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ALKALI TREATMENT OF MATURE *Pennisetum purpureum* FORAGE
2. EFFECT OF NaOH TREATMENT ON INTAKE AND GAIN OF HEIFERS

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Three treatments each of 6 heifers (initially 196 ± 25 kg/liveweight) received *ad libitum* for 77 days either (0) mature *Pennisetum purpureum* forage (60-65 days regrowth) or (2.5) the same forage treated on a DM basis with 2.5% NaOH or (5.0) 5.0% NaOH. All treatments received 3 kg air-dry/d of concentrate consisting of 74% maize flour residue, 24% cottonseed meal and 2% commercial minerals consisting predominantly of dicalcium phosphate. The animals receiving untreated forage also received 50 g/d of salt. Intake of forage was depressed by the NaOH treatment, and was 1.29, 1.26, and 0.98 kg DM/100 kg LW for treatments 0, 2.5 and 5.0 respectively. This was reflected in a depression in liveweight gain due to NaOH in Treatment 5.0 (0.78, 0.73 and 0.68 g/d respectively). In a second experiment the nylon bag digestibility during 24 h of the forage used in the three treatments was determined in 2 steers fed untreated *Pennisetum purpureum* forage alone. DM digestibility was increased ($P < .05$) by NaOH treatment and was 51%, 64% and 69% for the 0, 2.5 and 5.0 % NaOH treatments respectively. The experiment demonstrated that although NaOH treatment effectively increased DM digestibility of the *Pennisetum purpureum* forage, this was not reflected in increased growth rate.

Key words: *Pennisetum purpureum*, alkalis, NaOH, intake, weight gain

Although alkali treatment has been extensively investigated in temperate countries as an means of increasing the digestibility of poor quality fibrous materials, investigations with tropical forages are limited (Jackson, 1977; Escobar and Parra, 1983).

Previous experiments demonstrated that the dry matter (DM) digestibility of mature *Pennisetum purpureum* forage could be increased substantially by alkali treatment (Dixon and Escobar, 1984). The present experiment was intended to examine if this increased DM digestibility resulted in improved growth rate in young cattle.

Materials and Methods

Experiment 1

Eighteen heifers (9 Holstein and 9 Brown Swiss, 196 ± 25 kg liveweight) were allocated at random to one of three dietary treatments. The heifers were maintained in group pens which were roofed and paved in the area of the feeding troughs, and had free access to water.

The heifers were given either mature freshly-chopped *Pennisetum purpureum* forage (Treatment 0), the same forage treated with 0.600 kg NaOH/100 kg fresh forage (2.5% on dry matter basis, Treatment 2.5) or the forage treated with 1.200 kg NaOH/100 kg fresh forage (5.0 on dry matter basis, Treatment 5.0). For treatments 2.5 and 5.0 the NaOH was dissolved in 20 l water. This solution was mixed manually with the forage, and the mixture was stored in plastic drums for 24 h before being offered to the animals. Sufficient forage was offered to the animals to allow 10 to 20 % feed refusals. The heifers also received 3 kg (air-dry) per head per day of concentrate which consisted on an air-dry basis of 74% maize flour residue, 24% cottonseed meal and 2% minerals consisting predominantly of dicalcium phophate; the animals receiving forage without NaOH treatment also received 50 g per head per day of salt.

The weight of offered and refused forage was determined daily, and samples bulked on a weekly basis for DM determination. Samples of each forage were bulked over the experiment, and the composition determined using the following procedures: crude protein and ash by AOAC (1965), acid detergent fiber (ADF), cellulose, lignin and silica by Goering and Van Soest (1968) and *in vitro* digestibility by Alexander and McGowan (1966). The heifers were weighed weekly, and liveweight (LW) gain calculated by linear regression.

Experiment 2

The nylon bag DM digestibility of the samples of each forage bulked over the experiment was determined using two cannulated mature steers consuming freshly chopped *Pennisetum purpureum* forage *ad libitum*. The forage samples were dried at 85% for 48 h, ground (Christy and Norris Laboratory Mill, 4 mm screen), and the digestibility of duplicate 5 g samples determined during a 24 h incubation using nylon bags and the procedures described by Ørskov *et al.* (1980).

