Iranian Journal of Applied Animal Science

Utilization of Urea and Urease Treated Rice Straw by Indigenous Growing Cattle

Research Article

M. Akter[1*], M. Asaduzzaman[2], M.M. Hossain[1] and L. Asad[1]

[1] Department of Animal Nutrition, Genetics and Breeding, Faculty of Animal Science and Veterinary Medicine, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh
[2] Department of Dairy Science, Faculty of Animal Science and Veterinary Medicine, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh

Received on: 27 Sep 2014
Revised on: 15 Jan 2015
Accepted on: 31 Jan 2015
Online Published on: Sep 2015

*Correspondence E-mail: mofassara2012akter@gmail.com

Online version is available on: www.ijas.ir

ABSTRACT

The experiment was conducted to study the effect of treatment of rice straw with urea and a urease containing midden soil on the chemical composition of treated rice straw, feed intake of the animals, nutrients digestibility, body weight gain, feed conversion efficiency and overall economy of feeding for a period of 105 days. Twelve indigenous growing cattle (live weight 130.00±1.67 kg) were selected and divided into four groups having three animals in each group. The animals received 3.0% urea + 2.0% midden soil treated rice straw (group A), 3.0% urea + 3.0% midden soil treated rice straw (group B), 3.0% urea + 4.0% midden soil treated rice straw (group C) and 3.0% urea + 5.0% midden soil treated rice straw (group D). In addition, all the animals were supplied with 2 kg green grass, 450 g concentrate mixture and 40 g salt per 100 kg body weight. Treatment of rice straw with 3.0% urea+ 2.0% midden soil lead to an increase in crude protein content from 3.30 to 7.08%, which was further increased by 7.40, 7.90 and 8.14% if treated with 3.0% urea + 3.0% midden soil, 3.0% urea + 4.0% midden soil and 3.0% urea + 5.0% midden soil, respectively. The total live weight gain by the end of the experimental period (105 days) was 39.00, 42.50, 46.50 and 49.00 kg for groups A, B, C and D respectively. The addition of 5.0% midden soil as a urease source with 3.0% urea (D) treated rice straw not only significantly (P<0.01) increased the coefficient of digestibility of dry matter (DM), crude protein (CP), crude fibre (CF), ether extracts (EE) and nitrogen free extract (NFE), but also significantly (P<0.05) increased the coefficient of digestibility of (OM) compared to treatment of rice straw with 3.0% urea + 4.0% midden soil (C), 3.0% urea + 3.0% midden soil (B) or 3.0% urea + 2.0% midden soil (A). Digestible organic matter (DOM), digestible crude protein (DCP), digestible crude fibre (DCF), digestible nitrogen free extract (DNFE) and total digestible nutrients (TDN) contents were significantly (P<0.01) higher in diet D, compared to diets A, B and C. Total profit of meat production in group D was significantly higher (P<0.01) than in groups A, B and C.

KEY WORDS indigenous growing cattle, midden soil, rice straw, urea and urease.

INTRODUCTION

Total Livestock population in Bangladesh is estimated as 24.0 million cattle, 0.83 million buffaloes, 34 million goats, 1.10 million sheep (FAO, 2009). These large populations are providing animal protein in the form of meat and milk to mitigate protein deficiency of the nation. However, the productivity of these animals is very low due to the shortage of feeds in both quantity as well as quality. Rice straw is one of the major sources of roughages for ruminants in the tropics (Wanapat *et al.* 2009). But rice straw has a very low content in fermentable carbohydrate, along with low protein, unbalanced mineral and vitamin content while it's high in cellulose, hemicellulose and lignin and silica content results in low voluntary intake and low digestibility of nutrients therefore limiting the ruminal microbial functions. Treatment with nitrogen sources, whether the chemical or physical treatment, may improve the utilization of low quality roughages (McDonald *et al.* 2002). Urea treatment improves feed intake (Mahr-un-Nisa *et al.* 2004), digestibility of organic matter (Dolberg *et al.* 1981) and protein content of treated straw (Doyle *et al.* 1986). Urea treatment requires 3-4 weeks for proper hydrolysis of urea, which is time consuming. Jayasuriya and Pearce (1983) reported that treatment time could be successfully reduced from 2-3 weeks to 5 days by incorporating a source for urease enzyme at the time of application of the urea solution. Addition of urease has been reported to hasten the process of conversion of urea into ammonia (Munoze *et al.* 1991). In general urease enzyme catalyses the initial hydrolysis of urea to ammonium carbonates which decomposes to release ammonium ions (NH^{+}_{4}). Midden soil is a good source of urease enzyme, which is found in lower part of the cowdung pit, useable to the farmers at free of cost. The research work was undertaken to assess the upgrade of the nutritive value of rice straw by process of treating with urea and urease containing midden soil and its effects on growth performance of indigenous growing cattle.

