Relations of body condition score with milk yield and reproduction traits in Simmental cows

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SUMMARY

Introduction - Body condition score (BCS) is an important parameter to detect feeding regime and body energy reserves of animals and affects productivity of dairy cows. Recording BCS throughout lactation and eliminating effective environmental factors are essential processes for herd owners. Therefore, investigating the relationship between BCS and productivity characteristics is crucial for dairy sector.

Aim - The objectives of this study were to determine the change of BCS and its relationship to milk yield and reproduction characteristics of Simmental cows.

Material and methods - Milk yield and reproduction records of Simmental cows reared at Gokhoyuk state farm in Turkey, were used as study material. Milking cows were recorded by BCS at monthly intervals throughout a year. A scale of 1 to 5 with 0.25 increments was used to evaluate BCS (l= thin and **5**=fat). Lactation length (LL), lactation milk yield (LMY), 305 day milk yield (305 DMY) and dry period (DP) were chosen as milk yield traits and calving interval (CI), days open (DO) and number of services per conception (NSC) were evaluated as reproduction traits. To provide data analysis, five groups for parity, three groups for stage of lactation (SL) and four groups for season were classified. While the Pearson correlation coefficients were estimated between BCS and the characteristics, all statistical analyses were performed using SPSS 13.0.

Results and discussion - BCS means were 3.30± 0.04, 3.40± 0.03, 3.42± 0.03 and 3.37±0.02 points for 70±14 d, 140±14 d, 210±14 d and entire lactation period, respectively. The lowest and highest BCS means (3.25±0.03 and 3.54±0.05) were determined in summer and winter, respectively. Lactation length (LL), lactation milk yield (LMY), 305 daily milk yield (305 DMY) and dry period (DP) were determined as 306.9±1.68 d, 5764.5±65.47 kg, 5700.4±59.95 kg and 66.6±0.91 d, and highest milk yield was obtained in the subgroup with BCS≤3. Correlations between BCS and LL, LMY, 305 DMY and DP were estimated to be 0.004, -0.107, -0.115 and 0.002, respectively. Calving interval (CI), days open (DO) and number of services per conception (NSC) were 373.2±1.43 d, 92.8±1.46 d, and 1.96± 0.05, and correlations of BCS with CI, DO and NCS were -0.007, -0.004 and -0.007, respectively.

Conclusion - Results of the present research demonstrate that BCS was lowest during summer and highest during winter. In early lactation period, cows tended to lose BCS. LMY and 305 DMY significantly ($P<0.05$) affected by BCS. It was noticed that BCS ≤3 points ideal for higher milk production in Simmental cows. Exactly observing estrus cycle and decreasing insemination number per gestation to lower levels can be advised for dairy breeders as the profitable processes in the operations.

KEY WORDS

Simmental, cow, body condition score, milk yield, reproduction.

INTRODUCTION

Body condition score (BCS) is assumed as an important reflector to detect feeding regime and body energy reserves of dairy cows, and the records can be used for animal selection in herds[1]. Besides, BCS has a significant effect on many factors, such as milk production and fertility. Basic practices related to herd management, for example quality of feed, feeding strategy and stress are highly correlated with the BCS of an animal. While cows with poor condition are not able to produce sufficient milk, those with excessive fat may expose to metabolic disorders and an adverse effect on productivity. Hence, observing BCS throughout the production cycle and elimination of effective environmental factors can be seen the main targets for modern dairy operations. It was reported in an earlier study that loss of body proteins by 25% can causes to severity results for dairy cow[2]. Due to high heritability (0.38) of BCS[3], regarding the BCS data is a substantial process for dairy cow selection. In a study, BCS of Simmental cows were estimated to be 3.49, and genetic and phenotypic correlations of BCS with milk yield were -0.39 and -0.15, respectively[4]. Some authors emphasized that body fat reserves of a cow markedly effect on milk production and fertility[5,6]. Also, authors reported that high-yielding cows could be more exposed to body reserve mobilization[5]. Besides, cows with severe body condition loss have longer intervals to first ovulation and first estrus, more days open (DO) and lower first service conception rates[7]. Also, cows in poor body condition prior to calving expe-

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rience decrease in milk production during early lactation, problems with various metabolic disorders (ketosis, abomasus dislocation) and delayed onset of production cycle[8]. However, primiparous cows do not present a decrease in BCS so high as in multiparous cows[4]. Some researchers reported that cows in first 100 to 120 days of lactation should have BCS from 2.50 to 3.25 for efficient milk production, good health and reproductive activity[8]. On the other hand, optimum BCS are 3.0-3.75, 2.25-2.75, 3.0-3.50 and 3.0-3.75 points for calving interval (CI), peak milk production period (PMP), 150-200 days post calving (PC) and dry period (DP), respectively, by the other authors[9]. However, suitable BCS points have been offered to be 3.0-3.50, 2.50, 3.0-3.50 and 3.0-3.50 for CI, mating (MP), last period of lactation (LLP) and DP, respectively by a report[10]. In short, whilst many investigations have been conducted on BCS in many countries, these are generally focused on either milk yield or fertility. And therefore, detailed new studies on the both traits of dairy cows are still needed.

