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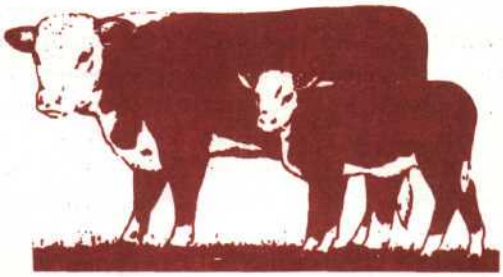

MICHIGAN BEEF PRODUCTION

COOPERATIVE EXTENSION SERVICE • MICHIGAN STATE UNIVERSITY

Correcting for Moisture Content of Feeds

By John C. Waller, Animal Science Dept.*

Variation in the moisture content of the feeds making up a ration is the largest single source of serious variation in rations using silage, haylage, green chop or high moisture grains. Moisture variations are almost always greater than variation caused by chemical components such as energy, protein, minerals or fiber. There is no way to insure as a successful feeding program using any feed that can vary in moisture content without formulating on a standard moisture basis and adjusting for moisture as often as necessary.

Problems due to moisture variation.

Grains vary in moisture content from 12 to 30% and silage from 50 to 75% or more which greatly affects the as fed nutrient composition. For example, 10 lbs. of corn silage at 50% moisture contains 5 lb. of dry matter, 3½ lb. of TDN and .42 lb. of protein. Ten lb. of corn silage at 70% moisture, however, contains only 3 lb. of dry matter, 2.1 lb. TDN and .25 lb. of protein. A steer eating 20 lb. of corn at 20% moisture would only have to eat about 18 lb. of corn at 10% moisture to get the same nutrients. If the price per lb. was the same for both moisture levels, buying the 10% moisture corn would result in getting over 11% more dry matter for the same money.

Also, it is necessary to correct for moisture in order to properly balance the ration. For example, an 800 lb. steer requires 2.19 lb. of total protein for a 2.6 lb. per day gain. The requirement for energy and protein could be met by feeding 5 lb. alfalfa hay at 12% moisture and 15 lb. shelled corn at 14% moisture. If alfalfa silage at 60% moisture was substituted for the alfalfa hay, however, 11 lb. of the alfalfa silage would be needed to balance the ration.

A sudden drop in roughage dry matter in a high concentration ration of 1 to 2 lb. (a 5 to 15% roughage change in most high grain rations) may result in digestive disorders and cattle going off feed, and even relatively small changes in moisture content of feedstuffs can result in an important change in the amount of roughage fed.

Ways to avoid problems due to moisture variation.

1. *Formulate on a standard moisture basis.* The simplest way to avoid errors in ration formulation is to formulate on a 100% dry matter or 90% dry matter basis and then correct for moisture after the ration is properly balanced.

Table 1 gives conversion factors for converting from a dry matter basis, and Fact Sheet E-1655 shows how to make this correction in balancing a ration. Tables 1, 2, 3 and 4 show how rations are corrected for moisture.

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Table 1. Correcting for moisture Content of Feedstuffs

1. To determine lb. as fed from lb. dry matter, multiply factor in column next to moisture content times lb. dry matter. For example, 10 lb. corn silage dry matter = 25 lb. corn silage at 60% moisture (10 x 2.50).
2. To determine lb. dry matter from lb. as fed, multiply factor in second column next to moisture content times lb. as fed. For example, 25 lb. corn silage at 60% moisture = 10 lb. corn silage dry matter (25 x .4).

% Moisture	Dry to as Fed	As Fed to Dry	% Moisture	Dry to as Fed	As Fed to Dry	% Moisture	Dry to as Fed	As Fed to Dry
10	1.11	.90	38	1.61	.62	66	2.94	.34
12	1.13	.88	40	1.66	.60	68	3.12	.32
14	1.16	.86	42	1.72	.58	70	3.33	.30
16	1.19	.84	44	1.78	.56	72	3.57	.28.
18	1.22	.82	46	1.85	.54	74	3.84	.26
20	1.25	.80	48	1.92	.52	76	4.17	.24
22	1.28	.78	50	2.00	.50	78	4.54	.22
24	1.31	.76	52	2.08	.48	80	5.00	.20
26	1.35	.74	54	2.17	.46	82	5.55	.18
28	1.39	.72	56	2.27	.44	84	6.25	.16
30	1.43	.70	58	2.38	.42	86	7.14	.14
32	1.47	.68	60	2.50	.40	88	8.33	.12
34	1.51	.66	62	2.63	.38	90	10.00	.10
36	1.56	.64	64	2.78	.36			

