MANAGING BEEF COW CONDITION SCORES THROUGH FEEDING

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Proper nutrition is critical to reproductive success in beef cow herds. In addition to minimizing cost and making use of available feed resources, a nutrition program for the breeding herd should have three goals: to have cows in the proper condition at calving time, to have cows in positive energy balance as soon as possible after calving, and to develop heifers to the proper weight before breeding. This paper will focus on the first of these goals and will describe nutrient requirements, feeding programs and other considerations involved in managing condition scores in beef cows.

CONDITION SCORE vs WEIGHT AS AN INDICATOR OF NUTRITIONAL STATUS

Nutritional requirements and reproductive performance of beef cows are influenced by body fat reserves. Research at the University of Minnesota and other universities have shown that visual evaluation is the only practical means to assess body condition (fatness) of beef cows. Visual assessment of condition at regular intervals is possible in many situations where weighing may be impossible. Live weight is a poor indicator of condition or fat reserves because gut fill, frame size and/or products of pregnancy prevent weight from being an accurate indicator of condition.

Two cows could have very different liveweights but similar condition scores or could have similar weights, but different condition scores. For example, an 1100 lb cow could be a 1000 lb cow with 100 lb of excess body reserves, or a 1200 lb cow that has lost 100 lb of body reserves. These cows should be fed differently, despite similar weight. In winter feeding studies where condition and weight were assessed, condition score commonly decreases to a greater extent than weight. This implies a greater loss of energy in relation to weight.

A nine point scoring system has been devised for visual appraisal of beef cow condition. Table 1 contains brief descriptions of condition scores (CS) 1-9. A more complete description of the condition scoring system can be found in Beef Cattle Management Update #15. Producers should become familiar with these descriptions. CS of cows should be routinely assessed and cows sorted into groups based on their need to gain, lose or maintain weight. It is generally agreed that beef cows in the Upper Midwest should be in moderate to good condition (CS 5 to 7) at calving. Managing heifers to be CS 6 or 7 at calving is desirable. Cows or heifers that are thinner than these guidelines may have trouble rebreeding. Cows that are fatter represent not only wasted feed, but also potential problems in calving, milk production, or rebreeding. More complete description of the effects of condition and nutrition on reproduction can be found in Beef Cattle Management Update #15. Managing condition for optimum reproductive performance is an important task for cow-calf producers.

Learning to assess CS of cows is not difficult. CS are most valuable when assessed at regular intervals by the same trained evaluator over a period of years. Once CS have been recorded and females sorted, however, the task of formulating specific diets to increase, maintain or decrease condition can be difficult. Keys to this are understanding the maintenance requirement of cows, and estimating the quantity of energy required to induce the desired CS change.

UNDERSTANDING ENERGY RESERVES

Gain or loss in weight of mature cows represents deposition or mobilization of stored energy, in the form of protein (muscle) or fat. Average or fat cows can mobilize body energy reserves during times of underfeeding with little negative effect on performance. On the other hand, if energy needs of thin cows are not met, production will suffer dramatically as her limited energy stores are utilized.

Weight gain or loss in beef cows involves both muscle and fat. Muscle contains water (approximately 67%), protein (20%), fat (10%), carbohydrate (2%) and ash (1%). Given this typical composition, a pound of muscle, including associated fat, would contain approximately 900 kcal. A pound of fat, which is almost entirely lipid, would contain more than 4000 kcal. Put another way, mobilizing 1000 kcal of protein would require loss of approximately 2.7 lb of live weight, while the same amount of energy mobilized as fat would only reduce body weight by 1/4 lb.

Estimating the amount of energy required to increase or decrease one CS is critical to devising feeding strategies to meet needs. Published equations can be used to calculate mobilizable fat and protein reserves in beef cows, based on weight, age, frame and condition score. Mobilizable energy reserves are a function of weight, percentage fat and percentage protein. Cows in CS 1, with 5.0% body fat, are assumed to have no mobilizable fat reserves. These equations assume that protein deposition and mobilization are minimal in cows that are CS 5 or greater. Thus, energy required to increase CS above 5, or energy mobilized as CS is reduced toward 5, are almost entirely influenced by changes in fatness. Changes in CS 1 through 5 involve both body fat and protein reserves.