MATERIALS AND METHODS

Collection of feed ingredients and processing

Rice straw was purchased from a local farmer for the experimental purpose. Rice polish, mustard oil cake, dicalcium phosphate and salt were purchased from a local market. Green grasses were cultivated in the fodder plot. Rice straw was chopped at a particle size of 4 to 6 cm prior to treatment. Midden soil was collected from different sides of the cowdung pit, mixed properly, dried in the sun; the composite sample was ground by an automatic grinder and preserved. Mustard oil cake was also ground with the help of a mechanical grinder. Commercial fertilizer grade granulated urea (NH_2-CO-NH_2, 43% N) was purchased prior to treatment.

Treatment of rice straw

Ten (10) kg of rice straw was spreaded on a clean concrete floor. Then commercial urea at the rate of 3.0% (on straw DM basis) was dissolved in 10 litres of water. The urea solution was sprayed throughout the chopped straw with a hand garden sprayer and the straw was mixed properly to achieve uniform wetting by the hand. Thereafter, finely ground midden soil was hand-sprayed to straw according to treatments (2.0%, 3.0%, 4.0% and 5.0% respectively in treatments A; B, C and D) and mixed manually as evenly as possible.

In this way, the total quantity of straw was mixed with urea solution and midden soil. Treated straw were kept into a silo pit, squeezed sufficiently to expel excess air and covered by double layer polythene sheet to ensure anaerobic condition. This preserved straw was kept for 7 days before feeding to the animals of group A.

Experimental design and dietary treatments

Twelve indigenous growing cattle with an average body weight of 130.00 ± 1.67 kg were selected for this study following randomized block design (RBD). The animals of group A received 3.0% urea + 2.0% midden soil treated ensiled straw, group B received 3.0% urea + 3.0% midden soil treated ensiled straw, group C received 3.0% urea + 4.0% midden soil treated ensiled straw and group D received 3.0% urea + 5.0% midden soil treated ensiled straw. Animals were supplied with treated rice straw *ad libitum*, 2 kg green grass and 450 g of concentrate mixture (where rice polish and mustard oil cake were mixed in 1:1 ratio) per 100 kg live weight of animal; dicalcium phosphate was given at 10 g / 100 kg body weight. Salt was supplied to the animal at 40 g / 100 kg body weight per day. The ration was adjusted weekly with the increase of body weight of the animals.

Management of animals

Experimented animals were housed in a clean, hygienic and well-ventilated face out stanchion barn. Animals were cleaned and served bath regularly and proper care was taken to prevent injuries or diseases. The experimental diet was supplied to all the animals twice daily and the left over was weighed in the following morning before offering feed. The animals were weighed individually at the beginning of the experiment for three consecutive days and the average weight was taken as the initial body weight; the animals were also weighed weekly prior to feeding through out the experimental period of 105 days.

Metabolic trial

At the middle of the feeding trial, a conventional metabolic assay was conducted for a period of 7 days to know the digestibility of feed nutrients and balance of nitrogen. During the trial period daily feed intake, faeces voided and urine excreted were recorded individually. From the daily ration of the different animal´ groups a sub samples of feed was also collected regularly for the analysis of proximate components. About 10% of the every day well mixed faeces of each animal were collected, sun dried and stored in polythene bags. At the end of the collection period the sun dried faeces were composite together and then ground in 1 mm sieve, which was used for the analysis of proximate components, except for two components (DM and CP) that were determined from fresh faeces. Total amount of urine excreted by each animal was collected and 10% sample was kept in the plastic labeled bottle and preserved in a refrigerator for N determination.

