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Research Article

EFFECT OF FEEDING TREATED RICE STRAW ON NUTRIENT UTILIZATION GROWTH PERFORMANCE AND BLOOD PARAMETERS IN BUFFALO CALVES

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ABSTRACT

A study was conducted to investigate the effect of feeding urea or urea-molasses treated rice straw on the growth performance and nutrient utilization in buffalo calves. Rice straw of CSR-30 cultivar of basmati rice was treated with 3.5% urea alone or 3.5% urea plus 3.5% molasses solutions and kept covered for 21 days. Twenty Murrah buffalo calves having an average body weight of 156.20±6.59 kg were divided randomly into four groups *viz*. T_1, T_2, T_3 and T_4 of five animals each. The experimental calves of group T_1 (control) were fed wheat straw-based control diet, while calves of groups T_2, T_3 and T_4 were fed untreated rice straw, 3.5% urea treated rice straw and 3.5% urea plus 3.5% molasses treated rice straw-based rations, respectively, for an experimental period of 4 months. Body weight gain, ADG, changes in body conformation was recorded. A digestion trial was conducted during the last month of experiment to access nutrient intake and utilization. Treatment with urea alone or urea plus molasses improved ($P<0.05$) the nutritive value of rations. DMI was significantly ($P<0.05$) higher in T_4 than other groups. Significantly higher ($P<0.05$) DM digestibility and CP digestibility were observed in calves fed treated rice straw. Digestibility of CF, NFE, OM and NDF was higher ($P<0.05$) in T_3 and T_4 group as compared to T_1 and T_2. ADG (g) was significantly ($P<0.05$) higher in T_4 than other groups. Significantly ($P<0.05$) higher Hb (g%) and serum protein (g/dl) was reported in T_4. The cost of feed per unit body weight gain was reduced by feeding urea-molasses treated rice straw in place of untreated rice straw or wheat straw leading to significant ($P<0.05$) improvement in feed conversion efficiency.

Keywords: Blood parameters, Buffalo Calves, Growth Performance, Nutrient Utilization, Treated Rice Straw

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Shortage of cultivated fodder especially during the seasonal dry period poses a great constraint to the growing livestock sector of India. In future, the livestock sector will have to rely on feed resources generated as by-products of the human food production activitye eg., cereal harvesting. (Devendra and Leng, 2011; Laconi and Jayanegara, 2015). Among cereals, India is the second biggest rice producer in the world after China (Sarnklong *et al.*, 2010) as a consequence of that, also produce huge amounts of rice straw and rice bran as by-products. Thus, rice bran and rice straw are particularly important by products that can be used as animal feeds. But, due to low protein, highly lignified fibre, silica and low digestible components (Van Soest, 2006), feeding rice straw alone to the animals cannot provide sufficient nutrients for growth and production. Also, rice straw has low ruminal degradation rate, low rate of passage and thus contributes to reduced feed intake (Sarnklong *et al.*, 2010). Poor quality roughage of rice straw has also been associated with high enteric methane emission due to more acetate production at the expense of propionate (Jayanegara *et al.*, 2013). The nutritional quality of the rice straw can be improved with various physical (chopping, grinding, soaking), chemical (alkali treatments such as sodium or calcium hydroxide, ammoniation or urea treatment) and biological (fibre degrading enzymes and white rot fungal inoculation) treatments (Sarnklong *et al.*, 2010). Among all, urea treatment is most hands-on and inexpensive method of improving nutritional quality of rice straw. Ammonia released after being dissolved in water is absorbed into cell wall of rice straw and break down the linkage between lignin and cellulose or hemicellulose and the residual urea in treated straw adds substantial amount of nitrogen which is naturally limited in rice straw, for rumen microbial protein synthesis (Polyorach and Wanapat, 2015) that further contributes to animal's metabolizable protein demand (Gunun *et al.*, 2016). Urea treatment @ 2-6% dry matter has been shown to increase rice straw digestibility by 2-100% (Van Soest, 2006) and improved productivity of animals (Gunun *et al.*, 2013).

