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A Note on the Response of Sheep to Differently Priced Sorghum Stover Traded Concomitantly and Implications for the Economy of Feeding

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ABSTRACT

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One low cost and two premium type sorghum stover purchased from fodder market in Hyderabad, India were investigated for Organic matter intake (OMI), organic matter digestibility (OMD) and organic matter intake and digestible organic matter intake (DOMI) with feeding trials on sheep. The average price of low cost stover was IRs 2.04 per kg dry stover while the premium stover types were priced at IRs3.40. Premium stover had consistently more favourable laboratory quality traits (nitrogen, fiber constituents, *in vitro* digestibility and metabolisable energy content). When fed to sheep unsupplemented, significantly higher digestibility, digestible organic matter intake and nitrogen balances were observed in premium type compared to low cost stover. The same held true when the three stover types were fed supplemented with a flat rate of 150 g/d of concentrate. However, economic assessment suggested that the price premiums of 50% and more paid for high quality stover were in excess unless their feeding facilitated overall increased intake and milk yield per dairy animal proportionally, decreasing feed expenditure for maintenance requirements.

Key words: Sorghum stover, Quality traits, Fodder, Economy.

INTRODUCTION

Sorghum stover is the major source of dry fodder for urban and peri-urban dairy production in Hyderabad, India (Tesfaye, 1998). The stover are traded extensively by fodder shops throughout the city and shops offer different types of stover at the same time at different prices; the purchaser has usually the choice between two types of stover and sometimes more. Blümmel and Rao (2006) surveyed six major stover traders monthly from 2004 to 2005 and following laboratory analysis of the stover observed that stover

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in vitro digestibility accounted for about 75% of the variation in stover prices, though other factors like season and location of the trader affected pricing. The poorest (47% *in vitro* digestibility) and best (52% *in vitro* digestibility) quality stover were sold on average for 3 and 4 IRs /kg dry stover, respectively, suggesting a price premium for quality stover of more than 30 per cent. The present work tested response in sheep fed differently priced sorghum stover unsupplemented and in another trial supplemented with a flat rate of concentrate the latter reflecting approximately the level of concentrate feeding in dairies in and around Hyderabad (Tesfaye, 1998).

MATERIALS AND METHODS

Three different cultivars of sorghum stover (*Telangana, Raichur and Andhra*) were purchased from two traders in July 2004 and from three traders in May 2006. Several 100 kg of each stover - which were sold in chopped form – were purchased and packed in Hessian bags and transported to ILRI livestock nutritional facilities located at ICRISAT in Patancheru where the stover were air-dried prior to the feeding trials.

Representative stover samples were collected from each Hessian bag and analyzed for nitrogen content by Kjehldal, neutral and acid detergent fiber and acid detergent lignin by Goering and Van Soest (1970) and for *in vitro* digestibility and metabolisable energy by Menke and Steingass (1988).

Male growing Deccani sheep housed in metabolic cages facilitating urine and faeces collection were used in the feeding trials. Two feeding trials were conducted, the first one with the batches of stover purchased in 2004 and which were fed as sole feed and the second one with the batches purchased in 2006 which were fed supplemented with a flat rate of 150g (133 g DM) of concentrate. All stover were offered *ad libitum* allowing for about 15% of refusal. Groups of sheep were balanced according to live weight and 6 sheep were allocated to any one treatment. Sheep were adjusted to a treatment for two weeks followed by a 10-days urine and faeces collection period.

Analysis of variance and differences between treatment were analyzed with the General Linear Model procedure of SAS (1988) for the data shown in the tables.

RESULTS AND DISCUSSION

The two traders at Azampura and Amberpet sampled in July 2004 each offered the same low cost stover type (*Telangana*) at the same fresh price of IRs1.70 /kg which translated into IRs 2.08 and 2.06 per kg dry stover, respectively, even though the traders had obtained their *Telangana* stover from different batches and sources. Each trader had at the same time also one premium stover on offer, sold at a fresh rate of IRs2.80 (type *Andhra*) and IRs3.0 (type *Raichur*) per kg which translated into IRs3.04 (*Andhra*) and IRs3.60 (*Raichur*) per kg dry stover, respectively (Table 1). In other words the premium charged for higher quality stover were 46% at Azampura market and 75% at Amberpet. Compared to the premium stover *Andhra* and *Raichu*r, both *Telangana* stover showed lower nitrogen content and higher fiber constituents NDF, ADF and ADL (Table 1). In

Table 1. Costs of different types of sorghum stover collected in 2004 from two traders and their corresponding nitrogen (N), neutral (NDF) and acid (ADF) detergent fiber, acid detergent lignin (ADL), *in vitro* organic matter digestibility (IVOMD) and metabolisable energy (ME) content

