# Influence of Endosperm Type On the Nutritive Value Of Grain Sorghum and Corn

C. A. Hibberd, R. Schemm and D. G. Wagner

## Story in Brief

The nutritive value of several varieties of grain sorghum and corn was studied utilizing *in vitro* dry matter disappearance and *in vitro* gas production procedures. IVDMD studies indicate that corn is the most digestible, white-bird resistant the least digestible and white-normal, hetero-yellow and waxy endosperm types intermediate in value. Moreover, hetero-yellow and waxy types appear superior to white-normal sorghum. Gas production studies indicate that white-bird resistant sorghum exhibits the lowest degree of starch availability. These studies demonstrate that there is a significant difference in digestibility of various grain varieties when dry, finely ground. Environmental conditions during the growing season may influence the nutritive value of sorghum, although this is not very clear.

## Introduction

Improved utilization of grain sorghum as an energy source for ruminants has been of concern to beef producers for some time. Due to the prevailing water shortage and fuel costs in western portions of the Midwest and in the Southwest, grain producers are likely to be increasing sorghum production as a viable alternative to corn. This means more sorghum will likely be available for feeding.

Past research has generally shown that grain sorghum has a lower feeding value than corn. Several processing methods have been shown to enhance the digestibility of grain sorghum. Moreover, some research has shown that there is a difference in feeding value between various varieties of grain sorghum. Such studies indicate that it would be feasible to initiate sorghum breeding programs to improve the nutritive value of grain sorghum. Improved processing methods and genetic selection should permit more efficient utilization of sorghum. The purpose of this research was to investigate certain nutritive characteristics of several varieties of grain sorghum differing in endosperm type and corn.

## Materials and Methods

Several grain sorghum varieties differing in endosperm type were grown at the Perkins Agronomy Research Station, and several varieties of corn were

grown at the Panhandle Agronomy Research Station. All sorghum varieites were planted, grown and harvested under similar dryland conditions in two consecutive years. All corn varieties were planted, grown and harvested under similar irrigated conditions in the same two consecutive years. Varieties grown and the endosperm classification are illustrated in Tables 1 (Year I) and 2 (Year II). The grains were all finely ground through a 20 mesh screen prior to evaluation.

The chemical composition of the grains was determined using conventional procedures. *In vitro* dry matter disappearance (IVDMD) of the grains was determined utilizing strained rumen fluid inoculum. Percent dry matter disappearance was determined after 24 hr of incubation.

*In vitro* gas production was also utilized to determine the starch availability of the various grains. This method involves yeast fermentation of sugars released by enzyme attack on the starch. The ground sample, an enzyme solution (amyloglucosidase) and commercial baker's yeast were placed in Ehrlenmeyer flasks, connected to an inverted buret gas recovery system. The gas produced by the yeast during fermentation was measured as milliliters of gas per gram of dry sample. The more gas produced, the greater is the digestibility.

## Results and Discussion

The chemical composition of the grains is illustrated in Tables 3 (Year I) and 4 (Year II). All of the sorghums were much higher in protein content than corn. Significant differences were obtained in both years. In general, the differences were small among the various sorghum endosperm types, but differences of 1.0 percent CP or more did exist. Figure 1 illustrates the IVDMD trends for the Year I crop. Corn had a significantly higher IVDMD ($P<.05$) than the sorghums. Dry, finely ground white-bird resistant sorghum was much more poorly digested ($P<.05$), and the waxy, white-normal and hetero-yellow endosperm types were intermediate in value. The data also illustrate that waxy sorghum tends to be the most digestible, although the difference was not significant at the .05 level.

IVDMD values for the second crop are illustrated in Figure 2. Similar trends as noted in Year I were observed. Corn was significantly more digestible ($P<.05$) than all the sorghum endosperm types. Among the sorghums, white-bird resistant was again significantly lower ($P<.05$) than all the others, and white-normal, hetero-yellow and waxy were intermediate in value. The white-normal endosperm was significantly lower ($P<.05$) than hetero-yellow and waxy types, indicating that this endosperm type is less desirable than either the hetero-yellow or waxy type.

In general, *in vitro* gas production studies also showed the white bird resistant endosperm type to have the lower starch availability in both years. The high tannin content of the bird resistant varieties of grain sorghum may hinder starch digestibility.

**Table 1. Descriptive characteristics and classification of the grains (Year I)**

| Variety | Seed coat color | Endosperm | | | Classification |
|---|---|---|---|---|---|
| | | Color | Hardness | Waxy or normal | |
| Pioneer corn 3149 | Colorless | Yellow-corn | Yellow dent corn | Normal | Corn |
| Pioneer corn 3306 | Colorless | Yellow-corn | Yellow dent corn | Normal | |
| Darset (bird resistant) | Brown | White | Intermediate | Normal | White-BR |
| Soft endo | Brown | White | Soft | Normal | White-normal |
| Redlan normal | Red | White | Intermediate | Normal | |
| OK 612 | Red | Hetero-yellow | Intermediate | Normal | Hetero-yellow |
| Dwarf redlan | Red | White | Intermediate | Waxy | Waxy |