Chemical analysis

Chemical analysis for crude protein (CP), crude fiber (CF), ether extract (EE), Ash and nitrogen free extract (NFE) were done with the correspondents samples of feed, left-over and faeces, following the AOAC (2004).

Statistical analysis

Data were analyzed using the "MSTAT" statistical programme to compute analysis of variation (ANOVA) for a randomized block design (RBD) and the mean values with standard error deviation (SED) were recorded. The Duncan's multiple range test (DMRT) was also done for different parameter to compare the treatment means.

RESULTS AND DISCUSSION

Chemical composition of feed ingredients

The initial rice straw content in crude protein was 3.30%; it was increased into 7.08% by treatment with 3.0% urea + 2.0% midden soil (ensiled) and to 7.40% with 3.0 %urea + 3.0 % midden soil treated rice straw (ensiled) (Table 1). The value was further increased by addition of 4.0% or 5% midden soil at the time of urea addition, into 7.90% and 8.14% respectively. Khan *et al.* (1999) describes the increased in the rate of urea hydrolysis and crude protein content of treated straw with the addition of urease sources. Untreated rice straw contains 36.10% CF, which was decreased by treatment with 3.0% urea with 2.0% midden soil (34.90%). The value has been further decreased by addition of the urease source to 33.80% with addition of 3.0% midden soil (B), to 33.60% with the addition of 4.0% midden soil (C) and to 32.80% with the addition of 5.0% midden soil (D). These results showed that the inclusion of increased level of midden soil with urea treated rice straw reduced the CF content.

According to Goto (1995) addition of urease at the time of urea (ammonia) treatment act on roughages by cleaving ester linkages between cell wall polymers. The use of 2.0, 3.0, 4.0 and 5.0% midden soil as a source of urease enzyme in urea treated rice straw helped to reduce the CF% in experimental diets A, B, C and D, by increasing cell wall porosity, making polysaccharides more available to enzymatic hydrolysis. The ether extract (EE) content was higher in 3.0% urea + 4.0% midden soil (2.10%) and 3.0% urea + 5.0% midden soil (2.20%) treated straw, against 1.25% of the untreated rice straw because additives used in urea treated rice straw contains high EE.

Untreated rice straw contained 44.33% NFE, while its content was lower in groups A, B, C and D (40.94%, 41.66%, 41.28% and 41.71%, respectively). Rice straw content in ashes was lower (15.02%) compared to treated rice straws: 15.06%, 15.09%, 15.12% and 15.15% in the treatments with 3.0% urea + 2.0% midden soil, 3.0% urea + 3.0% midden soil, 3.0% urea + 4.0% midden soil and 3.0% urea + 5.0% midden soil, respectively.

Feed and nutrient Intake

In the 105 days of the experimental period, the total feed (DM basis) consumption by growing bull calves was 413.75, 424.00, 430.13 and 432.13 kg for diet A, diet B, diet C and diet D respectively (Table 2). Animal receiving 3.0%, 4.0% and 5.0% midden soil as a source of urease with urea (Groups B, C and D) consumed more total DM than group A (2.0% midden soil). The DM intake was significant different (P<0.01) among the groups. DM intake per 100 kg live weight was 3.08, 3.12, 3.15 and 3.20 kg for treatment gropus A, B, C and D respectively. Khan *et al.* (1999) also reported a 14.2% higher DM intake in urea + soybean treated straw compared with untreated rice straw. The total CP intake in the experimental period in groups A, B, C and D was respectively 33.50, 34.62, 35.83 and 37.11 kg (Table 2). The total CP intake in D group animals was significantly higher (P<0.01) than for those receiving the diet A, B or C, suggesting that CP intake increased with the addition of increased level of urease enzyme (midden soil). Likewise, Narayan *et al.* (2004) found a higher CP intake in urea treated straw diets. The total organic matter intake by the animals in groups A, B, C and D was 289.07, 295.43, 298.82 and 306.19 kg respectively; the differences among groups were statistically significant (P<0.01).

