Forage Res., **49**(3) : pp. 364-368 (2023) **http://forageresearch.in**

COMPARISON OF FEEDING VALUE OF WHEAT STRAW AND RICE STRAW OF NON-BASMATI CULTIVAR IN MURRAH BUFFALO CALVES

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(Received : 10 December 2023; Accepted : 26 December 2023)

SUMMARY

An experiment was conducted to assess the feeding value of wheat straw and rice straw in the growing Murrah buffalo calves. Eighteen weaned calves of age 14.50±0.86 months and average live body weight of 142.67±5.01 kg were divided into three groups *viz*. T_1 (control), T_2 & T_3 of six animals each. Calves were fed experimental rations for a period of four months as per ICAR (2013) feeding standard. Group T_1 was fed wheat straw-based control ration while T_2 and T_3 calves were fed non-basmati rice straw and urea-molasses treated non-basmati rice straw-based ration, respectively. Oats and berseem mix was used as green fodder while concentrate mixture comprised of maize (37.0 parts), wheat (6.0), barley (12.0 parts), GNC (18.0 parts), mustard cake (18.0 parts), soybean meal (6.0 parts) mineral mixture (2 parts) and common salt (1 part). Average daily gain (ADG) was significantly higher in urea-molasses treat non-basmati rice straw fed calves (556.94g) as compared to wheat (455.56g) or untreated rice straw fed calves (413.88g). Relative increase in body height of the T_3 calves was higher than T_1 ($p>0.05$) and T_2 ($p<0.05$). Average feed intake of the overall experimental period (Table 3) was significantly ($p<0.05$) higher (7.93%) in T_3 than T_1. While, average feed intake of group T_2 was significantly ($p<0.05$) lower (3.26%) as compared to T_1. DMI as percent of BW was similar among all the treatment groups and varied from 2.53% in T_2 to 2.64% in T_3. DCPI and TDNI was significantly ($p<0.05$) higher in T_3 group as compared to T_1 and T_2. Urea-molasses treatment of non-basmati rice straw improved the digestibility of nutrient *viz*. DM, CP, CF, OM, NDF and ADF, significantly ($p<0.05$). Serum biochemical parameters remained similar among groups. Net saving per kg gain was highest in T_3. It was concluded that untreated non-basmati rice straw is poorly utilized in comparison to wheat straw, but urea-molasses treatment of non-basmati rice straw improves its feeding value significantly for the growing buffalo calves.

Key words: Buffalo calves, murrah, non-basmati rice straw, wheat straw

Lack of feed and fodder for the livestock is the major constraint and accounts for nearly half of all losses in Indian livestock production. According a study by ICAR- IGFRI (2022), India is facing deficit of 11.24% in green fodder, 23.4% in dry fodder and 28.9% in concentrate feed ingredient availability. It is apparent from the growing pressure on use of land for human population and industrialization that future animal production would depend largely on feeding by-products from food produced for human consumption (Laconi and Jayanegara, 2015). Seasonal scarcity of the cultivated fodder during lean period further demands exploring and nutrient enhancement of crop residues like rice and wheat straw. India being the second biggest rice producer after China (Sarnklong *et al.*, 2010) produces high amounts of by-products such rice hull and rice straw. Haryana estimates that about 14.82 lakh hectares of land are under paddy cultivation, which is expected to generate over 7.3 million tonnes of non-basmati paddy straw (Fernandes, 2023). Rice straw is generally left in the field because its transportation is uneconomical due to low bulk density. Burning rice straw in the field has been a great environmental hazard by producing global warming gases. Burning of 1 kg of rice straw produces nearly 0.7–4.1g of methane and 0.019–0.057 g of N_2O in addition to other gaseous pollutants like CO_2, SO_2, NO_x, and carcinogenic polycyclic aromatic hydrocarbons, dioxins, and furans and soil degradation (Oanh *et al.*, 2011). Rice straw is particularly important byproducts from paddy crop that can be used as animal feed. However, it needs either mixing with other nutrient dense feedstuff or suitable treatment prior to feeding owing to its low protein, highly lignified fiber

components or poor digestibility (Van Soest, 2006). Among others, urea treatment is a cheaper and farmer-friendly method that can improve the amount of protein content (Polyorach and Wanapat, 2015) and digestibility of the rice straw appreciably resulting in improved productivity of animals (Gunun *et al.*, 2013). Residual urea in the treated straw adds substantial amount of nitrogen for microbial protein synthesis in the rumen (Polyorach and Wanapat, 2015). This experiment was conducted to compare the feeding value of wheat straw with treated or untreated rice straw of Non-Basmati cultivar in growing Murrah Buffalo Calves.

