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Department of Animal Science
University of Minnesota, St. Paul

BODY CONDITION SCORING TO PREDICT FEEDING PROGRAM PROBLEMS FOR DAIRY CATTLE

Jeffrey K. Reneau and James G. Linn
Extension Animal Scientists

Introduction

With the advent of personal computers, the feed industry and others have become quite sophisticated in their ability to formulate dairy rations. However, it is well recognized that the actual ration reaching the cow may be quite different from the one formulated and the feeding recommendations left on the farm. Such simple things as day-to-day variation in forage moisture or quality, the farm to farm variation in average dry matter intake, or complications with malfunctioning or inappropriate feeding systems may foil the best attempts to provide an excellent feeding program. Ultimately, the cow is the final evaluator of ration adequacy. Measures of actual dry matter intake and study of herd production data such as milk composition and lactation curves, as well as the monitoring of the cow's body condition, are the best means of evaluating rations or diagnosing herd nutritional problems.

The careful management of energy in dairy cattle is crucial to efficient production and reproduction. Poor energy management is commonly observed as the most limiting factor contributing to low milk production and poor reproductive performance in both low and high producing herds. Concern over the energy content of rations will undoubtedly increase as milk production of cows and herds continues to rise via improved genetics, better herd management and the increased implementation of 3X milking.

Body condition scoring (BCS) has emerged as an effective tool in monitoring the energy intake of cows and herds. In spite of its subjectivity, BCS gives a surprisingly accurate assessment of a live animal's energy reserves. Convincing research evidence shows that body reserves are better reflected by BCS than by live weight change (3, 17, 13). This has been shown to be especially true in growing heifers including growing first calf lactating heifers and in dry cows in which live weight change reflects the rapid development of fetal tissues (8, 15). Live weight changes, such as during periods of unusually high dry matter intakes, reflect feed amounts in the digestive tract rather than the changing status of energy reserves (1).

The BCS techniques are relatively simple and inexpensive, lending themselves easily to routine dairy management use. Studies indicate that even a novice with very little training can become as competent in BCS (7).

Different Body Condition Scoring Systems

There are several BCS systems in use in the world today. This can lead, and has led, to confusion in interpretation of published information on BCS. For example, the British system uses a scale of 0 to 5 with 1/2 point increments resulting in a functional 11 point scale. The

Australian system uses a scale of 1 to 8, and in New Zealand an 11 point scaled is used. The United States BCS system developed in Virginia is an adaptation of the British system and uses a BCS scale of 1 to 5.

Table 1. Conversion table for differing body condition scoring systems.

1	2	3	4	5				Virginia system Wildman et al., 1982 (24)
0	1	2	3	4	5			British system Mulvany, 1981 (20)
1	2	3	4	5	6	7	8	Australian system Earle, 1976 (6)

All milk yield and body weight change data cited in this paper have been converted to the Virginia 1 to 5 point system to avoid confusion.

Body Condition Scoring (BCS) in the U.S.

The scoring system developed in Virginia is the most widely used in the United States. Under this system, cows are scored from 1 to 5 based on a visual appraisal and manual palpation of the loin, rump and tailhead regions. A score 1 cow is very emaciated, while a score 5 cow is very obese. Detailed criteria for each score are given in Appendix 1. This method lends itself well to the typical stall barn in which cows are restrained; however, it is not practical in the free stall situation.

Recently, a variation of the Virginia system has been developed in California (Appendix 2) (7). This scoring system, like those previously developed in Australia and New Zealand, relies on visual appraisal only. Consequently it is more practical for the free stall herd. Verification of this procedure has demonstrated that the method is equally as accurate and easy to use as other body scoring techniques. Although this method may not be precise enough for a detailed research situation, its use in commercial herd management conditions is probably adequate and would seem appropriate. Care should be taken not to inflate BCS during the winter months on long haired cattle, particularly heifers. Whenever there is doubt over a BCS, it is advisable to confirm the visual observation by the palpation procedure.

BCS Facts

A. BCS in Relation to Milk Production

1. As body condition at calving increases up to 4, milk yield and milk fat tend to increase during early lactation when cows are fed diets with sufficient fiber (2, 8, 12, 13, 16).

2. Cows with BCS above 3.0 at calving achieved earlier and higher peak milk yields and came closer to expected ME predicted production than did cows with BCS below 3. The higher BCS cows, however, were relatively less persistent than the lower BCS cows. This may be an important fact to remember in the diagnostic study of herd lactation curves (2, 24).

