Technology Section

Pakistan J.Sci.Ind.Res., Vo. 26, No. 5, October 1983

IMPROVEMENT IN THE DIGESTIBILITY OF BEET PULP BY CHEMICAL TREATMENTS

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(Received March 27, 1982)

Dry matter digestibility of beet pulp was increased from 44.83 to 60.38 and 67.73 per cent when it was treated with 3.5 per cent sodium hydroxide or 2.5 per cent calcium hydroxide respectively. The digestibility of the pulp first treated with 0.5 per cent calcium hydroxide and subsequently with 5 per cent ammonia was 71.2 per cent. A three fold increase in non protein nitrogen was also observed.

INTRODUCTION

Sugar-beet pulp is generated as a by-product of beet sugar. Its production in the year 1976-77 was 641,000 tonnes[1]. This is an excellent forage, rich in protein (upto 10 per cent) and energy (76 per cent) and can greatly improve the performance of dairy and meat animals. Present paper reports results of a study in which beet pulp was subjected to chemical treatment to improve its digestibility by the ruminants.

MATERIALS AND METHODS

1. Moisture Content, ash, protein and cellulose were determined according to the Stardard AOAC methods[2].

2. *Chemical Treatments*

a) Sodium Hydroxide Treatment. Dried beet pulp was treated with different concentrations (1.5-4.0 per cent) of commercial sodium hydroxide.

b) Ammoniation. Dried beet pulp was treated with 5% aqueous ammonia and was incubated at 55 ± 2° for 15 days in sealed containers.

c) Calcium Hydroxide Treatment. The material was treated with different concentrations of calcium hydroxide to increase its digestibility.

3. *In-vivo Digestibility*

A dry Sahiwal cow weighing 350 kg was obtained from M/s. Packages Dairy Farms Ltd. The cow was rumen fistulated and fitted with an aluminium cannula measuring 11.3 x 8 cm weighing 0.51 kg. The cow was given necessary treatment for one month and kept on maintenance ration according to N.R.C. recommendation. After one month the samples of treated substrate were infused in rumen according to the rumen techniques[3] in four replicates and were taken out after 48 hours. The samples were washed, dipped in alcohol for half an hour and washed again with distilled water until the washing gave no indication of soluble material left in the samples. These washed samples were dried in the oven at 103 ± 2° C to contant weight and weighed after cooling in a desicator containing calcium chloride. The co-eff. of digestibility as calculated according to the formula.

$$\text{co-eff. of digestibility} = \frac{\text{wt of sample infused} - \text{wt. of sample left}}{\text{wt. of sample infused}} \times 100$$

The results so obtained were analysed statistically according to the sendicore.

RESULTS AND DISCUSSIONS

Digestibility of Beet Pulp Treated with Different Concentration of Sodium Hydroxide. Dry matter, organic matter, cellulose and mineral digestibility of untreated beet pulp was 44.83, 44.05 32.19 and 53.81 per cent respectively. (Table 1). Treatment of the beet pulp with different concentration of sodium hydroxide from 1.5 to 4.0 per-cent increased its digestibility. The dry matter, organic matter, cellulose and mineral digestibility, after treatment with 3.5 per cent sodium hydroxide increased to 60.38, 58.87, 59.45 and 75.61 per cent respectively. A decrease in in-vivo digestibility was observed when the level of sodium hydroxide was more than 3.5 per cent. This decrease in the digestibility at higher level of sodium hydroxide, may be due to alkaliosis caused by excess of unreacted alkali. These

results are in agreement with the findings of other workers[4-7] who reported an improvement in the digestibility of various crop residues by alkali treatment and a decrease in the digestibility due to alkaliosis.

Digestibility of Beet Pulp Treated with Different Concentration of Calcium Hydoxide. The digestibility of beet pulp increased with an increase treated with different concentrations (0.5 to 2.5 per cent) is given in (Table 2). These findings are in accordance with the work of Nagi and Kehar[8] who found an improvement in the digestibility

Table 1. Rectuleo rumen digestibility of beet pulp treated with different conc. of sodium hydroxide.

Treatments	Rectuleo rumen digestibility percentage after 48 hours			
	Dry matter	Organic matter	Cellulose	Minerals
Beet pulp as such	44.83 ± 1.90	44.05 ± 1.10	32.19 ± 4.08	53.81 ± 2.18
Beet pulp 1.5 % sodium hydroxide treated	49.02 ± 1.60	49.31 ± 1.22	49.31 ± 1.77	62.38 ± 0.57
Beet pulp 2.0 % sodium hydroxide treated	51.33 ± 3.10	49.81 ± 3.01	51.48 ± 3.14	69.55 ± 2.44
Beet pulp 2.5 % sodium hydroxide treated	53.75 ± 2.0	51.97 ± 2.24	50.0 ± 1.00	72.74 ± 1.10
Beet pulp 3.0 % sodium hydroxide treated	56.39 ± 3.15	54.71 ± 2.17	53.17 ± 2.36	72.53 ± 1.36
Beet pulp 3.5 % sodium hydroxide treated	60.38 ± 3.58	58.87 ± 3.76	59.45 ± 2.82	75.61 ± 2.04
Beet pulp 4.0 % sodium hydroxide treated	57.20 ± 4.36	57.33 ± 4.13	56.08 ± 3.39	68.90 ± 3.39

Table 2. Rectuleo rumen digestibility of beet pulp treated with different conc. of calcium hydroxide.

