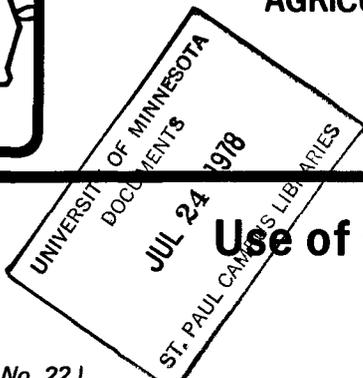


DAIRY HUSBANDRY
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**Use of High-Moisture Corn
for Dairy Cattle**



(Note: This is a revision of Animal Science Fact Sheet No. 22.)

High-moisture corn is mature grain not dry enough for conventional storage. It may be ear corn or shelled corn. Moisture content ranges from 28 to 40 percent for high-moisture ear corn and 25 to 32 percent for high-moisture shelled corn.

Propionic acid sometimes is used to preserve high-moisture corn. Review Agronomy Fact Sheet No. 29, "Preservation and Storage of High-Moisture Grain with Propionic Acid," for more details.

Structures for Storing High-Moisture Corn

Silos for high-moisture corn may be oxygen limiting structures or concrete stave towers. When exceptionally large amounts of corn are stored, bunker silos have proven satisfactory. Silo size depends upon amount needed and removal rate per day. Some silos may need reinforcement for high-moisture corn. Table 1 gives the capacity of tower silos for high-moisture ground ear corn or shelled corn.

Table 1. Capacities of tower silos

Settled depth Feet	High-moisture ground ear corn or high-moisture whole shelled corn*						
	Inside diameter in feet						
	10	12	14	16	18	20	22
	-----Tons-----						
20	37						
25	47	68					
30	56	81	111	144	183	226	272
35	65	95	129	168	213	264	318
40	75	108	147	192	243	302	363
45	84	122	166	216	274	339	409
50		135	184	240	304	377	454
55			203	264	335	415	499
60				288	365	452	545

*Add 10 percent more for ground shelled corn.

To minimize spoilage, the silo must be in good repair. Use of plastic around doors and proper door caulking will help prevent spoilage and molding. The top may be covered with plastic sheeting. Good packing and correct moisture level will assure proper fermentation and help minimize spoilage.

Removal rate is an important consideration when determining correct silo size. When the silo is first opened, about 4 inches a day should be removed the first several days. Removal of 2 to 3 inches per day is sufficient for winter feeding, while 4 to 6 inches should be removed during warm weather. Table 2 gives pounds of corn per inch of height for silos of different diameters. The table can help determine correct silo diameter for a given feeding operation. As an example, for a 16 foot diameter silo, 4 inches would equal 3200 pounds of high-moisture whole shelled corn (800 pounds per inch x 4 inches). At this removal rate, about 1½ tons of high-moisture corn should be fed each day (150 cows fed 20 pounds each).

Table 2. Pounds of wet corn per inch of height for silos of different diameters (30 percent moisture shelled corn)

Inside diameter of silo (feet)	Pounds per inch of height*
10	313
12	451
14	614
16	801
18	1014
20	1256
22	1513

*Reduce pounds by 15 to 20 percent for ear corn.

Harvesting Corn for Ensiling

Corn to be ensiled may be shelled or left on the ear. For maximum grain yield, corn should be mature. Corn maturity occurs when kernels contain about 25 to 35 percent moisture. When a physiologically mature kernel is split, a black layer is visible across its tip. For good ensiling, shelled corn should contain 25 to 30 percent moisture, and ear corn should contain 30 to 35 percent moisture. Moisture content can be determined with a moisture tester or by taking samples to a local elevator. Table 3 shows kernel and cob moisture contents and relationships to cob-kernel moisture levels.

Table 3. Approximate moisture relationship of the kernel, cob, and cob-kernel mixture

	Kernel	Cob	Cob-kernel mixture
	-----Percent-----		
	26	46	31
	28	48	33
	30	50	35
	32	53	37
	34	55	39
	36	57	41
	38	59	43
	40	60	45

Feeding Value of High-Moisture Corn

High-moisture corn for dairy cows should be ground or rolled. When whole kernels are fed, a large percentage of the kernels pass through the animal undigested. Undigested kernel corn may reach 10 to 20 percent of the total weight fed.

Generally, nutrient content of dry matter in high-moisture corn is similar to nutrient content in dry corn. Differences in production have been reported in a few instances; but these usually result from differences in dry matter intake and physical form, rather than in the corn's nutrient content. The higher moisture content must be recognized. More total pounds of high-moisture grain must be fed to equal nutrient intake from dry corn. Some dairymen have experienced lower production with high-moisture corn because less total dry matter was being fed. Table 4 shows the required amount of corn at different dry matter contents to equal the dry matter in dry grain.

Table 4. Amounts of high-moisture corn of various dry matter levels required to equal the dry matter in air-dry corn

	Percent of dry matter			
	Air-dry*	75	70	65
	-----Pounds-----			
10	12	12	13	
15	17	18	20	
20	23	25	26	
25	29	31	33	
30	35	37	40	
35	40	43	46	
40	46	49	53	

*Air-dry = 86 percent dry matter basis.

