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Full Length Article

Evaluation of Sugarcane as Alternate Fodder Source for Sahiwal Bull Calves during Fodder Scarcity Season in Pakistan

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ABSTRACT

This study was conducted to evaluate the substitution of sugarcane for conventional feeding regimes in Sahiwal bull calves. Twelve Sahiwal male calves aged of 12-14 months with an average weight of 95.5 kg were divided into four groups. Four groups having three experimental animals in each were randomly allotted to different feeding regimes; berseem (*Trifolium alexandrinum*) 70% and wheat straw (*Triticum aestivum*) 30% (T_0), berseem 70% and sugarcane tops 30% (T_1), berseem 70% and oat 30% (T_2) and berseem 70% and sugarcane (*Saccharum officinarum*) tops 30% (T_3) to justify the completely randomized design for a period of sixty days. All the groups were offered *ad-libitum* feeding. Two weeks digestion trial was conducted at the end of feeding trial (six weeks). For all four feeding regimes dry matter intake (DMI) was 2.68 in each treatment. The daily water intake (DWI) was 2.34, 3.04, 2.68 and 2.53 L in T_0, T_1, T_2 and T_3, respectively. Statistical analysis of the data for DMI and DWI did not show any significant ($P>0.05$) difference among the various groups. The data for daily weight gain (DWG) were 0.26, 0.43, 0.47 and 0.28 kg, in T_0, T_1, T_2 and T_3, respectively. The performance of the animals in terms of weight gain was significantly ($P<0.05$) better in T_1 and T_2. The feeding regime T_1 having sugarcane tops proved to be the better ration in terms of economical gain. Sugarcane included feeding regime T_3 showed poor performance as compare to T_1 and T_2. In conclusion, sugarcane tops may be kept on supplementing with seasonal fodder up to 30% for the economical weight gain. As the predominant system of livestock production in Pakistan is integration into crop agriculture and subsistence level. It was concluded that the valuable cash crops may not be preferred to be used as fodder crops.

Key Words: Sugarcane tops; *Avena sativa; Trifolium alexandrinum;* Sahiwal calves

INTRODUCTION

Agriculture occupies a key position in the national economy (25% of GDP) of Pakistan. This single sector is providing about 50% of the total employment in the country. Livestock has grown out as the biggest sub-sector of agriculture and is contributing 49.6% of the agricultural GDP (Anonymous, 2006-07). More than 65% of the national population is living in rural areas and livestock farming has been a symbol of prestige and well being in rural culture. It has been surveyed that about 35 million rural families are directly involved in livestock raising and deriving 30-40% of their incomes from it (Anonymous, 2006).

Average livestock holdings are reported in 2-5 cattle per household, which becomes > 80% of the total livestock population of the country in this herd size (Anonymous, 2006) and a subsistence level of farming. The animals serve as "Live Bank" for the farmers, from where they fulfill their emergent needs. The past policies to place more emphasis on crop agriculture has led to starch rich, protein poor diets (malnutrition) especially for poor communities in developing countries. At present the availability of animal protein in Pakistan (20.2 g) indicating a shortage of about 30%. The per capita availability of meat in the Pakistan is 19.8 kg, which is far below when compared with the values of developed countries viz., 125 kg in USA, 115 kg in Australia, and 107 kg in Canada (FAO, 2006). The demand for livestock products has been increasing with a high growth rate (6%); mainly due to population growth (2%), urbanization and increase in per capita income (4%), respectively. The uneven (33%) economy in the country has further widening the gap in balanced food (demand: availability) in poor classes of the people. Economic development demands elimination of dietary deficiencies, thus improving the overall nutritional status of the country's population. It demands qualitative as well as quantitative changes in the production and marketing of livestock products by processing for value addition. It has been estimated that there is big demand in livestock farming to cope with the national and export market in Asia, hence to alleviate the poverty through economic development at local level. The shortage of livestock products may be attributed to non commercialized farming.

