

## **PROCESSED GRAIN SORGHUM AND GRAIN SORGHUM COMBINATIONS FOR DAIRY COWS**

*J. E. Shirley, E. C. Titgemeyer, J. S. Drouillard,  
A. F. Park and M. V. Scheffel*

### **Summary**

Twenty-four Holstein cows were used to evaluate the effects of processing methods on grain sorghum utilization by lactating dairy cows. No difference was observed in the utilization of steam-flaked grain sorghum and pelleted grain sorghum obtained by adding water to finely ground grain sorghum prior to extrusion and oven drying at a temperature of 200EF. Extensive processing (pelleting or steam-flaking) improved feed efficiency relative to dry rolling. Cows fed diets containing more extensively processed grains ate less feed but produced the same amount of milk as cows fed diets containing dry-rolled grain.

(Key Words: Lactating Cows, Processed Grain Sorghum, Dry-Rolled Grain Sorghum.)

### **Introduction**

The nutritive value of grain sorghum for dairy cattle is improved by extensive processing methods such as steam-flaking, which disrupts the starch granules and makes the starch more accessible to rumen microorganisms. In recent years, research at Kansas State University has demonstrated that a processed grain sorghum product generated by grinding, adding water, extruding, and drying (hereafter referred to as pelleted grain sorghum) has a significantly improved energy value when compared to dry-rolled grain sorghum. We also have observed that feed efficiencies (milk produced per unit of feed intake) were slightly better with pelleted grain sorghum than with rolled corn. However, in those studies, feed intake and milk fat percentage were depressed when the pelleted grain sorghum was fed. This implies that the pelleted product may have been fermented

within the rumen too rapidly, thus creating a less than ideal fermentation.

One method to reduce this excessively rapid fermentation would be to reduce the degree of processing of the grain. This would be difficult in practice. A simple alternative would be to mix the processed grain with dry-rolled grain. A mixture of extensively processed grains (pelleted or steam-flaked) with less processed grain sorghum (dry-rolled) might provide the benefits of processing without the negative influences of an excessively rapid fermentation. Further, if mixtures were used, only a portion of the grain would need to be processed extensively; this would reduce processing costs for the grain sorghum and make it a more attractive feedstuff for Kansas dairies. The objectives of this study were to 1) compare the feeding value of steam-flaked and pelleted grain sorghum for lactating dairy cows and 2) determine if combining processed grain sorghum (steam-flaked and pelleted) with dry-rolled grain sorghum is beneficial.

### **Procedures**

Twenty-four Holstein cows were used in six concurrent 4×4 Latin squares. Cows were individually fed diets typical of those used in Kansas with all of the cereal grain supplied as grain sorghum (Table 1). The diets differed only in how the grain sorghum was processed. The following combinations were compared: 1) all pelleted; 2) all steam-flaked; 3) ½ pelleted, ½ dry-rolled; and 4) ½ steam-flaked, ½ dry-rolled.

Cows were fed each diet for 28 days, and feed intake and milk production were measured daily. Milk samples (AM/PM composite) were analyzed weekly for composition; milk protein,

fat, lactose, solids-not-fat, and somatic cells were measured by the DHIA Laboratory, Manhattan, KS. Cows were weighed and scored for body condition at the beginning and end of each period. On the final week of each 28-day period, blood samples were collected from the tail vein, and total amino acid and urea concentrations in plasma were measured.

### Results and Discussion

The cows responded well to all diets (Table 2). Processing of all of the grain sorghum, either by steam-flaking or by pelleting depressed ( $P<0.01$ ) dry matter intake but improved feed efficiency ( $P<0.01$ ). The addition of dry-rolled grain sorghum to the processed grains improved dry matter intake, but this was not translated into higher milk yield.

Processing did not affect plasma glucose or total amino acids but depressed ( $P<0.01$ ) plasma urea nitrogen (PUN). The decrease in PUN supports the argument that processing improves starch digestion in the rumen. This effect on PUN is interesting, because it demonstrates that diets high in rumen undegradable protein (39.4% of total protein) respond positively to rumen available carbohydrate when dry matter intake is high. Cows in this study weighed approximately 1380 lb and consumed 4.45% of body weight in dry matter on the processed grain diets and approximately 4.6% of body weight on the combination diets (processed and dry-rolled). The depression in PUN probably resulted from both a decrease in dry matter intake and an increase in energy available to the rumen microorganism.

In summary, extensive processing improves the feeding value of grain sorghum in diets for lactating dairy cows. No significant differences were observed between steam-flaking and pelleting.

