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Full Length Article

Nutritional Evaluation of Sugarcane Tops in Conventional Feeding Management System during Fodder Scarcity Season of Pakistan

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ABSTRACT

The study was planed to evaluate the substitution of sugarcane tops for different conventional feeding regimes in Sahiwal male calves. Nine Sahiwal entire male calves ranging in age of 12-14 months with an average weight of 95 ± 2.12 kg were divided into three groups in a completely randomized design. Berseem (*Trifolium alexandrinum* L.) 80% and wheat straw (*Triticum aestivum* L.) 20% was taken as basal ration (T_0), while in T_1 berseem 75% and sugarcane tops 25%; and in T_2 berseem 80% and oats (*Avena sativa* L.) 20% were used, respectively. All the groups were allowed for *ad-libitum* feeding according to the experimental plan. Two weeks digestion trial was conducted at the end of feeding trial (six weeks). The average dry matter intake (DMI) was 2.56, 2.59 and 2.70 kg in T_0, T_1 and T_2, respectively. Average daily water intake (DWI) was 1.14, 1.29 and 1.43 L in T_0, T_1 and T_2, respectively. Data for DMI and DWI did not show any significant ($P>0.05$) difference among the various groups. However, the DMI^{-1} $kg^{-0.75}$ in calves on different feeding regimes was 0.08, 0.09 and 0.07 kg in T_0, T_1 and T_2, respectively The DMI^{-1} $kg^{-0.75}$ showed a significant ($P<0.05$) difference among the treatments. Maximum DMI^{-1} $kg^{-0.75}$ was found in T_1 (0.09 kg) and it significantly ($P<0.05$) differed from other two (T_0 & T_2) groups. Minimum DMI^{-} $kg^{-0.75}$ was found in T_2 (0.07 kg), which differed significantly ($P<0.05$) from the other two (T_1 & T_0) groups. The data for daily weight gain (DWG) were 0.17, 0.40 and 0.49 kg, in T_0, T_1 and T_2, respectively. There was also significant ($P<0.05$) difference in feed conversion ratio among the groups. The calves in T_1 had the lowest FCR 11.05, while the calves in T_2 had the highest FCR 14.08. The feeding regime (T_1) having sugarcane tops proved to be the best ration in terms of economical gain. T_0 having wheat straw showed significantly ($P<0.05$) poor performance in terms of weight gain as compared to T_1 and T_2.

Key Words: Sugarcane tops; Oats; Berseem; Wheat straw; Fodder scarcity; Sahiwal calves

INTRODUCTION

The indigenous livestock resources comprised of 27.3 million buffaloes, 29.6 million cattle, 26.5 million sheep and 53.8 million goats in addition to 0.9 million camels in Pakistan (Anonymous, 2007). Despite of the large number of livestock, per capita availability of beef and mutton in the county (21 kg) is far below as compared with the values of developed countries viz., 125 kg in USA, 115 kg in Australia, and 107 kg in Canada (FAO, 2006). The overall availability of animal protein (20.2 g) in this country showed a shortage of about 30%. The demand for livestock products is continuously increasing (6%) in the region. The buffalo and cow male calves are the potential source of beef in this country as there is no special beef breed in the country. It has been estimated that if the calves produced in the country are raised up to the live weight of 300 kg or up to the age of two years, the indigenous production of beef may be doubled. The Sahiwal breed of cattle is very popular for milk and meat production (dual purpose) in Pakistan The average daily weight gain in Sahiwal calves is better (800 g) with good feed efficiency (4.77) and impressive economical gain in improved management systems. The animals are deficient both in energy and protein in Pakistan. For the nutritional requirements of animals have to rely mainly upon fodder, shrubs, grasses and agro-industrial waste (Sarwar *et al*., 2002). Straws and other dry roughages are the major contributors in the feeding of livestock in this country. Sugarcane is the 2nd biggest crop and significant amount of sugarcane tops are produced, while harvesting the crop during the winter fodder scarcity season in Pakistan. It has been realized that sugarcane tops can support the fodder deficiency in severe winter by mixing with other seasonal fodder like berseem (*Trifolium alexandrinum*) and oats (*Avina sativa*). Thus the present study was planned to study the utilization of sugarcane tops in conventional forage based ration in sahiwal bull calves for beef production.