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Livestock is taken as secondary priority in the prevailing an integrated system of agriculture in the country. This part of world is enriched with indigenous livestock genetic resource, well adapted to the local environment and well spread through out the country. Unstable fodder supply associated with nutritional imbalances, ultimately lead to lowered health and production (Sarwar *et al.*, 2002). Present feed balance sheet indicates a deficiency both in energy (26%) and protein (38%). Two permanent fodder scarcity periods (severe winter & severe summer) have been realized since long in Pakistan. During the fodder scarcity season farmers traditionally have no choice other than to feed their valuable cash crops like sugarcane and wheat just to sustain their family farm animals. New emerging livestock farmers are using sugarcane with the understanding as the most nutritious fodder for dairy animals. There would hardly be found an agricultural family involved in crops production and having no livestock. No doubt that the primary intention of an agricultural farmer is to cultivate land for cash crops and hence livestock feeding is depended on crop residues produced and or supplemented with if some fodder is available. Little land is spared for fodder production in an integrated system of agricultural farming.

Poor livestock production is attributed to meager feed resources and poor management systems (Afzal, 2006). Crop residues and other agricultural by-products in addition to the post-harvest or grazing on marginal lands are the main feeding avenues in an integrated agricultural farming system. The animals are deficient both in energy and protein. It has also been realized that in Pakistan two permanent scarcity periods are prevailing (i.e., severe winter & severe summer). Farmers are compelled to feed even their agricultural cash crops like wheat and sugarcane just to sustain the body needs of dairy animals or other livestock. Sugarcane is the second biggest crop in this country and hence significant amount of sugarcane tops are also produced, while harvesting the crop in the season of fodder scarcity. Livestock farmers believe that sugarcane is the only nutritious fodder in the crunch period when berseem and oats are not in abundance. Little literature is available on the nutritive quality of sugarcane or sugarcane tops as fodder. This study was planned to know the effect of sugarcane, sugarcane tops in comparison with berseem + wheat straw, and berseem + oats the seasonal feeding regimes in Sahiwal bull calves.

MATERIALS AND METHODS

The experiment was conducted at the Livestock Experiment Station; University of Agriculture, Faisalabad, Pakistan. Animals, green biomass stall and lab facilities of the livestock experiment station were used. Some laboratory facilities of Institute of Animal Nutrition and Feed Technology were also used. The feeding trial was run for a period of seven weeks (Feb- April, 2006).

Experimental animals. Twelve Sahiwal bull calves were selected from Sahiwal herd maintained at livestock experiment station of the University. All of the selected animals were vaccinated with Ivomec before start of experiment for the control of both ecto and endo-parasites. Experimental animals were also vaccinated against the contagious diseases like hemorrhagic septicemia and foot and mouth disease.

Experimental design. Animals were blocked by BW into 4 blocks, i.e., Group 1 (G1), Group 2 (G2), Group 3 (G3), Group (G4) and four treatments as T_0, T_1, T_2 and T_3 were allotted randomly. The calves were managed in individual pens and in a completely randomized design.

Feeding trial. Four rations were prepared having berseem as the basis (seasonal fodder) for all ration formulation. A basal ration (T_0) was prepared having 70% berseem and 30% wheat straw. In T_1 berseem 70% and 30% sugarcane tops; T_2, berseem 70% and oats 30%, and in T_3 berseem 70% and 30% whole sugarcane were used. The feed was offered *ad-libitum* to each animal according to the plan, after each six hours interval daily. The feeds were prepared daily at the rate of 3.5% of body weight of the experimental animals.

Daily feed intake. Feed was offered *ad-libitum* according to respective schedule. Feeding frequency was three times in a day. Feed intake was calculated by subtracting the refusal from the offered. Samples both from feed offered and feed refused were taken for proximate analysis.

Water intake. The water was provided *ad-libitum* to each individual. Fresh water was replaced to each individual two times in a day (8:00 & 2:00 pm). The remaining amount of water was considered as a refuse. The consumption was calculated by subtracting the refusal from water offered.

Weight gain. Weight gain was determined by weighing animals on weekly basis and by subtracting the initial form the final.

Digestibility trial. This trial was conducted using two animals randomly selected from each group. A protocol was as five days adjustment period and eight days of collection period (Maynard & Loosli, 1973). The digestibility coefficient for dry matter, crude protein, crude fiber and ether extract were calculated as described by Reaves and Henderson (1969).

Chemical analysis. The ration remaining in the mangers were collected early in the morning and collected samples were weighed and considered as refusal. The ration 1, 2, 3 and 4 (both offered & refused) were chemically analyzed for proximate composition (AOAC, 1990).

