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In vitro dry matter digestibility of selected forage sorghum silages as influenced by plant parts

Abstract
Eleven forage sorghum cultivars and one grain sorghum hybrid were used to determine the effect of individual plant parts on in vitro dry matter digestibility (IVDMD) of sorghum silage. IVDMD was highest for the head and lowest for the leaf sheath. When head and leaf blade parts were added to whole-plant material, IVDMD increased. When leaf sheath and stalk parts were added, IVDMD decreased, with the greatest decrease for leaf sheath. These results are consistent with an earlier study in our laboratory.

Keywords
Cattlemen's Day, 1994; Kansas Agricultural Experiment Station contribution; no. 94-373-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 704; Beef; Sorghum; Silage; Plant part; Digestibility

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IN VITRO DRY MATTER DIGESTIBILITY OF SELECTED FORAGE SORGHUM SILAGES AS INFLUENCED BY PLANT PARTS

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Summary

Eleven forage sorghum cultivars and one grain sorghum hybrid were used to determine the effect of individual plant parts on in vitro dry matter digestibility (IVDMD) of sorghum silage. IVDMD was highest for the head and lowest for the leaf sheath. When head and leaf blade parts were added to whole-plant material, IVDMD increased. When leaf sheath and stalk parts were added, IVDMD decreased, with the greatest decrease for leaf sheath. These results are consistent with an earlier study in our laboratory.

(Key Words: Sorghum, Silage, Plant Part, Digestibility.)

Introduction

We have shown in previous reports (KAES Reports of Progress 568, page 12 and 623, page 65) the tremendous variation in silage nutritive value traits among forage sorghum hybrids and varieties. Huge cultivar differences also occur in the proportion of plant parts (i.e., head, leaf blade, leaf sheath, and stalk) and their digestibility. Our objective was to continue to document the effect of the individual plant parts on the nutritive value of forage sorghum silages.

Experimental Procedures

Eleven forage sorghum cultivars and one grain sorghum hybrid (Table 1) were grown under dryland conditions near the Kansas State University campus in 1989. The agronomic and silage quality results were presented in the KAES Report of Progress 623, page 65. In addition, 10 whole plants of each cultivar were taken at the late-dough stage of kernel maturity and separated into head, leaf blade, leaf sheath, and stalk. The separated parts were chopped by hand with a knife to a length of about .4-inch. Approximately 400 g of each chopped plant part was placed in a nylon bag and ensiled in the center of the forage mass whole-plant material from the same cultivar in pilot-scale silos made from polyethylene-lined, 55-gallon barrels. The silos were opened 90 days postfilling, the ensiled plant parts were recovered, and the surrounding silage was sampled. The plant part and whole-plant silage samples were dried for 72 h and ground in a Wiley mill.

IVDMD of the ensiled plant parts, whole-plant silages, and reconstituted silages for the 12 sorghum cultivars were determined by the artificial rumen method of Tilley and Terry. Reconstituted silages were prepared by combining the four ensiled plant parts according to their respective proportions in the original whole-plant DM (Table 1). The weighted sum of the IVDMD of the ensiled plant parts also was determined and compared to the IVDMD of the whole-plant silage.

For five of the silages, plant parts were exchanged with whole-plant material in .05 g increments until all .5 g of the artificial rumen substrate was made up of the plant part. The rumen fluid used was from a fistulated, dry,

[1]Department of Statistics.

dairy cow fed a ration containing 80% forage sorghum silage on an as-fed basis.

Results and Discussion

The mean pH, DM content, and IVDMD for the ensiled plant parts are presented in Table 2. All three measurements were significantly different among the four plant parts. The head, which was the driest, had the highest pH, whereas the stalk, which was the wettest, had the lowest pH. IVDMD was highest for the head, whereas the leaf sheath was the least digestible. This trend occurred in all 11 grain-producing cultivars (data not shown).

The mean IVDMD for the whole-plant material was 57%, that for the reconstituted silages was 60%, and that for the sum of the ensiled plant parts was 58%. Differences between all three means were significant. The IVDMDs for both the reconstituted silages and sum of the ensiled plant parts were higher than the IVDMD of the whole-plant silages for all 12 cultivars (data not shown).

As shown in Figure 1, as head material was increased, digestibility increased. As leaf sheath material was increased, IVDMD decreased substantially. Leaf blade and stalk material had less effect on digestibility. The slope data in Table 2 show the results of pooling plant parts across cultivars and treating the data by regression. Positive values indicate that IVDMD increased as the plant part was added, and negative values indicate that IVDMD decreased. Thus, much of the difference in digestibility between forage sorghum cultivars probably can be explained by the percentage of dry matter from leaf sheath.

Table 1. Plant Part Proportions for the 12 Sorghum Cultivars

	Plant Part[2]			
Cultivar[1]	Head	Leaf blade	Leaf sheath	Stalk
DeKalb 42Y	69.7	12.1	8.3	9.9
Oro Kandy Kane	60.8	11.0	6.8	21.4
Rox Orange	58.3	9.9	6.7	25.1
DeKalb FS5	45.0	15.9	8.7	30.4
Pioneer 947	48.4	17.8	10.0	23.8
Northrup King 300	45.5	21.7	12.8	20.0
DeKalb FS25E	22.6	22.6	11.2	43.6
Funk's 102F	39.4	20.3	13.0	27.3
Funk's G1990	0	34.0	15.7	50.3
GA T-E Silomaker	33.4	19.5	14.0	33.1
Garst 333	31.3	19.4	11.8	37.5
Seed Tec Hi-Energy II	33.1	18.1	9.8	39.0
Mean	40.6	18.5	10.8	30.1

[1]DeKalb 42Y is a grain sorghum hybrid and GA T-E is Golden Acres Taylor-Evans.
[2]Plant part proportions are expressed as a % of the whole-plant DM.

