SINET: Ethiop. J. Sci., 21(1):145–151, 1998

ISSN: 0379–2897

Short communication

THE NUTRITIVE VALUE OF TEF STRAW AND ITS RESPONSE TO CHEMICAL TREATMENT WITH ALKALI

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ABSTRACT: The nutritional characters of tef straw from Awassa Woreda were studied by both chemical and biological means. Relative to some common roughages, tef straw is of lower crude fibre (32.1%) but higher soluble carbohydrates (59.5%) value. Its crude protein content (2.92%) is however very low. The adequacy of its major and trace minerals is controversial. In a feeding trial with diets containing tef straw, untreated tef straw was poorly consumed by lambs. Alkali treatment was effective in improving its palatability and in enhancing the efficiency of utilization of the ration for growth. The impact of alkali treatment of tef straw on the digestibility of the dry and organic matter of the ration was insignificant.

Key words/phrases: Composition, digestibility, growth, palatability, tef straw

INTRODUCTION

Tef [*Eragrostis tef* (Zucc.) Trotter] ranks first as a staple dietary cereal in Ethiopia. It is rich in vitamins, iron and calcium and provides most of the protein in the common Ethiopian diet (Mosi, 1981). It is cultivated on altitudes ranging from 300-2800 m and requires a high rate of rainfall at the early stage of growth. The mean grain yield per hectare is about 7,800 kgs and the amount of the straw according to Mosi (1981) is estimated to be about twice this value.

Tef straw is one of the major field crop residues that have great potential to serve as animal feed (IAR, 1974/75). Human food deficiency and the ever increasing population imply that more resources need to be channelled to promote cereal production. It is, therefore, likely that ruminant production will continue to be based on natural grazing and field crop residues. As a result, it has become essential to quantify the nutritive value of crop residues such as tef straw.

The utilization of straws is limited because of the restricted desire of animals to consume them. Intake and utilization of such low quality roughage can, however, improve by chemical treatment with alkali (Hoffman and Weston, 1971). The use of calcium hydroxide in improving the nutritional quality of tef straw was therefore additionally considered in this study.

MATERIALS AND METHODS

Tef straw samples were collected from farms in Awassa following standard sampling procedures. They were thoroughly mixed before a sub-sample of 1 kg was dried in forced draught oven at 105° C till constant weight. The absolute dry sub-sample was ground with a hammer mill to pass through 1 mm sieve. The dry matter (DM), crude fibre (CF), crude fat (EE), protein (CP), total ash, nitrogen free extract (NFE) content and the concentrations of some major and minor minerals of the prepared samples were analyzed as described in AOAC (1980). The accuracy of the values was controlled by running the analyses in duplicates. The nutrient composition of the alkali treated tef straw used in the biological studies was determined in similar manner.

In order to assess the degree of utilization of rations containing untreated and alkali treated tef straw, feeding and digestibility trials were conducted using weather lambs. Two groups of lambs with an average initial body weight of 20.9 ± 0.2 kg (mean $\pm$ standared error) were fed individually with rations containing untreated or alkali treated tef straw and concentrate mix for 16 weeks. Ten animals were assigned to each of the two treatments. Unrestricted but measured amount of tef straw was provided daily. This was supplemented with 600 g concentrate mix given to each animal in two equal halves; at 10:00 a.m. and 4:00 p.m. The concentrate mix consisted of 23% sunflower cake, 50% corn, 22% wheat bran, 3% meat and bone meal, 1% dry alfalfa leaf and 1% salt. The level of daily provision was determined based on the daily dry matter requirement (800 g) of the class of animals used in the experiment and the extent of voluntary tef straw intake (200 g day^{-1}) by lambs observed during a preliminary study. In each stall where a lamb was kept, arrangements were made to ensure easy and free access to fresh water. Daily food consumption by each animal was determined from the difference between the amount provided and the left-over every 24 hrs. Body weight measurement was recorded every two weeks.

Sufficient amount of alkali treated tef straw to feed the lambs till the end of the trial was prepared in advance. For this purpose, slaked lime was dissolved in tap water at the rate of 4 unit per 100 unit of dry tef straw to form the 4% alkali solution (or 4% calcium hydroxide solution). Each batch of tef straw was soaked in the solution for 24 hrs, was drained, rinsed with water and spread for sun drying for about two days. The air dried alkali treated tef straw was finally collected in sisal sacks and stored in a hay shed.

At the end of the feeding trial three lambs from each treatment were restrained in metabolism crates to conduct digestibility trial. After five days of acclimatization to the new environment the same feeding program as used in the feeding trial was continued for additional eight days. Faeces was collected every morning before feed was supplied. The faeces from each animal was weighed and stored frozen at about -20° C. At the end of the trial feed and faeces samples were analyzed for their proximate composition in order to calculate the digestibility coefficient of each nutrient.

