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The Effects Of Dietary Rumen-Protected Choline Supplementation on the Live Weight and Body Condition Score of Dairy Cows During the Transition Period

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ABSTRACT

The aim of this study was to investigate the effects of dietary rumen-protected choline (RPC) on the live weight and body condition score (BCS) of dairy cows during the transition period. A total of 30 Holstein dairy cows were allotted to one control group and two experimental groups (10 animals per group) that were fed different diets from 3 weeks prior to the expected calving date until 21 days postpartum, namely, 1) control group: basic diet; 2) treatment Group 1: basic diet supplemented with 60 g/animal/day of RPC; and 3) treatment Group 2: basic diet supplemented with 120 g/ animal /day of RPC. The mean live weights of the control group and treatment Groups 1 and 2 at parturition were 593.17 kg ± 29.211b, 672.060 kg ± 23.744a and 584.86 kg ± 25.300b, respectively. The differences between the groups in terms of weekly mean live weight were significant at parturition (P=0.0124), whereas they were not significant in the weeks post-partum. The time-dependent changes for intragroup x group interactions were also not significant for live weight (P>0.05). The mean body condition scores of the control group and treatment Groups 1 and 2 at the end of the research period were 2.58±0.163, 2.90±0.158 and 2.79±0.125, respectively (P>0.05). Rumen protected choline supplementation did not have a significant effect on the BCS of dairy cows during the transition period. Therefore, RPC is not required when proper rumen fermentation is occurring and isocaloric and isonitrogenous rations are provided. However, in order to better understand the effects of RPC on dairy cows during the transition period, there is a need for further studies on animals with known metabolic profiles, malnourished animals, those producing high milk yields and those with metabolic disorders.

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INTRODUCTION

Agriculture constitutes a significant proportion of the Turkish economy in terms of employment and the gross domestic product, with livestock and products derived from them being major contributors. Turkey has a substantial dairy industry but during the transition period there are significant economic losses attributable to nutritional imbalances. Metabolic disorders arise when there is nutritional deficiency or imbalance in high milk yielding cows. Metabolic disorders reduce milk yield, live weight and the body condition score (BCS). The frequency of metabolic disorders increases when there is an insufficient amount of feed consumed (Drackley, 1999). The loss of BCS during the early lactation period negatively affects reproductive performance (Mayne et al., 2002; Buckley et al., 2003; Shrestha et al., 2005). The metabolic profile provides a convenient means for predicting periparturient disorders that significantly affect dairy farm profitability due to reduced reproductive performance and reduced milk yield in cows.

Choline, which can be synthesized endogenously by dairy cattle, is closely related to methionine, folic acid and vitamin B12. Choline has a lipotropic structure that enables it to accelerate the metabolism of fats in the body, and it reduces fat accumulation by increasing the fat conversion rate and release of triglycerides in the liver. Therefore, in situations where there is choline deficiency, there is a shortage of phospholipids for the transport of fatty acids from the liver to the tissues, and fat accumulation may occur (Reece, 2008).

During the transition from the early dry period to the late dry period, i. e., the last three weeks of the dry period, a ration with low neutral detergent fiber (NDF) and high energy and nutrition values should be used due to the decreasing consumption of dry matter (DM), despite an increase in food and energy requirements, with the primary aim of preparing for the nutrition requirements in the lactation period (Winkleman et al., 2008). In the present study, the aim was to examine the effects of rumen protected choline (RPC) added to rations on the body weight and BCS of Holstein dairy cows in the transition period.

MATERIALS AND METHODS

This research was approved by the Animal Experiments Local Ethics Board of the Ondokuz Mayıs University (Approval number: B.30.2.OD.M.0.20.09.00-050.04/15).

The management of dairy cows, including housing and feeding, and protocols for the experimental treatments in this study, were documented by Alan and Salman (2019).

The study included a total of 30 Holstein cows so that the control group and two experimental groups each contained 10 animals. The control group was fed only a basal diet, while treatment Groups 1 and 2 were fed a basal diet supplemented with 60 and 120 g/animal/day RPC, respectively. Body weight and the BCS were determined as per the methodology developed by Ferguson et al. (1994).

Statistics

For the two parameters, body weight and BCS, comparisons were made among the mean values for weeks and groups with the ANOVA method, which were repeated weekly, and the descriptive statistics were calculated.

RESULTS AND DISCUSSION

The mean live weekly weights of the three groups are given in Table 1. The differences between the groups in terms of weekly mean live weights were significant at parturition (P=0.0124). However, there were no statistical differences among the groups for weekly mean live weight in the postpartum period (P>0.05).

Table 1. *Weekly mean live weights of Holstein cows by group (kg)*

Week	Control	Treatment Group 1	Treatment Group 2	P
0[#]	593.17±29.211b	672.06±23.744a	584.86±25.300b	0.0124*
1	586.42±29.035a	644.84±21.146a	573.01±22.702a	0.1076
2	575.88±25.722a	625.25±21.0240a	561.33±22.676a	0.1443
3	565.97±22.944a	612.94±21.872a	549.30±20.799a	0.1224
4	569.87±25.0136a	609.55±18.525a	552.07±20.665a	0.1749
5	573.24±22.693a	605.14±14.757a	554.05±21.016a	0.2014
P		0.3864		

[#]:at parturition, a, b: mean values within rows and in columns followed by different letters were significantly different at the 5% level.

