Storage Methods and Feeding Value for Ear Corn

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An experiment was conducted to compare the feeding value and dry matter storage losses for ear corn stored under atmospheric conditions (air-dry) and as reconstituted high-moisture ground ear corn in an oxygen-limiting silo or a concrete stave silo. Two hundred eighty-eight Hereford, Hereford-Angus and Angus steers averaging about 640 lb initially were fed for a period of 124 days.

The dry diets consisted of 92% ear corn and 9% supplement. Ear corn was stored under three conditions:

1. Air-dry (85% DM) stored in snow fence cribs and ground as needed in amounts for a 2- to 3-week supply during the experiment.
2. Ground with water added to give reconstituted high-moisture (68% DM) ear corn and stored in an oxygen-limiting silo.
3. Ground with water added as for 2 and stored in a conventional concrete stave tower silo.

Improvements in weight gain by steers fed the reconstituted high-moisture ear corn amounted to about 10 and 14%, respectively, for ear corn stored in the oxygen-limiting and concrete stave silos over steers fed air-dry ear corn stored in snow fence cribs. Only small differences were observed in dry matter intake. However, steers fed reconstituted high-moisture ear corn had lower feed requirements (12%) than those fed the air-dry ear corn due to the lower rates of daily gain obtained by the latter group.

Dry matter recovery data indicated a high rate of recovery for the ear corn stored in either silo. Only small differences in dry matter losses were observed between the oxygen-limiting and the concrete stave silos during this experiment.
Introduction

Several experiments have been conducted at South Dakota State University to study various types of diets with ear corn for growing and finishing cattle. Primarily, studies have been concerned with making the most efficient use of the cob portion of ear corn as the roughage source in various types of diets and amounts and types of supplements needed for most efficient utilization of ear corn.

Ear corn is frequently harvested at a moisture content below 25% and stored in suitable permanent or temporary structures. Storage structures can be relatively inexpensive, but consideration must be given to additional handling required for processing and feeding. Another common method is harvesting ear corn at a moisture content in the range of 25% to 35%, grinding and storing in a silo and feeding as ground high-moisture ear corn. Consideration should be given to costs involved in harvesting, storing, processing and feeding; cost and efficiency of storage structures; and feeding value when selecting methods of harvesting and storing ear corn.

This experiment was conducted to compare losses in storage and feeding value of ear corn stored as whole ears under atmospheric conditions (air-dry) in temporary snow fence cribs and as high-moisture (reconstituted) ground ear corn stored in an oxygen-limiting silo (Harvestore) or a concrete stave silo.

Procedures

Two hundred eighty-eight Hereford, Angus and Hereford-Angus steers were used in the experiment. They were purchased from a local auction market about 6 weeks prior to the beginning of the experiment.

During the first 2 weeks after arrival, the cattle were fed about 5 lb of high-moisture whole corn grain with a full feed of alfalfa-brome haylage. Ground ear corn was then substituted for the whole corn grain. The haylage was gradually reduced and the amount of ear corn increased over the next 2 weeks to a diet of ear corn without added roughage. For an additional 2 weeks prior to the experiment, the cattle were full-fed ground high moisture ear corn without supplemental protein.

Processing of the cattle during the preliminary period included ear tagging, injecting with Clostridium-chauvoei-septicum-novyi-sordelli bacterin and implanting with 36 mg of Ralgro.

The steers were weighed in early morning before feeding and again the following morning after an overnight stand of about 16 hr without feed and water. After the second weighing, the steers were allotted into 36 pens on the basis of weight and breed group to be fed ear corn from three storage methods with
12 pens for each storage treatment. Four protein supplement treatments with three replications were used with each corn storage treatment. Results for the supplement treatments have been reported previously (Cattle Feeders Day Series (83-10)).