Live weight gain and feed conversion efficiency

The experiment was conducted for 105 days to observe the growth performance of the animal because the age of the animal was about 1.0-1.5 year and the health condition of the animal was good. No disease was diagnosed during the experimental period. The total live weight gain for bull calves fed diets A, B, C and D was 39.00, 42.50, 46.50 and 49.00 kg, respectively (Table 2). The live weight gain of animals was significantly different between the groups (P<0.01). Average daily live weight gains differed significantly (P<0.01) in animals fed different diets: respectively 0.372, 0.405, 0.443 and 0.467 kg for the diet A, B, C and D. Similar findings were reported by Nguyen-Xuan-Trach (2004) who found a faster live weight gain in cattle fed on urea treated straw compared to those raised on untreated straw. The feed conversion efficiency in diets A, B, C and D was 10.60, 9.97, 9.25 and 8.81 respectively, the differences being highly significant among the groups (P<0.01).

Table 1 Chemical composition of diets and feed ingredients (g/100 g DM)

Feed Ingredients	DM g/100 g	Composition (g/100 g DM)					
		OM	CP	CF	EE	NFE	Ash
Rice straw	88.70	84.98	3.30	36.10	1.25	44.33	15.02
3.0% urea + 2.0% midden soil treated rice straw (ensiling)	47.93	84.94	7.08	34.90	2.02	40.94	15.06
3.0 %urea + 3.0 % midden soil treated rice straw (ensiling)	48.27	84.91	7.40	33.80	2.05	41.66	15.09
3.0% urea + 4.0 % midden soil treated straw (ensiling)	48.28	84.88	7.90	33.60	2.10	41.28	15.12
3.0% urea + 5.0% midden soil treated straw (ensiling)	48.45	84.85	8.14	32.80	2.20	41.71	15.15
Green grass	20.75	88.26	9.28	30.40	2.20	46.38	11.74
Concentrate mixture	91.73	87.29	17.15	9.16	11.89	49.09	12.71
Urea	96.12	-	264.00	-	-	-	-
Midden soil	89.97	-	2.78	-	-	-	59.39

OM: organic matter; CP: crude protein; CF: crude fibre; EE: ether extracts and NFE: nitrogen free extract.

Table 2 Feed and nutrient intake and growth performance of growing cattle fed different experimental diets

Parameters	Diets				SED	Level of significance
	A	B	C	D		
Initial live weight (kg)	130.00	131.67	130.83	129.00	4.57	NS
Final live weight (kg)	169.00^{c}	174.17^{b}	177.33^{ab}	178.00^{a}	5.07	**
Total live weight gain (kg)	39.00^{c}	42.50b^{c}	46.50^{ab}	49.00^{a}	1.22	**
Daily live weight gain (kg)	0.372^{c}	0.405^{bc}	0.443^{ab}	0.467^{a}	0.01	**
Total DM intake (kg)	413.75^{b}	424.0^{ab}	430.13^{a}	432.13^{a}	5.13	**
Average DM intake (kg/d)	3.94^{b}	4.04^{ab}	4.10^{ab}	4.12^{a}	0.05	*
Daily DM intake (kg/100 kg BW)	3.08^{c}	3.12^{b}	3.15^{b}	3.20^{a}	0.08	**
Total CP intake (kg)	33.50^{c}	34.62^{bc}	35.83^{ab}	37.11^{a}	0.59	**
Average CP intake (kg/d)	0.32^{b}	0.33^{ab}	0.34^{ab}	0.35^{a}	0.01	*
Total OM intake (kg)	289.07^{d}	295.43^{c}	298.82^{b}	306.19^{a}	7.73	**
Average OM intake (kg/d)	2.75	2.81	2.85	2.92	0.07	NS
Feed conversion efficiency (kg DMI/kg LWG)	10.60^{a}	9.97^{b}	9.25^{c}	8.81^{c}	0.21	**
Protein conversion efficiency (kg CP/kg LWG)	0.86^{a}	0.82^{ab}	0.77^{b}	0.75^{b}	0.01	**