The purposes of the study were to evaluate the change of BCS and to determine the relations of BCS with milk yield and reproduction traits in Simmental cows.

MATERIALS AND METHODS

Milk yield and reproduction records of Simmental cows raised at Gokhoyuk state farm in Turkey, were used the study material. The cows, 621, used in the present study were clinically healthy, in the lactation and kept under similar feeding conditions. The cows were assessed by BCS using a 5-grade scoring system which describes 1 point is emaciated and 5 points refer to an obese cow[11], and to obtain sensitivity, 0.25 and 0.50 increments were also used. Scoring was applied at monthly intervals for 12 months by the same technician. Milk yield traits were evaluated by lactation length (LL), lactation milk yield (LMY), 305-day milk yield (305 DMY), dry period (DP), and reproduction traits were tested by calving interval (CI), days open (DO) and number of services per conception (NSC). To evaluate cows by effective factors; 3 different stage of lactation (SL) (SL 1= 70±14 d, SL 2= 140±14 d and SL 3= 210±14 d), 5 parity (cows with parity ≥5 were assessed into 5th group) and 4 season groups were classified. Besides, milk and reproduction traits were assessed in 3 BCS subgroups (1= 2-3 points; 2= 3.25-4.0 points and 3= 4.25-5.0 points). Correlation coefficients between BCS and milk or reproduction traits were also estimated.

The data were tested by analysis of variance (One-Way ANOVA) and effects of the environmental factors on BCS were evaluated using the following linear model:

$$Y_{ijkl} = \mu + a_i + b_j + c_k + e_{ijkl}$$

Where: Y_{ijk}: is dependable variable *(BCS)*,

μ: population mean,

a_i: effect of season *(i = winter, spring, summer and autumn)*

b_j: effect of stage of lactation *(j = 70 ± 14, 140± 14 and 210± 14 days)*

c_k: effect of parity *(k = 1,2,3,4 and ≥5. lactation order)*

e_{ijk}: random residual effect.

To evaluate effect of BCS on milk yield and reproduction traits, following linear model was applied:

$$Y_{ij} = \mu + a_i + e_{ij}$$

Where: Y_{ijk}: dependable variable (*milk yield and reproduction traits*)

μ: population mean

a_i: effect of BCS (*j = 1,2,3*)

e_{ijk}: random residual effect.

The means were compared by Duncan's multiple range test based on the 0.05 level of probability and all statistical analyses were performed using SPSS 13.0 for Windows.

RESULTS

As seen from Table 1, season significantly (P<0.001) affected BCS, while the highest mean was determined in the winter and the lowest mean was obtained in the summer. Also, significant differences (P<0.05) were determined by SL and lowest mean (3.30±0.05 points) was calculation in first SL group (70±14 d) in the present research. After statistical analysis, no significant difference was found in BCS groups by parity and overall mean of BCS in the herd was calculated to be 3.37±0.02 points.

While BCS affected LMY and 305 DMY (P<0.05), no significant effect of BCS was determined on LL and DP (Table 2). Cows within BCS Group1 had more milk production than cows within BCS Group 2.

After testing reproduction traits by BCS, no significant difference was found (Table 3). CI, NSC and DO means were found to be 373.2±1.43 d, 1.96±0.05 and 92.8±1.46 d, respectively.

Negative and non-significant correlations were estimated betwen BCS and LMY, 305 DMY, CI, DO and NSC (Table 4).

DISCUSSION

In the present investigation, significant differences (P<0.001) in BCS by the seasons (Table 1) might be explained by effective feed assessing mechanism of cows in

Table 1 - Change of BCS (mean±SE) by environmental factors.

Season**	n	BCS
Winter	125	3.54±0.05 [a]
Spring	131	3.45±0.04 [ab]
Summer	137	3.25±0.03 [c]
Autumn	228	3.31±0.03 [cb]
Stage of lactation (SL)*	**n**	**BCS**
1	213	3.30±0.04 [a]
2	212	3.40±0.03 [b]
3	196	3.42±0.03 [b]
Parity (ns)	**n**	**BCS**
1	159	3.41±0.04
2	118	3.36±0.04
3	110	3.37±0.05
4	119	3.32±0.04
≥5	113	3.40±0.05
Overall	621	3.37±0.02

*P<0.05 - **P<0.001, ns: non significant
SL 1: 70±14 d, SL 2: 140±14 d, and SL 3: 210±14 d
[a, b, c]: Different letters on the same line indicate statistically significant differences

Table 2 - Milk production traits (mean±SE) by BCS groups.