Ear corn storage treatments were as follows:

1. Stored in snow fence cribs and ground as needed for a 2- to 3-week supply during the experiment and stored under cover after grinding.
2. Ground with water added to give reconstituted high-moisture ear corn and stored in an oxygen-limiting silo (17 ft x 50 ft Harvestore).
3. Ground with water added as for treatment 2 and stored in a conventional tower silo (18 ft x 50 ft concrete stave).

The ear corn used for the experiment was harvested the previous fall at a high moisture content. It was stored on the ground over winter in a tall, long windrow without cover. Grinding for silo storage was with a tub grinder using a 1/2 inch screen. The ground corn was moved from the grinder to a forage wagon. Each load was weighed and blown into one of the silos with water added through a 5/8 inch hose at the forage box beater as unloaded.

The corn for storage under atmospheric conditions was stored in six cribs made with snow fence. The whole ears were elevated into the cribs after weighing. The grain lost through shattering when elevating into the cribs was recovered and deducted from load weights to get net stored for this treatment.

A sample was taken from each load of ground grain before water was added to obtain the amount of dry matter stored in each silo. Several ears were taken from each load under crib storage and dried to determine dry matter stored. This corn was ground with same grinder as for that stored in the silo. It was ground as needed for a 2- to 3-week supply and stored under cover.

Grinding and storage of the corn began on March 14. Operations were continued depending upon weather and firmness of ground at storage area. Initially, operations were limited by the time frozen ground would support equipment. Later, there was a delay in the ground becoming firm enough to support the equipment. These factors resulted in a period from March 14 to April 18 during which the corn was processed and stored.

It was considered the best procedures would be to fill one silo, then the other with the remainder stored as whole ears in the cribs. Any changes in moisture content of the corn which came from changing weather conditions would be less serious than an extended period during filling of a structure. Filling of the concrete stave silo was from March 14 to March 21, March 31 to April 15 for the Harvestore and April 16 to April 18 for crib storage of whole ears.
All dry matter values were determined by drying in a forced-draft oven. A temperature of 100°C was used for samples of unfermented corn at storage. During feeding, samples were taken at weekly intervals, composited for monthly averages and dry matter fed determined by monthly weigh periods. These samples were dried at 70°C.

Rate of feeding at the beginning of the experiment was about 12 lb of dry matter per head daily. Increases for each diet were about 1.5 lb per head daily until the cattle were essentially on full feed in 7 to 9 days. Thereafter, the rate of feeding was regulated to amounts that would be nearly consumed by the next feeding. Total feed offered each day on an as-fed basis was determined by examining feed remaining in the feedbunks for each pen and checking amounts fed the previous day. A feeding schedule was used to determine the distribution between ground ear corn and supplement (92% and 8% of dry diet) on an as-fed basis. Diets were batch mixed on a pen basis and fed once daily.

The cattle were weighed at 4-week intervals in early morning before feeding. The experiment was terminated after 124 days when the supply of cribbed corn was depleted. Weight of the cattle at this time was about 1000 lb.

The corn remaining in each silo was then fed to these cattle to determine the quantity of corn stored that was recovered for feeding.

Results

Dry Matter Storage Losses

Dry matter losses as affected by storage method are shown in table 1. Days in storage are from midpoint of the time involved in processing and filling of storage structures to termination of feed-out following the feeding trial.

Although there were some differences in time between filling the two silos, differences in dry matter and protein values for the corn as stored are considered to be well within normal sampling error for two samples taken from the same feed source. These values obtained as the ear corn was fed indicate essentially no difference between ear corn at feeding from the two structures. The lower dry matter values would result from the water added as the corn was unloaded at the silo blower.

The protein content of ear corn fed from each silo was 1.15 percentage units (dry) higher than that at storage. An increase could result from sampling error, analytical error, or dry matter carbohydrate losses in fermentation and oven drying except these losses for protein. The latter would not appear to
explain the increase in view of the small losses in dry matter during storage for either silo. Dry matter recovered as a percentage of that stored indicated high recovery rates with only small differences between the two silos.

