

## The effect of body condition score on nutritional diseases and milk yield in dairy cattle

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**Abstract:** The purpose of this study is to examine the effects of body condition score (BCS) on nutritional diseases and milk yield in dairy cattle. Fifty-nine randomly selected Holstein Friesian cattle, lactation numbers 3–6, were used in this study from a total of 350 dairy cattle in the establishment. All of the cows in the study were fed with the same total mixed ration (TMR), and BCS was determined by inspection and palpation in the first 5 days after calving. The cows were separated into two groups according to their BCS score as  $BCS \leq 3$  and  $BCS > 3$ , and Group 1 contained 36 cows ( $BCS \leq 3$ ), while Group 2 contained 23 cows ( $BCS > 3$ ). One-month, 3-month, and 305-day milk yields and nutritional diseases as observed until postpartum day 35 have been determined in this study. Moreover, TMR analysis has been performed. As a result, the 1-month, 3-month, and 305-day milk yields were determined in Group 1 ( $BCS \leq 3$ ) and Group 2 ( $BCS > 3$ ), and no difference was determined between the groups ( $P > 0.05$ ).

**Key words:** Nutritional diseases, milk yield, total mixed ration, body condition score

### 1. Introduction

Body condition score (BCS) is a significant factor affecting dry matter consumption in high-yielding dairy cows. Cows with obese condition ( $BCS > 4$ ) consume less dry matter (about 1.68% of live weight). However, cows with normal condition ( $3 < BCS < 4$ ) and poor condition ( $BCS < 3$ ) had dry matter consumption equal to 1.84% of their live weight [1–3].

Energy requirement, which increase in direct proportion with milk yield at the beginning of lactation, cannot be met with insufficient dry matter consumption, and this deficit is compensated with the mobilization of body fat (negative energy balance). Nutritional diseases observed in animals with high milk yield (ketosis, abomasal displacement, hypocalcemia, mastitis, metritis, retained placenta, retentio secundinarium, acidosis, laminitis, dystocia) are all associated with one another, and the presentation of one of these causes the appearance of others. Cows with negative energy levels are prone to hepatic lipidosis and ketosis. About 60% of the body reserve of the cow is mobilized in the 3 weeks after the birth. Loss of points in BCS reflects the amount of mobilized body fat and the severity of the negative energy level [4–6].

The reproduction performance of the cow is more strongly associated with the change in BCS rather than live weight loss. A one-point decrease in the BCS after calving is equal to 50–60 kg of decrease in live weight and 550 kg of milk can be produced with a 1-point decrease in BCS.

In order to obtain 1-point increase in BCS, a cow needs to consume 270 kg of feed [7–9].

Each 1-point increase and decrease in BCS means a 56 kg increase or decrease of body weight. While each 1-point increase in BCS increases the body fat level by 12.65%, it decreases the protein level in the body by 12.19%. Furthermore, each 1-point increase in BCS increases the dry matter in the carcass by 7.23%. It has been reported that each 1-point increase in BCS between the dry period and calving is associated with 545.5 kg more milk yield in the first 120 days of lactation. It has also been stated that each 1-point increase in BCS in the dry period is associated with 300 kg less milk yield in the first 120 days of lactation. It was determined that a 1-point loss in BCS in the week after calving is associated with 241 kg more milk production in the first 120 days of lactation. Increase in milk yield in early lactation is important since it affects total milk yield [10–12].

Stored fat is used for milk yield in high-yielding dairy cows by mobilization at the beginning of lactation. A scoring system that is graded at every 0.25 interval within a scale from 1 to 5 is used for BCS in dairy cattle. The corresponding BCS values in the nutrition system are as follows: 1, extremely poor condition; 1.5, very poor condition; 2, poor condition; 2.5, moderate condition; 3, good condition; 3.5, very good condition; 4, fat condition; 4.5, very fat condition; 5, extremely fat condition [13].

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**2. Materials and methods**

The study was conducted between January 2018 and July 2018 in a commercial dairy establishment within Balıkesir Province, and 59 uniparous or multiparous Holstein Friesian cattle (Group 1, BCS ≤ 3, mean amount of milk in lactation for 305 days is 7997 kg; Group 2, BCS > 3, mean amount of milk in lactation for 305 days is 8725 kg), in lactation numbers 3–6 and randomly selected from a total of 350 cows, were used. The cows were fed with the same total mixed ration (TMR) in the study, and BCS was determined by inspection and palpation in the first 5 days after calving. The cows were separated into two groups according to their BCS scores as BCS ≤ 3 and BCS > 3, and Group 1 (BCS ≤ 3) contained 36 cows, while group 2 (BCS > 3) contained 23 cows (Table 1). Parameters of the cows were obtained from the herd management program (DeLaval ALPRO). The first 1-month, 3-month, and 305-day milk yields after calving were determined in the study, and statistical analyses were calculated in the IBM SPSS package program. The same TMR was given to all cows twice a day in the study, and the cows were milked 3 times a day with an automatic milking system (DeLaval). The contents of the TMR and nutrient composition were determined in the Balıkesir University Veterinary Faculty’s Animal Nutrition and Nutritional Diseases Laboratory according to the methods indicated in relevant sources

(dry matter 934.01, crude ash 942.05, crude protein 954.01, crude fat or ether extract 920.39, crude cellulose 962.09, starch 920.40) [14]. The approval of the local ethics committee (12.03.2018 nr. 2018/5) was obtained from the Etlik Veterinary Control Central Research Institute for the study.

