MEASURING THE EFFECTS OF DRY MATTER IN BEEF CATTLE

K-STATE Research and Extension

Dry matter (DM) is fundamental in beef cattle nutrition. Understanding it is critical for accurately and cost-effectively formulating diets and supplementation programs.

In another publication on DM, *Importance of Dry Matter in Beef Cattle Diets*, the basics of DM in beef cattle diets were introduced. That publication sets up the foundational concepts of DM. This publication covers how DM is determined on the farm or ranch, how variation in DM influences the composition of a diet, and the implications DM can have on the economics of a nutrition program.

How is Dry Matter Determined?

Aside from submitting feed samples to an analytical laboratory, there are several methods to determine the DM content of a feedstuff on the farm or ranch. While university or commercial analytical laboratories provide the most controlled environments, accurate and timely estimates of DM can be made using the following common techniques: 1) the hand method (hays and silages only), 2) using an electronic conductance moisture tester and probe (hays and silages only), 3) using a heat-type moisture tester with a scale (hays, silages, grains, and other commodities), 4) using a digital electronic grain tester (grains only), and 5) drying in either a microwave or conventional oven (hays, silages, grains, and other commodities).

Electronic conductance, heat-type, and digital grain moisture testers can be purchased from agriculture supply companies. Each of these techniques can be useful in certain situations when there is a need to quickly determine the DM content of a feedstuff to aid in feeding or diet formulation decisions.

A more detailed discussion of the hand, electronic conductance, heat-type scale, and microwave oven methods, including equipment needed and specific procedures to follow, is available in K-State Research and Extension publication *Determining Forage Moisture Concentration*, MF2833 (*https://bookstore.ksre.ksu.edu/pubs/MF2833.pdf*). While that publication focuses on forages, the same general procedure may be used to determine the DM content of any feed sample using an appropriate method, including conventional ovens with oven-safe plates or trays at 105 to 110 degrees Celsius or 221 to 230 degrees Fahrenheit.

The DM of a feedstuff may be calculated as follows:

%DM = ((dry sample weight – plate weight) ÷ (initial wet sample weight – plate weight)) × 100.

How Does Dry Matter Influence Diet Composition and Performance?

Accurate DM values for individual feedstuffs are important for the correct formulation of diets because these values influence what is ultimately fed to the animal. An example of the importance of this concept is shown in Table 1. Diet A is the intended formulation of a typical diet for a beef cow in early lactation, assuming a DM content of 30.00%, 91.50%, and 93.50% for corn silage, grass hay, and dried corn distillers grains with solubles, respectively. At a total AF intake of approximately 43 pounds per head per day, this diet would supply 26 pounds of DM per head per day as the complete diet calculates to approximately 61% DM (26.04 lb DM ÷ 42.90 lb AF = 60.7%). Again, the individual amounts fed on a DM basis of each feedstuff may be determined by multiplying the AF amounts by the DM content of each ingredient.

21.7 lb of corn silage AF × 0.30 = 6.51 lb DM

17.0 lb of grass hay AF × 0.915 = 15.60 lb DM

4.2 lb of DDGS AF × 0.935 = 3.93 lb DM

The percent dietary inclusions, regardless of basis, may be calculated by taking the individual amounts for each feedstuff, dividing them by the total amount fed, and multiplying by 100. Diet B is what the intended diet would formulate to if the corn silage and grass hay were wetter than anticipated and had a DM content of 23.50% and 84.5%, respectively. If the AF amounts and, therefore, the % AF inclusion, did not change, the % DM inclusion still would

change in this situation, given the DM amounts are now altered with the ingredient DM level. This diet now calculates to approximately 55% DM and would provide about 23 pounds of DM per head per day if the AF amount remained constant at 43 pounds per head per day.