MATERIALS AND METHODS

Eighteen weaned murrah buffalo calves of age 14.50±0.86 months and average live body weight of 142.67±5.01 kg were divided following CRD into three experimental groups *viz*. T_1 (control), T_2 and T_3 of six animals each. Feeding with experimental rations was done for a period of four months to meet out the nutrient requirement as per ICAR (2013) feeding standard. Different rations were formulated with a similar concentrate mixture and green fodder (oats and berseem) while type and form of dry roughage varied among the treatment groups. Portion of concentrate mixture and green fodder was kept similar among different rations while straw (wheat, rice or treated rice straw) was fed *ad-libitum*. Concentrate mixture comprised of maize (37.0 parts), wheat (6.0), barley (12.0 parts), GNC (18.0 parts), mustard cake (18.0 parts), soybean meal (6.0 parts) mineral mixture (2 parts) and common salt (1 part). Wheat straw was used as dry roughage for the calves under control group T_1 while untreated non-basmati rice straw (UT-NBRS) was used for calves under treatment group T_2 and; urea-molasses treated non-basmati rice straw (UMT-NBRS) was used for calves under T_3 group. Non-basmati rice straw was treated using 3.5kg each of molasses and urea per quintal of the straw. Forty-litre solution of urea and molasses was prepared and sprayed over the rice straw. The chemical composition of the different feed ingredients has been shown in Table 1. Urea-molasses treatment of the non-basmati rice straw increased its CP level from 4.16% to 8.40%.

Feed intake was recorded at each fortnight interval and body weight was recorded at monthly interval for two consecutive days to find out the feed intake and body weight gain during different progressive period of experiment. To determine feed intake, nutrient digestibility and nutritive value, a digestion trial was conducted during the last month of experiment for 7 days including 2 days of adaptation and 5 days of collection. The representative samples of feed offered, residue left and faeces voided were preserved and analyzed for proximate composition (AOAC, 2005) and fibre fraction (Van Soest *et al.*, 1991). Body measurements were taken at the starting and end of experiment. Blood samples were collected at the end of the experiment through jugular veni-puncture using sterilized needles to assess the effect of different diets on serum biochemical parameters (machine). The data generated during the study 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 results of the study revealed that total live weight gain and average daily gain (ADG) was significantly higher in urea-molasses treat non-basmati rice straw fed calves (66.83kg and 556.94g,

TABLE 1
Chemical composition of different ingredients & rations*

Ingredients	% DM	Parameters (% DM basis)									
		CP	EE	CF	T.A.	NFE	OM	NDF	ADF	P	Ca
Concentrate mix	90.25	19.68	2.75	6.25	6.63	64.69	93.37	22.60	10.10	0.65	3.60
Berseem	15.10	16.05	1.24	20.01	12.28	50.42	87.72	48.29	27.33	0.27	1.90
Oats	13.59	10.84	3.00	21.64	7.40	57.12	92.60	52.47	36.63	0.13	0.52
Wheat straw	91.53	3.85	2.50	36.59	7.07	49.99	92.93	74.00	46.09	0.06	0.40
UT-NBRS	87.15	4.16	2.55	36.77	7.60	48.92	92.40	59.40	45.54	0.04	0.36
UMT-NBRS	80.75	8.40	2.50	32.45	9.22	47.43	87.78	57.42	42.47	0.08	0.61

*Each value is mean of three observations.

respectively) as compared to wheat (54.67kg and 455.56g, respectively) or untreated rice straw fed calves (49.67kg and 413.88g, respectively). Body weight gain in untreated rice straw fed calves was numerically ($p>0.05$) lower than wheat straw fed calves. Relative increase in body height of the T_3 calves was higher than T_1 ($p>0.05$) and T_2 ($p<0.05$) while all other body measurements viz. body length, heart girth and abdominal girth changed non-significantly among different groups. In comparison to T_1 and T_2, feed intake (DM, kg/d) remained significantly higher in T_3 from 3rd week of experiment until completion. Average feed intake of the overall experimental period (Table 3) was significantly ($p<0.05$) higher (7.93%) in T_3 than control T_1. While, average feed intake of group T_2 was significantly ($p<0.05$) lower (3.26%) as compared to T_1. Similar results were also reported by

TABLE 2
Weight gain and Body Measurements, cm (Height, Length, Heart Girth, and Abdominal Girth) of experimental calves under different groups

