

Economic Value of Sorghum Stover Traded as Fodder for Urban and Peri-urban Dairy Production in Hyderabad, India

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Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] stover is the major source of dry fodder for urban and peri-urban dairy production in Hyderabad, India (Tesfaye 1998). Chopped stover is transported to Hyderabad in lorries from sorghum-growing regions as far away as 400 km. This is in addition to nonchopped stover coming in carts from places 50–100 km from the city. The purchaser usually has a choice between at least two types of stover. Fodder traders often name stover types after the regions from where they come, or the cultivar that is grown there. Anecdotal evidence and discussions with fodder traders suggested that stover prices vary — often from shop to shop at the same time — because of the cultivars and the cropping season (rainy or post-rainy). Stover selling, transporting, trading and its use in dairy production support the livelihood of many people from producers (farmers) to the end users. This study explored the economic value of sorghum stover in fodder trading and the relationship between stover price and quality.

Materials and Methods

Six major Hyderabad traders of chopped sorghum stover were sampled monthly from Nov 2004 to Nov 2005. Four replicate samples of 2500 g of each type of stover (of different quality, as claimed by the trader), were collected from the bottom, top, middle and side of the stover heap. The name of the stover type and its price and origin were recorded. After dry matter determination and grinding, the stover samples were analyzed for nitrogen content (used for crude protein estimation) and *in vitro* digestibility using a combination of conventional laboratory analysis with Near Infrared Spectroscopy (NIRS). The analysis of variance was carried out to detect differences if any for the prices of stover, crude protein (CP) content and *in vitro* digestibility of the stover samples. The relationship between the prices of stover types, their CP content and *in vitro* digestibility was assessed using linear regression analysis.

Results and Discussion

Price and type/origin of stover. The data presented here pertain to only those stover types that were clearly

identified by traders and traded by more than one trader. Based on these criteria, the stover samples were identified by region and cultivar: Andhra, Andhra Hybrid, Bellary Hybrid, Raichur, Rayalaseema and Telangana (Table 1). Two stover types from Andhra and Telangana regions were practically available round the year followed by Andhra Hybrid, which was available most of the time. Stover types Bellary Hybrid, Raichur and Rayalaseema were available from May to Sep. Stover from the Telangana region was offered at the lowest price of Indian Rs 2.3 kg⁻¹ in April 2005. The highest price of Indian Rs 4.3 kg⁻¹ was offered for Bellary Hybrid and Raichur stovers in Aug 2005 and for Andhra and Andhra Hybrid stovers in Oct 2005 (Table 1). The prices of most stover types were highest during Jul–Nov.

Traditionally sorghum fodder used to be brought to the Hyderabad market in cartloads from villages 50–100 km away. However, fodder shops are now trading sorghum stover from the other regions of Andhra Pradesh and from Karnataka and Maharashtra, which are 300–400 km away. Our discussions with fodder traders indicated that in the peak season daily arrivals of chopped stover range from 240 t to 350 t (35–40 lorry loads) while in the slack season arrivals range from 60 t to 150 t. The annual value of chopped sorghum stover (not counting the cart-transported stover from nearby villages) transported into Hyderabad was estimated to range from Indian Rs 140 million to 160 million (approximately US\$ 3–3.5 million). The growing demand for milk and therefore fodder has not only affected transport distances but also changed the grain-to-stover price ratio. The price of sorghum stover in Hyderabad's fodder markets in the late 1970s was about one-fourth of the grain price. Our survey during Nov 2004 to Nov 2005 indicated that the average price of sorghum grain in the wholesale grain markets around Hyderabad (Tandur, Mahabubnagar, Jedcherla, Jogipet) was about Indian Rs 6–7 kg⁻¹. The average sorghum stover price is now approximately half that of the average grain price.

Quality and type/origin of stover. The crude protein contents of all stover types were well below 7.5% (Table 2), the level widely considered as the minimum requirement for rumen microbes to efficiently digest the feed. The significant differences between the CP contents of stover

Table 1. Monthly availability and monthly mean price (Rs kg⁻¹) of sorghum stover of different cultivars traded by six fodder traders from Nov 2004 to Nov 2005 in Hyderabad, India.

