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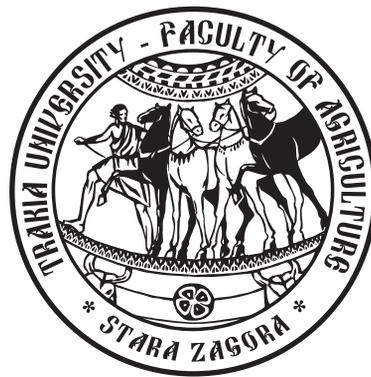
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Effect of body condition score at calving on body condition during lactation in Holstein and Brown Swiss cows

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Abstract. The study comprises 37 cows of which 20 Holstein and 17 Brown Swiss cows. The rearing technology in both breeds is free rearing in individual cubicles for rest. Milking is two times in milking parlour. Cows are divided in three technological groups depending on the physiological state, respectively: dry cows, Ist – up to 120-150th day and II^d lactation period. Feeding is on the basis of whole ration mixture including maize silage, alfalfa haylage, concentrated fodder and vitamin and mineral additives. The body condition of cows has been recorded on a monthly basis by using a 5-score evaluation system, from 0 to 5 points, recorded with accuracy up to 0.5 points. In Brown cows average BCS at calving is 3 points, average BCS during lactation is 1.64 points. In Holstein cows average BCS at calving is 2.8 points and average BCS during lactation is 1.38 points. Heifers from both breeds have a bit lower BCS at calving (3.0 points) than older cows, but they have less loss of body condition during lactation – 1.66 points. With cows at ≥ II^d lactation loss is more intensive as early as the first lactation month and till the lowest BCS they lose a total of 2.04 points. Holstein cows lose at the beginning of lactation more points (an average of 2.14) and reach lower BCS (1.05) compared to Brown Swiss ones in which these values are 1.85 and 1.20 points. BCS drops to the lowest value during lactation in cows from both breeds with poor body condition at calving (2 and 2.5 points). The smoothest are the changes in the body condition of cows that had reached BCS at calving 3.5 and 4 points.

Keywords: body condition score, losses of body condition, Holstein cows, Brown Swiss cows

Abbreviation: BCS – body condition score, LS-mean – least square mean

Introduction

Genetic (breed and individual), biological, related to current individual development and animals' physiological status and environmental factors have influence on the individual variation of cows' body condition. Body condition score (BCS) is used as an indicator about the quantity of accumulated energy reserves by dairy cows (Broster and Broster, 1998). It is a quick, non-invasive, cheap, slightly subjective evaluation of fat depositions in dairy cows regardless of their size and body weight (Waltner et al., 1993). The established very good relationship between BCS and total fat tissue content in the body is the basis for wide application for monitoring nutrition and the metabolic status of dairy animals. BCS values and changes in BCS relate to the cows' health and reproductive status (Veerkamp et al., 2000; De Vries et al., 2000; Pryce et al., 2001), so it could be a useful indicator within a complex index in selection by an aggregated genotype. Selection for improvement or for more stable BCS can also be a parameter for animal health (Bastin et al., 2007).

In cows with high genetic potential only for the productive traits lower BCS values have been established compared to those with average genetic dairy potentials (Pryce et al., 1999). The increase of food at the beginning of lactation cannot meet the high milk yield requirements, as a result of which mobilization of body tissues starts (Van Arendonk et al., 1991). The significant mobilization of body tissues in its turn results in deterioration of health and fertility (Harrison et al., 1990; Waltner et al., 1993). The differences in the degree of genetic improvement and the manager's strategies in the different countries and cattle populations bring different results in that direction in the studies of a number of authors. In Bulgaria does

not apply in practice the assessment of body condition of milk cows. If BCS is regularly determined in herds, producers can better regulate nutrition and management.

The objective of this study is to establish the effect of the different body condition score at calving on the change of body condition score during lactation in Holstein-Friesian and Brown Swiss cows under the same conditions of rearing and feeding.