Attributes	T_1	T_2	T_3
Body weight (kg)			
Initial	141.83±5.31	143.33±4.99	142.83±4.72
Month 1	159.00±5.01	154.33±5.02	162.17±5.55
Month 2	171.67^{b}±5.30	167.17^{b}±4.11	186.00^{a}±3.52
Month 3	182.83^{b}±6.51	180.67^{b}±4.63	199.50^{a}±3.55
Month 4	196.50^{b}±6.93	193.00^{b}±3.96	209.67^{a}±2.77
Total live weight gain, kg	54.67^{b}±4.14	49.67^{b}±2.01	66.83^{a}±3.32
ADG, g	455.56^{b}±34.53	413.88^{b}±16.76	556.94^{a}±27.67
Body Measurements, cm			
Initial body height	114.30+1.30	116.33+1.22	109.73+3.43
Final body height	323.13+6.60	321.33+4.49	317.56+8.35
Relative increase in height	1.83^{ab}+0.04	1.77^{b}+0.04	1.89^{a}+0.03
Initial body length	109.22+3.47	111.25+3.49	107.19+3.46
Final body length	286.88+7.75	285.09+5.41	287.19+6.73
Relative increase in length	1.63+0.06	1.57+0.09	1.69+0.08
Initial Heart girth	141.91+1.72	141.22+3.31	142.82+3.00
Final Heart girth	482.67+5.19	468.17+7.33	479.83+8.43
Relative increase in Heart girth	2.56+0.05	2.32+0.08	2.32+0.09
Initial Abdominal girth	142.75+5.75	152.95+5.65	147.83+7.41
Final Abdominal girth	700.67+6.61	702.83+4.88	698.83+6.64
Relative increase in Abdominal girth	3.95+0.23	3.63+0.17	3.79+0.26

Kumar *et al*. (2023) on basmati rice based total mixed ration in growing buffalo calves.

Regarding nutrient intake of calves during digestion trial (Table 4), it was observed that DMI was improved significantly ($p<0.05$) in T_3 group fed urea-molasses treated rice straw based rations as compared to other. There were no residual amount of concentrate and green fodder left by any of the group.

TABLE 3
Feed intake (DM, kg) of experimental calves under different treatment groups

Fortnight	T_1	T_2	T_3
I.	3.47±0.11	3.38±0.15	3.68±0.11
II.	3.75±0.08	3.64±0.13	3.83±0.12
III.	4.11^{b}±0.12	3.89^{b}±0.09	4.43^{a}±0.08
IV.	4.26^{b}±0.10	4.17^{b}±0.08	4.61^{a}±0.09
V.	4.41^{b}±0.10	4.29^{b}±0.11	4.93^{a}±0.09
VI.	4.55^{b}±0.04	4.46^{b}±0.08	5.04^{a}±0.10
VII.	4.70^{b}±0.08	4.54^{b}±0.13	5.20^{a}±0.07
VIII.	5.13^{ab}±0.19	4.86^{a}±0.12	5.32^{a}±0.06
Average FI, kg	4.29^{b}±0.03	4.15^{c}±0.05	4.63a±0.06
% change in FI	--	3.26% down	7.93% up

TABLE 4
Nutrients intake and their digestibility and nutritive value of different rations

Parameter	T_1	T_2	T_3
Nutrient intake			
DMI, kg/d	4.76^{b}+0.15	4.56^{b}+0.13	5.26^{a}+0.17
Straw DMI, kg/d	1.07^{b}+0.15	0.87^{b}+0.12	1.56^{a}+0.17
Roughage DMI, kg/d	2.51^{b}+0.14	2.30^{b}+0.13	3.00^{a}+0.17
DMI, %BW	2.62+0.11	2.53+0.07	2.64+0.06
DCPI, kg/d	0.441^{b}+0.01	0.445^{b}+0.01	0.538^{a}+0.01
TDNI, kg/d	2.839^{b}+0.08	2.732^{b}+0.07	3.219^{a}+0.11
Nutrient digestibility (%)			
DM Dig%	56.34^{b}+1.01	54.51^{b}+0.51	60.44^{a}+1.46
CP Dig%	64.92^{b}+0.52	65.17^{b}+0.50	69.90^{a}+0.56
EE Dig%	63.80+0.94	63.99+0.95	64.84+1.02
CF Dig%	51.83^{b}+0.64	52.30^{b}+0.30	55.15^{a}+0.70
OM Dig%	61.81^{ab}+0.81	60.70^{b}+1.44	64.97^{a}+0.79
NFE Dig%	62.72^{b}+0.59	62.79^{b}+0.40	65.22^{a}+0.70
NDF Dig%	57.53^{b}+0.27	57.23^{b}+0.25	60.01^{a}+0.46
ADF Dig%	46.19^{b}+0.46	46.06^{b}+0.40	49.14^{a}+0.82
Nutritive value of rations			
DCP%	9.27^{c}+0.16	9.77^{b}+0.13	10.24^{a}+0.08
TDN%	52.41b+0.33	51.01^{b}+0.25	62.93^{a}+2.36