Table 2. Conversion of a Feeding Formula From a Dry Matter Basis To An As Fed Basis

Feed	% In Ration DM	% Moisture	Conversion Factor	As fed lb. needed per 100 lb. of dry matter	As Fed Composition
Corn	5	20	1.25	6.25[A]	2.13[D]
Silage	90	68	3.12	281.25[B]	95.97[E]
Supplement	5	10	1.11	5.56[C]	1.90[F]
Total	100			293.06	100.00

A 5 x 1.25 = 6.25
B 90 x 3.12 = 281.25
C 5 x 1.11 = 5.56
D 6.25/293.06 = 2.13%
E 281.25/293.06 = 95.97%
F 5.56/293.06 = 1.90%

Table 3. Conversion of Lb. Dry Matter Per Head Daily to Lb. As Fed Per Head

Feed	Lb. DM	Moisture	Conversion Factor	Lb. as fed
Corn	1	20	1.25	1.25
Silage	18	68	3.12	56.16
Supplement	1	10	1.11	1.11
Total	20			58.52

Table 4. Conversion of Lb. Per Head Daily to Lb. Dry Matter

Feed	Lb. as fed	% Moisture	Conversion Factor	Lb. Dry Matter
Corn	1.25	20	.80	1
Silage	56.16	68	.32	18
Supplement	1.11	10	.90	1
Total	58.52			20

Caution: Many feed composition and nutrient requirement values are as a percentage composition of the feed. If, for example 11% protein is given as adequate for a ration containing 90% dry matter, the protein content for the same ration calculated on a 100% dry matter basis must be 11/.9 = 12.2%.

To convert nutrient requirements or feed composition values from 100% dry matter basis to an as fed basis, multiply the dry matter value times the % dry matter of the feed. For example, if No. 2 shelled corn has 10% protein on a dry basis and a feeder has 30% moisture corn, 10 x 70% dry matter = 7% protein on an as fed basis.

2. *Adjust for day to day variation in moisture content.*

a. *When feeding on a per head basis.* If a grain intake is controlled but the silage is fed free choice as in a growing ration, the cattle will tend to eat more pounds of silage as the moisture content increases and therefore will adjust for variation in the moisture content of the silage. The total pounds of grain fed will have to be increased as the grain increases in moisture, however. The reverse would be true for a finishing ration where the grain is being fed to appetite but the silage is limit-fed. In this case the pounds of silage fed will need to be increased as the silage increases in moisture to reach the desired roughage dry matter intake but the cattle will tend to adjust the grain intake as its moisture varies.

b. *When feeding on a percentage or proportional basis.* New proportions for the various ingredients need to be calculated each time a major ingredient changes significantly in moisture content. Ingredients expected to vary more than 3 to 5% in moisture during the feeding period should be checked periodically, followed by calculation of new feed formulas or proportions as major changes in moisture occur. (see table 1) Small changes in moisture content of just one major ingredient will alter the amount of energy or other nutrients consumed daily, which would be expected to affect performance. Many times when ingredients are proportioned out rather than weighed out, quality control is more satisfactory as pounds of dry matter per unit of volume may not vary greatly with small changes in moisture. Weighing feed ingredients daily aids in management and record keeping but adjustments need to be made for moisture variation to achieve good quality control.

3. *Adjust for moisture when buying feeds.* The multipliers in Table 2. may be used to determine the price per unit of dry matter simply by multiplying price times the appropriate factor for the indicated moisture. For example, shelled corn at 30% moisture and costing $60.00 per ton costs 60 x 1.43 = $85.94 per ton on a dry basis. Another source of corn costs $65 per ton at 25% moisture, or 65 x 1.33 = $88.85. In this case the 30% moisture corn is the better buy.

Table 4 gives the correction factors to correct shelled corn of different moisture contents to a 15.5% or standard No. 2 basis. For example, if No. 2 corn (standard 15.5% moisture) is priced at $80.00 per ton, 30% moisture corn is worth $80 x .8284 = $66.27 per ton. If the feeder was receiving 19% moisture corn and paying for 15.5% moisture he would receive only 95.86% of the dry matter he paid for. If corn is delivered with 7% moisture, while paying on a 15.5% moisture basis, the feeder would receive 110.06% of corn he paid for.