Economic gain and FCR. Economic gain and feed conversion ration was calculated by cost per kg feed formulated in each group and feed consumed per unit gain, respectively for individual animal in each group.

Statistical analysis. Data collected throughout the experimental period was subjected to analysis of variance (Steel & Torrie, 1984). The means were compared for significance ($P<0.05$) values by using Tukey's test. The Minitab statistical package was used to draw the valid conclusion for the said purpose.

RESULTS AND DISCUSSION

The average daily weight gain (DWG), dry matter intake (DMI), water intake (WI), feed conversion ratio (FCR) and digestibility of various feeds allotted to respective groups were noted in the study.

Dry matter intake (DMI). Average daily DMI was 2.680, 2.685, 2.685, 2.672 kg in T_0, T_1, T_2 and T_3, respectively (Table II). The analysis of variance showed non-significant difference (P>0.05) in DMI among the Sahiwal calves fed on different feeding regimes (roughages). It might be due to the high DM content (20.17%) and high in palatability in the feeding regime B (75% berseem & 25% Sugarcane tops) and hence more DMI accordingly. Results of the present study are in line with Defoor *et al.* (2002), Sugimoto *et al.* (2003) and Kincheloe *et al.* (2003), Gelvin *et al.* (2004), Gleghorn *et al.* (2004) and Nelson *et al.* (2004) who reported non-significant differences in daily dry matter intake of calves maintained on different forage based rations. Gorocica and Loerch (2005) also reported that in feedlot rations cattle had more DMI in high forage diets than on low forage in total mixed rations.

Water intake (WI). The average WI in different experimental group was 2.337, 3.004, 2.680 and 2.526 L in T_0, T_1, T_2 and T_3, respectively (Table II). The analysis of variance showed a significant (P<0.05) difference in water intake per day among Sahiwal calves fed on different levels of roughages. The average water intake per week per animal in different experimental group was 16.111, 19.104, 19.62 and 19.256 L in A, B, C and D groups, respectively. The results of the study showed that there were significant difference (P<0.05) in the water intake per week in group T_0 (A) than other groups T_1, T_2 and T_3 (B, C & D). As the water contents in berseem was very high and low DM as compare to other feeding regimes, the DMI and ADG were better in group B and C. The WI may be associated with the increased DM content of the feed and rate of DMI and body weight gain. The results of the present study are inline with those of Loneragan *et al.* (2001) who observed that a significant ($P < 0.01$) amount of variation in water intake were observed with BW, DMI and water sulfate concentration.

Maximum water intake per day was observed in group B, where 70% berseem and 30% sugarcane tops were fed but the significant difference were observed in groups B, C and D than group A. However, they took more water in later weeks as the weather kept on changing with raise in temperature. Other factors that may explain a significant ($P < 0.01$) variation in water intake were BW, DMI, water quality, barometric pressure, wind speed and humidity (Loneragan *et al.*, 2001, Patterson & Johnson, 2003; Johnson *et al.*, 2004).

Daily weight gain (DWG). The DWG per animal in different experimental groups was 0.258, 0.435, 0.476 and 0.258 kg in T_0, T_1, T_2 and T_3, respectively (Table II). The analysis of variance showed significant (P<0.05) difference in DWG among the male calves maintained on different feeding regimes. The average weekly weight gain was 1.810, 3.048, 3.333 and 2.000 kg in T_0, T_1, T_2 and T_3, respectively. The analysis of variance showed a significant (P<0.05) difference in total weight gain among the male

Table I. Proximate composition of different feeding regimes

Items%	T_0 (A)	T_1 (B)	T_2 (C)	T_3 (D)
Moisture %	61.18	79.18	84.28	76.78
DM%	38.82	20.82	15.72	23.22
CP%	14.65	15.80	17.60	14.84
E.E%	2.18	2.33	2.27	2.49
C.F%	24.52	21.87	19.66	26.35
Ash%	11.94	11.27	13.12	11.70

T_0: *Trifolium alexandrinum* 70% +*Triticum astivum* (wheat straw) hay 30%.
T_1: *Trifolium alexandrinum* 70% + sugarcane top 30%.
T_2: *Trifolium alexandrinum* 70% + *Avena sativa* 30%.
T_3: *Trifolium alexandrinum* 70% + *Saccharum officinarum* 30%.

