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NUTRIENT UTILIZATION IN BUFFALO BULLS FED CROP RESIDUE BASED RATIONS

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ABSTRACT: *In 4 x 4 LSD, four graded Murrah buffalo bulls (6 yrs; 353 ± 8.26 kg) were fed four iso-nitrogenous complete rations comprising of jowar stover (CR1), maize stover (CR2), red gram straw (CR3) and black gram straw (CR4) as roughage source and concentrate mixture in 60:40 proportion, to study the effect of feeding complete rations on nutrient utilization. The DM intake (kg/d) was similar in all the groups. The digestibility coefficients of DM, OM, CP, EE, CF, NDF, ADF, Cellulose and Hemi-cellulose were significantly (P<0.01) higher in buffalo bulls fed CR2 while NFE digestibility was higher (P<0.05) in CR3 when compared to those fed other complete rations. All the animals were in positive N, Ca and P balances. Further, the % DCP and % TDN were significantly higher (P<0.01) in buffalo bulls fed CR2. It could be concluded that maize stover compared to other crop residues could be a superior roughage source for inclusion in complete rations for feeding buffalo bulls.*

ORIGINAL ARTICLE

Key words: *Black Gram Straw, Buffalo Bulls, Complete Rations, Jowar Stover, Maize Stover, Nutrient Utilization, Red Gram Straw*.

INTRODUCTION

India posses huge livestock population comprising of 279 million bovines which produced 112.11 million tonnes of milk (FAO, 2009). This huge livestock population needs special attention of nutritionists for supplying sufficient nutrients not only to fulfill their hunger but also to maintain the optimum productivity potentials (Waje et al., 2010). In India, the area under fodder production has remained static at around 4% of the total cultivable land area for the last three decades (NIANP Feed Disc, 2005). There is little hope to increase the cultivated area under green forages or to regenerate the degraded pastures through intensive management. This necessitates efficient utilization of crop residues for ruminant feeding. In developing countries including India, the production of crop residues has steadily increased during the last four decades, as a spill-over effect of 'Green Revolution'. These crop residues have special importance in livestock feeding as they constitute a major portion of roughages. High percentage of structural carbohydrate and low nitrogen content of these roughages result in low palatability and poor nutrient utilization in ruminants. However, incorporation of these crop residues in complete diets improves both palatability and nutrient utilization (Dhuria et al., 2011). The complete feed system not only ensures better utilization of nutrients from agricultural crop residues but also supplies balanced nutrients, controls the ratio of roughage to concentrate, provide uniform blend of feed, reduces feed wastage and enables use of locally available feed ingredients (Raut et al., 2002; Krishnamurthy and Ramaprasad, 2005). Hence, an attempt has been made to study the effect of feeding complete rations containing different locally available crop residues on nutrient utilization in buffalo bulls.

MATERIALS AND METHODS

In 4 x 4 LSD, four graded Murrah buffalo bulls (6 yrs; 353 ± 8.26 kg) were used to study the effect of feeding complete rations containing different crop residues on nutrient utilization. The animals were housed in well ventilated conventional stall barn and fed respective diets throughout the experimental period. Four iso-nitrogenous complete rations (Roughage concentrate ratio 60:40) were formulated using locally available crop residues *viz.* jowar stover (CR1), maize stover (CR2), red gram straw (CR3) and black gram straw (CR4) as roughage component. All the bulls were offered 6.5 kg each of respective complete ration to meet the nutrient requirements as per ICAR (1998). The ingredient composition of these complete rations is furnished in Table 1.

Each period of LSD consisted of a 21 day preliminary period followed by a 7 day collection period. Representative samples of complete feeds, faeces and urine were collected and analyzed for proximate principles

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(AOAC, 2007) and fibre fractions (Van Soest et al., 1991). The estimation of calcium and phosphorus in feed and faeces was done as per Talapatra et al. (1940) and in urine samples was done according to the methods described by Ferro and Ham (1957) and Fiske and Subba Row (1925), respectively.

