Managing Body Condition Scores to Maximize Milk Yield and Reproduction

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Careful management of body reserves of dairy cows is crucial to efficient production because body fat is a necessary and important energy source for lactation in the first few months after parturition. Furthermore, excessive body fat before calving is often associated with decreased feed intake in the presence of normal milk yield. This results in large energy deficits, metabolic diseases, decreased fertility and increased culling. Postpartum energy deficits are minimized by maximizing dry matter intake through various management strategies including selection of high quality forages and feeds, providing rations high in energy density and feedbunk management. Cows should be in moderate body condition at calving to ensure maximum feed consumption capacity during the first two months of lactation.

The major energy reserve of the cow is stored in body fat as triglycerides containing long-chain fatty acids. The occurrence of negative energy balance immediately postpartum initiates mobilization of tissue triglycerides and the appearance of non-esterified fatty acids in the blood. Fatty acids from tissue triglycerides are used by the mammary gland and other tissues. Underconditioning, or thinness can lower milk yield and milk fat levels because of insufficient energy and protein reserves. Thin cows often may not cycle normally, show heat or conceive until they start to regain or at least maintain body condition.

Overconditioning, or fatness, usually begins during the last three or four months of lactation, when milk production has decreased and total nutrient levels have not decreased accordingly. These conditions are most likely to occur in animals with extended lactations and dry periods resulting from delayed conception. Cows overconditioned at calving lose more body weight and condition, usually over a longer period of time, and take longer to regain these losses because of lower feed intakes. Cows that are not overconditioned at calving are more efficient because they produce more milk directly from food energy rather than energy stored as fat.[1]

Research describing body condition scoring systems and effects of body condition score on milk yield, fertility and health has been recently reviewed.[2] Body condition scoring systems have been developed and refined in Great Britian, Australia, New Zealand and the United States. Although these similar systems all rely on observation and palpation, different thinness-fatness scales are often used. Furthermore, criteria for assigning scores to cows are of necessity somewhat subjective. Associations have been described between body condition scores, milk yield and fertility in pastured cows fed limited concentrates, and in moderate and high concentrate-fed cows. Few studies have been reported in cows yielding more than 22,000 lbs. The objectives of this paper are to 1) review an observation based body condition scoring method that is repeatable and useful for teaching condition scoring; 2) establish condition score criteria that define the lower and upper limits of acceptable (based upon currently available research) body condition at drying/calving and minimum condition postpartum; and 3) summarize recent studies investigating associations between condition score, yield and fertility in several California herds with rolling herd averages of 22,000 to 25,000 lbs.

Body condition scores have been demonstrated to have high correlations with fat deposits in subcutaneous, intra- and intermuscular and abdominal tissues.[3,4] The majority (50-70%) of body fat in Holstein cows is in the subcutaneous and muscular tissues. Intra-abdominal fat comprises approximately 23-30% of total body fat. Ultrasonic studies of fat depth in the neck, shoulder, rib, lumbar, rump, and tail region have demonstrated consistent changes in fat depth in each area as condition score changes. Major body fat deposits are depleted proportionately on a prioritized basis with subcutaneous fat being depleted first, intra-abdominal fat second and intramuscular depleted last. This research establishes that condition scores in the lumbar and pelvic regions can be used to estimate changes in both subcutaneous and total body fat. Other studies have demonstrated that because of changes in gut fill, condition scores are better correlated with body fat reserves than live weights. In fact, cows in early lactation with increasing feed intake may have declining fat and condition scores in the face of stable or even increasing live weight. Condition scoring, therefore, represents the easiest, most rapid and least invasive method to assess body tissue reserves and changes.