Mobilizable energy differences between condition scores are not equal. As CS increases up to CS 5, quantity of protein reserves increases at an increasing rate. Since fatness increases as a percentage of body weight, increases in quantity of fat are greater as CS increases. Thus, the greatest differences are between CS 4 and 5, where protein increase is maximal and fat increase relatively large, and between CS 8 and 9, due to the largest fat increase.

Based on these equations, a frame score 5 cow, with a mature weight of 1174 lb at CS 5, would have 47.9 lb of mobilizable protein, 181.7 lb of mobilizable fat and 887.4 reserve Mcal. A frame score 5 cow would weigh 995, 1174, or 1277 lb in CS 3, 5 or 7, respectively. Weight gain of 179 lb, including 29.5 lb of protein is required to increase CS from 3 to 5, while a gain of 103 lb, including 16.8 lb of protein is required for increase from CS 5 to 7. Quantity of fat required to increase from CS 3 to 5, or 5 to 7, are similar.

While the CS 5 and 7 cows would have similar lean tissue mass to maintain, the CS 7 cow weighs 8.7% more and thus would have a greater calculated maintenance requirement. Since fat would require little energy to maintain, and would contribute to insulation, actual energy required to maintain these cows should be relatively similar, perhaps even less for the CS 7 cow, despite the difference in weight.

Using the energy reserves listed in Table 2, 311.3 Mcal are required for this frame score 5 cow to increase from CS 4 to 5. This can be done during a 30 day period in mid-gestation. If hay (551.6 lb, or 18.38 lb/d) is fed for maintenance, an additional 501.7 lb of hay (16.7 lb/d) is required for the gain in CS (Table 3). Total feed required would be 1053.3 lb, or 35.1 lb/d. If hay is fed for maintenance, 334.8 lb of additional corn (11.6 lb/d; calculated as 702.9-368.1) would be required to gain 1 CS in the 30 day period. Table 3 allows calculation of feed requirements for other desired weight gain or loss. Keep in mind that all examples are a frame score 5 cow, with mature weight of 1174 lb. Larger or smaller cows would have different requirements.

In this example, reduction from CS 5 to 4 would require loss of 311.3 Mcal of body reserve energy. This represents 15 d of 0 feed intake (assuming no reduction in maintenance requirement) for a cow in the middle 1/3 of gestation, or 13 d in the last 1/3 of gestation.
The equations used assume that protein deposition and mobilization are minimal in cows that are CS 5 or greater. Thus, energy required to increase CS above 5, or energy mobilized as CS is reduced toward 5, is less than in cows with CS 5 or less.

FACTORS AFFECTING MAINTENANCE REQUIREMENTS OF CATTLE

The above examples include energy differences based on weight, age, CS and frame score. In these examples, all frame score 5 cows would be identical, an assumption that is clearly not appropriate. Differences in efficiency of energy utilization, or differences in maintenance requirements of cows should be considered as individual cows, cow herds and situations are assessed.

The maintenance requirement is defined as the amount of feed energy that will result in no loss or gain in body energy (NRC, 1984) or weight. By definition, net energy required for maintenance is the amount of energy equivalent to the fasting heat production (FHP) by the animal. Maintenance cost comprises approximately 70% of all energy required by beef cows. Energy required for maintenance of mature, non-pregnant, non-lactating cows is estimated to be 290 kcal ME/lb $BW^{.75}$/d. This value was originally thought to be constant for all cattle types in all situations. While it may be useful for describing the maintenance requirement of penned animals in nonstressful environments with minimal activity, it is clearly not adequate to describe all circumstances.