Statistical analysis of the data was carried out as per the procedures suggested (Snedecor and Cochran, 1994) using SPSS version 17.0.

Table 1 - Ingredient composition of complete rations fed to graded Murrah buffalo bulls during the metabolism trial

Ingredient	Complete rations			
	CR1	CR2	CR3	CR4
Jowar stover	60	–	–	–
Maize stover	–	60	–	–
Red gram straw	–	–	60	–
Black gram straw	–	–	–	60
Maize grain	6.0	7.2	8.0	9.6
DORB	7.7	8.1	10.5	12.5
Cotton seed cake	15.6	12.4	11.6	8.8
Gingelly cake	9.2	10.8	8.4	7.6
Mineral mixture	1.0	1.0	1.0	1.0
Salt	0.5	0.5	0.5	0.5
Total	100	100	100	100

RESULTS AND DISCUSSION

The chemical composition of crop residues and crop residue based complete rations fed to buffalo bulls during metabolism trial were presented in Table 2. The daily dry matter intake (DMI) calculated in terms of kg/100kg BW or as g/kg $W^{0.75}$ was similar among buffalo bulls fed complete rations containing different crop residues (Table 3) which may be attributed to the uniformity in particle size (8 mm mesh size) of feed ingredients included in the complete rations. Further, the DMI recorded in all the groups was higher than the requirement as suggested by ICAR (1998). This indicates that the diets were palatable and that incorporation of locally available crop residues as roughage source has not affected the palatability of complete rations. Similar findings were also reported by Rajmane and Deshmukh (2000) in goats, Jadhav and Deshmukh (2001) in sheep and Suresha et al. (2009) in goats.

Table 2 - Chemical composition (%DMB) of crop residues and complete rations

Nutrient	Jowar stover	Maize stover	Red gram straw	Black gram straw	CR1	CR2	CR3	CR4
Dry matter	91.45	92.08	93.56	91.67	92.72	92.87	93.18	92.60
Organic matter	92.19	92.69	97.65	92.2	90.84	91.08	94.05	90.85
Total ash	7.81	7.31	2.35	7.8	9.16	8.92	5.95	9.15
Crude protein	3.78	4.68	5.7	7.29	13.53	13.54	13.73	13.13
Ether extract	1.76	1.96	1.51	7.23	1.73	1.37	1.33	1.14
Crude fibre	41.44	39.34	59.95	54.03	33.90	33.71	45.18	39.56
Nitrogen free extract	45.21	46.71	30.49	29.66	41.68	42.46	33.81	37.02
Neutral detergent fibre	74.36	76.12	81.98	72.56	63.9	68.6	71.13	65.29
Acid detergent fibre	58.65	56.38	72.51	66.69	44.19	42.36	50.44	47.82
Acid detergent lignin	10.12	8.3	15.78	13.36	8.32	6.50	12.08	10.16
Hemicellulose	15.71	19.74	9.47	5.87	19.71	26.24	20.69	17.47
Cellulose	46.9	47.58	58.2	54.6	32.29	32.12	37.19	34.5
Silica	2.59	1.8	0.66	0.26	3.3	3.58	2.30	2.49