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MATERIALS AND METHODS

Experimental designs. The study was carried out at the Livestock Experiment Station; University of Agriculture Faisalabad. Nine Sahiwal male calves were identified from university herd for the said research project. The calves were managed in individual pens. All the animals were vaccinated against the seasonal diseases. Calves were treated with s LG- Evectin for the control of parasites. Animals were blocked by body weight (BWt) into three groups and allotted three treatment rations as T_0, T_1 and T_2, randomly in such a way that overall average weight in each group remained the same to justify a completely randomized design. The feeding trial was run for a period of 63 days (Feb- April, 2006).

Feeding trial. A basal ration (T_0) having *berseem* 80% and wheat straw 20% was prepared to serve as the control, while in ration T_1 berseem 75% and sugarcane tops 25%; and in ration T_2 berseem 80% and oat 20% were used The rations were offered *ad-libitum* to each animal according to the plan, after every eight hours interval daily.

Data collection. The first two week of the study served as adjustment period. The data were collected on daily feed intake, water intake daily and weight gain weekly. The average daily weight gain (DWG) and feed conversion ratio were also calculated during the feeding trial.

Daily feed intake. Feed was offered *ad-libitum* according to respective schedule. Feeding frequency was three times in a day. The quantity of feed remaining in the feeders was weighed daily and amount of feed consumed was determined. Samples both from feed offered and feed refused were taken for dry matter analysis. Dry matter both of control (T_0) and treatment feed (T_1 & T2) was also used to calculate the next offer for *ad-libitum* feeding on dry matter basis through out the experimental period.

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

Weight gain. Calves were weighed at the start of experiment and weakly intervals thereafter. Daily weight gain was also calculated by dividing the weekly weight over seven (number of days).

Digestibility trail. The digestibility trial was conducted using two animals randomly selected from each group at the end of feeding trial. Feed and faecal samples were collected for eight days. The faecal output was recorded daily at 8:00 am. The faeces were dried at 65°C for proximate analysis. The dried faecal samples were ground and analyzed for dry matter, crude protein, crude fiber and ether extract as per the procedure described in the publication by the AOAC (1990). The digestion trial was run to determine the digestibility of different feeds as described previously (Maynard & Loosli, 1973). The digestibility coefficient for dry matter, crude protein, crude fiber and ether extract were calculated as per the formula described by Reaves and Henderson (1969).

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

Chemical analysis. The ration remaining in the mangers were collected early in the morning and collected samples were weighed and considered as refusal. The samples of the feed offered and refused were also analyzed for the calculation of nutrient retention. The ration used in T_0, T_1 and T_2 (Table I) were chemically analyzed for proximate composition (AOAC, 1990).

Statistical analysis. The data collected through experiment were subjected to analysis of variance techniques (Steel & Torrie, 1984). The means were compared for significant ($P<0.05$) or ($P<0.01$) values by using Tukey's test. The Minitab statistical package was used to draw the valid conclusion.

RESULTS AND DISCUSSION

Dry matter intake. The average daily dry matter intake (DMI) was 2.56, 2.59 and 2.70 kg in T_0, T_1 and T_2, respectively (Table II). The analysis of variance showed non-significant difference ($P>0.05$) in DMI among the various feeding regimes. The DMI^{-1} $kg^{-0.75}$ showed a significant difference ($P<0.05$) among the groups. The DMI^{-1} $kg^{-0.75}$ of calves on different feeding regimes was 0.08, 0.09 and 0.07 kg in T_0, T_1 and T_2, respectively. Minimum DMI^{-1} $kg^{-0.75}$ was found in T_2 (0.07 kg) and it differed significantly ($P<0.05$) from the T_1 and T_0. There was wheat straw 20% on dry matter basis, which increased the crude fibre (cellulose) in this feeding regime, hence lowered the palatability and digestibility in calves. Maximum ($P<0.05$) DMI^{-1} $kg^{-0.75}$ was found in T_1 (0.09 kg), which significantly ($P<0.05$) differed from the other two (T_0 & T_2) groups. It might be due to the high DM content (20.17%) and palatability in the respective feeding regime T_1 (75% berseem and 25% sugarcane tops), hence, more DMI accordingly. This might also be due to type of cellulose that influenced the desirable fermentation in the rumen, rate of passage rumen to intestine (MacDonald *et al.*, 1995). Palatability and digestibility might have positive correlation for DMI (Orskov, 1992). Results of the present study are also 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 in their experiments. The results are in agreement with those reported by Petit and Flipot (1992) who further explained that the type and method of forage conservation and source of protein supplementation affected the DMI in Hereford steers. French *et al.* (2001) also supported the above findings that the different types of grasses had no effect on intake but the source of concentrate supplementation affected the DMI.