A: 3.0% urea + 2.0% midden soil treated rice straw (ensiled); B: 3.0% urea + 3.0% midden soil treated rice straw (ensiled); C: 3.0% urea + 4.0% midden soil treated straw (ensiled) and D: 3.0% urea + 5.0% midden soil treated straw (ensiled).
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SED: standard error deviation and NS: non significant.
* (P<0.05) and ** (P<0.01).
DMI: dry matter intake; OM: organic matter; CP: crude protein and LWG: live weight gain.

Moreover, the results indicated that feed conversion efficiency was increased by the addition of 4.0% midden soil (C) and 5.0% midden soil (D) with 3.0% urea treated rice straw. Animals receiving C and D diet were more efficient in converting feed into live weight gain; this might be due to the higher digestibility of nutrients and nutritive values of diets in group C and D animals by the addition of higher doses of urease enzyme source (midden soil) at the time of straw treatment with urea.

Apparent digestibility of nutrients and nutritive values

The apparent digestibility of different nutrients and nutritive values are shown in Table 3. The DM digestibility in the diet D (68.73%) was significantly higher (P<0.01) in comparison to that of diet C (66.46%), diet B (65.16%) or diet A (62.47%). Bae *et al.* (1988) also found higher DM digestibilities in cattle fed rice straw supplemented with soya-urease than in the untreated control group. The organic matter (OM) digestibility in diet C and D was significantly higher (P<0.05) than in diets A or B.

This may be associated to the ability of the midden soil urease enzyme to accelerate the release of ammonia from urea and therefore increased the availability of organic matter. Wanapat *et al.* (1984) observed that the OM digestibility of barley straw increased from 52.0% to 59.0% when small amount of soybean for a source of urease enzyme was added, at time of treatment.

The CP digestibility of the diets was 57.44, 61.63, 63.45 and 64.80% in treatments A, B, C and D respectively; CP digestibility was significantly higher (P<0.01) in group D compared to group A, B and C. Addition of 5.0% midden soil to the urea solution may helped to hydrolyze the urea improving the digestibility by the animals in these groups. Such positive result on CP digestibility support evidences that the associative effects of small quantities of supplement, such as minerals or proteins, enhance rumen fermentation leading to increased intake and digestibility. Significantly higher (P<0.01) CF digestibility was found in diet D (68.29%) compared to diet C (66.11%), B (65.19%) or A (64.02%).

Table 3 Apparent digestibility and nutritive value different diets

Parameters	Diets				SED	Level of significance
	A	B	C	D		
Nutrient digestibility (%)						
Dry matter (DM)	62.47[c]	65.16[b]	66.46[b]	68.73[a]	1.64	**
Organic matter (OM)	50.79[d]	55.48[c]	59.95[b]	61.45[a]	1.20	*
Crude protein (CP)	57.44[c]	61.63[b]	63.45[ab]	64.80[a]	2.37	**
Crude fibre (CF)	64.02[b]	65.19[b]	66.11[ab]	68.29[a]	1.76	**
Ether extract(EE)	70.71[b]	73.25[ab]	74.01[a]	75.00[a]	1.70	**
Nitrogen free extract (NFE)	46.01[c]	48.38[bc]	50.18[ab]	50.70[a]	1.09	**
Nutritive value (%)						
Digestible CP	6.41[b]	6.95[b]	7.26[a]	7.47[a]	0.28	**
Digestible CF	15.89[b]	15.94[ab]	16.12[b]	16.47[a]	0.42	**
Digestible EE	5.45	5.65	5.73	5.83	0.13	NS
Digestible NFE	19.83[c]	20.99[bc]	21.74[ab]	23.05[a]	0.50	**
Digestible OM	47.59[c]	49.55[b]	50.86[b]	52.82[a]	0.80	**
Total digestible nutrients	54.40[c]	56.62[bc]	58.02[ab]	60.11[a]	0.91	**

A: 3.0% urea + 2.0% midden soil treated rice straw (ensiled); B: 3.0% urea + 3.0% midden soil treated rice straw (ensiled); C: 3.0% urea + 4.0% midden soil treated straw (ensiled) and D: 3.0% urea + 5.0% midden soil treated straw (ensiled).
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SED: standard error deviation and NS: non significant.
* (P<0.05) and ** (P<0.01).