MATERIALS AND METHODS

The experiment was conducted in the Department of Animal Nutrition while feeding trial was carried out on the Buffalo farm of Department of Livestock Production Management, Lajpat Rai University of Veterinary and Animal Sciences, Hisar, India located at 29° 052' N and 75° 262' E at an altitude of 215 metre. The experiment was conducted after approval from the Institutional Animal Ethics Committee (IAEC), CPCSEA, New Delhi.

Twenty growing buffalo calves with an average body weight of 156.20±6.59 kg, were divided into four-treatment groups *viz*. T_1, T_2, T_3 and T_4 of five animals each, following completely randomized design. Nutrient need of the calves was met by feeding weighed quantity of different types of

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straw, green fodder and concentrate mixture according to ICAR (2013) feeding standards. The experimental calves of group T_1 (control) were fed wheat straw-based control diet, while calves of groups T_2, T_3 and T_4 were fed rice straw, 3.5% urea treated rice straw and 3.5% urea plus 3.5% molasses treated rice straw-based rations, respectively, for an experimental period of 4 months. For preparing urea treated rice straw, 3.5 kg of urea per 100 kg rice straw was dissolved in 40 litres of water while for preparing urea-molasses treated rice straw, 3.5 kg each of urea and molasses per 100 kg straw were dissolved in 40 litres of water and sprayed homogeneously over rice straw and then packed in polythene sheet under anaerobic condition for 21 days. After 21 days, the straw was opened, spread and aired before feeding to the calves. The concentrate mixture was prepared by using maize (34 parts), barley (15), groundnut cake (38), mustard cake (10 parts), mineral mixture (2 parts) and common salt (1 part). The record of daily feed intake was maintained and the experimental calves were weighed at fortnightly intervals on two consecutive days in the morning before feeding and watering. Fresh and clean drinking water were made available throughout the experimental period. At the end of the growth trial, a digestion trial was conducted following the conventional total collection techniques with five-day collection period to study the nutrients digestibility, nutrient intake and nutritive values of different rations. The prices of the ration ingredients, wheat straw, rice straw, urea and molasses were based on prevailing during the year 2020-21 for calculating the economics of feeding rice straw/treated rice straw in buffalo calves. Cost per kg of concentrate mixture, wheat straw, rice straw, urea treated rice straw and urea plus molasses treated rice straw was Rs. 23.59, 3.50, 2.50, 2.71 and 3.23, respectively. The proximate analysis of feed ingredients and fodder were estimated by using standard method by AOAC (2005). The data generated during experimental period was subjected to statistical analysis with SAS, 9.3.1 (2011) version by following standard method of analysis of variance as given by Snedecor and Cochran (1994).

RESULTS AND DISCUSSION

The chemical composition of feed ingredients, concentrate mixture, green fodder, wheat straw, rice straw, urea treated rice straw and urea molasses treated rice straws has been presented in Table 1. The CP, EE and CF contents of concentrate mixture was 22.69, 4.83 and 8.42%, respectively. CP content of wheat straw, untreated rice straw, urea treated rice straw and urea-molasses treated rice straw was 2.07, 2.87, 7.99 and 8.21%, respectively, indicating that there was adding of 5.12 and 5.34% crude protein in rice straw by respective treatments. The NDF and ADF content of rice straw decreased by 3.88 and 3.99 percent in urea and urea- molasses treatment, respectively.

The mean values of total body weight (BWG) and average daily gain (ADG) during the experimental period were 61.20, 57.34, 67.00 and 87.40 kg; 510.00, 477.81, 558.33 and 728.33 g in T_1, T_2, T_3 and T_4, respectively (Table 2) being significantly ($P<0.05$) higher in calves fed urea-molasses treated rice straw (T_4 group)as compared to others. BWG and ADG of urea treated rice straw fed calves (T_3) was also higher as compared to wheat straw (T_1) and untreated rice straw fed calves (T_2) but the difference was non-significant ($P<0.05$). Among the various body measurements, the height of experimental calves fed urea - molasses treated rice straw was significantly ($P<0.05$) more as compared to calves of other groups.