Results

There was no difference due to NaOH treatment of the forage in the content of crude protein or of cellulose, although there was a tendency for the ash content to increase (Table 1).

The NaOH treatment of the forage was associated with a depression in the intake of the forage (Table 2). However, since concentrate intake on a body weight basis was higher for Treatment 5.0 treated forage, the total DM intake was similar for all of the treatments. The NaOH treatment of the forage was associated with a significant ($P < 0.05$) decrease in liveweight gain from 0.78 kg/d to 0.68 kg/d at the 5% NaOH level of treatment.

The results from the nylon bag incubations indicate that DM digestibility was increased significantly ($P < 0.05$) from 51.1% for untreated forage to 64.2 and 68.8 % for the 2.5 and 5.0 % levels of NaOH treatment respectively (Table 1).

Table 1:
Chemical composition and digestibility of fresh Pennisetum purpureum, treated or untreated with NaOH, and of concentrate.

	Chemical fraction (% DM)						Digestibility (%)	
	Ash	Protein crude	ADF	Cellulose	Lignin	Silica	*In vitro*	*In vivo* (Nylon bags)
P. purpureum								
0% NaOH	15.76	6.66	47.15	34.15	9.77	3.21	45.04	51.1
2.5% NaOH	13.66	6.64	48.05	34.72	9.21	3.71	46.35	64.2
5.0% NaOH	10.78	6.67	47.46	34.55	9.07	3.57	48.71	68.8
Concentrate	5.06	17.51	41.47	9.02	2.43	-	74.01	-

Discussion

The initial randomization of the cattle unfortunately resulted in differences between the dietary treatments in the initial liveweight of the cattle. Therefore, because a fixed quantity of concentrate was given, the intake of concentrate as a percentage of liveweight tended to be greater for Treatment 5.0 (Table 2).

Table 2:
Intake and liveweight gains of heifers receiving a diet of fresh P. purpureum treated with or untreated with NaOH and concentrate.

	NaOH (%)		
	0	2.5	5.0
Intake (kg DM/10 kg LW)			
Forage	1.29	1.26	0.98
Concentrate	1.19	1.21	1.40
Total	2.48	2.47	2.38
Liveweight gains (kg/d)	0.78[a]	0.73[ab]	0.68[b]

[ab] $P < 0.05$

In agreement with previous experiments where freshly-chopped mature *Pennisetum purpureum* forage was treated with NaOH (Dixon *et al.*, 1983), the treatment of the forage with 2.5 and 5.0 % NaOH of the DM substantially increased the DM digestibility determined in nylon bags. Since total DM intake was similar for the three diets, and since the proportion of forage tended to decrease in Treatment 5.0 diet, the intake of digestible energy should have been increased in this treatment. Consequently, the observation that liveweight gain tended to decrease rather than increase at this level of alkali treatment of the forage was unexpected, and no satisfactory explanation for this differences can be offered. The reduced intake of alkali treated forage is in agreement with the experiment of Dixon and Parra (1983) where the intake of similar *Pennisetum purpureum* forage (in the presence or absence of concentrates) was depressed by 32% due to NaOH treatment. However in contrast Dixon *et al.* (1983) observed high intakes (3% of liveweight) of a 60/40 mixture of *Pennisetum purpureum* and *Canavalia ensiformis* forage treated with NaOH, suggesting a component of the canavalia forage was involved to maintain a high intake. Furthermore, in the majority of published experiments where roughage of low quality has been treated with alkali, the intake of roughage has increased due to the alkali treatment (Jackson, 1977; Escobar and Parra, 1983). Possibly the reduced intake in the present experiment was associated with a low palatability of the treated forage probably due to a deposition of unreacted NaOH on the surface of the fresh forage.

In conclusion, the NaOH treatment of the mature tropical forage was not a satisfactory method of increasing growth rate of young cattle.

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