Material and methods

The study comprises 37 cows, of which 20 Holstein and 17 Brown Swiss cows in the experimental base at Agricultural Institute – Stara Zagora, The rearing technology in both breeds is in free stall with individual cubicles for rest. Lactating cows move freely every day in yards. Milking is two times in milking parlour. Cows are divided in three technological groups depending on the physiological state, respectively: dry cows, Ist – up to 120-150th day and II^d lactation period.

Feeding is on the basis of whole ration mixture including maize silage, alfalfa haylag, concentrated fodder and vitamin and mineral additives. Concentrated fodder during lactation is according to the average milk yield of the group. Rations for all groups have been prepared according to the current requirements for cow nutrition (Todorov, 1995). Pregnant heifers for the last two months before calving are transferred to the group of dry cows, In this way they are under the same conditions of rearing and nutrition as older cows.

For the purpose of the experiment body condition of cows has

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been recorded on a monthly basis by using a 5-score evaluation system, from 0 to 5 points (Todorov and Mitev, 1992). Body condition score has been recorded with accuracy up to 0.5 points. The experiment includes all dry cows for the period from December 2008 to April 2009. Calvings are in the spring and part of the summer of 2009, respectively. In this way the factors year and season of calving are balanced and are not included in the models. The age of cows has been recorded as number of lactation and they are grouped in the following classes, respectively – Ist, II^d and IIIrd and more lactations.

The body condition scoring of cows before calving has been recorded in the period 7 to 10 days before calving. The minimum recorded score is 2 and the maximum one is 4, cows with these scores being single cases in both breeds. The predominant number of cows are within the limits of 2.5 – 3.5 points. To obtain greater approximation cows have been divided in the following classes depending on BCS at calving: 1st class – 2 and 2.5 points; 2^d - 3 points and 3rd class – 3.5 and 4 points. During lactation body condition score has been recorded monthly. The maximum loss of body condition has been calculated as difference between BCS at calving and the minimum BCS obtained during lactation for each cow.

To assess the influence of factors the following model has been used:

$$Y_{ijk} = \mu + P_i + L_j + BCS_k + e_{ijk}$$

Where:

Y_{ijk} is the dependable variable (the studied trait); μ is the population mean; P_i is the breed effect, L_j is the effect of lactation, BCS_k is the BCS effect at calving and e_{ijk} is the effect of not included random factors.

The data have been analysed by using the Harvey (1987) computer programme LSMLMW. Through the variance analyses (ANOVA) for each model the least square mean (LSM) have been obtained by classes of fixed factors.

Results and discussion

In the total number of cows predominant is the relative share of

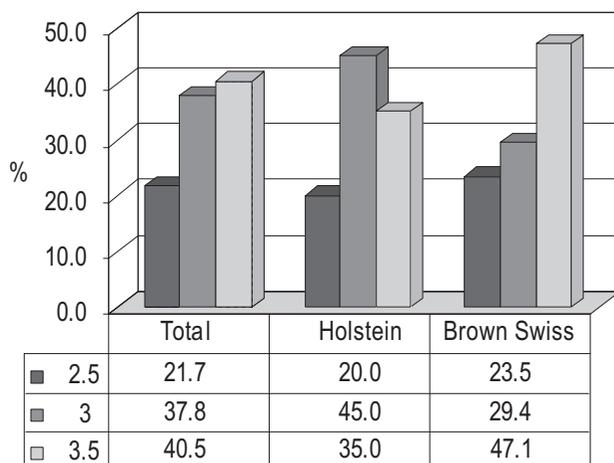


Figure 1. Distribution of cows (in %) according to body condition score at calving.

cows with high body condition score at calving – 3.5 – 4 points, 40.5 % (Figure 1). The next group according to BCS at calving is the one with 3 points – 37.8 % and the smallest is the share of cows with low body condition score – 2.5 and 2 points, 20.7%. Discussed by breeds, the lowest is the share of cows with low body condition score before calving in both breeds. In Holstein the relative share of cows with medium body condition score at calving is higher - 45 % (BCS 3 points), while in Brown Swiss cows predominant is the number of those with high body condition score at calving at 3.5–4 points (47.1 %).

