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Handling Feed Moisture in Ration Formulation and Inventory Control

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Nutritional quality control begins with knowing and adjusting for variations in the moisture content of feed ingredients. Moisture variations in feeds are almost always of more importance than variations in protein, mineral, and energy. Inventory control is affected by moisture content of feeds. Some feeds on hand are constantly changing in moisture content, and these changes frequently lead to financial losses when a price adjustment is not made for moisture losses.

Two pieces of equipment are essential in coping with moisture variation in feeds—a tester capable of determining moisture content of all feeds used at the lot, and a scale for weighing all feed purchased and fed. One of these without the other is of limited use in obtaining good nutritional quality control and inventory management.

Moisture Variation Is Large

Corn silage usually contains 50 to 75% moisture, thus 10 pounds* of corn silage contains between 2.5 to 5 pounds of dry matter—a variation of 100%. A steer eating 20 pounds of 15.5% moisture corn would only have to eat 18.8 pounds of 10% moisture corn to obtain the same nutrients. If 15.5% and 10% moisture corn cost the same, the latter would result in a cost reduction of a little over 6%. This is not much, but some cattle feeders have spent thousands of dollars for processing equipment which improves the value of grain about this much. And, 6% is about equal to the total benefit in feedlot performance from using antibiotics, Vitamin A, and trace mineral mixtures.

The moisture content of commodities must be considered when handling inventories and purchasing feeds. If, for example, one supply of hay costs $50/ton at 15% moisture and another supply was available at 10% moisture, the second supply would be worth $52.94/ton, all other things being equal. Many feeders have bought hay ignoring moisture content. Inventory losses of up to 15% due to moisture change are not uncommon during the first 30 days of storage on baled alfalfa hay. If the feeder both buys and sells on the basis of dry matter, his losses in inventory are then limited to a true loss of material, not moisture fluctuation.

Formulate on a Standard Moisture Basis

Good nutritional quality control is impossible without formulating on a standard moisture basis. The preferred standard is zero moisture or 100% dry matter. The National Research Council has adopted this system. The mathematics of balancing a ration and adjusting for its "as fed" composition are easy to manipulate.

When nutritional composition is given on a dry basis, conversion back to an "as is" basis is very easy. If, for example, No. 2 corn has 10% protein on a dry basis and a feeder has 30% moisture corn, protein on an "as is" basis can be estimated by multiplying dry matter percent of the feed times the value in the Feed Composition Table (0.70 x 10 = 7.0% protein on an "as is" basis). This technique is very useful for silages, etc. where it would be impractical to print nutrient composition tables for all possible moisture percentages.

Formulation of Rations

A feeder or nutritionist should formulate the ration on a dry basis. When feed samples are sent to laboratories for analysis it is their usual procedure to show the chemical analysis on both "as received" and on an oven dry basis. Conversion from a dry formula to an "as fed" basis is illustrated in *Table 1-A*. To determine how many pounds of 'as fed" feed are required to supply the equivalent dry matter, divide the dry matter required by the dry matter content of the specific feed.

*To convert to metrics, multiply pounds by 0.45 to find kilograms, and tons by 0.9 to find metric tons.

Table 1-A. Conversion of a feeding formula from a moisture free to an "as fed" basis.

Feed	*Dry Formula (%)*		*As Fed Dry Matter (%)*		*Pounds of "as fed" needed to make 100 lbs. of dry ration*				*As Fed Formula (%)*
Corn	5	÷	.80	=	6.25	÷	293.06	=	2.13
Silage	90	÷	.32	=	281.25	÷	293.06	=	95.97
Supplement	5	÷	.90	=	5.56	÷	293.06	=	1.90
					293.06				100.00

Formula Readjustment Is Often Necessary

If the silage and high moisture corn dry matter content changes (for example, in *Table 1-A* to 55 and 24% respectively), you should readjust your ration as illustrated in *Table 1-B*.

Compare the pounds of "as fed" feed required to make 100 lbs. of dry ration in *Tables 1-A* and *1-B*. By moving the decimal one place to the left it can be seen that a steer eating 10 lbs of dry matter would have to eat 29 lbs. of the ration in *Table 1-A* and only 21 lbs. of the one in *Table 1-B* to get the same nutrients.

Table 1-B. Readjustment of a feeding formula to an "as fed" basis.

Feed	*Dry Formula (%)*		*As Fed Dry Matter (%)*		*Pounds needed to make 100 lbs. of dry ration*				*As Fed Formula (%)*
Corn	5	÷	.76	=	6.76	÷	212.32	=	3.18
Silage	90	÷	.45	=	200.00	÷	212.32	=	94.20
Supplement	5	÷	.90	=	5.56	÷	212.32	=	2.62
					212.32				100.00

Moisture Changes Cause Imbalances

Assume you are mixing your ration properly, requiring 1.90% supplement on an "as fed" basis (as illustrated in *Table 1-A*). Now assume that the moisture of the silage and corn changed as in *Table 1-B*. If you do not readjust the feeding formula a serious shortage of protein could result. In this case, the cattle would receive only 72.5% as much supplement as they should have since the mixing formula was not recalculated.

Nutritional errors caused by moisture variation in rations have caused many feeders using feeds that are potentially variable in moisture content to stumble as cattle feeders. Failure to formulate on a uniform dry matter basis, making corrections when needed, is a major cause of problems in feeding high moisture feedstuffs.

Moisture Is Important When Buying Feeds

Relative value (dry matter purchased) when paying for corn on a 15.5% moisture basis while actually receiving corn of another moisture is illustrated in *Table 2*. If you are receiving 19% moisture corn and paying for 15.5%, you are receiving only 95.9% of the dry matter you paid for. If corn is delivered with 10% moisture, and you are paying on a 15.5% moisture basis, you are receiving 106.5% of what you are paying for.

When evaluating feed purchases, you should never lose sight of how much water you are forced to buy. For example, if you assume that corn and wheat have equal nutritional characteristics per unit of dry matter, the trading basis (15.5% moisture for U.S. No. 2 corn and usually about 8 to 10% moisture for wheat) is much more significant than any nutritional difference found in the two grains.

Table 2. Relative value of U.S. No. 2 corn (15.5% moisture) as affected by changes in moisture.

Moisture %	*DM Basis Multiplier*	*Moisture %*	*DM Basis Multiplier*	*Moisture %*	*DM Basis Multiplier*
0	1.1834	18	.9704	28	.8521
9	1.0769	19	.9586	29	.8402
10	1.0651	20	.9467	30	.8284
11	1.0533	21	.9349	31	.8166
12	1.0414	22	.9231	32	.8047
13	1.0296	23	.9112	33	.7929
14	1.0178	24	.8994	34	.7811
15	1.0059	25	.8876	35	.7691
16	.9941	26	.8757	36	.7574
17	.9822	27	.8639		

If 15.5% moisture corn is the purchase basis, it will require 1.1834 units of "as fed" corn to make 1 unit of dry matter.

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