Table 2. Mean pH, DM Content, IVDMD, and Slope Parameter Estimates for the Ensiled Forage Sorghum Plant Parts

Plant Part	pH	DM Content	IVDMD	Slope[1]
		%	%	
Head	4.42[a]	53.9[a]	64.8[a]	16.2[a]
Leaf blade	4.32[a]	28.2[b]	57.1[b]	4.2[b]
Leaf sheath	3.92[b]	25.0[b]	46.4[d]	-23.4[d]
Stalk	3.75[c]	19.0[c]	53.7[c]	-3.5[c]
SE	.047	1.21	.62	1.80

[abcd]Means within a column with unlike superscripts differ at $P < .05$
[1]Change in IVDMD per g increase in the respective plant part in the artificial rumen substrate.

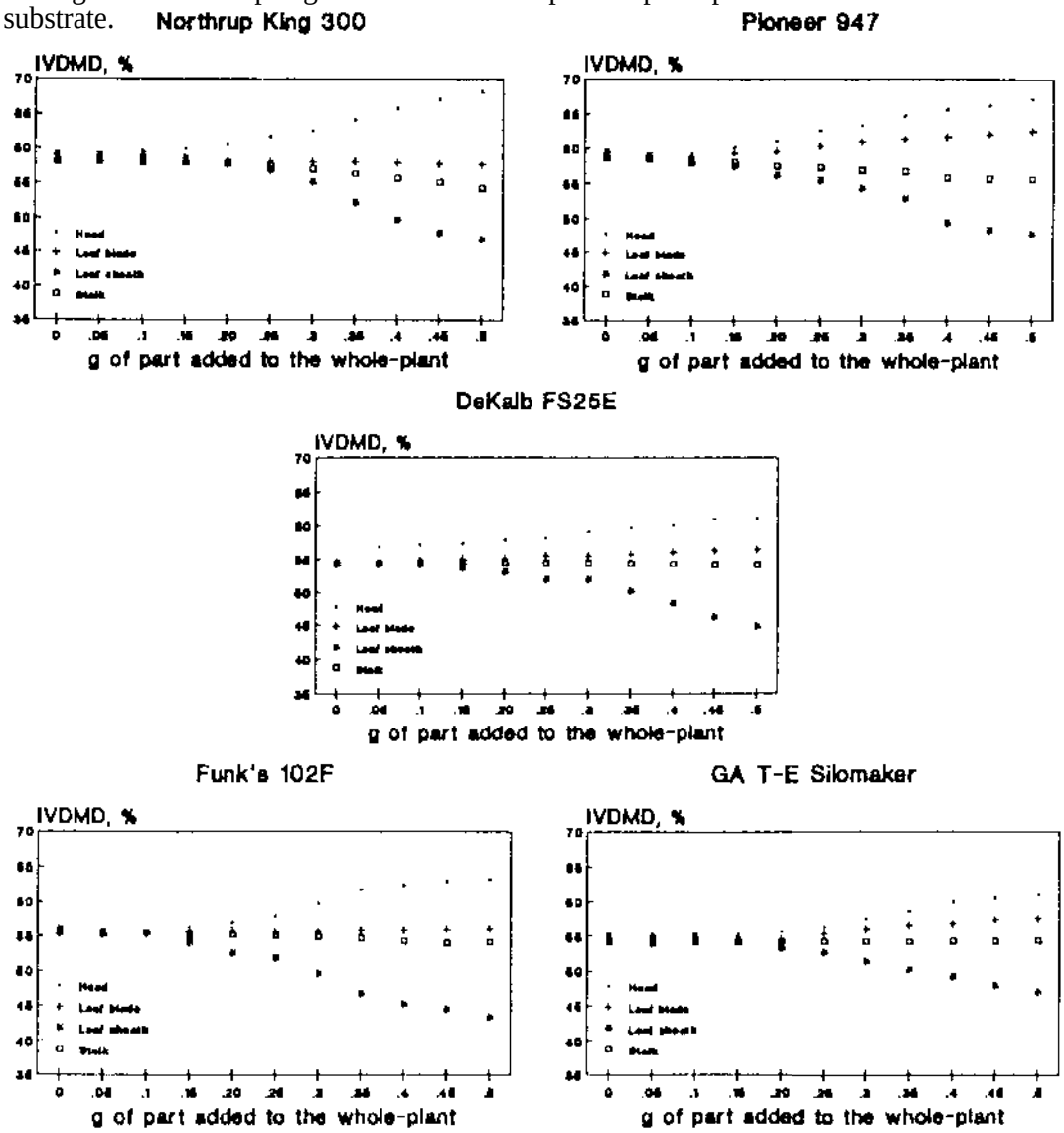

Figure 1. Influence of Plant Parts on IVDMD of the Five Forage Sorghum Hybrids