**Table 1. Experimental Diets**

| Ingredient                 | Pelleted                    | Steam-Flaked | ½ Pelleted<br>½ Dry-Rolled | ½ Steam-Flaked<br>½ Dry-Rolled |
|----------------------------|-----------------------------|--------------|----------------------------|--------------------------------|
|                            | ----- % of dry matter ----- |              |                            |                                |
| Alfalfa hay                | 27.34                       | 27.34        | 27.34                      | 27.34                          |
| Corn silage                | 19.5                        | 19.5         | 19.5                       | 19.5                           |
| Whole cottonseed           | 9.4                         | 9.4          | 9.4                        | 9.4                            |
| Soybean meal               | 9.0                         | 9.0          | 9.0                        | 9.0                            |
| Distillers grains          | 3.0                         | 3.0          | 3.0                        | 3.0                            |
| Pelleted grain sorghum     | 27.6                        | -            | 13.8                       | -                              |
| Steam-flaked grain sorghum | -                           | 27.6         | -                          | 13.8                           |
| Dry-rolled grain sorghum   | -                           | -            | 13.8                       | 13.8                           |
| Molasses                   | 0.85                        | 0.85         | 0.85                       | 0.85                           |
| Dicalcium phosphate        | 0.7                         | 0.7          | 0.7                        | 0.7                            |
| Limestone                  | 1.1                         | 1.1          | 1.1                        | 1.1                            |
| Sodium bicarbonate         | 0.87                        | 0.87         | 0.87                       | 0.87                           |
| Magnesium oxide            | 0.21                        | 0.21         | 0.21                       | 0.21                           |
| Trace-mineralized salt     | 0.31                        | 0.31         | 0.31                       | 0.31                           |
| Mineral/Vitamin mix        | 0.12                        | 0.12         | 0.12                       | 0.12                           |

**Table 2. Effect of Diets on Production Parameters of Lactating Dairy Cows**

| Parameter                              | Pelleted          | Steam-Flaked      | ½ Pelleted<br>½ Dry-Rolled | ½ Steam-Flaked<br>½ Dry-Rolled |
|--|-------------------|-------------------|----------------------------|--------------------------------|
| No. of cows                            | 24                | 24                | 24                         | 24                             |
| Dry matter intake (DMI), lb/day        | 61.5 <sup>a</sup> | 61.7 <sup>a</sup> | 64.2 <sup>b</sup>          | 63.1 <sup>b</sup>              |
| Milk, lb/day                           | 92.6              | 93.5              | 93.1                       | 92.4                           |
| Butter fat, %                          | 3.41              | 3.48              | 3.54                       | 3.47                           |
| Milk protein, %                        | 3.06              | 3.03              | 3.07                       | 3.06                           |
| Lactose, %                             | 4.95              | 4.94              | 4.95                       | 4.95                           |
| SNF, %                                 | 8.73              | 8.70              | 8.74                       | 8.74                           |
| Butter fat, lb/day                     | 3.14              | 3.25              | 3.27                       | 3.18                           |
| Milk protein, lb/day                   | 2.82              | 2.83              | 2.84                       | 2.81                           |
| 3.5% FCM, lb/day                       | 91.0              | 93.2              | 93.2                       | 91.5                           |
| Energy-corrected<br>milk (ECM), lb/day | 91.3              | 93.1              | 93.2                       | 91.6                           |
| ECM/DMI                                | 1.48              | 1.51              | 1.45                       | 1.45                           |
| SCC, ×1000                             | 199               | 126               | 312                        | 114                            |
| Body wt change, lb                     | -0.5              | +4.6              | +0.3                       | +7.0                           |

<sup>a,b</sup>Means with different superscript letter differ ( $P < 0.05$ ).

**Table 3. Diet Effects on Plasma Urea Nitrogen, Total Amino Acids, and Glucose Concentrations of Lactating Dairy Cows**

| Item            | Pelleted           | Steam-Flaked       | ½ Pelleted<br>½ Dry-Rolled | ½ Steam-Flaked<br>½ Dry-Rolled |
|-----------------|--------------------|--------------------|----------------------------|--------------------------------|
| Glucose, mg/dL  | 66.6               | 67.1               | 65.8                       | 66.3                           |
| Amino acids, mM | 2.61               | 2.46               | 2.54                       | 2.55                           |
| PUN, mg/dL      | 13.95 <sup>a</sup> | 13.95 <sup>a</sup> | 15.24 <sup>b</sup>         | 14.4 <sup>a,b</sup>            |

<sup>a,b</sup>Means with different superscript letter differ ( $P < 0.05$ ).