dairy guidelines

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# HIGH MOISTURE GRAIN CORN:

## Preservation and Feeding Value for Dairy Cattle

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The harvesting, storing and feeding of grain corn in the high moisture state has become both practical and widespread in recent years. This method of preservation presents an alternative to artificial drying or cribbing.

Corn grain is the basic energy ingredient in practically all dairy concentrate feeds. Corn contains 16 to 27% more net energy for lactating cows than oats (Table 1) and provides more energy per feed dollar or per acre in Virginia than any other cultivated crop.

Table 1. Chemical composition of various cereal grains

| | | Dry matter basis | | | |
|---|---|---|---|---|---|
| Grain | Dry matter (%) | Crude protein (%) | Crude fiber (%) | TDN (%) | Net energy (Mcal/kg) |
| Shelled corn | 89 | 10.0 | 2.2 | 91 | 2.42 |
| Ear corn | 87 | 9.3 | 9.2 | 85 | 2.21 |
| Barley | 89 | 10.9 | 5.6 | 83 | 2.14 |
| Wheat | 89 | 14.6 | 3.0 | 88 | 2.32 |
| Oats | 89 | 13.2 | 12.4 | 76 | 1.90 |

Corn as used in most dairy supplements, contains no more than 15% moisture. However, grain corn is usually harvested at higher moisture levels, and therefore it must be preserved in some way or molds will develop when the moisture content exceeds 18-20%.

Molds produce aflatoxins which, in turn, yield toxic metabolites. When these contaminated feeds are fed to cows or heifers, feed intake is depressed, animals lose their body condition or weight, suffer liver damage, and reduce milk production, and even death may occur.

For proper storage, grain corn can be either dried, cribbed or stored as high moisture corn. The common method of storage as high moisture grain is in a silo. Advantages and disadvantages of ensiling are indicated in Table 2. The moisture content at harvest should be 25-30% for shelled corn or 30-35% for ear corn. The use of sealed (air-tight) or concrete silos will provide a palatable, high quality feedstuff. However, it is important that good ensiling techniques be used. These include: (1) grinding, (2) rapid filling and thorough packing, (3) careful sealing after filling, and (4) adequate feeding out rate. These recommendations are not as critical when sealed silos are used.

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Table 2. Advantages and disadvantages for ensiled high moisture grain systems[+]

| Advantages | Disadvantages or limitations |
|---|---|
| 1. Earlier harvesting by 2-3 wk. This is an advantage to fall harvesting schedules and protection against losses due to potentially poor weather later in the season. | 1. Need an indication of moisture content at harvest for minimum yield and storage losses. |
| 2. Total losses reduced by 5-10% due to less lodging and ear drop, less handling and rodent-free storage. | 2. With conventional silos, top spoilage may occur and aflatoxins may form if adequate amounts are not removed and fed daily. Must balance silo diameter with number of animals and feeding level, especially during warm weather. |
| 3. Eliminates several rehandling operations, allows for greater mechanization, ease and convenience of handling, labor savings. | 3. Handling problems in freezing weather and heating in warm weather. |
| 4. Storage facilities may cost less. | 4. Grain starts to heat if feed removed too soon before feeding. Cannot stock large quantities of grain plus supplement. |
| | 5. For livestock feeding only. |
| | 6. Approximately 25% more weight to handle. |

[+]Jones et al., Can. J. Anim. Sci. 1974.

For proper ensiling it is important to minimize air or oxygen penetration so as to avoid heating and molding. High moisture ear corn should be ground before storage so that all kernels are cracked or broken. It is generally recommended that high moisture shelled corn be ground before storage in concrete silos. Regardless, the grain should be ground or rolled before feeding (medium to coarse grind, 3/4" to 1" screen size; 1/2" to 5/8" for under 28% moisture) or 10-20% of the whole kernels will pass undigested through the animal. If grain should appear in the manure, don't become alarmed as research studies suggest that this fraction contains very little available energy.

Grain ensiled in concrete silos must be fed at a rate which allows for the removal of at least 2 inches daily, and 3 to 4 inches in warm weather. Table 3 suggests the minimum feeding rate as affected by silo diameter and number of animals. From this you can project the number of days that high moisture grain will be available.

Example 1: Assume that a dairyman has a 14 x 32 ft. silo and that he has 120 cows in milk.

A 14 ft. diameter silo contains approximately 598 lb. per inch of 28% moisture whole shelled corn. Since the grain should be ground prior to storage in a concrete silo, we increase the capacity by 14% (or 84 lb./in.) to 682 lb. per inch. Removal of 2 inches per day will mean that at least 1364 lb. must be fed daily to avoid top spoilage in the winter. This amounts to 11 lb. per cow which, according to the guidelines in Table 4, is far too much corn when fed with very good quality corn silage or when fed to medium or low producing cows. This dairyman would have to buy hay or reduce the amount of silage.

When ground ear corn is fed, approximately 514 lb. are removed per inch or a minimum of 1028 lb. daily. This represents 13 lb. per cow. The lower part of the table indicates the number of cows required and the feeding rates to prevent top spoilage in silos of various diameters.

Example 2: Assuming that 10 lb. ground shelled corn is fed to each of 120 cows daily and from a 14 x 32 ft. silo, how many days will high moisture corn be available?