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. The average water intake in different experimental group was 1.14, 1.29 and 1.43 kg in feeding regimes T_0, T_1 and T_2, respectively. The analysis of variance showed a non-significant (P>0.05) difference in water intake among the groups. The average water intake per kg dry matter intake (WI^{-1} kg DMI) in calves on T_0, T_1 and T_2 were 0.46, 0.52 and 0.56 L, respectively. The analysis of variance showed a non-significant (P>0.05) difference in WI^{-1}kg DMI among calves fed on different rations. The results of the study showed that there were no difference (P>0.05) in the water intake in different groups. The minimum WI^{-1} kg DMI was observed in T_0, where 80% berseem and 20% wheat straw on dry matter basis was used. As the water contents in berseem was very high and low in DM content as compared to other feeding regimes, hence lowered WI^{-1} kg DMI was observed in T_0. The WI may be associated with the DM content and type of the feed. The rate of DMI might have more demand for WI the results of the present study are inline with those of Loneragan *et al.* (2001) who explained that a significant variation in water intake were observed with BW, DMI and salt concentration. However, maximum water intake was observed in treatment T_2, where 80% berseem and 20% oat was fed but the difference in all groups were not significant (P>0.05). However, overall an increase in water intake had been observed with time; as the weather temp was keep on increasing with time. Other factors explaining significant ($P < 0.01$) variation in water intake would be the BWt, DMI, water quality, barometric pressure, wind speed and humidity as described by earlier worker Loneragan *et al.* (2001), Patterson and Johnson (2003) and Johnson *et al.* (2004).

Weight gain. The average daily weight gain (ADWG) per animal was 0.17, 0.40 and 0.49 kg, in T_0, T_1 and T_2 experimental regimes, respectively. The analysis of variance showed a significant (P<0.05) difference in DWG among the various feeding regimes. The average weekly weight gain was 1.20, 2.83 and 3.43 kg in groups T_0 T_1 and T_2, respectively. The analysis of variance showed a significant (P<0.05) difference in total weight gain among calves maintained on various feeding regimes. Animals in T_2 showed highest (P<0.05) weight gain followed by T_1 and significantly (P<0.05) differed from T_0. It might be due to higher digestibility, DMI, type of protein and feed conversion efficiency in that particular feeding regime (Farahpour, 2002). The calves in T_0, showed minimum weight gain as compared to T_1, and T_2. It might be due to less DMI, DMD, CPD and WI with high proportion of wheat straw in the T_0. Calves fed on the diet T_2 (18.26% CP) had greater average weekly weight gain (AWG) than the other two T_0 and T_1. It might be due to high DMI and better DMD accordingly with a palatable ration for cattle. T_0 and T_1 had 16.32 and 16.40% CP with CPD 68.44 and 70.50%, respectively. The lower level of CP in T_0 and T_1 may be the other reason for lowered ADG. Calves maintained on T_2 had 18.28% CP with 75.64% CPD. It has been showed that higher level of protein content in the diet along with higher DMI increased the growth rate of experimental animals in feeding regime T_2. However, non-significant (P>0.05) differences were observed in T_2 and T_1 with respect to weight gain but significantly (P<0.05) differed from T_0 regime. The findings of the study are in accordance with those of Farmer *et al.* (2001), French *et al.* (2001), Kyum *et al.* (2003), Gleghorn *et al.* (2004) and Capucille *et al.* (2004) who reported significant differences in daily weight gain of claves in their experiments.

