ABSTRACT

Forty-two heifers (24 Holsteins and 18 Ayrshires) were used to compare utilization of rations containing 60% dry rolled and micronized sorghum grain. Calves within each breed were assigned to three groups: (a) control (dry rolled), (b) micronized (380 g/liter), and (c) micronized (230 g/liter). During an 8-wk trial, weights were recorded weekly and rumen samples for volatile fatty acid determination were taken 4 to 5 h after feeding during the 4th wk. Nine bull calves (six Holsteins and three Ayrshires) were in a 3 \( \times \) 3 Latin square design to determine digestibility of rations in the heifer trial. Mean weight gains were 46.9, 46.0, and 43.8 kg for heifers fed dry rolled, micronized (380 g/liter), and micronized (230 g/liter) sorghum grain. Average feed intake was higher in the group of heifers fed the dry rolled grain ration, i.e., 164.7 kg compared to 150.0 and 142.4 kg for the above groups fed micronized grain. There was a trend for greater feed efficiency by calves fed micronized grain which was consistent with slightly higher digestibility of dry matter and organic matter in the micronized rations. Micronized sorghum grain was accepted readily by young dairy calves.

INTRODUCTION

A limited amount of work on methods of processing sorghum grain for use in dairy calf rations has been reported. Schuh et al. (11) observed a significant improvement in feed efficiency due to steam flaking of grain compared to conventional steam rolling. In a later report (10) the value of pressure cooked milo was similar to that of steam flaked grain for dairy calves although there was a tendency for calves fed the flaked grain to consume more calf starter. Daniels et al. (5) found no significant differences in daily gains of calves fed rations containing expanded-extruded sorghum grain and those fed pelleted grain. However, there was a slight improvement in digestibility of energy in rations containing expanded-extruded grain.

Croka and Wagner (2) reported that finishing beef cattle fed micronized sorghum grain had improved feed efficiency with little change in weight gain compared to cattle fed dry rolled grain. Digestibility of dry matter in vitro was greater for micronized than for dry rolled grain and increased as the degree of micronization increased (3). Apparently, the change in starch due to gelatinization produced by this and certain other processing procedures makes starch more available to rumen microorganisms (13).

The purpose of this study was to compare micronized sorghum grain with dry rolled grain in rations for dairy calves.

MATERIALS AND METHODS

Trial 1

Forty-two dairy heifers (18 Ayrshires and 24 Holsteins) at 3 days of age were fed a starter ration consisting of a mixture of cereal grains, soybean meal, pelleted alfalfa meal, and mineral supplements. Each calf was fed whole milk at 8% of body weight to 6 wk of age after which the starter ration constituted the sole diet.

At 8 wk of age, heifers within each breed were assigned at random to three experimental rations with sorghum grain processed as follows: (a) control (dry rolled), (b) minimum micronized (density 380 g/liter), and (c) maximum micronized (density 230 g/liter). A feed mixture having 60% sorghum grain comprised the entire ration for the heifers (Table 1). Sufficient soybean meal was included to make a
ration with approximately 18% total protein on an "as fed" basis. Ground alfalfa hay was used at 15% to provide bulk and to promote development of the desired rumen microbial population.

Dry rolled grain (DRS) was prepared by cleaning the whole grain and then passing it through a set of rollers set to crack all the kernels. Micronized grain was prepared after cleaning by vibrating on a sloping metal plate under gas fired infrared heaters and then passing it through rollers under pressure to produce a minimum micronized (MS-380) and a maximum micronized (MS-230) product. A detailed description of the micronizing unit and conditions for the process have been published (2).

Each heifer was housed individually and fed twice a day to maximum consumption. Feed weighbacks were taken weekly during the 8-wk trial. Body weights were recorded on 2 successive days at the beginning and end of the experiment and once weekly during the experiment. One of the Ayrshire heifers fed dry rolled grain got sick and was excluded from the experiment. For statistical analysis, the missing data procedure of Snedecor and Cochran (12) was used.

During the 4th wk of the trial, 5 h after the morning feeding, a rumen fluid sample was drawn by stomach tube from each heifer. Saturated mercuric chloride was added to stop microbial action, and samples were frozen for later analysis. Rumen volatile fatty acids (VFA) were separated by gas chromatography by using the method of Erwin et al. (6).