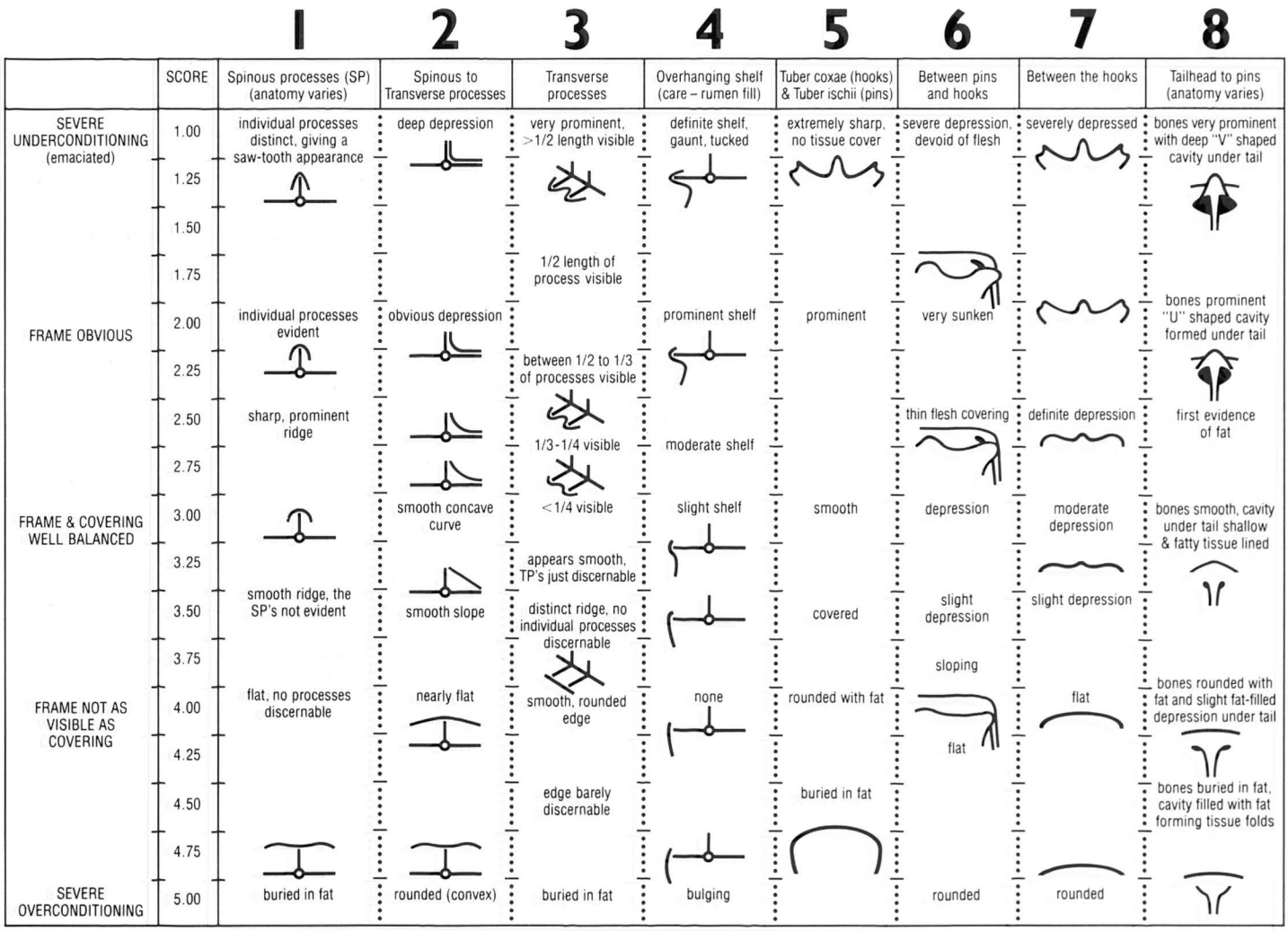
Research findings indicating that a certain magnitude of thinness, fatness, or condition loss is excessive demands a standardized scale to permit reliable use in the field. Most recent research reported in the United States uses a five-point scale. Seldom are criteria for extremes of condition well-defined. Thin cows are assigned values ranging from 0-2 and fat cows given values ranging from 4-5. It is often difficult to determine from research reports whether

thin or fat cows were truly emaciated or grossly obese.

Imprecision in establishing outer extremes of condition results in a smaller but potentially more important discrepancy among scores reported in the mid range of the BCS scale (eg. 2.0-4.0). Mid range scale discrepancies among researchers and practitioners are of concern because current research indicates optimum score ranges and changes are within 1.0 BCS.[5] Precision in score assignment can be increased by using a validated scoring system assigning fractional points on a scale ranging from severely emaciated to morbidly obese. The visual based scoring chart of Edmondson *et al,* provides a scale that has demonstrated repeatability within and among scorers, cows, novices and experts.[6] In this system overall BCS is derived as the average of individual scores assigned to eight different body areas. Precision of scores for each body location and overall was 0.25 - 0.50 units.

Research findings from the past decade suggest that the optimum range of BCS for health and reproduction while dry and at parturition is less than 1.0 point (3.0 - 3.75). Moderate decreases in body condition during the dry period have been associated with decreased yield and increased health disorders, culling and mortality. Postpartum drops in BSC 0.75 units and/or below an absolute score of 2.5 have had detrimental effects on reproduction. Health and reproductive effects have been very consistently reported by many investigators but associations between BCS and yield are more variable. It is likely that the presence of some minimally adequate BCS at calving and the *ad libitum* availability of high energy rations at parturition remove body condition constraints on milk yield. The studies of Haresign and Braun and calculations using data from Wright and Otto suggest that minimum BCS at calving is approximately 3.0.[3,4,7,8] Criteria depicting BCS of 2.5, 3.0 and 3.5 are most important to precisely define. Accordingly they are presented in Figure 1. The reader is referred to other publications for a comprehensive presentation of the scoring chart and its uses.[3,9] These suggested optimum BCS should be used with caution because of possible inconsistencies among scales used by various researchers. A conservative recommendation based upon current research may be BCS 3.25 - 3.50 at calving with a maximum

Figure 1.



