J. Natn. Sci. Coun. Sri Lanka 1979 7(2) : 115—118

SHORT COMMUNICATION

A study of various alkali treatments to improve the nutritive value of rice straw

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(*Paper accepted* : 19 *October* 1979)

Rice straw, the largest annually harvested agricultural by-product in Sri Lanka, is little used as an animal feed because of its low nutritive value. Spray treatment with sodium hydroxide solution improves its feeding value[4,5] but the high cost of treatment prohibits its use as an economical feed at present. The amount of sodium hydroxide required for treatment is one of the major cost components of this system.

A number of chemicals other than sodium hydroxide have been tested for their ability to increase digestibility of roughages[1,2,11,12,13] but none have been proved to be as effective as sodium hydroxide.[3]

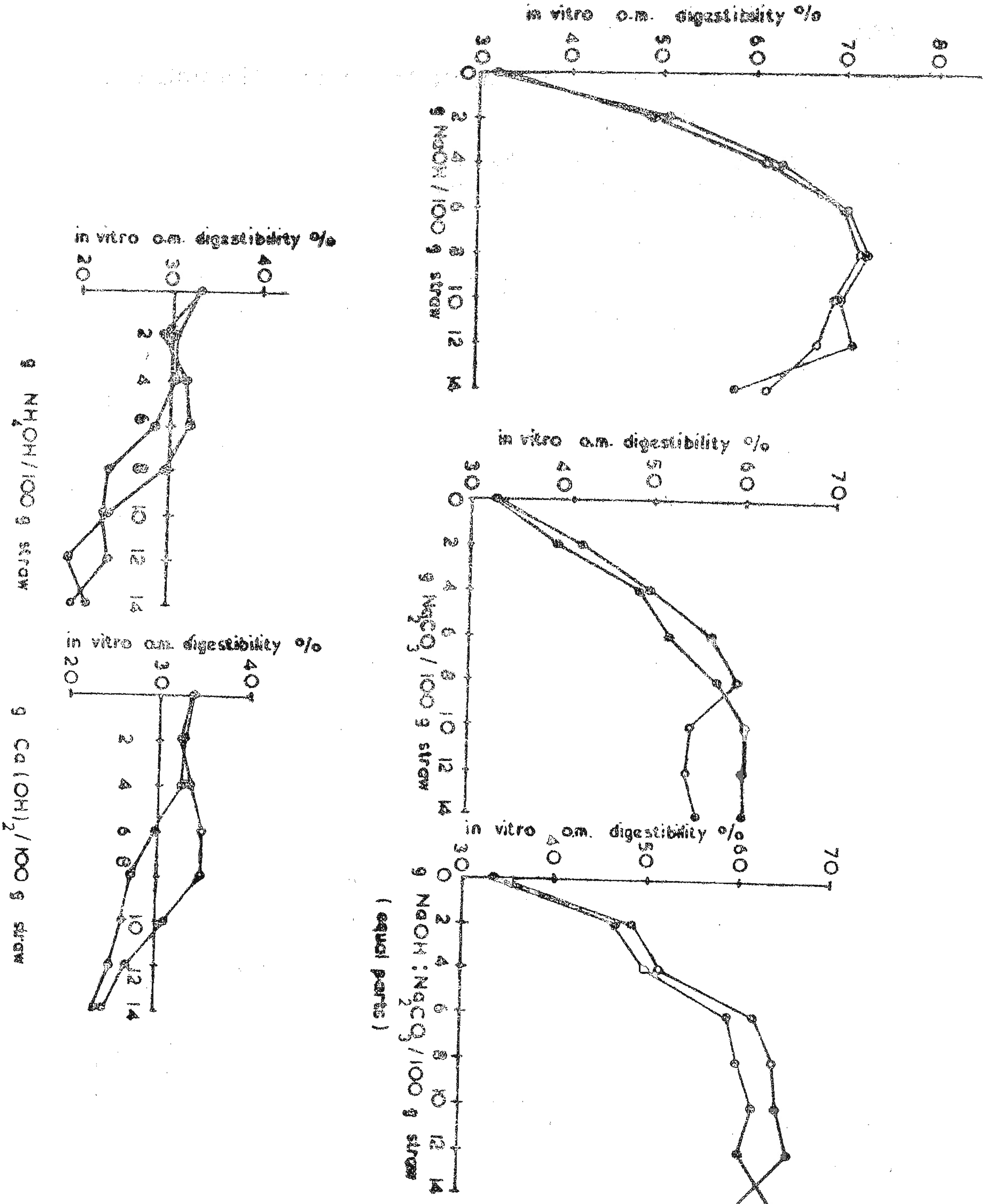
The present paper reports an experiment designed to study the effectiveness of a number of alkalis including ammonium hydroxide on *in vitro* digestibility of rice straw, with a view to finding a low cost treatment system.