In cows of both breeds high relative share of those with lower body condition score at calving is reported – 3 and less points. The differences between both breeds - 65 % in the Holstein cows, compared to 52.9% in the Brown ones are logical from the point of view of their type specificity. Because the cows from both breeds were fed uniformly during the dry period, the cause for the lower BCS of some of the cows could be the duration of the dry period or the previous lactation, which were outside the scope of this research.

Figure 2 presents the distribution in % of heifers and all other cows (II^d and later lactation) according to BCS at calving. A greater relative share of older cows have obtained higher body condition score at calving of 3.5-4 points – 47.1 %, while heifers with such body condition at calving are 35 %. In them the relative share of animals with low body condition score at calving of 2.5 and 2 points is higher – 25%, compared to 17,6% in older cows. Although there is no reliable difference, the average BCS at calving for cows at II^d and later lactation is higher than that of heifers, 3.12 and 3.00 points, respectively. Placed under the same conditions of feeding with the older cows during the last months of pregnancy not all heifers manage to reach higher body condition score at calving. The results obtained by us correlate to the publications by other authors. Samarutel et al. (2006) point out that in primiparous Holstein cows the share of cows with medium body condition score at calving is predominant – BCS from 3.25 to 3.75 points, lean cows with BCS ≤ 3.0 are 28 % and these with high body condition score 3.75 points are 26%.

Average milk yield for 305-day lactation of the Holstein cows included in the study is higher than that of the Brown ones ($P < 0.01$), (Table 1). All BCS values are higher for the Brown cows compared to the same for the Holstein, respectively – average BCS at calving - 3

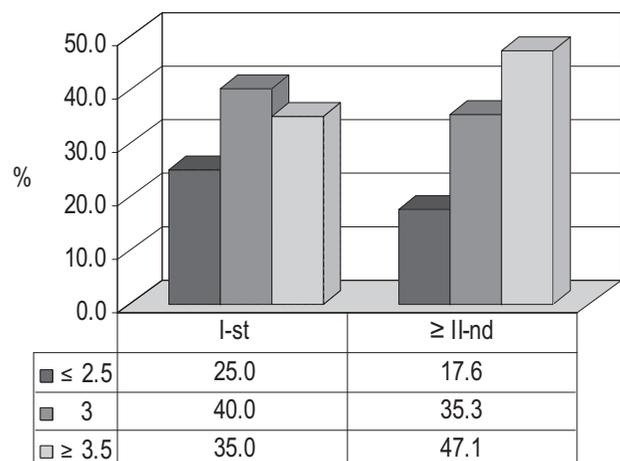


Figure 2. Distribution of cows (in %) according to body condition score at calving and number of lactation

Table 1. Average statistical data for the studied traits by breeds

Traits	Holstein cows (n = 20) Mean ± SEM	Brown Swiss cows (n = 17) Mean ± SEM
Milk yield for 305 days, kg	6262.2 ± 238.5**	5291.7 ± 234.4**
BCS at calving	2.80 ± 0.15	3.00 ± 0.14
Mean BCS for lactation ¹	1.38 ± 0.04***	1.64 ± 0.03***
Minimum BCS for lactation	1.05 ± 0.08	1.20 ± 0.09

** - $P < 0.01$, *** - $P < 0.001$, ¹For Holstein cows n = 212, for Brown Swiss cows n = 170

Table 2. Variance analysis of controlled factors in the studied traits

Variation sources	Degrees of freedom (n - 1)	BCS for lactation month		Maximum loss of BCS during lactation		Minimum BCS for lactation	
		F	P	F	P	F	P
Total of the model	363	8.48	***	29.47	***	21.63	***
$\mu - y \mu$	1	0.00	-	7.38	**	10.67	**
Breed	1	14.35	***	18.53	***	26.61	***
Number of lactation	2	1.07	-	0.05	-	17.62	***
BCS at calving	2	8.19	***	70.62	***	11.20	***