This chart was developed by A.J. Edmondson, I.J. Lean, L.D. Weaver, T. Farver, and G. Webster. It is reproduced courtesy of the *Journal of Dairy Science.*

drop of 0.50. Although these are narrow ranges, they are attainable targets for most cows.

Little research has been reported on the relationship of body condition score milk yield and fertility in intensively managed cows yielding above 22,000 lbs annually. Knowledge of BCS relationships in these high yielding cows is important because a significant number of herds currently have rolling herd averages at and well above that level. Emerging genetic, nutritional and biotechnological developments promise to continue the trend of increasing per cow milk yields. We have recently completed such studies on multiparous cows from three herds located in the central valley of California.

Cows, housing and management strategies in these three herds were very similar. Herd size ranged from 600 to 1500 cows. Housing was in freestalls and drylots and cows were milked in herringbone milking parlors. Cows were fed diets based on alfalfa hay and cornsilage, grains, cottonseed and cottonseed meal, and minimal use of by-products. Body condition scores during the dry period and at calving were between 3.0 and 4.0 for most cows. Most cows dropped 0.5 - 1.0 condition score in the postpartum period.

Table 1 presents summary data from these three studies. Each of these studies demonstrated a decline in fertility associated both with increased BCS and increased BCS loss after calving. In two of these three herds, there was no milk yield benefit associated with increased BCS at calving. The third herd had a highly significant positive association between BCS and yield as BCS increased between 3.0 and 4.0 and a negative relationship between score and yield when BCS at calving exceeded 4.0. These variable results are similar to those reported by others[10]. It is likely that tissue energy reserves above some minimal level (eg BCS 3.0 - 3.25) are unnecessary to maximize yield even in very high yielding cows. Further, BCS at calving above some higher threshold (eg. BCS 3.75) likely has a very significant detrimental effect on feed intake, energy balance and fertility because of the predilection of genetically superior cows to mobilize body tissues for milk yield. The increased yield associated with increasing BCS at calving in Herd #3 may be a result of dietary energy constraints on yield. Another possible reason for this observation in Herd #3 is that high BCS cows may have been genetically superior. Cows with high BCS in this expanding herd were disproportionately representative of cows with delayed conception in the prior lactation. It is likely that lower yielding (and genetically inferior) cows with delayed conception were at higher risk of culling in the prior lactation. This possible bias may confound the data from this herd. It should also be noted that while data from these herds do not provide information about the minimal BCS necessary for maximum milk yield, they do support previous reports indicating that optimum BCS at calving may be near 3.5.

Table 1. Summary of BCS, Yield & Fertility Data from Cows in Three High Yielding California Dairy Herds[11,12]

	HERD 1	HERD 2	HERD 3
No Cows	66	168	306
Peak Yield (lbs)	108	103	106
305 d Yield (lbs)	22,100	24,900	23,500
Mean BCS			
Dry	*	3.3	3.7
Fresh	3.3	3.7	3.7
Post Partum drop	0.6	0.9	0.4
BCS Associations			
FBCS x Yield	None	None	+ (above 3.25)
BCS Drop x Yield	None	+	+
FBCS x BCS Loss	+	+	+
Reproductive Measures			
Days to 1st Heat	n.s.	*	n.s.
Days to 1st AI	@ >3.5	*	*
FSC	*	n.s.	with BCS>4.0
S/C	n.s.	n.s.	*
ADO	@ >3.5	with BCS 3.0-3.5	n.s.
	@ Loss >0.75	with BCS Loss >0.75	
Pregnancy Rate	*	with BCS <3.0 postpartum	*

n.s. = not significant
* = not available

References

1. National Research Council: *Nutrient Requirements of Dairy Cattle.* National Academy of Science, Washington, D.C., 1989. 2. Ruegg, P.L., 1991. Compendium on Continuing Education 13 (5):1309-13. 3. Otto, K.L., Ferguson, J.D., Fox, D.G., and Sniffen, C.J., 1991. J. Dairy Science 74: 852-859. 4. Wright, I.A., and Russel, A.J.F., 1984. Animal Production 38:23-44. 5. Butler, W.R., and Smith, R.D., 1989. J. Dairy Science 72:767-783. 6. Edmondson, A.J., Lean, I.J., Weaver, L.D., *et al.,* 1989. J. Dairy Science 72:68-78. 7. Haresign, W. *Recent Developments in Animal Nutrition.* London, Butterworths, 1980. p1-16. 8. Braun, R.K., Donovan, G.A., T.Q., Tran *et al.,* 1986. Proceedings Annual Meeting AABP. 19:122-126. 9. Weaver, L.D. Veterinary Clinics of North America [Food Animal Pract.] 3:513-532, 1987. 10. Gearhart, M.A., Curtis, C.R., Erb, H.N., *et al.,* 1990. J. Dairy Science 73:3132-3140. 11. Upham, G.L. MPVM Thesis, University of California, Davis. 12. Ruegg P., 1991. A.J.V.R. In Press.