**3. Results**

The number of cows according to BCS is given in Table 1.

The cows were separated into two groups according to BCS, consisting of BCS ≤ 3 and BCS > 3 groups. The first 30-day, 3-month, 305-day milk amounts are shown for the groups in Table 2.

The relationship between milk yields and BCS is presented in Table 3.

The contents of the TMR and nutrient composition were determined and are presented in Table 4.

In the results of the study, the first 1-month, 3-month, and 305-day milk yields were determined for Group 1 (BCS ≤ 3) and Group 2 (BCS > 3), and no difference was observed between the groups (P > 0.05).

The cows were observed after birth and nutritional diseases were diagnosed according to symptoms. Nutritional diseases were observed in a total of 35 cows, and they were detected in 21 cows in Group 1 (BCS ≤ 3) and 14 cows in Group 2 (BCS > 3) (Table 5) [15,16].

**Table 1.** The numbers of cows according to BCS.

		Frequency, N	Percent, %
BCS	2.25	1	1.7
	2.50	4	6.8
	2.75	16	27.1
	3.00	15	25.4
	3.25	17	28.8
	3.50	3	5.1
	3.75	2	3.4
	4.50	1	1.7
	Total	59	100.0

**4. Discussion**

Body fat is mobilized for milk production with the start of lactation, since the cow falls to negative energy levels with calving. It has been stated that cows with higher BCS values have higher body fat reserves, and the reserved fat is mobilized for energy and used for milk yield. There is a linear relation between milk yield and BCS. Thin cows with low BCS have been stated to give less milk [17]. However, it was determined in our study that thin cows with low BCS gave more milk.

The ideal BCS for milk yield in lactation has been reported to be between 3.00 and 3.75 [18]. Correlation and regression coefficients were calculated between BCS and milk yield for Holstein Friesian cows, and high milk

**Table 2.** Comparison of BCS and milk yield between the groups.

	Group 1, BCS ≤ 3 (n = 36)	Group 2, BCS > 3 (n = 23)	t	P*
	Mean ± SE	Mean ± SE		
Mean milk yield in the first 30 days	34.86 ± 0.92	35.66 ± 1.33	0.514	0.609
Amount of milk in the first 3 months	2101.06 ± 110.63	2375.65 ± 98.47	1.723	0.090
Amount of milk in lactation for 305 days	7997.33 ± 383.59	8725.00 ± 446.72	1.216	0.229

\* P > 0.05.

**Table 3.** Comparison of milk yield and BCS.

		BCS
Mean milk yield in the first 30 days	Spearman's rho	0.113
	P*	0.399
	N	58
Amount of milk in the first 3 months	Spearman's rho	0.217
	P*	0.098
	N	59
Amount of milk in lactation for 305 days	Spearman's rho	0.193
	P*	0.143
	N	59

\*P > 0.05.

**Table 4.** Nutrient composition of TMR (DM%).

DM (dry matter) %	55.13
CP % (crude protein)	14.65
CF % (crude fat)	3.72
CC % (crude cellulose)	20.24
CA % (crude ash)	6.59
Nitrogen-free extract	9.93
Starch %	24.18

**Table 5.** Description of nutritional diseases.

Nutritional diseases	Description	Diagnosed cow number	
		BCS ≤ 3	BCS > 3
Dystocia	Assisted delivery with parturition	-	-
Retained placenta	Retention of fetal membranes >12–24 h after calving	2	2
Metritis	Purulent uterine discharge with temperature of ≥39.5 °C	8	4
Mastitis	Infection in udder and change in the appearance of the milk	10	6
Milk fever	Favorable response to calcium therapy and clinical signs of milk fever (muscular weakness, dry nose, including S-bend in neck)	-	-
Displaced abomasum	“Ping” sound on abdominal percussion	-	-
Lameness	Noticeably lame and any abnormality in locomotion	1	-
Clinical ketosis	Decrease in milk yield, reduced feed intake and reduced appetite/refusal in concentrate intake, excessive loss of body condition, constipation, ketone odor in breath/milk, nervous signs (weakness, mania, apparent blindness, pica)	-	2

yield was obtained in cows with BCS scores of 3.5 after calving [19].