Therefore, the increase in the total DMI was solely due to increased DMI form treated rice straw in T_3 (1.56kg/d) as compared T_1 (1.07kg/d) and T_2 (0.87kg/d). Intake of plain rice straw was numerically lower than wheat straw. DMI as percent of BW was similar among all the treatment groups and varied from 2.53% in T_2 to 2.64% in T_3. DCPI and TDNI was also observed to be significantly ($p<0.05$) higher in T_3 group as compared to T_1 and T_2. Additionally, urea-molasses treatment of rice straw improved the digestibility of nutrient *viz*. DM, CP, CF, OM, NDF and ADF,

TABLE 5
Serum biochemical parameters of calves under different treatment groups

Attributes	T_1	T_2	T_3
Glucose, mg/dl	51.86+3.76	52.10+3.40	54.62+2.10
Triglycerides, mg/dl	15.33+1.12	15.67+0.49	15.50+1.56
Total cholesterol, mg/dl	66.67+7.18	66.33+3.16	66.67+5.81
HDL, mg/dl	44.87+2.69	45.87+2.06	44.15+1.78
LDL, mg/dl	14.19+1.64	13.02+0.89	13.59+0.86
Serum Total protein, g/dl	5.59+0.41	5.63+0.18	5.91+0.13
SGPT, IU/L	62.27+1.64	60.58+1.46	61.43+1.79
SGOT, IU/L	138.10+4.67	136.97+3.95	138.60+4.22

TABLE 6
Economics of feeding Rice straw of Non-basmati cultivar in buffalo calves

Attributes	T_1	T_2	T_3
Average total DMI/d, kg	4.29	4.15	4.63
Average DMI/d from concentre, kg	1.80 (2.0)	1.80 (2.0)	1.80 (2.0)
Average DMI/d from green fodder, kg	0.80 (5.6)	0.80(5.6)	0.80(5.6)
Average DMI/d from dry roughage, kg	1.69 (1.85)	1.55 (1.78)	2.03 (2.5)
Average daily gain, kg	0.46	0.41	0.56
Feed conversion ratio (FCR)	9.68	10.12	8.41
Feed conversion efficiency (FCE)	0.11	0.10	0.12
Cost of feeding*, Rs./d	88.99	83.39	90.88
Total feed cost (120 days)	10,678.80	10,006.80	10,905.60
Total LWG, kg	54.67	49.67	66.83
Feed cost, Rs./kg gain	195.33	201.47	163.18
Net saving, Rs/kg gain	--	-6.14	+32.15

*concentrate mixture @ Rs. 27.35/kg; green fodder @ Rs. 2.5/kg; wheat straw @ Rs. 10.97/kg; rice straw @ Rs. 8.25/kg and urea @ Rs. 5.90/kg & UM treated straw @ 8.87/kg. **Values in parenthesis indicates feed intake on fresh basis.

significantly ($p<0.05$). The nutritive value in terms of DCP and TDN of T_3 ration was higher ($p<0.05$) than T_1 (control), which further was higher ($p<0.05$) than T_2. Hossain *et al*. (2010), Wanapat *et al*. (2009) also observed improved DMI and nutrient intake and nutrient digestibility on treated straw-based ration.

Feeding untreated or urea-molasses treated rice straw based ration in place of wheat straw based ration has no significant effect ($p>0.05$) on any of the serum biochemical attributes (Table 5). Although, there was a numerical increase in the blood glucose and serum total protein level in urea-molasses treated rice-straw fed calves as compared to others.

Economics of feeding different dietary regimen showed that a net profit of Rs. 38.29/- and Rs. 32.15/- can be gained by feeding urea-molasses non-basmati rice straw to the calves as compared to feeding plain non-basmati rice straw and wheat straw, comparatively.

CONCLUSIONS

Feed intake, nutrients' intake, nutrients' digestibility and growth of calves fed untreated non-basmati rice straw based ration is numerically lower than calves fed wheat straw based ration, although the difference is non-significant. Urea and molasses treatment of the non-basmati rice straw improve the protein content of the straw from an average value 4.16% to 8.40%. Feeding of urea-molasses treated non-basmati rice straw significantly improve the feed intake, body weight gain, nutrient digestibility and nutritive value of rations in terms of DCP and TDN. Therefore, Therefore, it was concluded that treatment of the rice straw with urea-molasses not only enhance its feeding value for ruminants but can prove to be an eco-friendly approach for proper disposal of this agricultural-waste.

Abbreviations used:

ADF: Acid detergent fibre
ADG: Average daily gain
CF: Crude fibre
CP: Crude protein
CRD: Completely randomized design
DCP: Digestible crude protein
DMI: Dry matter intake
FI: Feed intake
GNC: Groundnut Cake
NDF: Neutral detergent fibre
OM: Organic matter
TDN: Total digestible nutrient
UMT-NBRS: Urea Molasses treated Non-basmati rice straw
UT-NBRS: untreated Non-basmati rice straw

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