Table II. Average DMI, WI, Weight gain, FCR and Cost per kg affected by different feeding regimes

Items	T_0	T_1	T_2	T_3
A. Wt	95.33 ± 1.52^{a}	96.00 ± 1.0^{ab}	98.0 ± 3.2^{ac}	96.0 ± 1.0^{ad}
DMI	2.68 ± 0.38^{a}	2.68 ± 0.2^{ab}	2.68 ± 0.3^{ac}	2.67 ± 0.39^{ad}
W.I/day	2.33 ± 0.30^{a}	3.004 ± 1.4^{b}	2.68 ± 0.5^{ac}	2.52 ± 0.41^{ad}
W.I/ Week	16.11 ± 1.7^{a}	19.11 ± 3.4^{b}	19.10 ± 3.6^{bc}	19.26 ± 2.5^{bd}
DWG	0.258 ± 0.1^{a}	0.44 ± 0.1^{b}	0.47 ± 0.2^{bc}	0.28 ± 0.11^{ad}
WGW	1.81 ± 0.68^{a}	3.05 ± 1.1^{b}	3.33 ± 1.2^{bc}	2.00 ± 0.77^{ad}
FCR	8.13 ± 1.01^{a}	7.83 ± 1.1^{ab}	8.38 ± 1.1^{ac}	9.24 ± 0.74^{d}
Cost (Rs. kg^{-1})	21.96 ± 2.7^{a}	18.8 ± 2.7^{b}	31.51 ± 4.2^{c}	27.54 ± 2.2^{d}
DMD	77.47 ± 1.85^{a}	78.19 ± 0.93^{ab}	85.61 ± 3.20^{c}	65.26 ± 2.89^{d}

Fig. 1. Average water intake (L) per day, per week per group

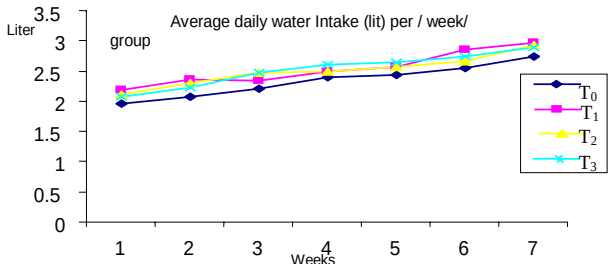
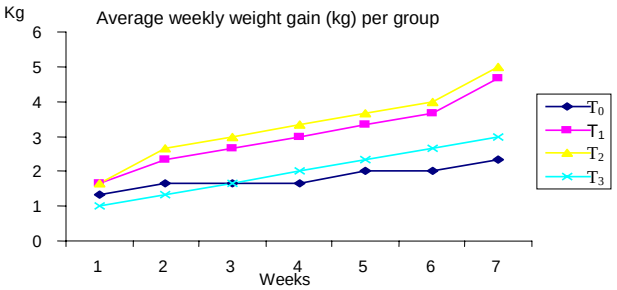


Fig. 2. Average weight gain (kg) per group per week



calves maintained on various feeding regimes. Calves in T_2 showed highest ($P<0.05$) weight gain followed by group T_1, which were significantly ($P<0.05$) different from group T_0 and T_3. The calves in group T_0, andT_3 gained lowest weight as compared to group T_1, and T_2. It might be due to poor DMI, WI and DMD, as it contained high proportion of wheat straw (with poor digestibility). Low levels of CP and digestibility could be the reason that these two groups T_0 and T_3 had lower gain than group T_2 and T_1, which had 17.60% CP and 75.64% CPD. This might be due to 30% wheat straw un-treated having high lignocellulose's bonding with poor digestibility in T_0.

Poor performance of the calves maintained on T_3 might be due to poor access to rind and or pith in whole sugarcane included in this regime. Calves maintained on the diet T_2 (17.60% CP) had greater ADWG and weight gain per week (WGW) than the other three groups. This showed that higher level of energy and protein in the diet increases the growth rate of calves. However, non-significant ($P>0.05$) differences were observed in group C and B in weight gain but significantly ($P<0.05$) differs from group A and D. The findings are in accordance with those of Farmer *et al.* (2001), French *et al.* (2001), Kyum *et al.* (2003) and Gleghorn *et al.* (2004), Capucille *et al.* (2004) who reported significant differences in DWG of claves used in their experiments as well.