** - $P < 0.01$, *** - $P < 0.001$

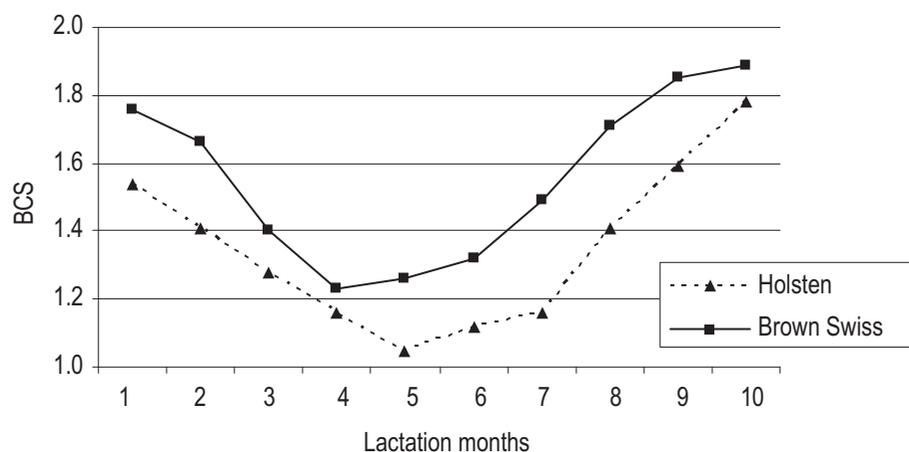
points, average BCS during lactation – 1.64 points and 1.2 points minimum BCS for lactation in the Brown Swiss breed and average 2.8 points before calving, 1.38 during lactation and 1.05 points minimum BCS in the Holstein.

The results from the analysis of the effect of controlled factors on BCS by lactation months, maximum loss and minimum BCS during lactation are presented in Table 2. Of the controlled factors included in the study reliable effect on the body condition of cows during lactation has been exerted by the breed and BCS at calving, $P < 0.001$. The number of lactation has no reliable effect on these traits. On the reached minimum BCS during lactation all three factors have had reliable effect, $P < 0.001$.

Figure 3 presents the effect of the breed on BCS variation during lactation. In Brown cows almost during entire lactation higher body condition score by about 0.5 points is recorded compared to

that of the Holstein. Difference has been observed in the period for achieving minimum body condition score during lactation in both breeds. Holstein cows reach minimum BCS approximately in the fifth month of lactation, while Brown ones – a month earlier. In our opinion these differences may be due both on breed peculiarities and on higher milk yield of Holstein cows included in the study (Table 1). Gallo et al. (1996) suggest that the minimum BCS occurred at 3 mo after calving for the worst yielding cows and at 4 mo for the best yielding cows. Regardless of the fact that the negative energy balance at the beginning of lactation is normal for the cows, its level and duration have an adverse effect on health status and fertility (Harrison et al., 1990; Waltner et al., 1993).

Harrison et al. (1990) established greater negative energy balance at the beginning of lactation in higher milk yield cows compared to medium milk yield ones. Koenen et al. (2001) state that