Trader	Cultivar	Purchase	Price fresh	Price dry	N	NDF	ADF	ADL	IVOMD	ME
			(Indian Rupees/kg)		% of dry strover					MJ/kg
Azampura	Telangana	July 04	1.70	2.08	0.6	80.7	44.6	5.7	38.6	5.56
Azampura	Andhra	July 04	2.80	3.04	1.1	69.0	36.2	3.2	49.6	7.12
Amperbet	Telangana	July 04	1.70	2.06	0.6	79.2	43.0	6.5	42.4	6.07
Amperbet	Raichur	July 04	3.00	3.60	0.9	73.0	37.0	3.8	43.8	6.19

addition, *in vitro* digestibility and metabolisable energy were higher in the premium stover. As observed by Blümmel and Rao (2006), when a trader offered choice between a low cost and a more expensive stover type, the latter had in most cases more favourable laboratory fodder quality traits. These findings are also in agreement with studies of farmer's perception about fodder quality differences in sorghum stover (Kelley and Parthasarathy Rao, 1994, Rama Devi *et al.,* 2000; Underwood *et al*. 2000, Parthasarathy Rao and Hall, 2003) where farmers were aware of cultivars-dependent fodder quality differences in sorghum stover.

The differences in laboratory fodder quality traits between low cost and premium stover were confirmed by the sheep feeding trials (Table 2). The premium stover *Andhra* and *Raichur* had significantly higher organic matter digestibility compared with the two *Telangana* stover (Table 2). *Andhra* stover had 7% higher organic matter digestibility than *Telangana* stover at Azampura shop while *Raichur* stover exhibited 6% higher digestibility than *Telangana* stover at Amberpet shop (Table 2). Kristjanson and Zerbini (1999) calculated that a one-percentage unit increase in digestibility in sorghum and pearl millet stover would result in increases in milk, meat and draught power outputs ranging from 6 to 8 per cent. According to these calculations, a difference in digestibility of 6 to 7% would equate to approximately 45% increase in animal production assuming a linear relationship between digestibility and animal output. While these estimates appear very high, they do broadly agree with the premiums of 46 to 75% paid for the higher quality stover.

Organic matter intake was significantly higher in *Andhra* stover with no significant differences observed between *Raichur* and *Telangana* stover. When purchased in July 2004, *Andhra* stover contained 1.1% nitrogen which meets the minimum microbial nitrogen requirement (Van Soest, 1994)

Table 2. Organic matter intake (OMI), organic matter digestibility (OMD) and organic matter intake and digestible organic matter intake (DOMI) relative to metabolic bodyweight when sorghum stover collected in 2004 were fed *ad libitum* as sole feed to sheep

Trader	Cultivar	OMD %	OMI g/d	OMI g/kg LW/d	DOMI g/kg LW/d	N-Balance g/d
Azampura	Telangana	50.9[b]	371[b]	19.7[b]	10.6[c]	-0.7[b]
Azampura	Andhra	57.0[a]	481[a]	25.7[a]	14.6[a]	1.9[a]
Amberpet	Telangana	52.1[b]	351[b]	18.9[b]	9.8[c]	-0.3[c]
Amberpet	Raichur	58.1[a]	401[b]	21.5[b]	12.5[b]	1.2[b]

[abc]Indicate significant difference between the treatments.

and which might explain the higher intake observed in this stover type compared to *Raichur*. The stover were fed unsupplemented and stover nitrogen contents might have exerted an effect on intake. Digestible organic matter intake was significantly higher in *Andhra* and *Raichur* than in *Telangana* stover. Nitrogen balances were positive in *Andhra* and *Raichur* fed sheep and negative in *Telangana* fed sheep (Table 2).

When purchased in 2006, stover prices were generally similar to 2004 (compare Table 3 and Table 1). Laboratory quality traits of *Telangana* stover were again inferior to the traits of the premium stover *Andhra* and *Raichur* however, nitrogen contents of these two stover were lower in 2006 (Table 4) than in 2004 and well beyond supporting minimum microbial nitrogen requirements. Blümmel and Rao (2006) reported considerable variation in stover nitrogen content within stover types which possibly explained the lack of correlation observed between stover nitrogen and stover price. Supplementation did not equalize the stover quality differences since *Andhra* and *Raichu*r treatments had 5.1 and 7.1% higher digestibility than observed in the *Telangana* treatment respectively and digestible organic matter intake and nitrogen balances were also significantly higher in the two premium stover.