**Table 2. Descriptive characteristics and classification of the grains (Year 2)**

| Variety | Seed coat color | Endosperm | | | Classification |
|---|---|---|---|---|---|
| | | Color | Hardness | Waxy or normal | |
| Pioneer corn | Colorless | Yellow corn | Yellow dent corn | Normal | Corn |
| Northrup king corn | Colorless | Yellow corn | Yellow dent corn | Normal | |
| Darset (bird resistant) | Brown | White | Intermediate | Normal | White-BR |
| Soft endo | Brown | White | Soft | Normal | White-normal |
| Redlan Normal | Red | White | Intermediate | Normal | |
| OK 612 | Red | Hetero-yellow | Intermediate | Normal | Hetero-yellow |
| Dwarf redlan | Red | White | Intermediate | Waxy | Waxy |
| 73BCT 1126 | White | Yellow | Intermediate | Waxy | |
| 73BCT 1133-2 | Brown | Yellow | Intermediate | Waxy | |
| 733CT 1122-2 | Red | Yellow | Intermediate | Waxy | |

**Table 3. Whole grain composition[a] (Year I)**

| Endosperm type | Percentage | | |
|---|---|---|---|
| | Protein | Ether extract | Ash |
| Corn | 9.56[a] | 5.36 | 1.70 |
| White-BR | 12.80[b] | 3.28 | 1.36 |
| Waxy | 13.12[b] | 1.27 | 1.90 |
| Hetero-yellow | 12.90[b] | 2.00 | 1.19 |
| White-normal | 14.26[b] | 1.30 | 2.14 |

[a]Dry matter basis

**Table 4. Whole grain composition[a] (Year II)**

| Endosperm type | Percentage | | |
|---|---|---|---|
| | Protein | Ether Extract | Ash |
| Corn | 9.40[a] | 6.72 | 1.73 |
| White-BR | 12.02[b,c] | 4.24 | 2.18 |
| Waxy | 13.54[b] | 5.08 | 2.78 |
| Hetero-yellow | 11.61[c] | 4.04 | 1.98 |
| White-normal | 11.48[a,b,c] | 5.48 | 2.25 |

[a]Dry matter basis

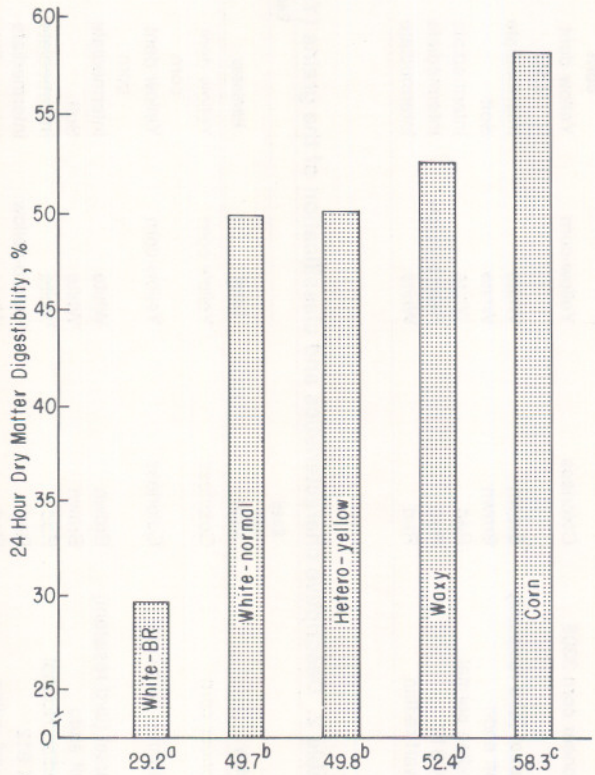


**Figure 1. Twenty-four hr *In Vitro* Dry Matter Digestibility of Dry, Finely Ground Grains (Year I crop). Significance levels are expressed at .05 levels.**

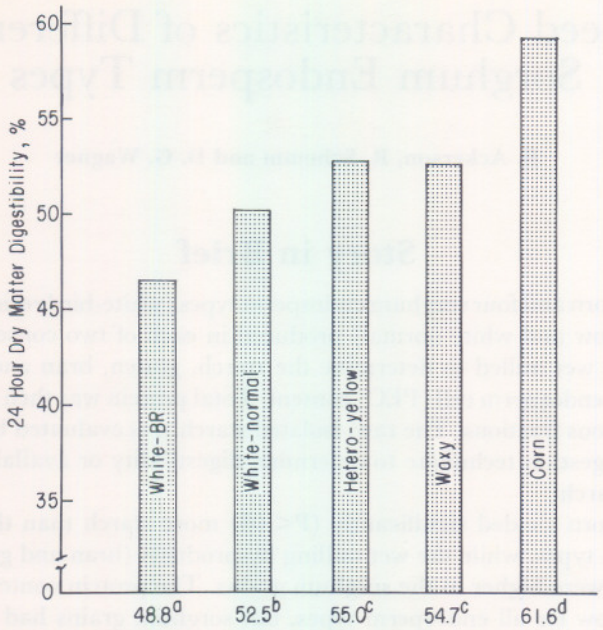


**Figure 2. Twenty-four hr *In Vitro* Dry Matter Digestibility of Dry, Finely Ground Grains (Year 2 Crop). Significance levels are expressed at .05 level.**

The gas production and IVDMD values, in general, were higher for all sorghum during the second year, indicating possible environmental effects on digestibility. Average rainfall during the growing season in Year I was about 1 inch below normal, but also 1.26 inches above normal during the second year. Environmental effects are not well understood.