Stover type/origin	Nov 2004	Dec 2004	Jan 2005	Feb 2005	Mar 2005	Apr 2005	May 2005	Jun 2005	Jul 2005	Aug 2005	Sep 2005	Oct 2005	Nov 2005
Andhra	3.4 (3) ¹	3.6 (3)	3.9 (3)	3.2 (6)	3.0 (3)	3.4 (1)	2.5 (1)	3.5 (1)	3.6 (3)	3.5 (1)	3.9 (1)	4.3 (2)	3.6 (1)
Andhra Hybrid				3.0 (3)	2.5 (5)	3.0 (5)	3.0 (4)	3.4 (3)	3.4 (1)	3.4 (3)	3.6 (3)	4.3 (1)	3.5 (2)
Bellary Hybrid							2.9 (2)	3.3 (2)	4.0 (1)	4.3 (1)	4.0 (1)		
Raichur							3.5 (1)	3.9 (1)		4.3 (1)			
Rayalaseema							2.7 (1)			3.7 (1)			
Telangana	2.5 (5)	3.2 (3)	3.4 (3)	3.4 (1)	2.5 (1)	2.3 (1)	2.7 (2)	3.6 (1)	3.8 (2)	3.2 (1)	3.0 (1)	3.3 (5)	3.0 (6)
LSD	0.3	0.3	0.3	0.5	0.2	0.2	0.2	0.3	0.4	0.2	0.4	0.6	0.3
P	<0.0001	<0.0001	0.006	0.28	<0.0001	<0.0001	<0.0001	0.01	0.25	<0.0001	0.0002	<0.0001	<0.0001

1. Figures in parentheses indicate the number of traders selling the stover type in a particular month.

Table 2. Estimates of crude protein content and *in vitro* digestibility of sorghum stover samples of various types collected from six fodder traders from Nov 2004 to Nov 2005 in Hyderabad, India.

Stover type/origin	Nov 2004	Dec 2004	Jan 2005	Feb 2005	Mar 2005	Apr 2005	May 2005	Jun 2005	Jul 2005	Aug 2005	Sep 2005	Oct 2005	Nov 2005
Crude protein content (%)													
Andhra	3.91	3.77	3.44	3.97	3.61	3.79	3.13	-	4.12	3.06	3.69	4.22	3.10
Andhra Hybrid	-	-	-	4.06	4.02	3.73	4.21	4.31	3.14	3.45	3.80	3.36	3.83
Bellary Hybrid	-	-	-	-	-	-	3.20	3.61	3.38	4.51	3.67	-	-
Raichur	-	-	-	-	-	-	2.95	2.60	-	3.17	-	4.03	-
Rayalaseema	-	-	-	-	-	-	3.28	-	-	2.94	3.10	-	-
Telangana	3.26	2.78	3.51	5.55	2.31	3.32	1.82	2.94	2.48	2.82	3.14	3.09	3.26
LSD	0.56	0.64	0.46	1.0	0.54	0.75	0.66	0.83	0.73	0.57	0.54	1.0	0.8
P	0.02	0.004	0.76	0.02	<0.0001	0.45	<0.0001	0.0002	0.0001	<0.0001	0.02	0.02	0.15
<i>In vitro</i> digestibility (%)													
Andhra	48.2	48.6	50.0	50.9	51.5	51.0	46.6	-	48.8	50.9	51.5	51.8	50.2
Andhra Hybrid	-	-	-	48.9	49.1	49.7	47.4	50.9	47.7	47.6	50.9	49.3	50.5
Bellary Hybrid	-	-	-	-	-	-	47.8	48.1	48.2	50.7	51.1	-	-
Raichur	-	-	-	-	-	-	50.5	52.1	-	52.4	-	49.8	-
Rayalaseema	-	-	-	-	-	-	48.5	-	-	48.8	51.9	-	-
Telangana	46.0	44.1	45.4	54.4	51.7	52.2	47.8	51.7	48.1	49.5	49.1	45.9	45.5
LSD	1.5	2.4	2.1	2.3	2.3	2.3	1.6	1.9	1.9	1.8	1.5	1.7	2.6
P	0.004	0.0007	0.0001	0.0006	0.01	0.05	0.002	0.0002	0.67	<0.0001	0.01	<0.0001	<0.0001