**Figure 3.** Variation in BCS during lactation depending on the breed

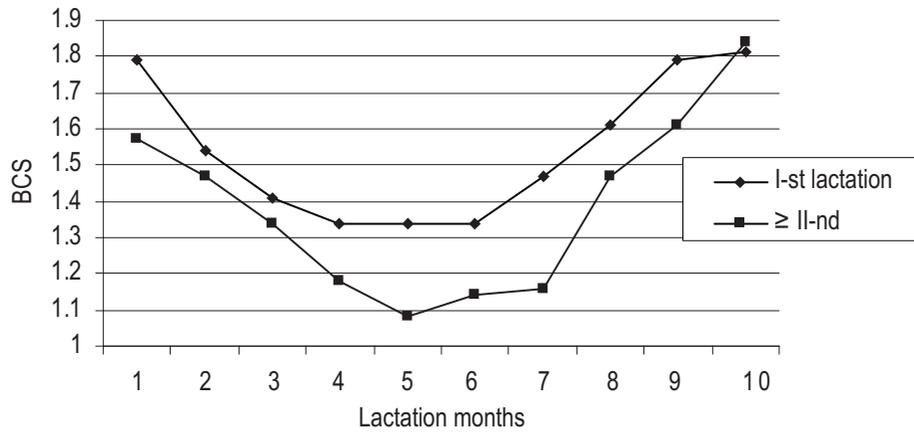


Figure 4. Effect of the number of lactation on variation in BCS during lactation

by increasing the percentage of Holstein the average BCS value is reduced. The average loss of BCS after calving is higher in Holstein, 1.2 points respectively, compared to Red-and-White cattle – 1 point. Authors state that this difference is due to the different productivity as well, which is 1000 kg greater in the Holstein (8003 kg compared to 6975 kg). There are data about higher BCS in Holstein cows compared to other breeds. Rossoni et al. (2007) state that since 2002 the Italian Brown Swiss Cattle Breeding Association has included BCS in the system for assessing the morphological qualities of cattle, and assessment is on a 1 to 5 scale. Average BCS at calving of 3.2 points is reported for the Brown cattle, after which BCS decreases slightly up to the 90th day and then gradually increases reaching 3.5 at the end of lactation. These data differ insignificantly from those, reported about the Holstein in Italy by Gallo et al. (1996), who establish average BCS of 3.55 at calving and less than 3.4 at the end of lactation. According to authors most probably these differences are due to differences in the milk yield level and rearing organization of both breeds.

Figure 4 presents the difference in BCS changes in heifers and cows at II^d and further lactation. Although they have a bit lower body condition before calving (3.0 points), heifers have lower loss of BCS during lactation, both for the first month and upon reaching the lowest BCS of 1.34 points. The total loss of BCS from before calving to the minimum BCS is 1.66 points. In older cows the loss is more intensive as early as the first lactation month, and to the lowest BCS

they lose a total of 2.04 points. A probable reason about that is the different intensity of metabolism in different ages. Waltner et al. (1993) established reliable effect of the number of lactation on the body condition changes of cows during lactation. They state that with the increase of the number of lactation losses of body reserves increase from 0.3 points for first lactation, to 0.9 points for 4th and further lactations. Gallo et al. (1996) also state that for heifers losses during lactation are less compared to older cows.

Figure 5 presents the results about the effect of BCS at calving on body condition during lactation in Holstein cows. Body condition decreases significantly after calving and it drops to almost 1 point both in cows with BCS 2-2.5 points at calving and those with BCS 3. The slightest are the changes in BCS during lactation in cows with the highest body condition at calving – BCS 3.5-4 points. The body condition of these cows does not drop under 1.3 points during lactation. In Brown cows, as reported in the breed effect, body condition score does not drop below 1.3 points in none of the groups, (Figure 6). The lowest values are reached by cows with BCS at calving 2 – 2.5 points, and they are the slowest to recover their body condition at the end of lactation. Cows with body condition score at calving 3 and more points have less losses of body reserves during lactation. Minimum BCS in both groups reached an average of 1.5 points in the middle of lactation and higher values towards the 10th lactation month.