There is 682 lb. per inch or 8184 lb. per ft. At 28 ft. silage height, there would be approximately 114.6 tons (229,000 lb.). Dividing the total amount by 1200 lb. (the amount fed per day), the high moisture grain should last for 190 days.

Table 3. Approximate capacities and feeding rates when high moisture corn is stored in silos of various sizes.

| | Inside silo diameter (ft.) | | | | |
|---|---|---|---|---|---|
| | 12 | 14 | 16 | 18 | 20 |
| Silage density | ----------(lb./inch height)---------- | | | | |
| 28-WSC‡ | 439 | 598 | 781 | 988 | 1220 |
| 28-GSC+ | (500) | (682) | (890) | (1126) | (1390) |
| 30-GEC‡ | 377 | 514 | 671 | 848 | 1048 |
| No. cattle to remove 2" daily | | | | | |
| WSC (lb. per head) | ----------No. cows---------- | | | | |
| 5 | 176(201)+ | 239(272) | 312(356) | 395(450) | 488(556) |
| 10 | 88(100) | 120(137) | 156(178) | 198(226) | 244(278) |
| 15 | 59( 67) | 80( 91) | 104(119) | 132(150) | 163(186) |
| 20 | 44( 50) | 60( 68) | 78( 89) | 99(113) | 122(139) |
| GEC (lb. per head) | ----------No. cows---------- | | | | |
| 5 | 151 | 206 | 268 | 339 | 419 |
| 10 | 75 | 103 | 134 | 170 | 210 |
| 15 | 50 | 69 | 89 | 113 | 140 |
| 20 | 38 | 51 | 67 | 85 | 105 |

+Whole shelled corn (WSC) stored at 28% moisture. For ground shelled corn (GSC), increase capacity and cow numbers by 14%, as shown by the numbers within ( ).

‡Ground ear corn (GEC) stored at 32% moisture.

High moisture corn is well accepted by dairy cows and will support high levels of milk production. The high moisture state is at least comparable in feeding value, on a dry matter basis, to the equivalent dry grain. High moisture corn lends itself to mechanical handling and feeding and can be fed by various systems:

1. Mixed with silage and a suitable supplement to form a complete ration or mixed only with silage and a high protein concentrate fed separately at milking time.

2. Fed separately at different levels for cows of varying production levels.

3. Blended with protein supplement and fed as a grain mixture immediately after mixing.

High moisture corn must be fed as part of a balanced ration. Special care must be given to the protein, calcium and phosphorous content of the supplement. We recommend that a forage test be conducted upon samples of the forage and the grain and that the amount of high moisture grain fed be based upon quality and kind of forage. Maximum suggested feeding levels are indicated in Table 4. Feeding rate is important. High moisture shelled corn plus the concentrate supplement should not supply more than 50-60% of the total ration dry matter consumed. Higher levels have reduced forage consumption, reduced crude fiber intakes to 13% of total dry matter intake, and depressed milk fat test. The problem can be avoided by feeding hay. Minimum crude fiber intakes should be 16-17% of the total dry matter. High moisture ear corn can be fed at higher levels than high moisture shelled corn before these effects are observed. When first embarking upon this type of feeding program, make gradual changes in the ration. A minimum of 7 to 14 days is required for cows to adjust to the change.

Table 4. Maximum feeding levels of high moisture corn, depending upon type and quality of forage.

| | Level of milk production (lb./day) | | | |
|---|---|---|---|---|
| Feeding program/feeds | Over 50 | 30-50 | Under 30 | Dry |
| A. Corn silage A[+] | 58 | 68.5 | 77 | 25 |
| HM shelled corn | 15 | 5 | 0 | 0 |
| Supplement | 9.6(36%)[‡] | 9(32%) | 5(44%) | 5(20%) |
| Grass hay[+] | - | - | - | 7 |
| Crude fiber (% of DM) | 16.5 | 20.0 | 23.6 | 26.3 |
| Concentrate (% of DM) | 48.8 | 32.6 | 14.2 | 23.1 |
| B. Corn silage B[+] | 72.5 | 85.5 | 60 | 20 |
| HM shelled corn | 10 | 0 | 0 | - |
| Suppelment | 8(44%) | 6.2(44%) | 6(44%) | 5(16%) |
| Grass hay[+] | - | - | - | 7.5 |
| Crude fiber (% of DM) | 16.5 | 20.0 | 19.4 | 25.1 |
| Concentrate (% of DM) | 36.1 | 15.6 | 20.3 | 24.7 |
| C. Mainly legume silage | 38 | 44 | 49 | 45 |
| HM shelled corn | 15 | 10 | 5 | - |
| Supplement | 17.5(20%) | 14.5(16%) | 12(20%) | 6(16%) |
| Crude fiber (% of DM) | 17.1 | 20.1 | 23.6 | 29.7 |
| Concentrate (% of DM) | 66.5 | 56.6 | 45.4 | 25.3 |

[+]Assumed forage analysis - Corn silage: 35% dry matter (DM), 7% crude protein (CP)(DM basis); crude fiber (CF), corn silage A 26%, corn silage B 22%; legume silage, 14.6% CP, 36.7% CF; grass hay: 9.8% CF, 39.4% CF.

[‡]Crude protein content of supplement.