OVERCOMING THE NUTRITIONAL LIMITATIONS OF RICE STRAW FOR RUMINANTS

2. RESPONSE OF GROWING SAHIWAL AND LOCAL CROSS HEIFERS TO UREA UPGRADED AND UREA SUPPLEMENTED STRAW

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Summary

Thirty-six heifers of three different breeds were fed rice straw, either upgraded with 4% urea, or supplemented with 2% urea, sprayed on the straw just prior to feeding. The effects on liveweight gain and dry matter intake were measured for pure Sahiwal heifers, Sahiwal x local crosses and Jersey x local crosses. Urea upgraded straw gave better growth than urea supplemented straw, average 217 g/day/animal versus 71 g/day/animal. This was associated with a higher intake of upgraded straw, compared to supplementation straw (2.4 versus 1.8 kg/100 kg BW). No overall breed effect on growth was found ($P > 0.05$).

(Key Words: Rice Straw, Urea Supplementation, Sahiwals, Growing Heifers)

Introduction

Rice straw is a major feed resource for ruminants in many tropical countries, especially during the dry season. Despite frequently occurring shortages of roughage in Sri Lanka the straw is often burned in the field for disposal. Straw contains too little digestible energy and protein to sustain even maintenance of animals (O'Donovan, 1983).

There are two ways to overcome this deficiency of nutrients. The first method is to upgrade the straw through treatment with urea which is converted into ammonia (Ibrahim, 1983; Perdok et al., 1982). Alternatively, the deficient nutrients may be provided as supplements, like concentrates, urea or immature green forages (Creek et al., 1984, Ghebrehiwet et al., 1988).

In this experiment, the effect of urea upgrading versus supplementation with urea(sprayed on straw) on liveweight gain and intake was studied for heifers of three different breeds.

Materials and Methods

Treatments

Rice straw supplemented with 2% urea, which was sprayed on the straw just prior to feeding, was compared with rice straw upgraded with 4% urea under airtight conditions. Each ration was fed to six growing heifers of three different breeds, i.e. Sahiwal, Sahiwal x Local cross and Jersey x Local cross. This resulted in six groups of six animals each, 12 of each breed.

The 12 pure Sahiwals varied in age from 11 to 29 months and in weight from 90 to 200 kg liveweight. The 12 Sahiwal crosses and 12 Jersey crosses were about one year old and varied in weight from 60 to 90 kg. The three groups came from different farms within the Coconut Triangle in Sri Lanka. The 12 animals of each breed were allotted homogeneously in regard to body weight to two ration groups over two stables. The animals were housed back to back in open two-row sheds.

Feeds and feeding

The basal feed was rice straw, obtained from village farmers and fed unchopped. The straw was either supplemented(sprayed) or upgraded with urea.

The urea supplement was given to the animals by adding a 2% solution of urea to the straw just prior to feeding without allowing time for reactions between urea and the straw. After putting

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straw in the feed trough, it was sprayed with 100 ℓ urea solution / 100 kg airdry straw, resulting in 2.0 kg urea / 100 kg airdry straw.

The upgraded straw was produced by addition of 4 kg urea in 100 ℓ water to 100 kg airdry straw allowed to react for 9-11 days in a concrete pit sealed with polythene(Schiere et al., 1988). The straw was mixed with the urea solution in the pit itself using watering cans. After nine days, the upgraded straw was fed over the next three days. On the 12th day, a new lot of upgraded straw was started that had been made on the fourth day.

Straw was fed *ad libitum*, keeping the feed troughs full day and night and removing refusals every morning. In addition to the experimental rations, all animals were fed 1 kg of fresh grass (cut in the field irrespective of maturity). The grass (unchopped) was offered on top of the straw in the feed troughs. Also given was a daily supplement of 0.5 kg local rice bran, and 20 g sodium sulphate, 10 g di-calcium phosphate and 30 g mineral mix. The animals had free access to drinking water.

Measurements

The experiment lasted for 11 weeks, consisting of a three week adaptation period and a eight week measurement period. Body weights were determined before feeding at weekly intervals using a cattle scale. Dry matter intake(DMI) of the animals was estimated for each group of three animals, by weighing feed offered and feed refused during five days, so for each ration group there were two observations. Samples of feed offered and refused were taken and analyzed for dry matter at Peradeniya University. Due to distance and logistical problems, the analyses were not carried out immediately, so dry matter contents may have been overestimated.

Statistical analysis

Liveweight gain and dry matter intake were analyzed using three-way analysis of variance (Snedecor and Cochran, 1980), with type of straw (upgraded, supplemented), breed (Sahiwal, Sahiwal x Local and Jersey x Local) and stable (1,2) as main effects. Mean rate of liveweight gain(LWG) was calculated by means of linear regression analysis(Snedecor and Cochran, 1980).