Losses during fermentation of high moisture grain and losses in volatile materials in oven drying frequently exceed the dry matter losses shown in table 1. The corn was weighed at storage in loads of around 6 tons. Weights for recovery were daily feed records for 12 pens each with 8 cattle fed from each silo. These differences in weighing procedures could result in sizable errors in weights for dry matter calculations. However, it would seem reasonable to expect that any errors would be similar between the two silos, since the same procedures were used for each in storing and feeding. The data do indicate a high rate in recovery of dry matter stored and similar rates for each method of storage.

<table>
<thead>
<tr>
<th>TABLE 1. EAR CORN DRY MATTER LOSSES AS AFFECTED BY STORAGE METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>Days stored</td>
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<tr>
<td>-------------</td>
</tr>
<tr>
<td>Ear corn stored</td>
</tr>
<tr>
<td>DM, %</td>
</tr>
<tr>
<td>Wet, lb</td>
</tr>
<tr>
<td>Dry, lb</td>
</tr>
<tr>
<td>Protein (dry), %</td>
</tr>
<tr>
<td>Ear corn recovered</td>
</tr>
<tr>
<td>DM, %</td>
</tr>
<tr>
<td>Wet, lb</td>
</tr>
<tr>
<td>Dry, lb</td>
</tr>
<tr>
<td>Protein (dry), %</td>
</tr>
<tr>
<td>Ear corn DM recovered of the total stored, %</td>
</tr>
</tbody>
</table>

Dry matter recovered from the air-dry grain stored in the snow fence cribs was not compared to that from silos. Procedures in storing, processing and feeding differed considerably from those used for storage in the silos. Dry matter losses during storage of whole ear corn and in processing and feeding should be small with good storage structures and good management in processing and feeding.
Feedlot Performance

Feedlot performance of the cattle fed ear corn stored under the three conditions is shown in table 2. Steers fed the air-dry ground corn with supplement gained 2.72 lb daily with 6.99 lb of feed (dry) required per pound of gain over the 124-day experiment.

Steers fed high-moisture ear corn gained at a faster rate with an advantage over dry corn of 9.9% for those fed corn from the Harvestore and 14.0% for those fed corn from the concrete stave silo.

Feed consumption was slightly less for steers fed from the Harvestore. This lower feed intake and the lower rate of gain resulted in about equal feed efficiency between steers fed ear corn from the Harvestore or concrete stave silo.

The favorable rates of gain and feed efficiency shown for ear corn diets likely were influenced by termination of the experiment at weights less than market finish. However, the 124-day feeding experiment and silo storage time in excess of 200 days should be sufficient for comparisons between the methods of storage and feeding value of the ear corn.

TABLE 2. FEEDLOT PERFORMANCE OF FINISHING CATTLE AS AFFECTED BY EAR CORN STORAGE METHODS (June 10 to October 12, 124 days)

<table>
<thead>
<tr>
<th>Item</th>
<th>Air-dry cribs</th>
<th>Reconstituted Harvestore</th>
<th>Reconstituted concrete stave</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of animals</td>
<td>95&lt;sup&gt;a&lt;/sup&gt;</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>Initial shrunk wt, lb</td>
<td>642</td>
<td>642</td>
<td>640</td>
</tr>
<tr>
<td>Final shrunk wt, lb</td>
<td>979</td>
<td>1013</td>
<td>1023</td>
</tr>
<tr>
<td>Avg daily gain, lb</td>
<td>2.72</td>
<td>2.99</td>
<td>3.10</td>
</tr>
<tr>
<td>Avg daily feed, lb&lt;sup&gt;b&lt;/sup&gt;</td>
<td>19.01</td>
<td>18.31</td>
<td>19.16</td>
</tr>
<tr>
<td>Avg feed to gain ratio&lt;sup&gt;b&lt;/sup&gt;</td>
<td>699</td>
<td>612</td>
<td>618</td>
</tr>
</tbody>
</table>

<sup>a</sup> Initially 96 steers but one died of acute polio encephals malacia.

<sup>b</sup> Feed values are on a dry basis.

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