3. Cattle that require additional body reserves are most efficient at depositing these stores during lactation and not the dry period. A lactating cow uses metabolizable energy from feed at an efficiency of 75% to replace body reserves. Whereas, the dry cow uses energy from feed at an efficiency of only 60% to replace body reserves. Thus, it will require approximately 15 to 25% more feed to replace body reserves during the dry period than when a cow is lactating (2, 12, 13).

   Studies in which cows were fed to reach desired BCS during the dry period show no economic benefit when careful energy input-output calculations were compared (9, 10).

4. Dry matter intake is generally less and loss in body condition tends to be greater during early lactation for fat cows (above 4 BCS) than for optimal condition cows (3 to 4 BCS) (11, 13, 18). In high-conditioned cows fed low energy level diets in early lactation, body condition loss could become excessive (greater BCS unit = 1). Thus, to fully benefit from added BCS at calving, there needs to be good management of early lactation nutrition. Correct body condition at calving supplements dietary energy intake during early lactation to maximize milk production. However, correct amounts of dietary energy are required to reduce the rate of fat mobilization; thus avoiding the complications caused by rapid weight loss.

   Cows calving with low BCS (below 3.0) tend to eat more and gain weight earlier than higher BCS cows. Thus, there appears to be little advantage in achieving high BCS (greater than 4) at calving (even if BCS is gained in lactation) where early lactational nutritional management is excellent (16). This of course will depend on herd average production level. This statement is less true as cow performance reaches levels above which even the best possible nutritional management cannot compensate for energy demands (i.e., 90 to 100 lbs milk).

5. Excessive body condition at calving is undesirable. Cows with BCS above 4, particularly when combined with long lactations, long dry periods (>70 days) and poor early lactation nutritional management, will have lower milk yields, more metabolic disease and lower reproductive performance (2, 12, 22). However, it should be emphasized that both the rate and extent of condition score loss are more critical than actual condition score at calving in the development of fatty liver and other subsequent health problems. Studies have shown that many obese cattle did not develop fatty liver when the BCS loss in early lactation was less than 1 BCS unit.

B. BCS and Reproductive Performance

1. Research efforts to associate obesity and higher body condition scores at calving with impaired reproductive performance have had mixed results. It has been demonstrated that fat cows with fatty liver had longer periods to first ovulations, first estrus and conception. Study of herd reproductive records is advisable before drawing cause and effect conclusions on the effect of high BCS on reproduction. In many cases, excessively fat cows are often those cows with previous infertility problems also (12).

2. Cows in negative energy balance have a lower reproductive performance than those in positive energy balance (Table 2) (2, 12, 14).

Table 2. Effect of weight change on reproductive performance (14).

	Weight gain	Weight loss
Conception rate	67%	44%
Services/conception	1.5	2.32

This observation is independent of actual BCS. For example, in one study thin first calf heifers achieved good intakes and began to gain weight early in lactation were more fertile than those in good condition but were in negative energy balance.

3. An extension of fact #2 is that not only the amount of body condition loss but the rate of body condition loss in early lactation may also impair reproductive performance (Table 3) (2, 12, 23).

Table 3. Relationship between postpartum body condition loss and reproductive performance (23).

Body condition loss*	No. cows	Days to 1st ovulation	Days to 1st estrus	Services per conception	Days open
Minor	23	24 ± 2 **a	40 ± 5	1.7 ± 0.2	92 ± 11
Moderate	16	34 ± 1 b	35 ± 5	1.8 ± 0.4	88 ± 8
Severe	15	35 ± 4 b	53 ± 8	1.9 ± 0.3	104 ± 14

* Body condition loss during the first 2 weeks postpartum was defined as follows: minor, less than 0.5 unit; moderate, 0.5 to 1.0 unit; and severe >1.0 unit of body condition score.
** Mean $\pm$ SE.
a,b Means within columns with different superscripts differ significantly: $P < .05$.

4. Dry cow feeding practices should be aimed toward maintenance of condition scores. Dry cows should not be allowed to lose weight or body condition. Excessively fat cows should not be put on diets during the dry period. Studies show that excessive weight loss during the dry period predisposes the cow to development of fatty liver syndrome and other common postpartum problems (12, 26). In order for cows to maintain body condition, they must gain 1 to 1.5 pounds per day to offset the rapid development of the fetus.

