Review Article

Performance Profile of Dairy Animals Under Compromise with Dynamics in Body Condition Score. A Review

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Abstract | Body condition scoring being the subjective and non-invasive yardstick gives the access about the body reserves of cow without intervention of any technology and expenses. It provides an instant apprehension of animal's body state and is readily utilized in operational decision making. Body condition score (BCS) dynamics affects production profile of milk yield, peak milk yield, persistency and the milk constituents; also affects reproductive traits of oestrous, ovulation, conception rate, calving interval; dry period influences production and reproductive profile. BCS affects body weight. High as well as low BCS cows are prone to metabolic and related disorders. Mobilization of body tissues increases blood glucose, fatty acids, urea and total protein with advancement of calving and lactation affecting production, reproductive and health traits. Ideal body condition optimizes production, minimizes reproductive and health disorders, and maximizes economic returns.

Keywords | Body condition score, Milk yield, Persistency, Reproductive traits, Health

Editor | Asghar Ali Kamboh, Sindh Agriculture University, Tandojam, Pakistan.
Received | August 18, 2017; **Accepted** | September 26, 2017; **Published** | September 26, 2018
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Citation | Manzoor A, Untoo M, Zaffar B, Afzal I, Fayaz A, Dar ZA, Shafiq S (2018). Performance profile of dairy animals under compromise with dynamics in body condition score. A Review. J. Anim. Health Prod. 6(3): 80-85.
DOI | http://dx.doi.org/10.17582/journal.jahp/2018/6.3.80.85
ISSN (Online) | 2308-2801; **ISSN (Print)** | 2309-3331

INTRODUCTION

Effective management of dairy animals gets compromised by challenges related to the nutrition, production, reproduction, metabolic diseases, etc. (Ashaq et al., 2017). Proper identification of these problems through specific managemental tools canmitigate them. Body condition score (BCS) is one such managemental tool which can subjugate these challenges and improve profitability in a dairy farm. BCS is a subjective measure to evaluate energy reserves regardless of body measurement (Manzoor et al., 2017; Mushtaq et al., 2012). Body condition scores can be used to identify the cows needing special attention andto determine whether extra feed is needed.

BCS systems have been worked out by many scientists like Lowman et al. (1976) using a 0 to 5 scale in beef cattle, eight grade scale in dairy cows by Earle (1976) and 6 point scale by Prasad (1994). Currently at various parts of the globe many body condition scoring systems are in use (Table 1). Body condition scoring provides a yardstick to assess the condition of cow without involvement of high technology and extra cost (Ashaq et al., 2017). It can be taken up by the farmer himself with some practice and can adjust the adequate nutritional program to attain desired body condition at various stages of lactation. The chine, loin, rump, pin bone, hook bone, ribs, and lumbar vertebrae are land marks to determine the score (Mishra et al., 2016; McNamara, 2011). Ideal body condition should augments milk production, decreases reproductive and health disorders, and exploits economic returns (Manzoor et al., 2017). The aim of this review is to elucidate the understanding of relationship of BCS with physiological stage, production, reproduction, dry period, physical characteristics, blood

profile and health of dairy animal.

Table 1: Body condition scoring system in various countries of the world

Country	Scale	Interval	Points
New Zealand	1-10	0.5	19
Denmark	1-9	1.0	9
Australia	1-8	0.5	15
USA	1-5	0.25	17
UK/Ireland	0-5	0.5	11