Shelled Corn Versus Ear Corn

The choice between shelled and ear corn will depend on available harvesting and handling equipment. Both shelled and ear corn can be successfully used in a feeding program. Shelled corn is higher in energy and crude protein than is ear corn.

High-moisture ear corn should be ground before ensiling to insure fermentation, exclude air, and prevent spoilage. Shelled corn may be ground before ensiling, especially in conventional tower silos.

Shelled corn will provide more energy per unit of dry matter. It may fit better into overall corn handling, especially if some corn is harvested for purposes other than high-moisture ensiling. On the other hand, ear corn provides a more fibrous feed which is useful in maintaining cows on feed and in preventing milk fat depression. The value of the cob is much less than the grain, but it does contain some feed value (table 5).

Table 5. Feed value of corn grain components

	Percent of crude protein*	Mcal net energy per pound*
Shelled corn	10	.94
Ear corn	9	.89
Corn cobs	3	.46

*100 percent dry matter basis.

Methods of Feeding High-Moisture Corn

Several procedures can be used to feed high-moisture corn. These include:

- feeding a constant amount to all cows and an added grain mix to supply additional energy and protein to top producing cows;
- mixing high-moisture corn with protein, mineral, and vitamin supplements to provide a complete grain mix (mixing a urea containing supplement with high-moisture corn for an extended time can result in acceptability problems because of ammonia release from the urea);
- feeding high-moisture corn according to production with a protein supplement used as a "top-dress" (fed individually on top of a base grain);
- blending high-moisture corn and supplements with forages and offering these as an "all-in-one" ration.

A complete grain mix using wet corn requires that supplements be added to the corn as it comes from the silo. Mixing is required. The grain mix is then formulated the same way it is for conventional rations. Simple mixtures are shown in

table 6. They are based entirely on high-moisture grain, but other grains may be added. Maintain fresh palatable grain mixtures and avoid heating.

Table 6. Examples of simple, complete grain mixtures* using high-moisture corn

Ingredient	Approximate crude protein percent**							
	10		12		14		16	
High-moisture shelled corn	1800	—	1700	—	1600	—	1500	—
High-moisture ear corn	—	1770	—	1670	—	1550	—	1450
44 percent protein supplement	200	230	300	330	400	450	500	550
Trace-mineral salt	20	20	20	20	20	20	20	20
Calcium-phosphorus supplement	20	20	20	20	20	20	20	20
Vitamin premix	5	5	5	5	5	5	5	5

*Amounts of salt, calcium-phosphorus supplements, and vitamins are estimated. The ration may need adjustment for mineral supplementation according to the kind and amount of forage fed.

**Expressed on a wet, or as is, basis.

With the top-dress method, high-moisture corn is fed according to production. This method works well in a stanchion barn and is useful in providing protein supplement in amounts that cows need. This could be of important economic significance when protein prices are high. The amounts of corn and protein supplement needed to meet cows' requirements at different production levels are given in table 7. At higher grain levels, feed intake may become limiting. If this occurs, these cows' protein needs should be met even though energy intake may still be limiting. Protein supplements that contain large amounts of urea should not be used.

Low Fat Test

Some dairymen feeding high-moisture corn have experienced a low milk fat test. The reason is not always clear. Generally, milk fat test declines when forage intake decreases. If the total ration contains 15 to 18 percent crude fiber, there usually is no problem. However, when high-moisture corn is offered to cattle in a feed bunk, many cows will consume the corn at the expense of other feeds. In this situation, milk fat may be reduced for individual cows.

If a drop in test results does occur, make sure that the forage or fiber intake is adequate. If the problem persists, the use of sodium bicarbonate (2 to 4 ounces/cow/day) or magnesium oxide (1 to 2 ounces/cow/day) may help partially restore fat. Feeding 4 to 6 pounds of ground oats or beet pulp also can improve fat test.

Mixing Supplements with High-Moisture Corn During Ensiling

Generally, the addition of protein supplements—such as soybean meal or urea—to high-moisture corn at ensiling time is not recommended. Since the urea is converted to ammonia in the silo, some loss of nitrogen and a lower feed intake result. The addition of minerals or other supplements is not recommended. The feed value of acid-treated corn is equal to ensiled high-moisture corn. Acid-treated corn has no effect on milk production or fat test.

Table 7. Guide* for top-dressing protein supplement on high-moisture shelled corn with various forage feeding systems**

Pounds of milk	Alfalfa hay		Alfalfa hay and corn silage		Corn silage		NPN***-treated corn silage	
	Pounds HMC	Pounds 44% supplement	Pounds HMC	Pounds 44% supplement	Pounds HMC	Pounds 44% supplement	Pounds HMC	Pounds 44% supplement
40	12	0	8	2	0	5	2	2
50	18	0	13	3	5	6	8	3
60	24	1	20	5	11	7	13	4
70	27	2	23	6	15	8	17	6
80	31	3	26	7	20	9	22	7
90	34	4	29	8	24	11	25	8

*Calculated to meet the requirements of cows weighing approximately 1300 pounds and producing milk that tests 3.5 percent fat.

**Feed intake may be limited at higher levels of production. Forage dry matter fed at approximately 2 percent of body weight.

***Nonprotein nitrogen such as urea, ammonia, and commercial additives.