Feed conversion ratio (FCR). The average FCR was 8.13, 7.834, 8.38 and 9.24 kg in T_0, T_1, T_2 and T_3, respectively. There was non-significant difference ($P>0.05$) in feed conversion ratio among T_0, T_1 and T_2 groups. The calves on group T_1 had the lowest FCR 7.834 and significantly ($P<0.05$) differed from the calves in group T_3 (Table II). The values for FCR in group T_3 were significantly ($P<0.05$) higher than the other groups. Animals maintained in group T_2 having 70% berseem and 30% oats had gained higher ADG as well as over all total gain per week than the other three groups and hence proved to be more efficient in terms of weight gain. This might be due to the higher crude protein content (17.60% CP) than the groups T_0, T_1 and T_2 having 14.71%, 15.80% and 14.84% CP contents as reported in various otherstudies (Veira *et al.,* 1994; Coverdale *et al.,* 2004; Gelvin *et al.,* 2004; Gleghorn *et al.,* 2004; Brown *et al.,* 2005).

Digestibility trial. The average dry matter digestibility (DMD) per animal in different experimental groups was 77.47, 78.19, 85.61 and 65.26 in T_0, T_1, T_2 and T_3, respectively. The feeding regime T_2 and T_3 showed a significant ($P<0.05$) difference from other two groups T_0 and T_1. DMD was significantly ($P<0.05$) higher in T_2 where 70% berseem and 30% oat having good quality of energy and protein as compared than other groups. The poor ($P<0.05$) digestibility was observed in T_3 in which 30% sugarcane was used, which posed a barrier in the form of rind and pith of sugarcane stalk to digest with poor nitrogen content in it.

Economical gain. The costs of one kg live weight gain in group A, B, C and D were 21.962, 18.802, 31.511 and 27.538 rupees, respectively. The minimum cost of production was (Rs. 18.80) in group B (70% berseem + sugarcane tops 30%). The Sahiwal calves maintained in group C (70% berseem + 30% wheat straw) was proved to be 31.51 Rs. kg^{-1} gains, the most expensive one amongst the all groups. The animals maintained in group T_0, had lowest feed gain ratio, hence cost per kg gain was increased. The DM content in T_2 was lower than the other three groups and cost of the ingredients was highest; hence lowered the economical gain. Thus for an economical production of meat, sugarcane tops may be supplemented with leguminous fodders up to 30% in forage feeding system for Sahiwal cattle.

CONCLUSION

For economical production of meat, crop residues like sugarcane tops may be supplemented with seasonal fodders up to 30% in forage feeding system rather instead of the cash crops like sugarcane.

REFERENCES

Afzal, M., 2006. Key note address. *In*: "*National Conference on Investment Opportunities in Livestock Sector"*, pp: 10–9. N.A.R.C. Islamabad

Anonymous, 2006. *Economic Survey of Pakistan*. Government of Pakistan, Economic Advisor's Wing, Finance Division, Islamabad

AOAC, 1990. *Official Methods of Analysis of Association of the Analytical Chemists*, 15th edition. Arlington Virginia, USA

Brown, E.G., M.J. VandeHaar, K.M. Daniels, J.S. Liesman, L.T. Chapin, D.H. Keisler and M.S.W. Nielsen, 2005. Effect of increasing energy and protein intake on body growth and carcass composition of heifer calves. *J. Dairy Sci*., 88: 585–94

Coverdale, J.A., H.D. Tyler, J.D. Quigley and J.A. Brumm, 2004. Effect of various levels of forage and form of diet on rumen development and growth in calves. *J. Dairy Sci*., 87: 2554–62

Capucille, D.J., M.H. Poore and G.M. Rogers, 2004. Growing and finishing performance of steers when fed recycled poultry bedding during the growing period. *J. Anim. Sci*., 82: 3038–48

Defoor, P.J., M.L. Galyean, G.B. Salyer, G.A. Nunnery and C.H. Parsons, 2002. Effects of roughage source and concentration on intake and performance by finishing heifers. *J. Anim. Sci.*, 80: 1395–404