Body Condition Score and Physiological Stage

BCS decreases as lactation proceedsfrom calving until reaching the lowermost body condition score. Lean Holstein and Brown Swiss cows lost 0.41 points, the ones with medium body condition – 0.76 and the ones with good body condition –1.05 points (Gergovska et al., 2011), whereas, Manzoor et al. (2017) found a loss of 0.92 points, 0.66 and 0.47 points in higher, moderate and thinner BCS crossbred cows, respectively; and Rao et al. (2002) found loss of 3.12, 3.06 and 0.87 (on 5-point scale) in Holstein Friesian crosses at 60, 90 and 120 days of lactations, respectively. Cows with high BCS level before calving retained a good degree of BCS in the first five months of lactation (Jilek et al., 2008). BCS decreases to minimum by the second month of lactation, affecting energy balance and impairing health and reproductive performance (Bewley and Schutz, 2008; Grummer et al., 2004; Theurer et al., 2003). High producer cows with relatively low feed intake during transition becomes victim of negative energy balance (Mulligan et al., 2006). Crossbred cows calving at higher body condition lost larger portion of condition score during early lactation (Ashaq et al., 2017; Singh et al., 2015; Singh et al., 2009). Desirable body condition score at different physiological and lactation stages are mentioned in Table 2 and 3.

Table 2: Desirable body condition score at different physiological stage

Stage of lactation	Body condition score (1-5 scale)
Less than 80 days	2.5
80-159 days	2.7
160-239 days	3.39
Dry period	3.38
Days open	
Less than 60 days	2.66
60-100 days	2.92
>100 days	3.22

Body condition Score and Parity

Dynamics of BCS gets significantly affected by parity, as first parity dairy cows drain more BCS in early lactation and gets synergized by lower net energy intake potentiating negative energy balance for longer compared to later parity cows.High producing cow in1st parity lost 6.5% of her body weight (BW) from calving to 29 days in lactation, while2nd and more parity cows lost 8.5 and 8.4% of their body weight in 34 and 38 day of lactation, respectively (Straten et al., 2008). Energy balance turned positive at 71, 60 and 73 days of lactation for 1st, 2nd and 3rd parity cows, respectively. 1st parity cows recovered body weight comparatively at higher rate than older parity cows, while trend in body weight was nonlinear (Berry et al., 2006).

Table 3: Desirable body condition score in physiological stage of lactation

Stage	Score (1-5 Scale)
Drying off	3.5-4.0
Calving	3.5-4.0
One month postpartum	2.5-3.0
Mid lactation	3.0
Late lactation	3.0-4.0
First lactation heifers at calving	3.5

Body Condition Score and Production Traits

Higher milk yield was related to greater and longer loss of BCS in Holstein cows (Manzoor et al., 2017; Gergovska et al., 2011). Cows calving at low body condition score produced lowest milk yield (Pramanik, 2000). Both high and low condition score cows took more days to accomplish peak milk yield as compared to moderate condition score cows (Manzoor et al., 2017; Singh et al., 2009). However, Roche et al. (2007b) observed non-significant rise in milk yields above a calving BCS of 5.0 (9 point scale) (approximately 3.0 in the 5-point scale) in pasture based dairy cows. Mean daily and peak milk yield showed an increase of 4.1 and 7.8 kg, respectively, for every increase of one unit of condition score in crossbred cattle and has linear relation with BCS during first 6 months of lactation (Rao and Moorthy, 2002). Early calving negatively affected milk yield and milk fat percentage in heifers, while showed higher protein percentage than those with late calving (Abeni et al., 2000). Correlations of body condition traits with milk production were moderate to high (-0.556 and 0.623) in Brown-Swiss (Tiezzi et al., 2013). Negative correlation of -0.316 ($P<0.05$) and -0.404 ($P<0.01$ exists between BCS and peak yield at 42 days and 56 days postpartum in crossbred cows, respectively (Singh, 2015). There exist a marked behavioral and physiological responses in terms of augmented vocalization, time spent on grazing, aggressive behavior, and fat metabolism and reduced milk production to a short-term feed restriction in all BCS groups (Schutz et al., 2013).