Table 4. Relative Value of U.S. No. 2 Corn (15.5% Moisture) As Effected By Changes in Moisture

Moisture %	Multiplier	Moisture %	Multiplier
0	1.1834		
1	1.1716	19	.9586
2	1.1598	20	.9467
3	1.1479	21	.9349
4	1.1361	22	.9231
5	1.1243	23	.9112
6	1.1124	24	.8994
7	1.1006	25	.8876
8	1.0888	26	.8757
9	1.0769	27	.8639
10	1.0651	28	.8521
11	1.0533	29	.8402
12	1.0414	30	.8284
13	1.0296	31	.8166
14	1.0178	32	.8047
15	1.0059	33	.7929
16	.9941	34	.7811
17	.9822	35	.7691
18	.9704	36	.7574

If 15.5% Moisture Corn is the purchase basis it will require 1.1834 units of purchase base corn to make 1 unit of 100 dry matter base corn.

When evaluating commodity purchases, a feeder should never lose sight of how much water he is forced to buy. If the feeder, for example, assumed that corn and wheat had equal nutritional characteristics per unit of dry matter, the trading basis (15.5% moisture for U.S. No. 2 Corn and usually about 8-10% moisture for wheat) is probably much more significant

than any nutritional difference found in the two grains.

In any area there are so called "norms" in terms of how much moisture should be in feed commodities. In general, livestock feeders are very lax in observing moisture standards until the feeds become so wet as to cause storage or handling problems. Reputable suppliers usually observe the standard very closely, being sure that they do not supply more or less moisture than the standard calls for.

A large elevator could lose $1 million a year simply by selling grain containing 2% or 3% less moisture than the standard allows. In some cases there is no standard or established moisture level for commodities. In these cases commodities are usually sold using protein, fat and fiber guarantees. In the case of oil meals, as the moisture content rises the protein content usually goes down. Feeders should always remember that "as is" feeds are similar to a pie where moisture is like the first slice removed from the pie. The larger the first slice the less is left. There are many implications to the pie concept. If, for example, one sample of soybean meal had 44% protein and 12% moisture, and another sample had 44% protein and 7% moisture, the prospective purchaser would need to look critically at the difference in the two samples. By removing the water, the prospective purchaser can see that the first sample is 50% protein on a moisture free basis (100 - 12 = 88; 45 .88 = 50%) and the second sample is 47% (100 - 7 = 93; 44 .93 = 47%). The first sample is a higher protein meal on a moisture free basis, and quite possibly a better quality meal even though it contained more water.

How to properly obtain feed samples for analysis

Inaccurate sampling can lead to greater error than using average values. The sample must be representative of all of the feed in question. New plastic bags that can be sealed work well as containers and can be shipped in milk cartons or insulated paper bags. If the material is silage or other feed high in moisture, seal in a plastic bag and freeze if possible, then test for moisture or send, completely labeled, to the testing laboratory as soon as possible.

The following guidelines will help you in obtaining representative samples.

Grain Sampling. Take a minimum of 5 samples with a grain probe if possible, from various places in the bin or truck. Mix them thoroughly in a clean container, then take about a pint of the mix for the sample.

Hay Sampling. To sample loose or chopped hay, take samples from various locations in the pile or stack, using a forage sampler. To sample baled hay, take core samples from the end of a dozen or more bales taken from various places in the mow or stack.

In either case, mix the various samples in a clean container, then take enough of the mix to fill a ½ gallon bag for the final sample.

Silage Sampling. In tower silos take samples as the unloader is removing silage. In bunker silos or piles, take 15 or more double handfuls from several locations. Mix samples in a clean container, then take about ½ gallon for analysis.

It is desirable to sample silage several times during the feeding period, particularly if there is any great variation in the variety or date of cutting and maturity when the silo was filled. Many feeders will sample at least once weekly where they have their own moisture tester.

Testing for Moisture

Proper sampling and access to a moisture tester are essential to determine feed moisture levels. The most useful moisture tests are taken on the farm, due to losses in moisture and changes in the feed when sent to a testing laboratory, and time lag between when the sample is sent and when an analysis is received. An inexpensive relatively accurate moisture tester can be purchased from your local Dairy Herd Improvement Association milk tester or from Koster Crop Tester, 4716 Warrensville Center Road, Cleveland, Ohio 44128. Many county agents also have moisture testers in their offices. Many local elevators have testers that can test for moisture in grains.

The best recommendation, however, is to purchase your own tester. It costs $100 to $200 and can also be useful in determining the best point to harvest hay, haylage, silage or grains. It is a relatively small investment compared to the large investment in silos and feeding and harvesting equipment and the losses that can occur due to harvesting at the wrong time or errors in buying and selling due to not knowing the moisture level.

If the feed is being sampled for nutrient analysis also, the sample can be sent to the Ohio State University Soil and Forage Testing Laboratory for analysis. Your local county agent can give you instructions as to cost and how to prepare the sample for sending to the laboratory.

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