While the daily protein intake does not significantly change between these two example scenarios, the actual amount of total digestible nutrients (TDN) consumed on a per-cow per-day basis is more significantly influenced (16.6 vs. 15.0 lb). If 16.6 pounds of TDN daily are necessary to meet energy requirements, then a deficiency in TDN intake would result in a loss of body condition and weight, the extent of which is dependent on the duration of feeding and various animal and environmental factors. A deficiency in energy intake due to underfeeding DM will decrease daily gain for growing and finishing cattle. In most situations, underfeeding because of overestimating DM has the greatest potential negative effect on animal performance. Likewise, overfeeding due to underestimating DM alters the composition of the diet. It may negatively influence performance, particularly in situations where forage and concentrate proportions are critical for avoiding metabolic disorders like acidosis, such as when backgrounding cattle or finishing cattle are being adapted to high-concentrate diets.

How Does Dry Matter Affect Economics?

Understanding DM is critical for accurately pricing feeds, both within the same type and across various feedstuffs. Practically all feeds have both a dry and a moisture component, and the price must be adjusted relative to the moisture level so that feeds are fairly evaluated. While feedstuffs are usually priced as-is or as-fed, pricing on a DM basis allows for a direct and more accurate comparison of the dry quantity of feed. This pricing model is most important for feeds with a low DM content because those feeds are mostly water, and buying water can be expensive. To adjust the price of feeds in relation to their moisture level, they should be priced on a 100% DM basis. This is done by taking the price per unit of measure and dividing it by the DM content in decimal form. Using an example of wheat silage, if it is priced at $30 per ton on an AF basis, that would equate to $111.11 per ton on a DM basis at 27% DM. This is determined by simply taking the AF price and dividing by the DM content in decimal form ($30/ton AF ÷ 0.27 = $111.11/ton DM). Again, the concept of dilution applies here because water accounted for within any given

Table 1. Effect of feedstuff dry matter on diet composition and amounts fed.

Diet A – Intended Formulation					
Ingredient	**% DM[1]**	**% DM Comp.[2]**	**% AF Comp.[3]**	**DM lb[4]**	**AF lb[5]**
Corn Silage	30.00	25.05	50.58	6.51	21.70
Grass Hay	91.50	59.85	39.63	15.60	17.00
DDGS[8]	93.50	15.10	9.79	3.93	4.20
Total		100.00	100.00	26.04	42.90
Total Diet % DM[1]	CP, lb[6]	TDN, lb[7]			
60.70	3.1	16.6			

Diet B – Actual Formulation					
Ingredient	**% DM[1]**	**% DM Comp.[2]**	**% AF Comp.[3]**	**DM lb[4]**	**AF lb[5]**
Corn Silage	23.50	21.80	50.58	5.10	21.70
Grass Hay	84.50	61.41	39.63	14.40	17.00
DDGS[8]	93.50	16.79	9.79	3.93	4.20
Total		100.00	100.00	23.43	42.90
Total Diet % DM[1]	CP, lb[6]	TDN, lb[7]			
54.62	2.9	15.0			

[1] % DM = dry matter content of the individual feedstuff or total diet
[2] % DM Comp. = percent composition of the diet on a dry matter basis
[3] % AF Comp. = percent composition of the diet on an as-fed basis
[4] DM lb = pounds fed per head per day on a dry matter basis
[5] AF lb = pounds fed per head per day on an as-fed basis
[6] CP, lb = pounds of crude protein fed per head per day
[7] TDN, lb = pounds of total digestible nutrients fed per head per day
[8] DDGS = dried corn distillers grains with solubles

quantity dilutes the cost per unit. However, the total costs for a given quantity will be the same whether on an AF or DM basis. For example:

20 AF tons of wheat silage, 27% DM,
at $30 per ton equals $600.00 ($30 × 20 tons)

5.4 DM tons of wheat silage (20 × 0.27)
at $111.11 per ton equals $600.00 ($111.11 × 5.4 tons)

Remember the following:

1. Price per unit will always be **higher on a DM basis (water is gone)**
2. Price per unit will always be **lower on an AF basis (water is present)**

As the DM content for a given feed increases, the cost per unit on a DM basis decreases, provided the AF cost stays the same because that same total cost is spread out over more units of DM (Table 2). Using the prices for wet distillers grains, sources A and C in Table 2, and assuming either of those sources would be fed in a diet at 7 pounds of DM per head per day, that would be a difference of $0.12 per head per day between the two. In this example, while 4 percentage units may appear to be a relatively minor difference in DM content, it can substantially influence the cost of the feeding program.