Body condition score at calving has reliable effect on BCS loss

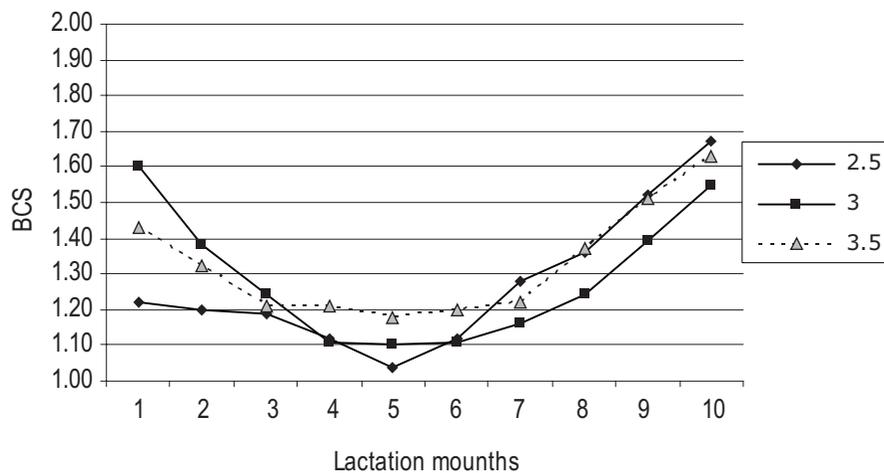


Figure 5. Variation in BCS during lactation depending on BCS at calving in Holstein cows

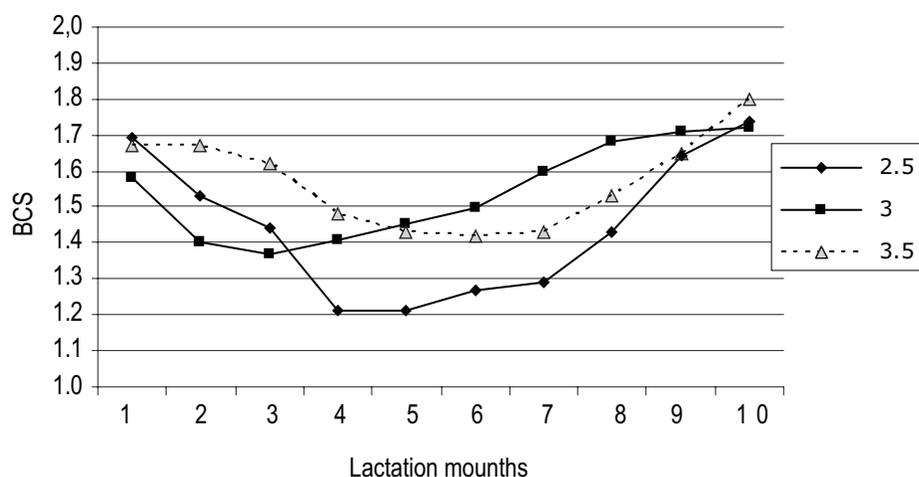


Figure 6. Variation in BCS during lactation depending on BCS at calving in Brown Swiss cows

Table 3. Effect of body condition score of cows at calving on the maximum BCS loss during lactation

BCS at calving	Total	Losses of BCS				
		Holstein cows		Brown Swiss cows		
		n	LS-mean ± SE	n	LS-mean ± SE	
Mean of the model	37	1.97 ± 0.08	20	2.14 ± 0.09	17	1.85 ± 0.09
≤ 2.5	8	1.63 ± 0.16	4	1.75 ± 0.21	4	1.50 ± 0.18
3	14	1.96 ± 0.12	9	2.11 ± 0.13	5	1.80 ± 0.16
≥ 3.5	15	2.33 ± 0.12	7	2.57 ± 0.15	8	2.25 ± 0.13

Table 4. Minimum values of BCS during lactation achieved in cows with different BCS at calving

BCS at calving	Total	Losses of BCS				
		Holstein cows		Brown Swiss cows		
		n	LS-mean ± SE	n	LS-mean ± SE	
Mean of the model	37	1.13 ± 0.01	20	1.08 ± 0.01	17	1.19 ± 0.02
≤ 2.5	8	1.06 ± 0.03	4	1.00 ± 0.03	4	1.12 ± 0.04
3	14	1.14 ± 0.02	9	1.11 ± 0.02	5	1.20 ± 0.03
≥ 3.5	15	1.20 ± 0.02	7	1.13 ± 0.02	8	1.26 ± 0.03

during lactation (Table 3). As a whole cows with higher body condition at calving – 3.5 – 4 points, have achieved higher losses of body reserves during lactation. Higher are BCS losses in Holstein cows compared to Brown ones, which is probably related to the breed predisposition to more intensive mobilization of body reserves for milk production.