In the transition period, the changes in BCS show important effects on the health of the herd, milk yield, and

reproduction performance. The level of fat stored in the body gives the BCS and the energy amount stored in the body. Changes in the amount of energy stored in the body cause changes in BCS in the transition period. Increases

and decreases in BCS give information about the amount of energy stored in the body [20].

In our study, cows with BCS > 3 were diagnosed with ketosis, and previous studies supported our results. Entering the dry period and calving with a high BCS score (BCS  $\geq$  3.75) increases the risk of ketosis and reproductive disease (metritis, cystic ovaries). However, entering the dry period and calving with a low BCS score (BCS < 2.50) increases the risk of retained placenta, lameness, dystocia, and culling [17,21]. Since cows with more fat at calving have higher concentrations of nonesterified fatty acids in plasma and higher negative energy balances, and consume less feed compared to thin cows, their risk for ketosis increases. In multiparous cows, metritis and retained placenta are associated with low BCS at birth. However, ketosis and metritis are experienced more in cows with extreme conditions at calving, or those remaining in the dry period for too long. These two factors are cumulative. Long dry period has an independent effect on ketosis. However, this effect is sometimes overshadowed by BCS. Cows mobilize the excess fat reserve in their body for more milk fat synthesis. Cows with poor conditions mobilize less body fat in the first 3-month period after calving, and this results in decreased milk fat concentration independent of milk yield, dry matter consumption, or ration-use efficiency. The effect of BCS on milk yield at calving is associated with more milk fat content in the first 3 months of lactation [17,22].

It has been observed that cows with BCS < 3 at calving do not begin their cycle in postpartum weeks 3–5; their pregnancies last more than 3 months; they are prone to dystocia, retained placenta, and metritis; and they are culled from the herd [23]. In our study higher rates of retained placenta and metritis were observed in cows with BCS  $\leq$  3 than cows with BCS > 3. Similar results were reported in obese cows with BCS > 4 that were observed to have severe negative energy levels [24]. Obesity is formed by giving more concentrated feed in the dry period and fattening the animal in the prepartum period. Decreased amounts of dry matter consumption and higher negative energy levels in obese animals after calving increase the risk of abomasal displacement, metritis, mastitis, and dystocia [25].

The most ideal BCS value in calving is about 3.5 for milk yield on the 5-point scale. Nevertheless, milk yield is slightly increased if the BCS is above 3 [26]. In our study, the BCS is between 3.0 and 3.50 in 53.6% of the cows in the groups.

It was shown that high-yielding cows with BCS scores below 3.5 in the first month of lactation mobilize their body reserve more, and the milk yield is highest in the first 5 months of lactation. It has been reported that the effect of BCS on calving and first insemination interval is

significant [27]. Similar results have been obtained in our study.

It has also been reported that BCS has no effect on milk yield [28]. Completely different results were reported in various studies about the effect of BCS on milk yield since a standard and objective BCS was not used, and different breeding methods were applied [29].

A BCS of 3.5 at calving has been reported to cause maximum milk production in the first 90 days of lactation. Less milk production were observed when BCS was below 3 or above 4. The 305-day milk yield in lactation was reported to be associated with a 0.75-point decrease in BCS. It was also reported that BCS changes caused less daily milk yield [30].

BCS scores below 2.5 and more than a 1-point loss in BCS after calving have been stated to cause low reproductive performance and low pregnancy rates. Thin cows are culled from the herd since they cannot get pregnant. Cows with fat conditions and BCS > 4 at calving have lower pregnancy risks. Lower pregnancy at first insemination and lack of rutting problems have been reported with loss of BCS after calving. However, it was stated that no problems were likely to occur when cows to be inseminated did not have BCS scores below 2.5 or above 3.5. It was indicated that delayed rutting after calving or changes in the estrous cycle such as decreased progesterone affect reproduction in cows with BCS loss or low BCS score [31].

No statistical difference was observed between BCS and milk yield ( $P > 0.05$ ). Cows with fat condition at birth have higher risk of ketosis. Ketosis is a highly prevalent nutritional disease seen in fresh cows after calving. Clinical findings of ketosis are extreme body condition loss, feed consumption (particularly concentrated feed), decreased milk yield, and nervous signs. Ketosis is associated with nutritional diseases such as metritis, mastitis, milk fever, lameness, and displaced abomasum, which are commonly observed after calving. It was stated that despite the strong association between ketosis and nutritional diseases, better care and feeding will result in decreased risk of ketosis and nutritional diseases [32]. It is estimated that more than 50% of cows suffer from at least one subclinical disease in the transition period [33].

In conclusion, by evaluation of BCS after birth and implementing a good care and feeding program in the transition period, it is intended to switch to a type of agricultural production that causes no harm to animal health and be able to perform sustainable, traceable, and reliable production in animal breeding, to establish cost-effective and profitable animal breeding businesses and maintain operations.

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