This could be due to the positive impact of urease enzyme from midden soil in releasing higher amount of ammonia that by penetrating the cell wall, softens it resulting in an easy access of rumen microbes to CF. The apparent digestibility of EE and NFE in diet D is statistically different (P<0.01) from diet A, B and C.

The DCP contents of the different diets were 6.41, 6.95, 7.26 and 7.47% for diet A, diet B, diet C and diet D respectively.

The variation in DCP content among the treatment groups was highly different (P<0.01). Results also showed that DCP content increased by adding an urease source (such as the midden soil) to urea treated straw based diet. Addition of 4.0% and 5.0% midden soil as an urease source to urea treated straw at the time of treatment helped to improve the digestible crude fibre (DCF) value in group D (16.47%) and group C (16.12%), the difference being statistically significant (P<0.01).

The four groups (A, B, C and D) were statistically different (P<0.01) on regards to DOM: it was 47.59, 49.55, 50.86 and 52.82% respectively.

No differences (P>0.05) among the diets were observed on respect to DEE. Digestible nitrogen free extract (DNFE) in the diets A, B, C and D was 19.83, 20.99, 21.74 and 23.05% respectively, the later being statistically different (P<0.01) from the other groups. Total digestible nutrient (TDN) in group D (60.11%) was significantly higher (P<0.01) than that in groups C (58.02%), B (56.62%) and group A (54.40%). To produce a quicker improvement in the nutritive value of the straw, an exogenous source of urease is necessary in orders to hydrolysis the urea (Khan *et al.* 1999).

Nitrogen balance

The daily nitrogen intake was 46.48, 48.17, 50.23 and 51.97 g for bull calves fed on diets A, B, C and D respectively (Table 4) and differed significantly (P<0.01). The animals fed on diets D showed higher nitrogen intake than the animals fed on diets A, B and C (P<0.01). The average daily faecal nitrogen excretion was 23.06, 21.85, 22.06 and 21.24 g for bull calves fed on diets A, B, C and D respectively. The differences were not significant among the treatment groups (P>0.05), although animals fed on diets B, C and D consumed more nitrogen. The urinary N excretion was significantly different (P<0.01) for bull calves fed on different diets: 5.51, 5.40, 5.15 and 5.18 g respectively for diets A, B, C and D. Animals fed on diet A showed higher urinary nitrogen excretion (P<0.01) compared to animals fed on diets B, C or D, suggesting that the urinary nitrogen excretion was reduced by the additional treatment of increasing levels of midden soil with urea treated rice straw. On Table 4 it is shown that total nitrogen excretion was statistically significant (P<0.01) in animals fed the diet A (28.57 g/d) compared with those on diets B (27.25 g/d), C (27.24 g/d) and D (26.43). However, the differences were not significant between diets B and C (P>0.05). The nitrogen balance for diets A, B, C and D were 17.91, 20.92, 22.98 and 25.54 g/d respectively (Table 4).

All the animals used in the experiment experienced a positive nitrogen balance and the differences among groups were not statistically significant (P>0.05). According to Puri and Gupta (1994), rice straw treated with urea increase the nitrogen balance. Mithalal and Taparia (2007) reported that nitrogen balance was increased with the increase of nitrogen intake in goats.

It had been noted that around one third of the urea-N applied for straw treatment is left after storage and aeration (Chenost and Kayouli, 1997). However, if the treated straw was not aerated after treatment the loss of added N would be much lower.

Economics of feedings animals on different diets

The daily average feed cost per animal was Tk. 28.85, 29.30, 29.83 and 30.00 for diets A, B, C and D, respectively (Table 5).