Dry Period

There occurs a significant reduction ($p<0.001$) in BCS fr-

Table 4: Correlation coefficient between BCS and production traits (Manzoor et al., 2017)

	BCS	Daily milk yield (kg/day)	Peak milk yield (kg)	Days to attain peak milk yield (days)	Dry period (days)	Days to first service (days)
BCS	1					
Daily milk yield (kg/day)	0.343*	1				
Peak milk yield (kg)	0.662**	0.372	1			
Days to attain Peak milk yield	-0.072	-0.751**	-0.080	1		
Dry period (days)	-0.330*	-0.426**	-0.065	0.354*	1	
Days to first service (days)	-0.768**	-0.262	-0.462**	0.051	0.284	1

* Significance at p<0.05., ** Significance at p<0.01

om dry period (3.40 points) to the 2nd month of lactation (2.86 points) in Mont-Beliad cows (Mouffok et al., 2013). Dry period of 60 days has significant effect on total milk yield, days of lactation and persistency,fat and protein yield in the subsequent lactation (Al-Anbari et al., 2012; Kuhn et al., 2006) while change in body condition score from drying-off to calving had no significant effect (P<0.01) on total milk yield, milk fat percentage, milk energy or milk lactose percentage, days of lactation and persistency,however, milk protein percentage was less for high BCS cows (Al-Anbari et al., 2012; Lake et al., 2005). Dry periods of 20 days or less resulted considerable losses in fat and protein yield in the subsequent lactation. When adjusted for milk yield, short dry periods actually led to higher cell scores and poorer fertility in the compared to 60 days in the subsequent lactation (Kuhn et al., 2006). Dry period of 8 weeks seems optimal to gain the body condition score in cows at drying off (Friggens et al., 2004). Correlation coefficient between BCS and production traits are presented in Table 4.

Body Condition Score and Reproduction Traits

BCS could be used as a potential indicator of fertility and functional traits (Tiezzi et al., 2013; Kadannideen and Wegmann, 2003). Negative energy balance inhibits LH pulse frequency and lowers level of blood glucose, insulin and insulin like growth factor, collectively limits the estrogen production by dominant follicles and resulting in extended period of post-partum anestrus and reduced fertility (Hess et al., 2005; Pushpakumara et al., 2003; Butler, 2000).Holstein cows with BCS one point higher than average at 10th week of lactation had 5.4 days shorter to first observed heat, calving interval 14.6 day shorter, days to first service 6.2 day shorter, a 9% better conception rate and 1.9 kg less daily milk than average (Pryce et al., 2001). High producing first parity dairy cows losing ≥ 12% and second parity cows losing ≥ 15% of their body weight (BW) from calving to nadir body weight had decreased response to conception at first AI. Cows experienced marked losses in BCS had half first service conception rate than that experienced modest losses in BCS (Gillund et al., 2001). Conception at first AI increased by 53% with each additional unit in BCS from 40 to 60 days in milk (Straten et al., 2009; Krpalkova et al., 2014). Pregnancy rate at first AI significantly decreased by 10% in cows calving in poor condition (BCS <2) (Gatiusa et al., 2003). However, Mulliniks et al. (2012) reported that body condition score had no effect on pregnancy rates.Cows loosing ≥1 unit BCS after calving had a prolonged interval to luteal activity restoration (Shrestha et al., 2005; Tamadon et al., 2011). Animals calving at high BCS (BCS >4) showed a significant decrease in the number of days open (5.8 or 11.7) than animals with an intermediate (BCS 3) or low body condition (<2), respectively.

Body Condition Score and Physical Characteristics

Yan et al. (2009) found that the correlation coefficient (*r*) was highest (0.62 to 0.88) with heart girth, followed by belly girth (0.52 to 0.88) and length (0.51 to 0.83) and lowest (0.35 to 0.69) with height at wither. Heart girth was, therefore, selected as the primary indicator for prediction of body weight and energy balance. There exists a highly significant relationship of condition score with body weight and heart girth (Nielsena et al., 2002; Gallo et al., 2001) and between body weight and BCS (Toshniwal et al., 2008). Jong (2005) reported phenotypic correlation of BCS with angularity and chest width as 0.51 and 0.55, respectively. Similarly, the genotypic correlation was - 0.75 and 0.71, respectively. There exists a positive relationship between the body condition and the legs, (between r=0.19 and r=0.31) (Miko et al., 2014). Bigger animals have poorer fertility and an unfavourable correlation between production and growth rate (Wall et al., 2007).