Van Arendong et al., (1991) state that as a result of milk yield selection food consumption increases but not enough to cover the increased needs of the organism. By applying only productivity selection it is expected to increase mobilization of body reserves at the beginning of lactation. That unwanted effect of productivity selection can be reduced by taking into consideration the energy balance information in selection solution. Direct information about practical energy balance is not available mainly due to the lack of information about food consumption. However BCS is already used as an indicator about the amount of stored body reserves by dairy

cows (Broster and Broster, 1998).

Samarutel et al. (2006) state that for the first 30 days after calving cows had lost an average of 0.49 points from BCS, while the weak ones had lost 0.25 points, the ones with medium body condition – 0.48, high body condition – 0.60 points. For the period from calving to reaching the lowest body condition score weak cows had lost 0.41 points, those with medium body condition – 0.76 and with high body condition – 1.05 points. The studies of Ruegg et al and Milton. (1995) also state that cows of higher body condition have been losing live weight longer after calving. Cows of medium body condition in the study had lost 0.80 points after calving, and in the first week and around the calving itself they had lost 0.25 points. Loss of BCS had continued to the 50 - 90th lactation day. The main factor that had influenced losses of live weight after calving is BCS at calving, milk yield has had no reliable effect. After reaching the minimum BCS during lactation cows had increased their scores and

the increase has had no reliable effect either on BCS at calving or on milk yield.

In spite of reporting greater losses of BCS in cows of higher BCS at calving, their minimum scores are higher than in cows with low BCS at calving (Table 4). That shows that attention should be drawn to reaching higher body condition score at calving. That makes it possible for cows to mobilize greater amount of body reserves at the beginning of lactation, without reaching too low body condition score (1 point). Bastin et al. (2007) state that from April 2006 BCS is controlled on a monthly basis in 76 dairy herds in Walloon, Belgium. The first aim of that control is to develop and propose later a practical management handbook to dairy farmers. Moreover, BCS results are sent to each farmer as a “list of BCS balance in the herd”. That allows farmers regularly to regroup cows that are no longer in the needed body condition depending on the number of their lactation and the period of lactation. The second aim of that score is to develop a model for assessment of the breeding value of that trait. Results obtained by us show that such a practice is recommended to be introduced in our dairy farmers.

Conclusion

In Brown Swiss cows average BCS before calving is 3 points, average BCS during lactation is 1.64 points. In Holstein cows average BCS before calving is 2.8 points and average BCS during lactation is 1.38 points. Heifers of both breeds have slightly lower body condition before calving (3.0 points) than older cows, but they have less loss of BCS during lactation – 1.66 points. In cows at $\geq 11^{\text{d}}$ lactation the loss is more intensive as early as the first lactation month and until the lowest BCS they lose a total of 2.04 points. To the lowest score BCS during lactation drops in cows of both breeds with low body condition before calving (2 and 2.5 points). The smoothest are the body condition changes of cows that had reached BCS before calving 3.5 and 4 points. Holstein cows lose more points at the beginning of lactation (an average of 2.14) and they reach lower BCS (1.05) compared to Brown Swiss ones in which these scores are 1.85 and 1.20 points. Reporting of the BCS of cows in different physiological periods will allow for better regulation of the diet in accordance with the needs of animals.

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Todorov N and Mitev J, 1995. Effect of level of feeding during dry period, and body condition score on reproductive performance in dairy cows, IXth International Conference on Production Diseases in Farm Animals, Sept.11 – 14, Berlin, Germany, p. 302 (Abstr.).

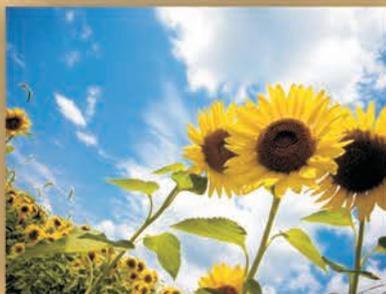
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