Using standard livestock nutritional principals (McDonald *et al.,* 1988) and ME values of the stover (Table 3) and assuming gross energy values of 18.4 MJ/kg efficiencies

Table 3. Costs of different types of sorghum stover collected in 2006 from two traders and their corresponding nitrogen (N), neutral (NDF) and acid (ADF) detergen fiber, acid detergent lignin (ADL), *in vitro* organic matter digestibility (IVOMD) and metabolisable energy (ME) content

Trader	Cultivar	Purchase	Fresh	Dry	N	NDF	ADF	ADL	IVOMD	ME
			(Price INR/kg)		% (dry matter)					MJ/kg
Azampura	Telangana	May 2006	1.60	1.97	0.4	75.6	53.3	6.8	38.2	5.3
Azampura	Andhra	May 2006	3.00	3.60	0.4	70.3	48.0	5.2	46.4	6.74
Hitech	Raichur	May 2006	3.10	3.37	0.6	67.2	45.7	4.8	48.6	6.82

(k_m) for providing maintenance requirements by *Telangana, Andhra* and *Raichu*r stover can be calculated as 0.604, 0.631 and 0.633, respectively. From these k_m factors net energy content of *Telangana, Andhra* and *Raichur* stover for providing maintenance requirements can be calculated as 3.20, 4.25 and 4.32 MJ/kg, respectively. Sorghum stover traded in Hyderabad is exclusively used in dairy production. A 500 kg dairy animal which is about the weight of buffalos in the urban and peri-urban dairy systems around Hyderabad (Anandan *et al*., 2009) would require about 37 MJ net energy per day or 13.4, 10.0, 9.9 kg of *Telangana, Andhra* and *Raichu*r stover, respectively. These maintenance rations would come at a daily cost of IRs 26.4 (*Telangana*) 36 (*Andhra*) and 33.4 (*Raichu*r), respectively. Similar relationships can be calculated for milk production with k_l factors of 0.52, 0.548 and 0.550 and net energy contents for milk production of 2.76, 3.69 and 3.75 MJ/kg for *Telangana, Andhra* and *Raichu*r, respectively. Assuming energy content of buffalo milk to be 4.4 MJ/l, the production of 1 liter of milk would cost IRs3.14, 4.29 and 3.95 in *Telangana, Andhra* and *Raichu*r fed dairy, respectively. While simplified, on the surface these calculations appear to suggest that the premiums paid for *Andhra* and *Raichu*r stover are exaggerated. However, feeding of the premium stover will mitigate intake constraints allowing higher level of milk to be produced, proportionally lessening the feeding costs for maintenance requirements. These considerations are elaborated in Table 5 assuming an intake ceiling of 4% of live weight in dairy buffalo on stover based feeding regime (Anandan *et al*., 2009) and ignoring protein requirements while assuming that all energy is supplied by the sorghum stover. Even though *Telangana* stover is the cheaper fodder for maintenance and production overall benefits would be much higher on *Andhra* and *Raichur* fed animals because overall milk production would be higher and the economically unproductive feed costs for maintenance are proportionally reduced. In fact, fodder traders and dairy producers simply stated as reason for preference of Andhra and Raichur over Telangana stover that the animal are giving more milk when fed the former two stover. While the higher milk production would justify the higher prices for the premium fodder still more work is required to understand the choices of stover in the context of the overall feeding and dairy management system.

Table 4. Organic matter intake (OMI), organic matter digestibility (OMD) and organic matter intake and digestible organic matter intake (DOMI) relative to metabolic bodyweight when sorghum stover collected in 2006 were fed to sheep *ad libitum* on top of a flat rate of 133 g (DM) of concentrate

Trader	Cultivar	OMD %	OMI g/d	OMI g/kg LW/d	DOMI g/kg LW/d	N-Balance g/d
Azampura	Telangana	55.2[b]	473[b]	26.7b	14.7[b]	3.9[c]
Azampura	Andhra	60.7[a]	606[a]	29.9a	18.2[a]	5.0[a]
Hitech	Raichur	62.3[a]	515[b]	27.2[b]	17.0[a]	4.4[b]

[abc]Indicate significant difference between the treatments.

Table 5. Effects of energy intake level over maintenance requirements and resulting cost benefits estimates from milk sales assuming 500 kg dairy buffalo with a maximum intake potential of 4% of body weight fed entirely on different types of sorghum stover

Variable	*Telangana* stover	*Andhra* stover	*Raichur* stover
Intake potential (kg)	20.0	20.0	20.0
Stover requirement for maintenance (kg)	13.4	10.0	9.9
Intake capacity for milk production (kg)	6.6	10	10.1
Stover required for 1 kg of milk (kg)	1.59	1.22	1.17
Milk from stover intake capacity (kg)	4.15	8.20	8.63
Daily income from milk (IRs) [1]	104	205	216
Feed costs (IRs)	39.4	71.1	67.5
Net benefit (IRs) [2]	64.6	133.9	148.5

[1]Assuming a sales price of 25 IRs per liter of milk.

[2] without including other feed costs that would normally be fed in the same proportion along with the three types.

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