Body Condition Score and Health

Low BCS cows were prone to reproductive compromise whereas, obese cows had lower superoxide dismutase and were more sensitive to oxidative stress and metabolic diseases (Roche et al., 2013; Bernabucci et al., 2005). Holstein dairy cows with BCS of 4.3 at drying off had a higher incidence of milk fever, ketosis and abomasal displacement endometritis than cows with a BCS of 3.8.(Kim and Suh , 2003; Ostergaard et al., 2003). However, low BCS Hol-

stein and crossbred cows during the lactation were more vulnerable to mastitis.(Loker et al., 2012). Animals in 4-5th month of lactation were more susceptible (59.49%) to mastitis with hind quarters more affected (56.52%) than forequarters (43.47%) (Joshi and Gokhale, 2006). There exists a significant associations exists between mastitis infection rates and BCS, frequency of concentrate feeding and amount of roughage at drying off and dry period in dairy cows, depicting that feeding practices affects risk of mastitis (Valde et al., 2007). Harpothn et al. (2014) reported that irrespective of BCS at dry off in Holstein-Friesian dairy cows, low energy diet fed were comparatively healthier with little risk of developing metabolic disorders in early lactation than cows fed with the high-energy diet. Correlation between dairy character (DC) and BCS was -0.61 and incidence of diseases other than mastitis in Danish Holstein was 0.43, and between DC and mastitis was 0.27 (Lassen et al., 2003).

Body Condition Score and Biochemicals

Propionate production in dairy cows with low dry matter intake doesn't suffice glucose demand during the early postpartum period resulting inmobilization of body reserves (Drackley et al., 2001). Fatter dairy cows undergo extensive mobilization of body fat before calving while, thinner cows mobilize fat, amino acids from the diet or from the skeletal muscle breakdown as well as glycerol resulting in more glucose production and this continued during the first weeks of lactation (Kokkonen et al., 2005; Reynolds et al., 2003). High-BCS cows had the lowermost postpartum energy balance and the highest plasma concentrations of leptin prepartum, none sterified fatty acids and β-hydroxybutyrate postpartum milk fat content and insulin-like growth factor (Pires et al., 2013). Crossbred cows of low BCS group (BCS 1.5 to 3.0) maintained constant glucose concentration up to first estrous after parturition, whereas moderate BCS group (BCS 3 to 4.5) showed increasing trend up to 28 days after parturition and high BCS Group (BCS ≥ 4.5) up to stage 14 after parturition (Singh et al., 2009). Serum calcium, phosphorus, glucose and cholesterol profile in cyclic vs. postpartum anestrus cows were 14.53 vs. 9.78; 7.88 vs. 6.20; 70.25 vs. 52.25 and 140.58 vs. 94.35,respectively. The serum biochemical outlines were significantly inferior in postpartum anestrus cows (Muneer et al., 2013).

EPILOGUE

Body condition scoring provides a yardstick for determining the condition of cow without aid of any high technology and investment. It gives an instant evaluation of the body state of the animal and is readily incorporated in operational decision making. Physiological stage affects BCS. BCS fluctuation affects production profile of milk yield, peak milk yield, days to attain peak yield, daily milk yield, persistency and the milk constituents; also affects reproductive traits of oestrous, ovulation, conception rate, pregnancy rate, parturition ease, days open, calving interval, dry period of 60 days is sufficient for optimum production and reproductive profile. BCS affects body weight; and heart girth in turn affects body weight. Obese cows are more prone to metabolic disorders while thinner cows are immuno compromised and shows mastitis. As calving and lactation advances, mobilization of body tissues cause increase in blood glucose, fatty acids, urea and total protein affecting production, reproductive and health traits. Ideal body condition during each stage of lactation is that which enhances milk production, curtails reproductive and health disorders, and maximizes economic returns.

ACKNOWLEDGEMENTS

Authors are highly thankful to dean faculty of veterinary science, Shuhama, SKUAST-Kashmir.

CONFLICT OF INTEREST

There is no conflict of interest among authors.

AUTHORS CONTRIBUTION

The Authors worked cooperatively while collection of information related to this review article.

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