Numerous factors can induce differing maintenance requirements in animals of the same weight. Variations in maintenance requirement due to sex can be significant. Males typically have greater requirements than females of similar weight. Maintenance requirement per unit of size is commonly thought to diminish with increasing age however, there are data to the contrary.

Differences in body composition affect maintenance requirements of mature beef cows. There is a significant negative correlation between condition score and energy requirements. In one experiment, Hereford and Charolais cows were fed equivalent amounts of feed per unit weight, but cows in low condition lost weight while those in high condition tended to gain weight. University of Minnesota researchers estimated energy requirements of Angus x Hereford and Angus x Holstein cows during winter. Among Angus x Hereford cows, thin cows, those with less than 20% empty body fat, had 6.1% higher maintenance requirements than their fat counterparts (131.5 vs 123.5 kcal ME/kg $BW^{.75}$). In contrast, fatter Angus x Holstein cows had 2.7% higher maintenance requirements (142.4 vs 138.6 kcal ME/kg $BW^{.75}$) than thin cows of similar breeding.

Failure of weight (or $weight^{.75}$) to completely explain requirements of cows in varying condition should not be unexpected since fat requires little energy to maintain. Lean body mass should provide greater precision for predicting requirements than weight. Cows of similar weight but different CS would differ in lean body mass and thus, maintenance requirement. Maintenance energy requirements are closely correlated with body lean (protein) mass, and poorly correlated to body fat mass in sheep.

The divergent energy requirements of lean and fat tissue in beef cattle have been described. In the study, using mature, nonpregnant, nonlactating Angus cows, protein required 9.3 times as much energy to maintain as fat (192.9 vs 20.7 kcal/kg). Thus, 88.6% of total energy used for maintenance was used to maintain protein, 11.4% for fat. In other studies estimates of energy required to maintain fat were negative, suggesting that increased quantities of fat reduce the maintenance requirement of protein.

In contrast, others have suggested that condition may not be a dominant factor in determining maintenance requirements. Regression of retained energy on $BW^{.75}$, body fat and protein of Angus x Hereford and Angus x Holstein cows explained 75% of the variation in energy retention by Angus x Hereford cows, but only 32% of the variation in energy retention by Angus x Holstein cows. Thus, factors other than body composition and live weight accounted for variation in requirements of Angus x Holstein cows. Distribution of fat and protein affect energy requirements independent of amount of fat. For example, fat Angus x Hereford cows had lower winter energy requirements in part because fat deposition in these breeds occurs subcutaneously and contributes to insulation, whereas fat deposition in Angus x Holstein cows occurs internally to a greater extent and does not contribute to insulation.

Skeletal muscle accounts for by far the largest protein store in the body. The high cost of maintaining skeletal muscle is due to the constant protein synthesis and degradation that occurs in this dynamic tissue. However, traditional research emphasis on economically important tissues (i.e., emphasis on skeletal muscle and condition as variables) may have resulted in biologically important tissues being overlooked. Visceral protein stores turn over at an even greater rate than skeletal muscle and fasting heat production (FHP) is more highly associated with weight of protein in the viscera than with weight of protein in the carcass of pigs. This supports the theory that energy expenditure of visceral organs comprised a major portion of basal energy expenditure. It has been estimated that gastrointestinal tract, liver and heart accounted for 30% of basal energy expenditure; skin, brain and kidney accounted for an additional 22%.

Stage of production can account for differences in visceral organ mass. Nebraska researchers estimated that liver, heart and kidney account for 37% of fasting energy expenditure in pregnant and nonpregnant Hereford heifers and that weight and energy expenditure of these tissues increased with greater feed intake. Differences in previous plane of nutrition influenced FHP of lambs with similar weight and body composition. Others have described changes in vital organ mass due to previous nutrition and growth rate and concluded that mass of these metabolically active tissues is responsible for differences in FHP. Declining production near the end of a typical feeding period has also been implicated. Michigan researchers observed smaller livers in 1360 lb Simmental steers, than in 1210 lb steers slaughtered earlier in the same experiment. The larger steers were growing at a rate of less than 2 lb/day when slaughtered, while gain of the smaller steers was approximately 3.8 lb/day at slaughter. Lactation induces an increase in visceral organ mass in cows and rats and these increases result in increased basal energy expenditure.