Average daily DMI in terms of kg/d, % BW and /kg metabolic body size (Table 3) was significantly ($P<0.05$) higher in T_4 (6.15, 2.52 and 99.95, respectively) as compared to T_1 (4.95, 2.30 and 88.11, respectively), T_2 (4.68, 2.21 and 84.43, respectively) and T_3 (4.83, 2.15 and 84.78, respectively). Statistically similar DMI among T_1, T_2 and T_3 indicates that rice straw was equally good palatable as wheat straw. DMI from concentrate mixture was same among all the four groups. But, DMI as contributed by roughage was significantly ($P<0.05$) higher in group T_4 which reflects that the increase in total DMI might be due to the feeding of urea-molasses treated rice straw-based ration. Abate and Melaku (2009) and Hossain *et al.* (2010) reported higher DM and nutrient intake in treated straw-based ration. DM digestibility was not affected significantly due to feeding rice straw in place of wheat straw in the ration of buffalo calves; however, urea-molasses treatment increased the DMD. CP digestibility was significantly ($P<0.05$) improved upon urea treatment (71.58%) or urea-molasses treatment (72.45%) as compared to untreated rice straw (68.10%) and wheat straw (67.91%). Similarly, the digestibility of CF, NFE, OM and NDF were also higher ($P<0.05$) in calves fed urea treated or urea plus molasses treated rice straw as compared to wheat straw or untreated rice straw fed groups. These results are in agreement with those reported by Wanapat *et al.* (2009). Yang and Beauchemin (2006) also observed higher ADF and NDF digestibility of treated straw-based rations. Urea-molasses treated ration (T_4) had highest ($P<0.05$) percent of TDN (64.98%) followed by T_2 (63.09%), T_1 (61.39%) and T_2 (60.09%). DCP values were significantly ($P<0.05$) high in T_3 and T_4 groups as compared to T_1 and T_2. DCP intake (kg/d) was significantly ($P<0.05$) higherin T_4 (0.627), followed by T_3 (0.482), T_1 (0.396) and T_2 (0.387). T_4 group had highest ($P<0.05$) TDN intake per day (3.998) as compared to T_1 (3.043), T_2 (2.811) and T_3 (3.045). It

Table 1. Chemical compositions (% DM basis) of different feed ingredients and concentrate mixture fed to experimental calves

Ingredients	% DM	Parameters (% DM basis)							
		CP	EE	CF	Ash	NFE	OM	NDF	ADF
Concentrate mixture	92.32	22.69	4.83	8.42	8.20	55.86	91.90	16.12	8.92
Wheat straw	89.06	2.07	1.34	36.82	8.07	51.70	91.93	74.28	49.80
Berseem	18.56	15.20	1.10	19.65	11.82	47.67	88.18	59.60	48.90
Maize green	25.90	11.37	2.54	29.79	6.87	49.43	93.13	68.10	42.82
Untreated CSR-30	90.40	2.87	1.36	34.98	13.09	47.70	86.91	68.36	49.67
Urea treated CSR-30	87.44	7.99	1.48	32.65	12.89	44.99	87.11	64.48	47.10
Urea-molasses treated CSR-30	86.51	8.21	2.08	31.87	12.22	45.62	87.78	64.37	45.73

*Each value is mean of three observations.

Abbreviations: DM: dry matter, CP: crude protein, EE: ether extract, CF: crude fibre, NFE: nitrogen free extract, OM: organic matter, NDF: neutral detergent fibre, ADF: acid detergent fibre.