BCS Objectives

The objective of BCS is to identify suboptimal feeding practices or discrepancies between feed recommendation and actual herd performance. However, it should not serve as solely a monitor but also be used to aggressively manage the high producing cow with the goal of optimizing productivity while minimizing development of potential health and reproductive efficiency problems. BCS of cows at different times during the production cycle provides opportunity to observe changes in body reserves relative to associated changes in milk

production, reproduction and health. Appropriate management action should be taken on both an individual cow and/or herd basis to meet target goals for BCS before problems develop.

When Cows Should Be Body Scored

The more frequently cows are scored, the better the assessment of changes in body reserves. Ideally cows would be scored monthly or bimonthly. In most herds, this becomes a major undertaking and is not practical. Adding BCS to routines where cows are normally handled reduces extra work and makes efficient use of labor. For example, body score cows at calving, breeding time, during veterinary examinations, or when vaccinations are given. The most likely time BCS will be missed is during mid-lactation. Yet if efficient restoration of body reserves is going to occur, assessment of BCS at this time is very crucial as the ideal time to restore body reserves is during mid to late lactation. Restoration of body reserves during a normal 50 to 60 day dry period is both difficult and not an economical use of feed. The following are the suggested minimal times cows should be scored:

1. At calving.

2. At 5 to 6 weeks after calving (at approximately peak milk production, at the first heat, or when the first rectal exam is done postpartum, etc.).

3. At 150 to 200 days after calving (in mid-lactation).

4. At dry off.

At these times cows should score in the ranges listed in Table 4.

Table 4. Recommended body condition scores of dairy cattle at critical times (21).

Time of scoring	Desired scoring	Reasonable range
Cows		
Calving	3.5	3.0 - 4.0
Peak milk	2.5	2.0 - 2.5
Mid-lactation	3.0	3.0 - 3.5
Dry off	3.5	3.0 - 3.5
Heifers		
6 months	3.0	2.5 - 3.0
Breeding	3.0	2.0 - 3.0
Calving	3.5	3.0 - 4.0

If the body condition scores of the cows are outside the reasonable range, management steps should be taken to define and correct the problem. The most important thing to look at is the change in body condition between one stage of lactation and another. Table 5 provides some diagnostic clues as to causes of BCS outside reasonable ranges.

Table 5. Relationship of stage of lactation to body condition score (BCS) or to changes in BCS and its possible diagnostic significance.

Time period	Body condition score	Reason	Suggested remedy
Dry off	High (>4.0)	Cows gained excessive weight during late lactation.	Reduce ration energy in last 1/3 of lactation.
	Low (<3.0)	Cows not fed to gain weight during late lactation.	Increase energy in last 1/3 of lactation.
Dry off to calving	Gain in BCS above 4.25	Excessive energy In dry cow ration. Excessive average days dry resulting from herd reproductive failure/ inefficiency.	Measure DM intake, re-analyze forages and reformulate rations reducing energy. Limit days dry to 70 days maximum. Ideal days dry is 50-60 days. Establish stronger reproductive management.
	Loss in BCS	Dry cows losing weight on dry cow ration.	Check actual intakes; re-analyze forages; adjust ration energy density to stop weight losses. Check individual cow for possible twins or chronic disease (liver, kidneys, etc.). Check individual cow for possible twins or chronic disease (liver, kidneys, etc.).
Calving to peak production	BCS too high (>3.0)	Genetics Inadequate protein in early lactation ration relative to cows' intake levels.	Cull cows based on production ability. Measure intakes and adjust ration protein. Challenge feed protein to a maximum of 19% CP in ration DM.
	BCS loss of 1 unit (i.e., 3.5 to 2.5)	This is expected and normal for productive cows.	Maximize ration energy density but keep ration effective fiber levels high enough to maintain normal rumen fermentation. Consider adding niacin and fat to rations if BCS loss approaches 1 unit. Supplement niacin. Use supplemental fat.
	BCS losses greater than 1 unit or BCS decrease below 2.5	Cows too thin at calving or have lost excessive weight.	Measure DM intakes. Minimize body fat mobilization by: maximizing ration energy density, feeding high quality forages, supplementing fat into the ration. Consider niacin supplementation for cows at 3.5 BCS or greater at calving.