Treatments	Rectuleo rumen digestibility percentage after 48 hours			
	Dry matter	Organic matter	Cellulose	Minerals
Beet pulp as such	44.83 ± 1.90	44.05 ± 1.10	32.19 ± 4.08	53.81 ± 2.18
Beet pulp 0.5 % calcium hydroxide treated	47.11 ± 3.24	45.73 ± 2.58	36.45 ± 1.38	57.71 ± 3.72
Beet pulp 1.0 % calcium hydroxide treated	49.30 ± 2.23	49.27 ± 2.11	42.67 ± 2.46	49.66 ± 5.49
Beet pulp 1.5 % calcium hydroxide treated	51.36 ± 2.03	51.41 ± 2.33	46.48 ± 2.51	50.22 ± 3.49
Beet pulp 2.0 % calcium hydroxide treated	59.35 ± 2.93	57.68 ± 1.52	55.95 ± 2.40	65.11 ± 3.33
Beet pulp 2.5 % calcium hydroxide treated	67.73 ± 1.70	66.63 ± 1.23	63.63 ± 1.11	75.54 ± 2.80

Table 3. Proximate Analysis of Beet pulp given sodium hydroxide treatments.

Treatments	Ash %	Cellulose %	Nitrogen %	Dry matter %
Beet pulp as such	4.02	50.96	1.54	90.0
Beet pulp 1.5 % sodium hydroxide treated	5.39	45.38	1.55	88.6
Beet pulp 2.0 % sodium hydroxide treated	7.45	51.44	1.58	88.5
Beet pulp 2.5 % sodium hydroxide treated	8.55	48.41	1.58	87.6
Beet pulp 3.0 % sodium hydroxide treated	9.45	51.30	1.44	88.1
Beet pulp 3.5 % sodium hydroxide treated	9.21	54.53	1.53	87.4
Beet pulp 4.0 % sodium hydroxide treated	7.62	54.47	1.53	88.1

Table 4. Proximate Analysis of beet pulp given different treatments.

Treatments	Ash %	Cellulose %	Nitrogen %	Dry matter %
Beet pulp as such	4.02	50.96	1.54	90.0
Beet pulp 0.5 % $Ca(OH)_2$ treated	5.27	47.30	1.78	74.37
Beet pulp 1.0 % $Ca(OH)_2$ treated	4.96	52.23	1.60	80.70
Beet pulp 1.5 % $Ca(OH)_2$ treated	4.88	51.13	1.65	75.70
Beet pulp 2.0 % $Ca(OH)_2$ treated	6.24	54.14	1.60	78.80
Beet pulp 2.5 % $Ca(OH)_2$ treated	8.35	53.74	2.15	81.47
Beet pulp 5.0 % ammoniated	3.99	55.52	3.55	88.10
Beet pulp 0.5 % $Ca(OH)_2$ + 5% ammoniated	6.20	54.21	3.68	88.80

of straws by calcium hydroxide treatment.

Digestibility of Beet Pulp when Treated with Calcium Hydroxide and/or Ammonia. The dry matter digestibility of untreated beet pulp was 44.83 per cent which is equivalent to wheat straw. Ammoniation (5 per cent w/w) of beet pulp increased its dry matter, organic mater, cellulose and mineral digestibilities to 53.01, 53,32, 48.3 and 47.55 per cent respectively. These results are supported by the findings of Homb[9] *et al.* who reported that digestion co-efficient of starw increased after ammonia treatment from 48 to 66 per cent. Dry matter digestibility of 0.5 per cent calcium hydroxide treated pulp was 47.11 per cent as compared to the untreated beet pulp (44.83 per cent). An increase in the dry matter, organic matter, cellulose and mineral digestibility to 71.2, 70.0, 75.2 and 75.79 per cent respectively was observed when beet pulp was successively treated with 0.5 per cent calcium hydroxide and 5 per cent ammonia. This increase in the digestibility brings ammoniated and calcium hydroxide treated beet pulp equivalent to good quality hay with an added advantage that nitrogen contents are roughly doubled and storage life is extended.

Proximate Analysis of Beet Pulp Treated with Sodium Hydroxide, Calcium Hydroxide and/or Ammonia. Proximate analysis of beet pulp treated with different concentrations of sodium hydroxide is given in Table 3. The ash contents increased with an increase in the conc. of sodium hydroxide (3.5 per cent w/w). The increase in ash content might be due to the formation of insoluble salts of higher molecular weight. Cellulose did not show a regular pattern. Treatment of beet pulp with different concentration of calcium hydroxide increase the ash and cellulose contents (Table 4). A two to three fold increase in nitrogen content was noted when beet pulp was ammoniated after treatment with 0.5 per cent calcium hydroxide.

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