65; 2.00; 1.33 kg DM), Ca soaps (0; 0.2; 0.4; 0.6 kg DM) and protein supplement were calculated to

Table 1. Composition of diets, daily intake and performances of heifers

Treatments		1	2	3	4	E.M.S.
Straw	kg d.m.	4.01	4.05	4.30	4.11	0.04
Beet pulp	"	3.27	2.65	2.00	1.33	
Fatty acid soaps	"	-	0.20	0.40	0.60	
Supplement	"	0.71	0.82	0.93	1.02	
Molasses	"	0.35	0.35	0.35	0.35	
Total	"	8.34[a]	8.07[b]	7.98[b]	7.41[c]	0.04
Initial L.W.	kg	419	430	431	429	512.14
Weight gain	g/d	508	484	484	323	32936.25

a,b,c: P<0.05.

provide the same quantities of NE (U.F.L.) and Nx6.25. Calan gates were used to obtain individual daily intakes. Weight gains were measured on fasted animals as the average of two weighings on successive days.

The second trial measured the straw's *in situ* dry matter de gradability after 24, 48 and 72 hours of incubation, using the nylon bag technique with 9 fistulated cows (3 per treatment) and the diets used in treatments 1, 3 and 4 from the previous heifer trial. Rumen liquid was sampled for analysis 0, 2, 6 and 10 hours after the morning feed on the day when the bags were introduced into the rumen.

Table 2. Characteristics of the rumen fluid and *in situ* d.m. degradabiblity of straw.

Treatments		1	3	4	E.M.S.
pH		6.4	6.5	6.6	0.15
Ammonia N	mg/l	118.4	180.4	180.4	18020.71
Total V.F.A.	mmol/l	104.7[a]	83.8[b]	75.1[b]	650.10
Acetic acid	%	70.1	70.7	71.0	2.44
Degradability					
24 h	%	27.9	23.9	27.8	10.96
48 h	"	35.6	33.9	35.7	2.82
72 h	"	41.4	40.2	40.5	2.57

a,b: P<0.005.

Results and discussion

Increasing amounts of Ca soaps, although allowing a noticeable reduction in the quantity of concentrates, did not cause increases in straw consumption which averaged 4.1 kgDM/day, and so a negative effect on total DM intake was observed (8.3; 8.1; 8.0; 7.4 kg DM/d) (Table 1). Theoretical and actual intakes of both NE and N were similar (between 5.8 and 6.0 U.F.L. and 555 and 566g PDIN). There were noticeable differences in the levels of PDIE consumed, although these differences were within the recommended ranges for the ratio of nitrogen and energy.

Daily liveweight gains, close to 500g/d, were satisfactory for the control diets and treatments 2 and 3, whilst the diet with the highest concentration of Ca soaps gave only a modest gain. Even if this difference was notable (-36% with respect to the control) the variability in weight gain prevented this difference reaching significance.

The addition of Ca soaps and the consequent reduction in beet pulp reduced rumen fermentation causing an increase in pH (1:6.4; 2:6.5; 3:6.6) and a lower molar concentration of V.F.As. (105 *vs* 84 and 75 mmol/l). However, no differences were observed in the molar percentage of acetic acid with values stable at between 70 and 71%. N-NH3 concentrations varied considerably: the lowest values, recorded in the control animals, could be due to improved rumen microflora protein synthesis, itself favoured by the increased availability of energy in the rumen. Finally, no significant differences were observed in rumen degradability of straw DM. Losses of DM from the bags were similar and appear to confirm the lack of effect of saponified fatty acids on rumen cellulolytic activity (4).

Conclusions

The use of Ca soaps and the consequent reduction in quantity of concentrates used did not increase straw intake. However, even if no negative effects were observed on rumen cellulolytic activity, the use of large amounts of Ca soaps appears to worsen the efficiency of utilisation of straw based diets, whilst no effects were seen with levels of 0.2 and 0.4 kg Ca soap/d.

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