**Trial 2**

Nine dairy steers (six Holsteins and three Ayrshires) with uniform weights and 4 to 6 wk
of age were used to determine digestibility of the three rations in the previous heifer experiment. The design was a $3 \times 3$ Latin square with comparison periods of 15 days and 7 days allowed for ration changes between periods. Intake was restricted to 1.5 times the maintenance requirement. Total fecal collections were made during the last 5 days of each period. Feed and feces starch were determined as glucose polymers by the procedure of MacRae and Armstrong (8). Crude protein, dry matter, and ash were determined by standard AOAC procedures.

**RESULTS AND DISCUSSION**

Average gains were 46.9, 46.0, and 43.8 kg for heifers fed rations containing DRS, MS-380, and MS-230 (Table 2). Differences in gain among treatment groups and breed by ration interaction were not statistically significant ($P > 0.05$). Greater weight gains ($P < 0.01$) by Holstein than by Ayrshire calves were associated with correspondingly greater feed intake.

During the first 4 wk of the trial, there was a consistent increase in weekly weight gains in all groups whereas gains tended to be more erratic during the last 4 wk. Presumably, larger rumen capacity during the latter stage allowed a large amount of variation in body fill. Procedures to lessen variation in weight due to body fill and a longer feeding period would no doubt be advantageous in trials with calves of the size in this trial.

Average feed consumption over the entire trial was higher by heifers fed the dry rolled grain ration than by those fed micronized grain rations, i.e., 164.7 compared to 150.0 and 142.4 kg for the M-380 and M-230 groups. Feed efficiency was higher ($P < 0.05$) for the groups of calves fed micronized grain than for those fed DRS (Table 2). There was little difference in feed efficiency between groups fed the two micronized rations. Improvement in efficiency by calves fed micronized grain was consistent with observations on ration digestibility, and agrees with results by Croka and Wagner (2) with finishing beef cattle. Moreover, the results due to micronizing grain in this trial are similar to those reported by others who have processed sorghum grain for calves by other improved methods (5, 11).

Molar percentages of rumen VFA were similar in calves fed the different rations (Table 3). The relatively low molar percentage of acetic acid and correspondingly high propionic acid were typical for calves fed high grain rations. Change in the acetic:propionic ratio due to micronizing the grain was less than in work by Croka and Wagner (4), possibly because sorghum grain constituted a smaller percentage of the total ration in this trial.

### TABLE 3. Molar percentages of rumen VFA.

<table>
<thead>
<tr>
<th>Acid</th>
<th>Dry rolled</th>
<th>M (380 g/liter)</th>
<th>M (230 g/liter)</th>
<th>SE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(Molar %)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Acetic</td>
<td>45.8</td>
<td>45.6</td>
<td>45.1</td>
<td>1.68</td>
</tr>
<tr>
<td>Propionic</td>
<td>30.4</td>
<td>35.9</td>
<td>30.8</td>
<td>2.09</td>
</tr>
<tr>
<td>Isobutyric</td>
<td>3.5</td>
<td>1.6</td>
<td>2.1</td>
<td>.55</td>
</tr>
<tr>
<td>Butyric</td>
<td>10.4</td>
<td>9.6</td>
<td>10.9</td>
<td>1.11</td>
</tr>
<tr>
<td>Isovaleric</td>
<td>3.5</td>
<td>2.7</td>
<td>2.9</td>
<td>.69</td>
</tr>
<tr>
<td>Valeric</td>
<td>8.8</td>
<td>6.4</td>
<td>6.7</td>
<td>1.22</td>
</tr>
</tbody>
</table>

In vitro digestibility of grain dry matter (Table 4) indicated increased accessibility of...
starch for microbial breakdown in the micronized grain. Dry matter and organic matter digestibility in the total ration was slightly higher for the M-380 and M-230 than for the DRS ration (Table 5). Differences between the micronized grain rations and the DRS ration approached statistical significance (P ca..08). Protein digestibility was not changed appreciably by processing treatments, indicating that the dry heat treatment, micronization, did not produce sufficient protein denaturation to depress digestibility. Total starch digestibility was high for all the rations, which agrees with other work on micronizing sorghum grain (7). Riggs et al. (9) suggested that an increase in digestibility of some popped grain fractions, e.g., organic matter, might be due to slightly lower feed intake. However, this would not be the reason for increased digestibility in this trial or in certain other experiments with micronized grain (1, 4) since feed intake was controlled. As indicated above, increased availability of grain dry matter for microbial breakdown appears to be the most plausible explanation for increased digestibility of rations containing micronized grain.

REFERENCES