Table 2. Growth performance of calves under different dietary treatment groups

Attributes	Treatment				SEM
	T_1	T_2	T_3	T_4	
BWi (kg)	154.60±6.85	156.40±6.71	157.20±7.11	156.60±5.69	3.04
BWf (kg)	215.80^b±7.95	213.74^b±9.64	224.20^b±9.16	244.00^a±5.32	4.65
BWG (kg)	61.20^b ±4.41	57.34^b ±3.38	67.00^b ±5.76	87.40^a ±5.91	3.50
ADG, (g)	510.00^b±36.74	477.81^b±28.16	558.33^b±48.02	728.33^a±49.27	29.20
Hi (cm)	114.63±1.84	116.06±1.38	114.64±2.07	115.82±2.89	0.98
Hf (cm)	127.85^b±2.55	127.49^b±2.97	127.89^b±1.20	136.80^a±2.56	1.43
Li (cm)	140.05±2.66	139.36±2.02	140.92±2.88	137.86±3.76	1.35
Lf (cm)	161.81±5.14	162.08±6.85	160.88±4.33	170.00±3.56	2.49
HGi (cm)	135.94±3.55	136.55±4.02	134.78±4.73	137.16±5.28	2.05
HGf cm	149.13±4.41	149.86±1.80	152.30±1.92	157.40±4.58	1.74
AGi (cm)	149.63±5.98	148.47±5.73	151.58±2.03	151.24±9.18	2.89
AGf (cm)	162.91±7.33	165.87±4.58	163.80±6.28	174.40±4.29	2.84

*Mean values bearing different superscripts in a row differ significantly (P<0.05).

Abbreviation:BWi=initial body weight; BWf=final body weight; BWG: body weight gain; ADG: average daily gain; Hi: initial height; Hf: final height; Li: initial length; Lf: final length; HGi: initial heart girth; HGf: final heart girth; AGi: initial abdominal girth and; AGf: final abdominal girth.

Table 3. Dry matter intake, nutrient digestibility, nutritive value and nutrients' intake of experimental calves

Attributes	Treatment				SEM
	T_1	T_2	T_3	T_4	
			Dry Matter Intake		
DMI, kg/d	4.95^b±0.15	4.68^b±0.07	4.83^b±0.05	6.15^a±0.10	0.14
DMI, kg/d (Roughage)	3.01^b±0.38	2.73^b±0.23	2.83^b±0.24	4.25^a±0.12	0.18
DMI, kg/d (Concentrate)	1.94±0.26	1.95±0.27	1.99±0.24	1.90±0.14	0.11
DMI %BW	2.30^b±0.08	2.21^b±0.10	2.15^b±0.10	2.52^a±0.07	0.05
DMI/kg BW0.75	88.11^b±2.11	84.43^b±3.01	84.78^b±2.89	99.95^a±2.78	2.01
			Nutrient Digestibility (%)		
DM	59.68^{ab}±1.0	57.78^b±1.21	60.06^{ab}±1.24	62.75^a±0.47	0.62
CP	67.91^b±1.03	68.10^b±0.90	71.58^a±0.75	72.45^a±0.77	0.61
EE	69.87±1.68	70.91±2.19	70.29±1.76	70.76±1.58	0.84
CF	50.22^b±1.60	49.85^b±1.27	55.15^a±0.93	56.53^a±0.95	0.88

NFE	69.52^{b}±0.94	69.46^{b}±0.99	70.17^{ab}±0.73	72.77^{a}±0.79	0.50
OM	59.83^{b}±1.24	58.29^{b}±1.03	63.11^{a}±0.83	64.97^{a}±1.10	0.78
NDF	47.60^{b}±1.17	46.68^{b}±1.05	56.86^{a}±1.16	57.09^{a}±1.07	1.24
ADF	45.28±1.47	45.76±1.74	46.15±1.84	46.03±1.86	0.80
Nutritive value and Nutrient Intake					
CP%	11.79^{b}±0.01	12.15^{b}±0.1	13.96^{a}±0.01	14.07^{a}±0.01	0.24
DCP%	8.01^{b}± 0.12	8.27^{b}±0.11	9.99^{a}±0.11	10.19^{a}±0.11	0.23
TDN%	61.39^{c}±0.67	60.09^{c}±0.37	63.09^{b}±0.59	64.98^{a}±0.37	0.48
DCPI, kg/d	0.396^{c}±0.01	0.387^{c}±0.01	0.482^{b}±0.01	0.607^{a}±0.01	0.02
TDNI, kg/d	3.04^{b}±0.12	2.81^{b}±0.03	3.05^{b}±0.06	3.998^{a}±0.08	0.11