Differing production potential between breeds can account for differences in visceral organ mass, and thus maintenance requirements. In a study involving several breeds of beef cattle, potential milk production was related to estimated maintenance requirement, even in nonpregnant, nonlactating cows. Higher milking breeds had greater weight in visceral organs and greater maintenance requirements.

Animal factors such as activity, hair coat and hide thickness may affect maintenance requirement. Distance required to obtain forage or water, quality of pasture, and structural and mouth soundness of the cow will affect her ability to meet her maintenance requirement. Environmental factors that affect maintenance requirement include cold stress (acute or chronic), which is affected by wind, water and mud, and heat.

Despite considerable work, attempts to predict maintenance requirement of individual animals have not been largely successful. Researchers at the University of Minnesota have described substantial within-herd variation of maintenance requirements and efficiency of energy usage in purebred Angus cows. These workers were able to categorize cows as efficient, average or inefficient based on energy deposition. However, routinely measured variables were not well correlated with individual efficiency. Thus, individual differences, due to factors that are not easily distinguishable, contribute heavily.

Based on the above discussion, individual producers should consider whether they expect the maintenance requirements of their cow herd to be average, above or below. Calculated feed requirements should be tempered with this consideration.

BALANCING FEED COST WITH REPRODUCTIVE PERFORMANCE

Achieving reproductive success does not necessarily mean supplying a lot of expensive supplemental feed to beef cows. Timing of feed supplementation can be more important than how much feed is supplied. Feed should be offered in order to meet the needs of breeding females at the most critical times. At other times feed costs can be conserved through use of low cost feedstuffs.

A summary of high vs low cost producers in the Nebraska Integrated Resource Management (IRM) program offers insight as to the importance of lowering costs, especially feed costs. Low cost producers required $88.74 less per calf weaned, yet weaned heavier calves than high cost producers. This resulted in a $.20 reduction in cost per pound of calf produced.

Low cost producers had almost $45/cow less feed cost than high cost producers, more than half of the total difference in cost of production between the two groups. As stated before, a dry cow in mid-gestation can be fed low cost feedstuffs and maintained quite cheaply, while still meeting her nutrient requirements, which are low during that period. One of the keys to this is maximum use of crop residues. Producers in most areas of Minnesota have access to corn stalk residue or straw from small grains. Crop residues, especially corn stalks can be grazed at minimal cost. Producers who do not have stalk residue should consider leasing it from neighbors. If hay is priced at $40 to 80/T, a fair price for leased stalks would be $9 to $16/cow/month. Stalks can also be harvested as stacks or large, round bales. Harvested stalks are worth $18 to $37/T of DM. If cows are in adequate condition, feedstuffs such as corn stalks should be considered during late fall and early winter; thin cows should receive higher quality feed.

When considering any purchased feedstuffs, cost per pound of energy (TDN) should be evaluated in order to make purchase decisions. Be aware that many by-product feeds have extremely low DM content, some are so low that even if they are free, the transportation cost may be too high for them to be proper choice. Tables 5 and 6 include examples of pricing feedstuffs based on their energy content.

Because of lower maintenance requirements, weight gain may be easier to put on in mid-gestation than in late gestation. As a rule of thumb, if weight gain is desired in mid-gestation, increasing quantities of good quality forage may be adequate. On the other hand, if weight gain in late gestation is desired, supplemental grain or silage will probably be required.

This paper deals primarily with energy as a nutrient. Producers should be careful to consider all nutrients when formulating diets. Since the protein requirement of a cow in mid-gestation is quite low, most maintenance diets require little protein supplementation. All protein sources should be evaluated on a cost/lb of protein basis when purchase decisions are made. In addition, proper vitamin and mineral nutrition of the cow herd are critical to success.