Results and Discussion

Liveweight gain and dry matter intake of animals on urea upgraded straw were significantly ($P < 0.01$) higher than on urea supplemented straw(see table 1).. On an average, the animals on upgraded straw grew 217 $g.d^{-1}$ versus 71 $g.d^{-1}$ for the animals on supplemented straw. The straw intakes were 2.4 and 1.8 kg/100 kg BW, respectively. The stable effect and the effect of initial weight(as a covariable) were not significant($P > 0.05$).

The difference in DMI and LWG between urea upgraded and supplemented straw as found in this experiment agrees with an experiment of A. de Rond and colleages (unpublished data), who

TABLE 1. EFFECT OF BREED AND TYPE OF STRAW ON LIVEWEIGHT GAIN AND INTAKE OF HEIFERS RECEIVING UREA UPGRADED RICE STRAW OR RICE STRAW, SUPPLEMENTED WITH 2% UREA[1]

	Sahiwal		Sahiwal x Local		Jersey x Local	
	Upgraded	Supplementd	Upgraded	Supplemented	Upgraded	Supplemented
Liveweight gain (g/day)	282^{a}	105^{bc}	185^{b}	70^{c}	183^{b}	39^{c}
Dry matter intake(kg/100 kg BW)[2]						
Straw	2.33^{a}	1.89^{b}	2.49^{a}	1.83^{b}	2.59^{a}	1.70^{b}
Grass	0.13	0.14	0.25	0.26	0.22	0.25
Rice bran	0.29	0.31	0.54	0.56	0.48	0.54
Total	2.75	2.34	3.27	2.65	3.30	2.49

[1] a,b,c: Values with the same superscripts are not significantly different ($p > 0.05$).
[2] Estimated.

showed that results are dependent on the level of urea used. They compared untreated straw with urea upgraded and urea supplemented straw, using 2%, 4% and 6% urea solutions. At the two highest levels (4% and 6%) a significant difference in dry matter intake resulted between upgraded and supplemented straw, while intakes were almost equal at a level of 2% urea. As optimum treatment levels they found 2% urea when supplied as a supplement and 4% urea when upgrading straw. The nutritional superiority of upgraded straw (4% urea) over supplemented straw (2% urea) was also shown by van der Hoek et al.(1989) who found a higher milk and butterfat production, as well as less liveweight loss of lactating Surti buffaloes, when fed the upgraded straw. The higher growth rate on upgraded straw was associated with a higher intake of urea upgraded straw compared with the urea supplemented straw, as also shown by Jaiswal et al.(1983) Karunaratne and Jayasuriya(1984) and Perdok et al.(1984). It might also be caused by the fact that upgraded straw has a higher dry matter digestibility(Hossain and Rahman, 1981; Karunaratne and Jayasuriya, 1984), and a crude protein content exceeding 7 % (Schiere and Ibrahim, 1985), compared with 4 % in untreated straw (Doyle et al., 1986) and intermediate content in straw supplemented with 2 % urea. Jayasuriya and Perera(1983) even found crude protein contents of upgraded straw as high as 11-13% in the dry matter, of samples that had not been ovendried before crude protein determination. By ovendrying part of the urea is lost in the form of gaseous ammonia, which underestimates the actual crude protein content of fresh upgraded straw.

Doyle et al.(1986) reported an experiment with sheep, which attempted to partition the benefit of upgrading into that caused by the higher nitrogen content and by the chemical reaction of ammonia with cell wall components. Urea supplementation of untreated straw at a rate of 1.2% of dry matter intake increased intake of digestible organic matter from 270 to 430 $g.d^{-1}$, while upgrading with urea resulted in an intake of 480gd^{-1}. The intakes of nitrogen on both rations were equal (12 $g.d^{-1}$). They concluded, that appropriate supplementation with urea, under ideal conditions, accounted for 75 % of the increase in nutritive value of straw by the treatment reaction *per se* (Doyle et al., 1986).

No overall effects of breed on liveweight gain and dry matter intake were found ($P > 0.05$). Breed straw type interactions were not found either ($P > 0.05$), although liveweight gain of pure Sahiwals on upgraded straw was higher ($P < 0.05$) than liveweight gain of both crosses on upgraded straw (table 1). The better growth of Sahiwals may be due to a different growth stage or life history of the crosses. Confounding of breed effect and life history/origin of the animals is possible, since the three groups came from different farms.

Whether treatment is economically justified depends on beef prices and cost of inputs. Also important are the hidden benefits of urea upgraded straw, like better health and probably younger age of first calving. The economical evaluation of urea upgraded straw as a cattle feed has been elaborated by Nell et al.(1986) and Schiere et al.(1988).

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