The feed cost per kg live weight gain in groups A, B, C and D was Tk. 104.59, 97.09, 89.93 and 85.73 respectively. Feed cost for body weight gain was significantly (P<0.01) higher in animals in the groups A and B than in groups C or D.

Feeding animals on different diets was seemed to be economic when the cost of per kg of meat produced was low. From the Table 5, it is evident that feed cost per kg meat production was the highest (Tk. 197.34) for diet A and the lowest (Tk. 169.65 and 161.75) for diets C and D.

Table 4 Nitrogen balance in growing cattle

Parameters	Diets				SED	Level of significance
	A	B	C	D		
Nitrogen intake (g/d)	46.48[c]	48.17[bc]	50.23[ab]	51.97[a]	1.35	**
Fecal N excretion (g/d)	23.06	21.85	22.06	21.24	0.26	NS
Urinary N excretion (g/d)	5.51[a]	5.40[ab]	5.15[c]	5.18[bc]	0.16	**
Total N excretion (g/d)	28.57[a]	27.25 [b]	27.24[b]	26.43[c]	0.31	**
N balance (g/d)	17.91	20.92	22.98	25.54	1.50	NS

A: 3.0% urea + 2.0% midden soil treated rice straw (ensiled); B: 3.0% urea + 3.0% midden soil treated rice straw (ensiled); C: 3.0% urea + 4.0% midden soil treated straw (ensiled) and D: 3.0% urea + 5.0% midden soil treated straw (ensiled).
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SED: standard error deviation and NS: non significant.
** (P<0.01).

Table 5 Economics of feeding animals on different diets

Parameters	Diets				SED	Level of significance
	A	B	C	D		
Feed cost (Tk./animal/d)	28.85	29.30	29.83	30.00	0.68	NS
Feed cost (105 d)	3029.12[b]	3076.50[ab]	3131.80[a]	3150.70[a]	18.57	**
Labour cost (105 d)	900.00	900.00	900.00	900.00	-	-
Other cost (105 d)	150.00	150.00	150.00	150.00	-	-
Total cost of rearing (105 d)	4079.12[b]	4126.50[ab]	4181.80[a]	4200.70[a]	20.71	**
Weight gain (kg/105 d)	39.00[c]	42.50b[c]	46.50[ab]	49.00[a]	1.22	**
Meat production (kg/100 kg of body weight 53.00%)	20.67[c]	22.53[b]	24.65[a]	25.97[a]	1.17	**
Cost/Kg weight gain	104.59[a]	97.09[b]	89.93[c]	85.73[d]	4.15	**
Cost/Kg meat production	197.34[a]	183.15[b]	169.65[c]	161.75[d]	7.82	**
Total meat price (280 Tk/kg)	5787.60[d]	6308.40[c]	6902.00[b]	7271.60[a]	326.98	**
Total profit	1708.48[d]	2181.90[c]	2720.00[b]	3071.60[a]	299.66	**
Profit in relation with group A (Tk.)	0.0000[d]	473.42[c]	1011.52[b]	1363.12[a]	258.72	**

A: 3.0% urea + 2.0% midden soil treated rice straw (ensiled); B: 3.0% urea + 3.0% midden soil treated rice straw (ensiled); C: 3.0% urea + 4.0% midden soil treated straw (ensiled) and D: 3.0% urea + 5.0% midden soil treated straw (ensiled).
The means within the same row with at least one common letter, do not have significant difference (P>0.05).
SED: standard error deviation and NS: non significant.
** (P<0.01).

The cost of meat production by animals in groups C and D was significantly lower (P<0.01) than in group A and B. It was also evident that, for the total length of the trial period, the profit in groups C (3.0% urea plus 4.0% midden soil treated rice straw) and D (3.0% urea plus 5.0% midden soil treated rice straw) was higher (respectively Tk. 1011.52 and 1363.12) compared to the obtained in group A (3.0% urea plus 2.0% treated rice straw).

CONCLUSION

Rice straw treatment with urea and midden soil upsurge its nutrient composition, digestibility and TDN value. Urea and midden soil treated rice straw significantly improved animal performance, including body weight gain and meat yield. For better utilization, rice straw could be treated with 3.0% urea + 5.0% midden soil. Moreover, this treatment reduced the rearing cost of animals by improving the growth performance of animals.