*Mean values bearing different superscripts in a row differ significantly (P<0.05).
Abbreviations: DMI: dry matter intake; DMI %BW: dry matter intake as percent of body weight; DMI/kg BW0.75: dry matter intake per kg metabolic body size; DCP: digestible crude protein; TDN: total digestible nutrients; DCPI: digestible crude protein intake; TDNI: total digestible nutrients intake.

Table 4. Blood parameters of experimental calves under different treatment group

Attributes	Treatment				SEM
	T_1	T_2	T_3	T_4	
Haemoglobin (g%)	11.43^{b} ±0.11	11.40^{b}±0.11	11.23^{b} ±0.11	11.98^{a} ±0.07	0.12
BUN, mg/dl	30.92±2.21	33.12±2.98	27.46±2.81	30.02±2.17	1.27
Plasma glucose, mg/dl	47.20±2.43	51.40±3.17	53.80±1.96	54.40±2.62	1.35
Triglycerides, mg/dl	22.00±4.39	20.60±3.99	23.80±3.58	27.80±4.08	1.95
Total cholesterol, mg/dl	40.00±3.15	44.40±3.76	45.40±3.66	43.20±3.30	2.35
Serum protein, g/dl	2.97^{b} ±0.36	2.90^{b} ±0.46	3.38^{ab} ±0.20	4.02^{a}±0.52	0.24

*Mean values bearing different superscripts in a row differ significantly (P<0.05).

Table 5. Economics of feeding paddy straw in dietary regimen of buffalo calves

Attributes	Treatment			
	T_1	T_2	T_3	T_4
Daily DMI (Kg)	4.32	4.24	4.46	5.36
Cost of feeding /d (Rs.)	63.36	62.08	63.03	67.02
Total Feed Cost (120 d)	7603.20	7449.60	7563.6	8042.40
Feed cost /kg gain	124.40	129.91	112.89	92.02
FCR	8.64^{b}±0.64	8.96^{b}±0.41	8.22^{b}±0.69	7.51^{a}±0.59
FCE	0.12^{b}±0.01	0.11^{b}±0.01	0.12^{b}±0.01	0.14^{a}±0.01

*Mean values bearing different superscripts in a row differ significantly (P<0.05).

shows that nutrients digestibility, nutrients intake and nutritive value of rations were not affected by feeding rice straw in place of wheat straw as dry roughage, however, these attributes can be improved significantly (P<0.05) by feeding urea or urea- molasses treated rice straw.

Hb (g%) and serum total protein (g/dl) were significantly (P <0.05) higher in animals fed urea-molasses treated paddy straw (T_4) group than animals of other groups (Table 4). It might be due to the fact that urea-molasses treatment improves utilization of nutrients in the feed by augmenting their digestion and absorption. Other blood parameters viz. blood urea-nitrogen (BUN), plasma glucose, total cholesterol and triglycerides remained unaffected.

The cost of feeding per kg gain was Rs. 124.40, 129.91, 112.89 and 97.02 in treatment groups T_1, T_2, T_3 and T_4, respectively, which indicated that the cost of feed per unit gain reduced by feeding urea and urea-molasses treated rice straw in place of wheat straw and untreated rice straw. The feed conversion efficiency and feed conversion ratio were also improved significantly (P<0.05) in urea treated groups.

CONCLUSION

Urea or urea plus molasses treatment enhances the nutritive values of total mixed ration in terms of percent crude protein and percent digestible crude protein substantially. Feeding of urea-molasses treated rice straw increase the nutrient utilization leading to increased growth performance, feed conversion efficiency, feed conversion ratio and reduces feeding cost per unit gain in growing buffalo calves.

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