WDGS A: $300 per ton DM basis ÷ 2,000 lb per ton = $0.15 per lb DM × 7 lb DM = $1.05.

WDGS C: $265 per ton DM basis ÷ 2,000 lb per ton = $0.13 per lb DM × 7 lb DM = $0.93.

If the DM content of individual feedstuffs is less than intended, how does it affect the cost of the final diet? An example of this case is shown in Table 3. If the DM is less than intended, then the cost of the total diet on a DM basis increases because the same total costs are applied to fewer tons or pounds of DM. In this situation, if the AF amounts do not change, then neither does the cost per head per day nor the cost per ton on an AF basis. Remember, in this example, DM is being underfed, which may increase costs in the long run if weight and body condition cannot be maintained. Likewise, when growing or finishing cattle, cost per pound of gain may be increased if performance is reduced due to underfeeding DM, yet the diet's cost remains the same.

Table 2. Effect of feedstuff dry matter content on cost per ton on a dry matter basis.

Feedstuff	$/ton AF Basis		Dry Matter of Feed[2]		$/ton DM Basis	lb of DM per ton	lb of water per ton
Corn Silage, A	45	÷	0.25	=	180	500	1,500
Corn Silage, B	45	÷	0.30	=	150	600	1,400
Corn Silage, C	45	÷	0.35	=	129	700	1,300
WDGS[1], A	90	÷	0.30	=	300	600	1,400
WDGS[1], B	90	÷	0.32	=	281	640	1,360
WDGS[1], C	90	÷	0.34	=	265	680	1,320
Grass Hay, A	130	÷	0.80	=	163	1,600	400
Grass Hay, B	130	÷	0.87	=	149	1,740	260
Grass Hay, C	130	÷	0.95	=	137	1,900	100

[1] WDGS = wet corn distillers grains with solubles

[2] Percent converted to decimal form

Table 3. Effect of feedstuff dry matter on diet costs.

Diet A – Intended Formulation			
Ingredient	**% DM[1]**	**DM lb[2]**	**AF lb[3]**
Corn Silage, $35/ton	30.00	6.51	21.70
Grass Hay, $60/ton	91.50	15.60	17.00
DDGS[4], $200/ton	93.50	3.93	4.20
Total		26.04	42.90

Diet % DM[1]	$/ton AF	$/ton DM	$/hd/day
60.70	61.67	101.79	1.32

Diet B – Actual Formulation			
Ingredient	**% DM[1]**	**DM lb[2]**	**AF lb[3]**
Corn Silage, $35/ton	23.50	5.10	21.70
Grass Hay, $60/ton	84.50	14.40	17.00
DDGS[4], $200/ton	93.50	3.93	4.20
Total		23.43	42.90

Diet % DM[1]	$/ton AF	$/ton DM	$/hd/day
54.62	61.67	113.10	1.32

[1] % DM = dry matter content of the individual feedstuff or total diet

[2] DM lb = pounds fed per head per day on a dry matter basis

[3] AF lb = pounds fed per head per day on an as-fed basis

[4] DDGS = dried corn distillers grains with solubles

Summary

Dry matter is a fundamental concept in beef cattle nutrition. While it can be easily overlooked or misinterpreted, it is important for appropriately balanced and economical rations and supplementation programs. Key points to remember are: 1) nearly all feedstuffs contain both a dry and a moisture component 2) the terms "AF basis" and "DM basis" are used to refer to how the value is expressed 3) DM of feedstuffs varies but can be measured on the farm/ranch 4) DM values for feeds can affect performance and 5) the DM value for a feed will affect not only the cost per unit on a DM basis of the feed itself but also the total cost of the final diet, either on a per unit of measure or per head per day basis. These concepts apply if producers use feedstuffs from their operation or are evaluating options for purchased ingredients.

References

Slocombe, J., R. Price, and L. Lomas. Determining Forage Moisture Concentration. Kansas State University. MF2833. November 2008. *Determining Forage Moisture Concentration*, MF2833 (*https://bookstore.ksre.ksu.edu/pubs/MF2833.pdf*).

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