Group	LL	LMY*	305 DMY*	DP
1	307.3±2.96	6004.6±121.28 b	5919.3±107.93 b	65.4±1.54
2	306.8±2.21	5626.9±82.69 a	5573.7±76.72 a	67.5±1.18
3	307.8±5.07	5776.9±195.07 ab	5741.4±191.72 ab	65.2±3.85
Overall	306.9±1.68	5764.5±65.47	5700.4±59.95	66.6±0.91

*P<0.05
Group = 1: BCS 2.00-3.00, Group 2 = BCS 3.25-4.00 and Group 3 = BCS 4.25-5.00
LL: lactation length, LMY: lactation milk yield, 305 DMY: 305 daily milk yield, DP: dry period
a, b, c: Different letters on the same line indicate statistically significant differences

Table 3 - Reproduction traits (mean±SE) by BCS groups.

Group	CI	NSC	DO
1	374.3±2.48	1.94±0.08	92.7±2.56
2	372.6±1.95	1.98±0.06	93.8±1.91
3	372.8±5.12	1.86±0.18	91.5±5.06
Overall	373.2±1.43	1.96±0.05	92.8±1.46

BCS groups = 1: BCS 2.00-3.00, 2 = BCS 3.25-4.00 and 3 = BCS 4.25-5.00
CI: calving interval (day), NSC: number of services per conception,
DO: days open (service period)

Table 4 - Correlations of production traits with BCS.

Trait	BCS
LL	0.004
LMY	-0.107
305 DMY	-0.115
DP	0.002
CI	-0.007
DO	-0.004
NSC	-0.007

the cool climatic conditions. As a general concept that homeothermic animals have a thermoneutral zone in which energy expenditure to maintain normal body temperature is minimal, constant and independent of environmental temperature[12]. Moreover, cows with high BCS are at higher risk of developing liver failure and lipidosis during heat stress. As a matter of fact that a general loss might be seen due to relatively less feed consumption and feed efficiency in summer months. In the present study, determined undistinguished BCS means for transit seasons (spring and autumn) evidently revealed the relationship between climatic environment and BCS. In spite of significant difference had been calculated in BCS levels, mean points of all season groups were assessed in reasonable ranks (3.0-3.5 points) for investigated Simmental herd. On the other hand, some readjustments in feeding strategies for dairy herds are needed for hot months to prevent severe dropping in BCS of cows.

Calculated lowest BCS mean belonging to first SL might be explained by an intensive body reserve mobilization related to milk production at the beginning of lactation and regaining reserves with dropping milk yield in later periods. Actually, this case could be assumed as an expected change for lactation physiology of cows. Suggested BCS levels by some authors[9,10] for different SL support this concept. Besides, heat stress early post-partum aggravates negative energy balance in lactating cows and thus, reduces BCS, and adversely affects the fertility[13]. At this view, taking additional precautions for the first lactation period could be advised to dairy owners.

No effect of BCS by parity (Table 1) might be commented with uniform body depositing of Simmental cows in the investigated farm. Besides, obtained overall BCS of the herd (3.37±0.02 points) was assumed within the acceptable thresholds.

The study pointed out that LL and DP were not affected by BCS (Table 2). Calculated LL (306.9±1.68d) and DP (66.6±0.91d) means could be assessed to be admissible for milking cows. Table 2 also illustrates that LMY and 305 DMY values were highest in Group 1. Because of Group 2 and Group 3 were occurred from cows with BCS ≥3.25 points, keeping cows into moderate BCS points could be seen a major approach for herd management. Moreover, estimated LL, LMY, 305 DMY and DP means were found as better than some study results conducted on the same breed in Turkey[14,15].

In reproductive traits (Table 3), estimated nonsignificant difference points out to similar fertility characteristics of assessed Simmental cows. In normal, dairy cows are expected to give birth to one calf per year to continue producing milk in dairy enterprises. At this point, determined CI (373.2±1.43) and DO (92.8±1.46) might be regarded to be suitable intervals but determined NSC mean (1.96±0.05) might be commented to be relatively high for reproductive efficiency of the herd.

Estimated negative correlations between BCS and LMY or 305 DMY was found as parallel to findings of some researchers[4]. In contrast to decreased BCS levels, using mobilized body reserves for milk production might be regarded as the main cause of this case. Really, highest milk yield was obtained from the cows in Group 1 in the study. In this context, this finding could be regarded to be an expected result and in agreement with the results those demonstrated the association of BCS with milk production traits (Table 2).

CONCLUSIONS

It is concluded that BCS was lowest in the summer and highest in the winter. In the first phase of lactation, milking cows tended to lose BCS. In other words, taking extra precautions in these periods are clearly required in the farms. This study also revealed that LMY and 305 dMY was affected by BCS. Moreover, it can be manifested that BCS points ≤3 are ideal for relatively high milk production for Simmental cows. Exactly observing estrus cycle and decreasing insemination number per gestation to lower levels can be advised for dairy breeders as the profitable processes in the operations.

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