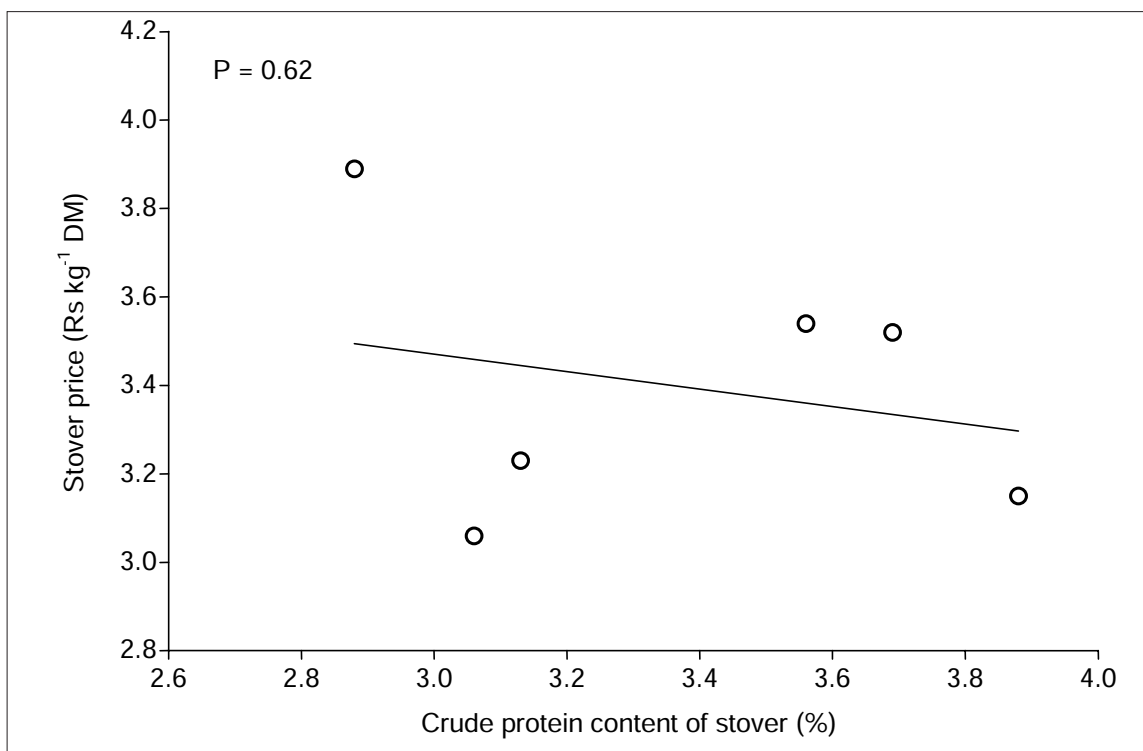


Figure 1. Relationship between crude protein content and price of stover.

types that were traded for most months suggest that the protein deficiency that needs to be addressed through supplementation will vary depending on the type of stover fed to the animal. Significant differences were noted for *in vitro* digestibility between stover types that were traded during all months except July. *In vitro* digestibility defines the proportion of a feed that can be utilized by the animal, and the difference between stover types collected in any one month varied approximately by 4–5 units except for July. The stover from different regions/cultivars differed significantly ($P < 0.0001$) for their offered prices, CP content, and *in vitro* digestibility (Table 3). However, trader, month and cultivar \times month interactions had all highly significant ($P < 0.0001$) effects. No significant relation ($P = 0.62$) was observed between stover crude protein content and the price (Fig. 1). In contrast, variations in *in vitro* digestibility accounted for 75% of the variations in stover prices (Fig. 2).

The difference of roughly 5 percentage units (range 46.9–51.7%) in *in vitro* digestibility between stover types was associated with a price difference of close to Indian Rs 1 kg⁻¹ (Table 3 and Fig. 2). It was shown for a wide range of cultivars that a 4–5 percentage unit difference in

in vitro digestibility is quite common in existing cultivars and could be increased further without a concomitant decrease in grain yields (Ravi et al. 2003; Reddy et al. 2005). Sellers and buyers are obviously not analyzing CP or digestibility, and stover quality assessments are largely empirical and sensual. Greenness, whiteness of stem pith and soft texture are sensual criteria often employed. However, these evaluation systems can fail at times, as it probably did with some of the types that were offered by a single trader. Almost immediate feedback about stover quality will become available as indicated by the changes in milk yield. Stover quality and price did not match in these cases and buyers' demand probably ceased quickly.