Table 1. DESCRIPTION OF CONDITION SCORES FOR BEEF COWS

Condition score	Percentage body fat	Description
1	5.0	Emaciated
2	9.4	Poor
3	13.7	Thin
4	18.1	Borderline
5	22.5	Moderate
6	26.9	High moderate
7	31.2	Good
8	35.6	Fat
9	40.0	Extremely fat

Adapted from Fox et al. (1988).

Table 2. WEIGHT, MOBILIZABLE FAT AND PROTEIN AND ENERGY RESERVES OF BEEF COWS, BASED ON CONDITION SCORE

CS	Wt, lb	Mobil fat, lb	Mobil prot, lb	Reserve energy, Mcal
1	841	0.0	0.0	0.0
2	916	28.3	9.3	142.2
3	995	66.6	20.3	331.0
4	1082	117.0	33.1	576.1
5	1174	181.7	47.9	887.4
6	1226	238.4	50.0	1136.7
7	1277	300.0	52.1	1404.8
8	1328	365.6	54.3	1694.4
9	1380	436.5	56.4	2004.8

Adapted from Fox et al. (1988).
Example is a frame score 5 cow, mature weight, kg at CS 5.

Table 4. HIGH vs LOW COST PRODUCERS, NEBRASKA

Item	Low cost producers	High cost producers
	-- Feed costs, $/calf weaned --	
Alfalfa hay	25.75	51.58
Other hay	33.07	31.69
Silage	1.86	18.81
Total harvested	60.68	102.08
Other	92.76	96.28
Total	153.44	198.36
	-- Total costs, $/calf weaned --	
Total feed costs	153.44	198.36
Other operating	77.77	105.42
Ownership costs	135.35	151.52
Total	366.56	455.30
	------------ Summary -------------	
Cost/calf weaned, $	366.56	455.30
Average weaning wt, lb	500	489.5
Cost, $/lb weaned	0.73	0.93

IRM cooperating herds 1990, average of 1987, 1988 data.

Table 5. PRICING FEEDSTUFFS BASED ON ENERGY (TDN) CONTENT

Feedstuff	Price, $/T	DM, %	Cost/T of DM	TDN, % in DM	Cost/T of TDN
Corn grain	70	85	82.35	91	90.50
Corn grain	90	85	105.88	91	116.35
Corn grain	110	85	129.41	91	142.21
Corn silage	18	32	56.25	70	80.36
Corn silage	24	32	75.00	70	107.14
Oats	120	88	136.36	75	181.82
Barley	85	88	96.59	83	116.37
Wheat	110	88	125.00	90	138.89
Corn screenings	80	85	94.12	80	117.65
Corn screenings	60	85	70.59	80	88.24
Grain dust	65	88	73.86	80	92.33
Alfalfa hay	80	88	90.91	58	156.74
Alfalfa hay	100	88	113.64	58	195.92
Grass hay	30	88	34.09	45	75.76
Grass hay	40	88	45.45	54	84.18
Wheat straw	50	88	56.82	43	132.14
Potato waste	16	20	80.00	78	102.56

Table 6. COST OF ENERGY (TDN) IN HAY AND CORN

Price	TDN cost, cents/lb	Energy-equivalent value of other feedstuff
Legume-grass hay, $/T	hay	corn, $/bu
20	2.1	0.91
40	4.1	1.78
60	6.2	2.69
80	8.3	3.57
100	10.3	4.46
120	12.4	5.37
Whole corn, $/bu	corn	hay, $/T
1.50	3.5	33.52
2.00	4.6	44.53
2.50	5.8	56.14
3.00	6.9	66.79
3.50	8.1	78.41
4.00	9.2	89.06

Assumptions: hay = 88% DM, 55% TDN in DM; corn = 85% DM, 91% TDN in DM.