Table 5. Relationship of stage of lactation to body condition score (BCS) or to changes in BCS and its possible diagnostic significance.

Time period	Body condition score	Reason	Suggested remedy
Peak to mid-lactation	BCS too high (>3.0)	Genetically inferior cow.	These cows are strong culling candidates if low milk production is not due to feed related problems.
		Cows on high energy diet too long.	Move cows to lower energy ration as body reserves are restored and BCS is >3.0.
	BCS remains low (<2.5) or cows continue to lose BCS.	Cows not recovering from loss of condition in early lactation.	Balance ration to meet production energy requirements. Do not lower ration energy density until cows reach a BCS >3.0.
		Ration energy density too low.	
		Chronic disease.	
	Some cows low BCS (<2.5); some cows too high (>3.5).	Large variation in herd genetic ability.	More consistent use of AI in herd and cull cows of low genetic merit.
		Cows not fed to meet energy requirements. High dairy merit cows are underfed and unusually thin while genetically inferior cows are overfed and put on weight.	Measure intakes; analyze forage; balance rations. Be sure to meet requirements of cows. Group cows according to milk production and BCS. Be sure all cows have access to feeds fed in bunks.
Late lactation to dry off	BCS too high (>3.75)	Cow receiving excess energy.	Measure intakes; analyze forage; adjust ration to productive and body tissue restoration needs.
		Calving intervals too long.	Improve herd reproductive management; cull infertile cows sooner.
	BCS too low or cows not gaining BCS to reach 3.5 at dry off	Intakes lower than expected (ration palatability, forage quality change, or heat stress, etc.).	Place cows on higher energy ration last 1/3 of lactation.
		Individual cows may have chronic disease affecting liver, kidneys, feet, etc.	Consult a veterinarian.

NOTE: > means greater than; < means less than.

Feeding for BCS

Many nutritionists and dairy producers try to have cows gain 100 to 300 pounds prior to dry off anticipating an early lactation benefit in milk production and reproductive performance. The difficulty in gaining this amount of weight and restoring BCS in high producing cows is often underestimated. For example, assuming a positive energy balance is reached by 100 DIM, it will be necessary to gain 0.5 to 1.5 pounds each day to achieve a 100 to 300 pound live weight gain by 305 days in milk. The calculated amount of extra corn above production requirements necessary to achieve that gain is 1.5 to 4.5 pounds per day, respectively for the 200-day period. If restoration of body condition is delayed until the last 100 days of lactation, the challenge becomes even greater. Some cows of exceptional dairy merit will not put on weight even when left on high production rations the entire lactation. In many cows with a normal lactation length and 50 to 60 dry days, it is nearly impossible to achieve gains in BCS. In a Colorado study, cows with BCS less than 3.5 were fed 4 pounds and 8 pounds of extra corn per day with no change in BCS observed during the 50 to 60 day dry over the unsupplemented controls. Unfortunately, no comparison of dry matter intakes were reported so that total energy intake could be compared. It should be remembered that in order for dry cows to maintain BCS during the dry period, they must gain 1 to 1.5 pounds per day in live weight. This is because of the very rapid growth of fetal tissues.

In general, lactating cow rations are based on meeting of maintenance and production needs under average DMI and environmental conditions. Consideration needs to be given to gain in body condition such as is recommended in 1989 Dairy NRC.

Quantitative information relating body condition scores to body composition is limited. There is little consensus as to what one unit change in BCS relates to in body weight change (Table 6). Because of this, accurately formulating rations to achieve certain prescribed condition scores is difficult if not impossible.

Table 6. Live weight change for each unit change in BCS converted to the Virginia system (scale of 1 to 5).

1984	Wright & Russell (25)	(n = 15)	290 lbs/BC unit Friesian
1985	Ducker, et al. (3)	(n = 100)	121 lbs/BC unit Friesian
1978	Frood & Croxton (8)	(n = 225)	66 lbs/BC unit Friesian
1982	Grainger, et al. (13)	(n = 162)	120 lbs/BC unit Holstein 92 lbs/BC unit Jersey

There is data accumulating in the U.S. as a result of the BST studies which may in the future provide more information about the relationship between BCS and body weight. Such information may enable more precise ration formulations to better control herd and individual cow energy balances. In the mean time, adjustment of rations to meet BCS goals must be based on close monitoring of BCS during lactation and accurate feed and feeding information.

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