Table I. Proximate analysis of different rations

Items%	T_0	T_1	T_2
DM%	13.10	20.17	15.76
CP%	16.32	16.40	18.28
E.E%	2.33	2.40	2.70
C.F%	22.50	21.30	19.31
Ash%	12.10	11.50	12.80

T_0: *Trifolium alexandrinum* 80% +*Triticum astivum* straw 20%
T_1: *Trifolium alexandrinum* 75% + Sugarcane tops 25%
T_2: *Trifolium alexandrinum* 80% + *Avena sativa* 20%

Table II. DMI, DMI^{-1} $kg^{-0.75}$, WI and ADG affected by different feeding regimes

Parameter	T_0	T_1	T_2
DMI^{-1}day	2.56 ± 0.432^{a}	02.58 ± 0.39^{ab}	2.69 ± 0.46^{ac}
$DMI^{-1}kg^{-0.75}$	0.08 ± 0.01^{b}	0.09 ± 0.01^{c}	0.07 ± 0.01^{a}
WI (Lit)	1.14 ± 0.43^{a}	1.29 ± 0.49^{ab}	1.43 ± 0.81^{ac}
WI^{-1} kg DMI	0.46 ± 0.20^{a}	0.52 ± 0.22^{ab}	0.56 ± 0.36^{ac}
ADG(kg)	0.17 ± 0.14^{a}	0.40 ± 0.27^{b}	0.49 ± 0.31^{bc}
B. Wt.$kg.^{-0.75}$	31.23 ± 1.26^{a}	28.27 ± 2.54^{b}	37.22 ± 3.75^{c}
WG $(kg)^{weekly}$	1.20 ± 0.96^{a}	2.83 ± 1.88^{b}	3.43 ± 2.19^{bc}
FCR	12.46 ± 1.71^{a}	11.05 ± 1.09^{b}	14.08 ± 2.09^{c}

Table III. Average digestibility in different feeding regimes

Parameters	T_0	T_1	T_2
DM	77.47 ± 1.85^{a}	78.19 ± 0.93^{ab}	85.61 ± 3.19^{c}
CP	68.44 ± 1.75^{a}	70.50 ± 2.70^{ab}	75.64 ± 2.03^{c}
CF	69.46 ± 1.69	70.56 ± 1.56	70.42 ± 2.28
EE	70.93 ± 4.55	73.77 ± 1.66	72.60 ± 2.56

Digestibility. The digestibility coefficients for different feed nutrients of the three diets are presented in Table III. The average dry matter digestibility (DMD) was 77.47, 78.19 and 85.61% for the diet T_0, T_1 and T_2, respectively. The crude protein digestibility (CPD) was better (75.64%) in T_2 consisting of 80% berseem and 20% oats than the T_0 and T_1 (68.44 and 70.50%). It might be due to the more palatable constituents of the ration.

Orskov (1992) also described that animals adapted to the conventional rations showed a high digestibility along with high intake as compared to non conventional feeds. The difference in dry matter digestibility and crude protein digestibility were significant (P<0.05). The crude fiber digestibility (CFD) was 69.46, 70.42 and 70.42% in the diets T_0, T_1 and T_2, respectively. The ether extract digestibility was 70.93, 73.77 and 72.60% of diet T_0, T_1 and

T_2, respectively. However, the diets did not differ in crude fiber and ether extract digestibility. The variation in CPD in different feeding regimes may be due to the type of nitrogen and rate of degradation in non conventional feeding regimes (Van Soest, 1965; Kandil & El-Shaer, 1990).

Feed conversion ratio. Average feed conversion ratio was 12.458, 11.05 and 14.08 kg in T_0, T_1 and T_2, respectively. There was a significant difference ($P<0.05$) in feed conversion ratio among the groups. The calves in T_1 had the lowest FCR 11.05 and the calves in T_2 had the highest FCR 14.08. The calves in T_1 were fed on diet 75% berseem and 25% sugar cane tops having highest DM % in the ration and highest DMI^{-1} $kg^{-0.75}$, whereas the water intake was also higher in T_1. Calves maintained in T_2 were fed on diet 80% berseem and 20% oats; having 18.26% CP diet had greater ADG; total gain per week and $^{-0.75}$ kg BWt. than the other two groups T_0 and T_1 having 16.32% and 16.40% CP in diets, which in conformity with the previous studies (Veira *et al.,* 1994; Coverdale *et al.,* 2004; Gelvin *et al.,* 2004; Gleghorn *et al.,* 2004; Brown *et al.,* 2005).

CONCLUSION

The findings of the discussed research revealed that the crop residues like sugarcane tops could be a potential source of fodder and successfully can substitute the shortage of feed stuff in fodder scarcity season in Pakistan. They provide marvelous results in terms of economical weight gain when mixed with leguminous fodder like berseem in winter scarcity season. The crop residue and agro-industrial waste should not be wasted but may be utilized to feed the livestock in mixed form with other conventional fodder for the economical gain.

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