RESULTS AND DISCUSSION

The nutrient composition of tef straw (untreated and alkali treated) is presented in Table 1. As compared to wheat and barley straws (Ranjhan, 1980 and Cullison, 1982) tef straw contains less crude fibre. It is in general low in protein and ash. Tef straw is comparable to other roughages in calcium and manganese content; its phosphorus, and copper concentration are relatively higher whereas its magnesium, sodium and iron values are lower (Cullison, 1982). The implication of the mineral composition of tef straw in practical sheep and cattle nutrition is controversial in that it is adequate in all of the minerals according to McDonald *et al.* (1988) and Legel (1990) but adequate only in magnesium, copper, iron and zinc according to Kirchgessner (1987). But it is noted that it is similar with most roughage, even with the ones considered quality, in this respect.

Table 1. Nutrient composition (mean ± SE) of tef straw and the effect of alkali treatment.

Components	Tef straw	
	Untreated	Alkali treated
Dry matter (%)	91.60±0.24	90.50±0.28
Proximate fractions in % DM		
Crude protein	2.92±0.003a	2.15±0.01b
Ether extract	1.80±0.03a	1.30±0.04b
Crude fibre	32.10±0.08a	35.00±0.11b
NFE	59.50	53.90
Ash	6.72±0.05a	7.00±0.09b
Major minerals (g kg^{-1} DM)		
Calcium	3.1	
Phosphorus	2.8	
Magnesium	1.1	
Sodium	1.0	
Potassium	10.6	
Minor minerals (mg kg^{-1} DM)		
Iron	93.0	
Manganese	34.5	
Copper	5.0	
Zinc	62.5	

Different letters in the same row indicate significant differences ($p \leq 0.05$ — t-test). NFE, nitrogen free extract.

Table 2 shows that the average daily concentrate intake by lambs supplied with alkali treated and untreated tef straw hardly differed. The intake of the straw, however, doubled with alkali treatment. As a result, the mean daily total dry matter consumption in the two groups differed significantly ($p \leq 0.05$). Though the influence of alkali on the palatability of straw was as expected it is noted that the voluntary intake of the untreated tef straw by lambs was exceptionally very low. In accordance with dry matter intake, daily body weight gain increased significantly ($p \leq 0.05$) when tef straw was treated with alkali. With alkali treatment of tef straw total dry matter intake increased by 21% and body weight gain by more than 200%. Evidently, there was a marked improvement in the efficiency of nutrient utilization due to alkali treatment. In agreement with this, in a trial where intake was regulated at equal levels and a complete diet containing 25% straw was provided, live weight gain of calves improved substantially when the straw was treated with 5% alkali (Kristensen, 1981). Similarly, in a feeding trial with high concentrate and low straw diet (80:20) Levy *et al.* (1977) reported that energy conversion efficiency improved with alkali treatment of the straw.

Table 2. Feeding and digestibility performance (mean ± SE) of lambs fed with rations containing untreated and alkali treated tef straw.

Parameters	Tef straw	
	Untreated	Alkali treated
Dry matter intake (DMI) g day^{-1}		
Tef straw	125±1.2a	257±5.26b
Concentrate mix	524	528
Total	649	787
Body weight gain (BWG) g day^{-1}	36.9±2.9a	110.8±2.02b
Feed efficiency (DMI/BWG)	17.6	7.1
Ration digestibility (%)		
Dry matter	72.5±1.77	71.5±0.35
Organic matter	70.0±2.90	72.6±2.60
Crude protein	80.5±1.06a	69.3±2.90b
Crude fibre	85.7±1.17	83.6±1.68
Crude fat	37.0±7.80	55.0±5.80
Ash	35.0±3.0	35.0±2.80

Different letters in the same row indicate significant differences ($p \leq 0.05$).

The results of digestibility trial presented in Table 2 indicate that the dry matter and organic matter digestibility of the rations containing tef straw was slightly above 70%. There was, however, no significant ($p \leq 0.05$) effect of alkali treatment in both of the characters. The response to alkali treatment was not positive probably because of the relatively high NFE content of tef straw and also due to unsatisfactory efficiency of $Ca(OH)_2$ in improving digestibility. In agreement with this, Garmo (1981) reported that $Ca(OH)_2$ is less effective than other types of alkali in improving the *in vitro* organic matter digestibility of straws. It is possible to ascribe the unsatisfactory effect of $Ca(OH)_2$ in improving digestibility to its lower rate of reaction. The only marked ($p \leq 0.05$) difference was observed in the digestibility of protein. Though the rational is not very clear, alkali treatment had a negative effect on the digestibility of crude protein. It is, however, possible to attribute the effect to the loss of some soluble proteins and the binding of some of the residual protein with the fibre of the alkali treated tef straw.

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