FAO, 2006. *FOA, Statistical Year Book*. www.faostatisticalyearbook2006fao.org

Farmer, R.C., Cochran, D.D. Simms, E.A. Klevesahl, T.A. Wickersham and D.E. Johnson, 2001. The effects of several supplementation frequencies on forage use and the performance of beef cattle consuming dormant tallgrass prairie forage. *J. Anim. Sci.*, 79: 2276–85

French, P., E.G.O. Riordan, P.O. Kiely, P.J. Caffrey and A.P. Moloney, 2001. Intake and growth of steers offered different allowances of autumn grass and concentrates. *Anim. Sci*., 72: 129–38

Gorocica, B.M.A. and S.C. Loerch, 2005. Effect of cattle age, forage level and corn processing on diet digestibility and feedlot performance. *J. Anim. Sci*., 83: 705–14

Gleghorn, J.F., N.A. Elam, M.L. Galyean, G.C. Duff, N.A. Cole and J.D. Rivera, 2004. Effects of crude protein concentration and degradability on performance, carcass characteristics and serum urea nitrogen concentrations in finishing beef steers. *J. Anim. Sci*., 82: 2705–17

Gelvin, A.A., G.P. Lardy, S.A.N. Soto, D.G. Landblom and J.S. Caton, 2004. Effect of field pea-based creep feed on intake, digestibility, ruminal fermentation, and performance by nursing calves grazing native range in western North Dakota. *J. Anim. Sci*., 82: 3589–99

Johnson, P.S., H.H. Patterson and R. Haigh, 2004. *Effects of Sulfates in Water on Performance of Steers Grazing Rangeland*, pp: 41–45. South Dakota State University Beef Report

Kincheloe, J.J., J.G.P. Bowman, L.M.M. Surber, D.L. Boss, K.A. Anderson and T.K. Blake, 2003. Effects of barley or corn on performance and digestibility in finishing diets. *In: Proceedings, Western Section, American Society of Animal Science*, Vol. 54

Kyum, M.K., S.M.E. Rahman, M.R. Islam, M.S.I. Khan and A. Sultana, 2003. A study on the growth performance of crossbred growing bull calves fed by supplementing molasses with straw based diets and conventional concentrates. *Online J. Biol. Sci.*, 3: 26–31

Loneragan, G.H., J.J. Wagner, D.H. Gould, F.B. Garry and M.A. Thoren, 2001. Effects of water sulfate concentration on performance, water intake and carcass characteristics of feedlot steers. *J. Anim. Sci*., 79: 29–41

Maynard, L.A. and J.K. Loosli, 1973. *Animal Nutrition*, 6th edition, p: 347. Tata McGraw Hill Publishing Company Ltd., Bombay, New Delhi

Nelson, M.L., D.J. Marks, J.R. Busboom, J.D. Cronrath and L. Falen, 2004. Effects of supplemental fat on growth performance and quality of beef from steers fed barley-potato product finishing diets: I. Feedlot performance, carcass traits, appearance, water binding, retail storage and palatability attributes. *J. Anim. Sci.*, 82: 3600–10

Patterson, T. and P. Johnson, 2003. Effects of water quality on beef cattle. *In: Proceedings, the Range Beef Cow Symposium XVIII*. December 9, 10, and 11, Mitchell, Nebraska

Reaves, P.M. and H.O. Henderson, 1969. *Dairy Cattle Feeding and Management*, 5th edition, p: 25. Wiley Eastern Pvt. Ltd., New Delhi

Sarwar, M., M.A. Khan and Z. Iqbal, 2002. Feed resources for livestock in Pakistan. *Int. J. Agric. Biol*., 4: 186–92

Steel, R.G.D. and U.H. Torrie, 1984. *Principal and Procedures of Statistical: A Biometrical Approach*, 2nd edition. 182 McGraw hill Book Co. Inc, New York, USA

Sugimoto, M., S. Kuzuoka, C. Yayota and Y. Sato, 2003. Effects of supplemental protein sources during the grazing period on performance, ruminal characteristics and blood constituents in early weaned growing Wagyu steer calves. *J. Anim. Sci*., 74: 303–11

Veira, D.M., G. Butler, J.G. Proulx and L.M. Poste, 1994. Utilization of grass silage by cattle: effect of supplementation with different sources and amounts of protein. *J. Anim. Sci.*, 72: 1403–8

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