Conclusion

The high monetary value of sorghum stover clearly supports the concept of concomitantly improving grain yield and stover quality traits in sorghum improvement programs, and achieving 4–5 units' difference in stover *in vitro* digestibility is feasible without sacrificing grain yields.

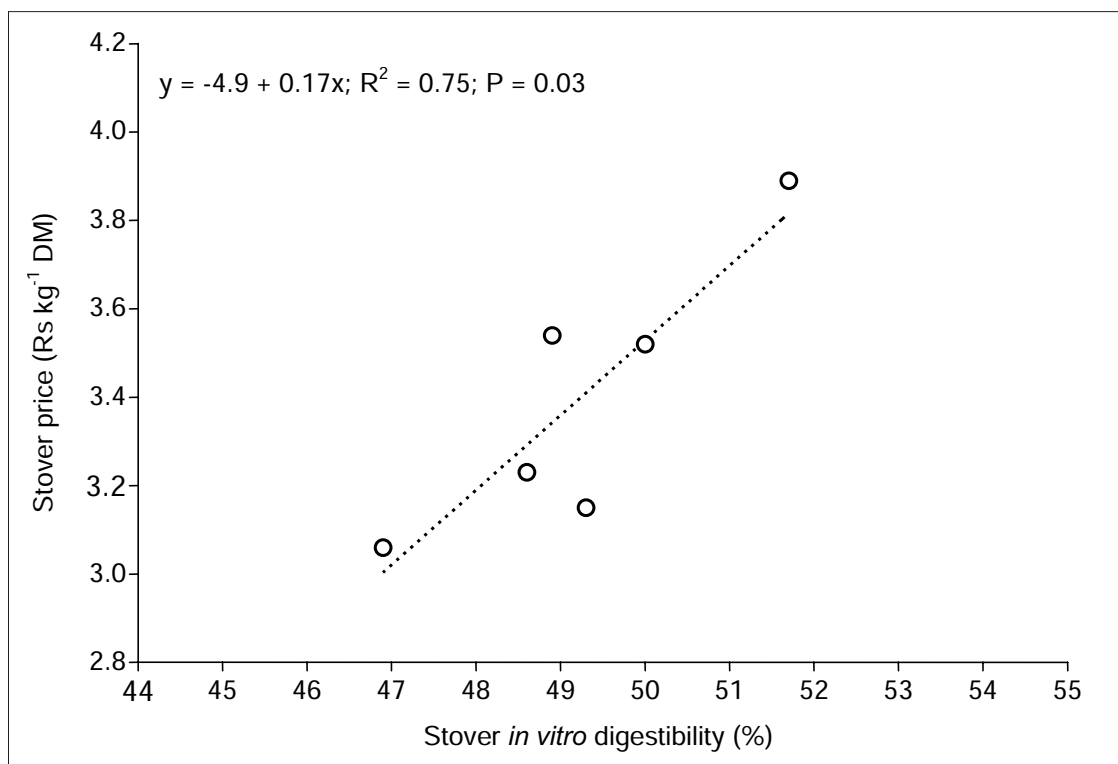


Figure 2. Relationship between *in vitro* digestibility and price of stover.

Table 3. Across-year mean values¹ for stover price, stover crude protein (CP) and *in vitro* digestibility.

Stover type	Price (Rs kg ⁻¹)	CP (%)	<i>In vitro</i> dig. (%)
Andhra	3.52 ^b	3.69 ^a	50.0 ^b
Andhra HB	3.15 ^{cd}	3.88 ^a	49.3 ^{bc}
Bellary HB	3.54 ^b	3.56 ^a	48.9 ^{bc}
Raichur	3.89 ^a	2.88 ^b	51.7 ^a
Rayalaseema	3.23 ^c	3.13 ^b	48.6 ^c
Telangana	3.06 ^d	3.06 ^b	46.9 ^d

1. Different superscripts indicate statistical differences.

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