The digestibility co-efficients (Table 3) of DM, OM, CP, EE and CF were higher ($P<0.01$) in buffalo bulls fed CR2. These results corroborated with findings of Nageswara Rao et al. (1995) who reported higher digestibility in native bucks fed maize stover based complete ration among different crop residue based complete rations. Similarly, Raja Kishore (2012) also reported increased digestibility of nutrients in buffalo bulls fed maize stover based complete rations compared to either red gram straw or black gram straw based complete ration. The digestibility co-efficients (Table 3) of NDF, ADF, hemicellulose and cellulose were higher ($P<0.01$) in CR2 which might be due to lower lignin content of the ration. Similar observations were reported by Nageswara Rao et al. (1995) in native bucks. Further, results revealed that the digestibilities of nutrients in other crop residue based complete rations are also within the normal range. These results support the hypothesis that complete feeds provide uniform supply of nutrients at regular interval which helps to maintain steady rumen environment resulting in better digestibility of nutrients (Talpada et al., 2002). Similar to these observations higher digestibility in complete rations were observed by Reddy et al. (2001) in buffalo bulls, Mahender et al. (2006) in Nellore lambs and Kumar et al. (2010) in lactating Murrah buffaloes. The DCP content expressed as % in the diet consumed was higher ($P<0.01$) in buffalo bulls fed CR2 when compared to those fed CR1, CR3 and CR4. The higher DCP content in

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buffalo bulls fed CR2 might be due to its higher CP digestibility. Similarly, TDN content expressed as % in the diet consumed was higher (P<0.01) in buffalo bulls fed CR2 as compared to those fed other complete rations which may be a reflection of increased nutrient digestibilities in buffalo bulls fed CR2 when compared to others.

Table 3 - Nutrient utilization and nutritive value of complete rations

Particulars	CR1	CR2	CR3	CR4
Dry matter intake				
Kg / 100 kg BW	1.74	1.70	1.67	1.68
g / kg $W^{0.75}$	75.12	75.12	75.90	75.30
Nutrient digestibility (%)				
Dry matter**	$52.98^{b} \pm 0356$	$58.37^{c} \pm 0.87$	$55.30^{b} \pm 1.19$	$48.41^{a} \pm 0.88$
Organic matter**	$55.44^{a} \pm 0.28$	$61.47^{c} \pm 0.41$	$57.73^{b} \pm 0.83$	$53.85^{a} \pm 0.53$
Crude protein**	$67.80^{b} \pm 0.69$	$70.68^{c} \pm 0.55$	$66.39^{b} \pm 0.80$	$64.12^{a} \pm 0.65$
Ether extract**	$55.22^{c} \pm 0.36$	$56.62^{c} \pm 0.65$	$51.24^{b} \pm 0.68$	$46.96^{a} \pm 0.74$
Crude fibre**	$44.85^{a} \pm 0.51$	$54.94^{c} \pm 0.68$	$48.48^{b} \pm 0.87$	$43.99^{a} \pm 0.67$
Nitrogen free extract*	$59.95^{a} \pm 1.14$	$63.94^{ab} \pm 1.20$	$66.88^{b} \pm 2.39$	$61.53^{a} \pm 0.95$
Neutral detergent fibre**	$44.26^{b} \pm 0.31$	$56.31^{d} \pm 0.63$	$47.07^{c} \pm 0.90$	$41.84^{a} \pm 0.70$
Acid detergent fibre**	$36.76^{ab} \pm 0.40$	$44.77^{c} \pm 0.93$	$37.69^{b} \pm 1.26$	$34.53^{a} \pm 0.79$
Hemi cellulose**	$61.67^{a} \pm 0.69$	$75.15^{c} \pm 0.64$	$69.93^{b} \pm 0.65$	$61.84^{a} \pm 0.90$
Cellulose**	$48.13^{a} \pm 0.80$	$61.45^{b} \pm 0.22$	$46.35^{a} \pm 1.39$	$48.16^{a} \pm 1.03$
Nutrient intake (g /kg $W^{0.75}$)				
DCP intake	6.89 ± 0.14	7.19 ± 0.20	6.96 ± 0.31	6.33 ± 0.12
TDN intake*	$38.71^{ab} \pm 1.17$	$42.92^{c} \pm 1.55$	$41.89^{bc} \pm 1.40$	$37.49^{a} \pm 0.71$
Nutritive value				
DCP (%)**	$9.17^{b} \pm 0.09$	$9.57^{c} \pm 0.07$	$9.16^{b} \pm 0.11$	$8.41^{a} \pm 0.09$
TDN (%)**	$51.52^{b} \pm 0.26$	$57.10^{d} \pm 0.39$	$55.20^{c} \pm 0.78$	$49.80^{a} \pm 0.48$