In addition, there were no statistical differences between the groups in terms of BCS. The highest losses of body weight and BCS in the postpartum period were in treatment Group 1.

Table 2. *Body condition scores in Holstein cows during the transition period (mean ± SEM).*

Week	Control	Treatment Group 1	Treatment Group 2	P
-3*	3.15±0.198	3.60±0.179	3.27±0.124	0.1718
0**	3.15±0.198	3.60±0.179	3.27±0.124	0.1718
1	2.68±0.163	3.05±0.166	2.84±0.123	0.2366
3	2.58±0.163	2.90±0.158	2.79±0.125	0.3132
P		0.4157		

* 3 weeks before parturition, **at parturition

There were no significant differences between means within the same week and for the duration of the experiment (P > 0.05)

Adequate body reserves are a prerequisite for maximum milk production during early lactation. However, it is not desirable for animals to have excessive fat tissue reserves that are used intensively at the start of lactation. Changing the condition of the body too quickly leads to health physiological problems; the risk of calving problems is reduced if cows are in optimal physical condition for this particular phase of the production cycle (Wildman et al., 1982; Edmondson et al., 1989; Otto et al., 1991; Ruegg and Milton, 1995).

In the current study, the mean live weights of cows at parturition were 593.17±29.211 kg, 672.060±23.744 kg and 584.86±25.300 kg, in the control, experimental Group 1 and experimental Group 2, respectively. The differences between the groups in terms of mean parturition weight were statistically significant (P=0.0124). Weekly mean live weights in the first three weeks after parturition decreased in the control and treatment groups. This situation can be explained by the stress caused by birth, evidence of which included insufficient dry matter intake, with a potential consequence being reduced milk production. The mean live weight loss in treatment Group 1 was higher at the end of the transition period. Cows in that group lost a mean of 66.92 kg (approximately 9.9 %) of their live weight in the first 5 weeks after parturition, whereas cows in the control group and experimental group 2 had mean weight losses of 19.93 kg and 30.2 kg, respectively. This showed that cows that gave birth to high weight calves suffered a greater loss in live weight in the first five weeks of lactation.

The calculation of BCS involves visual and tactile evaluation of certain body regions in order to subjectively assess the energy reserves in the cow's body (Wright and Russell, 1984). BCS is widely used as a tool to aid herd management in Turkey. In this study, the BCSs of the groups in the transition period were similar in the dry period, at birth and in the early lactation period. The mean BCS values for the control group and Groups 1 and 2 were 3.15, 3.60 and 3.27, respectively. After parturition, decreases in BCS were determined for the 1st and 3rd weeks of lactation in the control group and both treatment groups. However, there were no statistical differences among the groups in terms of BCS. These results are similar to those obtained by many researchers, including Heuer et al. (1999) and Buckley et al. (2003).

The BCS reductions for the first three week period after parturition were 0.57, 0.70 and 0.48 units in the control group, experimental Group 1 and experimental Group 2, respectively. BCS losses at the end of the 3rd week of lactation were higher among animals in experimental Group 1 that started the lactation period with a higher BCS. The decrease in live weight accompanying parturition in this study mirrors the findings of many researchers, including Minuti et al. (2015). The present study shows that the BCSs of the animals in the present study were in the reference ranges between the preparturient period and parturition. The findings of this study matched those of Pipenbrink and Overton (2003) who reported that the use of RPC at different levels (0.45, 60 and 75 g/day) did not have a significant effect on live weight and BCS.

Edmondson et al. (1989) reported that the target BCS should be 2.75 in the dry period, 3.0 at calving and > 2.5 during the first weeks of lactation. In the present study, the BCSs of cows in the lactation period were similar to those recommended by Edmondson et al. (1989), whereas they were different in the dry period. Van Horn et al. (1992) reported that mean BCS scores in the range of 3.00 to 3.75 in the dry period and at birth, and 2.25 to 2.75 in the first weeks of lactation, were optimum. Also, Wattiaux (1996) reported that the mean BCS should be 3.00 to 3.50 in the dry period and at birth and 2.50 in the first weeks of lactation. The BCSs recorded in the current study correspond with those recommended by Van Horn et al. (1992) and Wattiaux (1996). In the present study, the BCSs of animals in the transition period were in the desired range, which shows that the animals were properly fed.

Cows undergo major physiological and metabolic changes in a short time during the transition period. Because of these rapid changes, the incidence of many metabolic diseases such as fatty liver, ketosis and displaced abomasum is quite high. Determining the changes in body condition of animals during the transition period provides important information about the general condition of the particular animal. In the present study, the addition of RPC to the rations of cows in the transition period did not have a significant effect on both body weight and BCS. Therefore, it appears that there is no need for RPC in situations where both the appropriate rumen fermentation environment exists and isocaloric and isonitrogenic rations are provided. However, to better understand the effects of RPC on dairy cows during the transition period, there is a need to conduct studies on animals with known metabolic profiles, malnourished animals, high milk producing animals and those with metabolic disorders.

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