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The Utilization of Nitrogen from Spent Tea Leaf and Urea by Sheep fed Alkali Treated Rice Straw as the Sole Source of Roughage

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Abstract: A feeding trial with crossbred sheep, to investigate the usefulness of spent tea leaf (STL) as a source of protein for sodium hydroxide treated rice straw is reported. Three concentrate rations prepared by mixing ground maize either with urea (14 g or 18 g per 100 g concentrate) or spent tea leaf (18 g per 100 g concentrate) were compared. Treated straw (4% w/w) was given to appetite as the only source of roughage. The animals on diet containing STL performed equally well as those on urea npn diets although STL containing diet provided only 6% crude protein. This observation points to a possible by-pass nature of STL protein. It also appears to be an excellent source of supplementary protein for sodium hydroxide treated straw-based diets.

1. Introduction.

The usefulness of non-protein nitrogen (npn) compounds in the nutrition of ruminants has been well documented.[1,2,12] Urea, the commonest npn compound of choice has increased the feeding value of both untreated[3], [4] and chemically treated[5,6] poor quality roughages. Urea at 2% level of supplementation has significantly increased the digestibility and voluntary dry matter intake of sodium hydroxide treated rice straw.[8]

Spent tea leaf (STL), the residue from the manufacture of instant tea has 32% crude protein in dry matter. Feeding trials conducted in Sri Lanka have indicated the possibility of incorporating up to 18% STL in the concentrate component of rations of growing calves.[9]

The feeding trial reported in this paper was aimed at investigating the usefulness of STL as a source of protein for ruminants fed sodium hydroxide treated rice straw. An attempt was also made to compare STL protein with urea npn.

2. Materials and Methods.

The apparent digestibility of three diets was determined using growing sheep (Jaffna local x Bikaneri) of average liveweight 22 kg (range 21 kg to 24 kg). Rice straw variety H_4 chopped into 20 to 50 mm lengths, treated with 40 g sodium hydroxide (NaOH) dissolved in 1·2 litres of water per kg of straw as described previously,[7] was given to appetite as the only source of roughage. In addition, three concentrate rations (Table 1) prepared by mixing ground maize either with urea (14 g or 18 g per 100 g maize) or spent tea leaf (18 g per 100 g maize) was given at the rate of 100 g per animal per day.

Table 1 – Composition of concentrate rations used in the feeding trial.

	Ration Number		
	R–1	R–2	R–3
Amount of ground maize (g)	100·0	100·0	100·0
Amount of urea added to ground maize (g/100g)	14·0	18·0	–
Amount of spent tea leaf added to maize (g/100g)	–		18·0
Dry matter (g/100g)	89·3	88·3	90·3
Ash (g/100g dry matter)	2·9	3·3	8·5
Crude protein (g/100g dry matter)	29·8	55·6	15·5

Table 2 – The average chemical composition of treated straw, spent tea leaf and ground maize.

	treated straw	ground maize	spent tea leaf
Dry matter (g/100g)	92·4	89·8	91·8
Composition of dry matter (g/100 g dry matter) Ash	17·4	1·9	3·9
Crude protein	3·8	9·6	32·0
Crude fibre	30·8	2·3	13·4

Three animals were used for each treatment. They were housed individually in metabolism crates designed to enable the separate collection of faeces and urine. The feeding period was of 20 days duration, the first 12 days to allow for adjustment to the rations with voluntary intake and digestibility measured over the last 8 days. Voluntary intake was measured by feeding in amounts 10% greater than the previous day's intake, and determining the actual intake by daily weighing of refused feed. Water and a standard mineral mixture were freely available to all animals throughout the experiment.

Samples of concentrate, treated straw and faeces were stored for subsequent analysis for moisture, ash, crude fibre, and crude protein by conventional methods. Urine was collected daily in plastic buckets containg 16 ml of 1 N hydrochloric acid; the volume determined a 2% aliquot was refrigerated for subsequent nitrogen determination.

3. Results and Discussion.

The average chemical composition of treated straw, ground maize and STL used in the feeding trial is shown in Table 2. Spent tea leaf used in concentrate ration R–3 had a dry matter content of 91.8% and a crude protein content of 32.0% on dry basis. The quantity of STL used in the ration was restricted to 18 g per 100 g concentrate as this level had been found to be the most suitable for growing calves in a previous study.[9]

The present observations are in general agreement with earlier reports on the influence of non-protein nitrogen supplementation on apparent digestibility of alkali treated straw.[8] Urea intake up to 2% to 3% of the total dry matter consumed increased the estimated [11] metabolizable energy value of straw to 7.5 MJ/kg dry matter, making the treated straw equivalent to a medium quality hay.

Table 3 – Intake and apparent digestibility of dietary constituents

	concentrate ration number			SE of difference between means
	R – 1	R – 2	R – 3	
Crude protein content of total diet (g/100 g DM consumed)	9·44	12·27	6·04	–
Estimated ME content of straw[1] (MJ/kg DM)	7·75	7·74	7·61	–
Intake of urea (%) (intake as a % of total DM consumed)	2·83	2·97	..	–
Digestibility of dietary constituents (%)				
Dry matter (DMD)	62·0	61·5	61·6	0·64
Organic matter (OMD)	68·9	68·1	67·2	0·70
Digestible organic matter in dry matter (DOMD)	58·7	57·7	56·7	0·70
Derived digestibility of straw[2] organic matter	64·7	64·6	64·3	–
Intake				
Ad libitum intake of straw dry matter				
g/animal/day	465·5	517·0	489·1	66·13
g/Kg W 0·75/ day	48·9	54·3	51·4	6·94
N balance (g/day)	+0·99	+6·32	+1·83	–

1· Metabolizable energy estimated as DOMD X O·145 [11]

2· Concentrate organic matter digestibility assumed to be 85%

The addition of 18% STL to concentrate ration R–3 increased the crude protein content of the total diet only marginally to 6·0%, yet its influence on the apparent digestibility and voluntary intake of straw dry matter was comparable to the treatment R–2 having a crude protein equivalent of 12.3% (Table 3) Furthermore, at 6% level of crude protein this diet was able to bring about a positive nitrogen balance which in fact was twice as much as the 14% urea supplemented diet. These observations suggest a possible by - pass nature of the

STL protein. It is possible that the polyphenols present in STL[9] may be acting as a chemical agent in reducing microbial degradation of STL protein in the rumen, thereby making the valuable aminoacids available in the abomasum and lower digestive tract. Since the first draft of this paper was written, we have confirmed in our laboratory that the STL protein has a very low rumen solubility compared to many standard protein concentrates (example: 12% compared to 50% in the case of coconut oil meal at 8 hours of fermentation) and that the by- pass protein from STL is about 80% digestible in the lower digestive tract.

It has been established that concentrate rations prepared with up to 18% STL are highly acceptable and safe to growing calves fed forage diets.[9] A recent trial has also shown that up to 20% STL can be included in the concentrate component of dairy cattle rations without harmful effects.[8] Since supplementation of low protein feeds based on roughage with a form of by-pass protein increases feed intake and improves feed conversion ratio (kg feed intake/kg gain) of ruminants,[10] STL could become an excellent source of protein for poor quality roughage based diets, especially alkali treated straw diets.

Further research is however required to evaluate the quality of STL protein for ruminants.

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