ACKNOWLEDGEMENT

The authors sincerely appreciate and are grateful to the authority of Ministry of Science and Information and Communication Technology, Government of Bangladesh to provide financial support for conducting the research work.

REFERENCES

AOAC. (2004). Official Methods of Analysis. 17th Ed. Association of Official Analytical Chemists, Arlington, VA, USA.

Bae D.H., Jung K.K. and Choi C.B. (1988). Studies on urea utilization as a source of ammonia for the rice straw treatment. *Korean J. Anim. Sci.* **30(1),** 282-283.

Chenost M. and Kayouli C. (1997). Roughage Utilization in Warm Climates. FAO Animal and Health, Rome.

Dolberg F., Sadullah M., Haque M. and Ahmed R. (1981). Storage of urea treated straw using indigenous material. *World Anim. Rev.* **38,** 37-41.

Doyle P.T., Devendra C. and Pearce G.R. (1986). Rice Straw as a Feed for Ruminants. International Development Program of Australian Universities and Colleges Limited (IDP), Canberra, Australia.

FAO. (2009). Food and Agriculture Organization of the United Nations the State of Food Insecurity in the World.

Goto M. (1995). Ammoniation of barely straw effect on anatomical and physiochemical characteristics of the cell walls. *Ann. Zootech*. **44(1),** 70.

Jayasuriya M.C.N. and Pearce G.R. (1983). The effect of urease enzyme on treatment time and the nutritive value of straw treated with ammonia as urea. *Anim. Feed Sci.* **6,** 123-131.

Khan M.J., Scaife J.R. and Hovell F.D. (1999). The effect of different sources of urease enzyme on the nutritive value of wheat straw treated with urea as a source of ammonia. *Asian-australas J. Anim. Sci.* **12(7),** 1063-1069.

Mahr-ur-Nisa M., Sarwar M. and Khan M.A. (2004). Influnce of adlibitum feeding of urea treated wheat straw with or without corn steep liquor on intake, *in situ* digestion kinetics, nitrogen metabolism and nutrient digestion in Nili- Ravi buffalo bulls. *Australian J. Argic. Res.* **55(2),** 229-236.

McDonald A.A., Edwards R.A., Greenhalgh J.F.D. and Morgan C.A. (2002). Animal Nutrition. Pearson Education, Harlow, UK.

Mithalal G. and Taparia A.L. (2007). Incorporation of water hyacinth silage in the ration of cross bred heifers. *Indian J. Anim. Nutr*. **15(1),** 64-66.

Munoze F., Joy F. and Alibes X. (1991). Treatment of leguminous residues with urea. Influence of dosage, moisture, temperature and addition of urease. *Ann. Zootech.* **40,** 215-225.

Narayan D., Sharma K. and Naulia U. (2004). Nutrititional evaluation of lentil straw and urea treated wheat straw in goats and lactating buffaloes. *Asian-Australas J. Anim. Sci.* **17(11),** 1529-1534.

Nguyen-Xuan T. (2004). An evaluation of adaptability of alkali treated of rice straw as feed for growing beef cattle under smallholders circumstances. *Livest. Res. Rural Dev*. **16(7),** 52-56.

Puri J.P. and Gupta B.N. (1994). Effect of feeding ammonia treated rice straw on growth and nutrient utilization in cross- bred calves. *Indian J. Anim. Nutr. Anim. Sci.* **7(3),** 191-194.

Wanapat M., Sundstol F. and Garma T.H. (1984). A comparison of alkali treatment methods to improve the nutritive values of straw. *Anim. Feed Sci. Technol.* **12,** 295-309.

Wanapat M., Polyorach S., Boonnop K., Mapato C. and Cherdthong A. (2009). Effects of treating rice straw with urea or urea and calcium hydroxide upon intake, digestibility, rumen fermentation and milk yield of dairy cows. *Livest. Sci*. **125,** 238-243.