Rice straw variety H4, milled (Christy Norris Laboratory mill) to pass through a 1.0 mm screen was treated with sodium hydroxide, sodium carbonate, equal parts of sodium hydroxide and sodium carbonate, calcium hydroxide or ammonium hydroxide. Milled straw (100 g) was mixed with the alkali solution (0, 2.0, 4.0, 6.0, 8.0, 10.0, 12.0, or 14.0 g alkali in 120 or 200 ml water) in a domestic food mixer; the alkali being added as a fine jet from a 20 ml syringe over a five minute period and mixing continued for a further five minutes.

Four to six hours after treatment, the treated material was dried in an oven at 98°C for six hours and from these quadruplicate samples containing 0.5 g straw dry matter were weighed into 100 ml polypropylene centrifuge tubes for subsequent *in vitro* digestion by the method of Tilley and Terry.[10] Rumen liquor for *in vitro* digestion was obtained from four fistulated wether sheep of 25 kg average live weight receiving a standard diet of 400 g hay and 100 g concentrate mixture. Fistulated sheep also had access to *ad libitum* mineral mixture and drinking water.

In view of the low crude protein content of rice straw (4% to 5% in dry matter) 1.0 ml of 1.0N ammonium sulphate was added to each centrifuge tube at the time of innoculation with rumen liquor.

The effect of alkalis at different dilutions on the *in vitro* organic matter digestibility (IVOMD) of rice straw is shown in Figure 1. Sodium hydroxide was clearly the most effective alkali for rice straw. This confirms the work reported elsewhere for many low quality roughages.[3,7]



in vitro o.m. digestibility %
g NaOH / 100 g straw
in vitro o.m. digestibility %
g NH_4OH / 100 g straw
in vitro o.m. digestibility %
g Na_2CO_3 / 100 g straw
in vitro o.m. digestibility %
g $Ca(OH)_2$ / 100 g straw
in vitro o.m. digestibility %
g NaOH : Na_2CO_3 / 100 g straw
(equal parts)

Figure 1.

Sodium carbonate alone was less effective than pure sodium hydroxide. But unlike the findings of Chandra and Jackson[1] for ground maize cobs, the mixture of equal parts of sodium hydroxide and sodium carbonate did not improve the organic matter digestibility of rice straw any further than pure sodium carbonate. This could have been due to the nature of the substrate as different substrates may require specific treatments.[9]

Similar to the work reported elsewhere[2,11] calcium hydroxide appeared to have no effect on the organic matter digestibility of rice straw. This was probably because of its low solubility since Gharib *et al*,[2] found that when calcium hydroxide treated material was allowed to stand for 150 days, its digestibility increased as much as the material treated with sodium hydroxide. This could be of significance when developing techniques for ensiling alkali treated straws.

In recent years, ammonium hydroxide has attracted much attention for the treatment of roughages because of the added advantage of increased nitrogen content of the treated material. However as recorded by Waiss *et al*[13] ammonium hydroxide was much less effective than sodium hydroxide in increasing the digestibility of straw. The poor response to ammonium hydroxide could have been due to the 'open treatment' practiced as a closed reaction vessel may probably be essential to obtain maximum effectiveness.[3]

With all alkalis, the dilution rate examined showed no significant influence of digestibility. As reported earlier[4,6] there appears to be no benefit in increasing the volume of solution beyond 120 ml per 100 g straw.

Sodium hydroxide was the most effective alkali for improving the nutritive value of rice straw. The diminishing digestibility response with increasing level of sodium hydroxide from 4 to 8 g/100 g straw is in general agreement with work that has been reported earlier.[6,8] As suggested by Jayasuriya,[4] 4 to 6 g sodium hydroxide per 100 g straw appears to be the most effective dosage for treating rice straw. However in view of the high cost of sodium hydroxide, more effective methods of treatment will have to be developed if alkali treated straw is to be of benefit to the ordinary farmer. This aspect should receive high priority in future research.

Acknowledgements

Financial assistance from the National Science Council of Sri Lanka is gratefully acknowledged.

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