^{abcd} values in the rows bearing different superscripts differ significantly. *P<0.05; **P<0.01

Table 4 - Effect of feeding complete rations on intake and balance (g / d) of N, Ca and P in buffalo bulls

Particulars	CR1	CR2	CR3	CR4
Nitrogen, g/d				
Intake	130.47	130.77	131.45	129.46
N outgo, g/d				
In Faeces	63.72	64.66	63.08	63.56
In Urine**	15.89^{a}	14.79^{a}	17.23^{b}	14.89^{a}
Total	79.61	79.45	80.30	78.44
N balance				
g/d	50.86	51.31	51.14	51.01
Percent of intake	38.98	39.24	38.91	39.40
Percent of absorbed**	76.19^{b}	77.63^{c}	74.81^{a}	77.42^{bc}
Calcium, g/d				
Intake	54.21	55.23	54.95	55.54
Ca outgo, g/d				
In faeces *	35.93^{a}	37.17^{ab}	37.92^{b}	36.39^{a}
In Urine**	3.90^{a}	3.77^{a}	4.47^{b}	5.28^{c}
Total**	39.83^{a}	40.94^{ab}	42.39^{b}	41.67^{b}
Ca balance				
g/d*	14.38^{b}	14.29^{b}	12.56^{a}	13.88^{ab}
Percent of intake*	26.53^{b}	25.87^{b}	22.85^{a}	24.99^{ab}
Percent of absorbed**	78.65^{b}	79.12^{b}	73.67^{a}	72.40^{a}
Phosphorus, g/d				
Intake	28.90	29.63	29.37	28.65
P outgo, g/d				
In faeces	11.12	11.82	11.81	11.40
In Urine**	5.80^{a}	6.19^{ab}	6.70^{bc}	7.04^{c}
Total	16.92	18.00	17.56	17.25
P balance				
g/day	11.97	11.63	11.81	11.40
Percent of intake	41.43	39.25	40.20	39.78
Percent of absorbed**	67.33^{c}	65.25^{bc}	63.80^{ab}	61.78^{a}

^{abcd} values in the rows bearing different superscripts differ significantly. *P<0.05, **P<0.01.

All the buffalo bulls were in positive balance for nitrogen, calcium and phosphorus (Table 4) indicating that the complete rations fed to buffalo bulls met the requirements. Further, this might be due to better utilization of these minerals due to uniform supply of required nutrients by complete feeds. Positive N, Ca and P balances were reported by Rekhate et al. (2008) in goats, Pandya et al. (2009) in crossbred calves and Suresha et al. (2009) in

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goats fed complete ration. The nitrogen retention expressed as % absorbed was higher (P<0.01) in CR2 compared to CR1 and CR3 while, no significant difference was observed among CR2 and CR4. These results corroborated with the findings of Raja Kishore (2012) who reported higher (P<0.01) N retention in maize stover based complete ration compared to either red gram straw or black gram straw based complete rations. High N retention observed in buffalo bulls fed CR2 might be due to better digestibility of nutrients leading to optimal utilization of dietary N by rumen microbes (Reddy et al., 2002) or poor quality of nitrogen in other crop residues (Sihag et al., 2008). The calcium retention expressed as % absorbed was higher (P<0.01) in CR2 compared to CR3 and CR4 while, no significant difference was observed between CR1 and CR2. Similar observation was reported by Raja Kishore (2012) in buffalo bulls. However, the phosphorus retention expressed as % absorbed was higher (P<0.01) in CR1 compared to CR3 and CR4 while, no significant difference was observed between CR1 and CR2.

CONCLUSION

It is concluded that maize stover was superior roughage source among the locally available crop residues considered for inclusion in complete rations of buffalo bulls.

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