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INFLUENCE OF NUTRITION ON THE MILK UREA LEVEL IN BULGARIAN BROWN CATTLE BREED COWS

MILENA MIHAYLOVA[1], GANCHO GANCHEV[2*], YOVKA FENEROVA[1], STAYKA LALEVA[1] and NEDKA DIMOVA[1]
[1]*Agricultural Institute, BG-6000, Stara Zagora, Bulgaria*
[2]*Trakia University, Faculty of Agriculture, BG-6000 Stara Zagora, Bulgaria*

Abstract

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The study was conducted during the regular milk control of cows from the Bulgarian Brown Cattle (BBC) breed from the Agricultural Institute - Stara Zagora herd for the months of July and October 2014. Animals were divided into two groups according to the daily milk level - Elite group with a daily milking density of over 20 kg and a First group with a milk density of up to 20 kg. The ration consists of a total mix ration that was provided in the feeding racks. The milk urea content was determined in the laboratory of the Agricultural Institute - Stara Zagora by the Angelov, Ibrisimov and Milashki's method (1999). Milk samples for analysis were taken during the morning milking of the cows and studied immediately. The results of the survey were statistically processed with the STATISTICA for Windows software package. The study provides the opportunity to supplement information on the impact of protein and energy levels on the ration for maximizing the use of protein feeds effectively and limiting nitrogen losses in the environment. Concentration of crude protein above 16% in the dairy cow diet with sufficient energy for microbial growth, is associated with poor utilization of the protein – increase in urea level in milk above 20.0 mg/dl. Low levels of urea in milk – below 6.0 mg/dl are associated with insufficient amount of microorganism-accessible rumen protein (PBR), although the availability of enough energy in the diet.

Key words: cows; milk; protein in the ration; urea

Abbreviations: FUM – feed units per milk, PDI – protein digestible in intestine, PBR – protein balance in the rumen, RDP – rumen degradable protein, TMR – total mixed ration, BBC – Bulgarian Brown Cattle

Introduction

Dairy cattle's breeding has the largest share in the release of ammonia emissions from livestock farming into the environment. Ammonia production depends on the cows' diet energy and protein content, the building solutions of the stalls, the external and internal climate, and the cultivation system - either stall or pasture. Bacteria in the rumen of ruminants are able to use ammonia and available fermenting carbohydrates to produce high-quality microbial protein. Sources of ammonia are predominantly the feed non-protein nitrogen, the recycled urea, and the degraded and deamidated rumen degradable protein (RDP). The level of ammonia in the rumen is influenced by many factors, including the level and the source of rumen degradable protein, the sources of carbohydrates, the balance between protein and carbohydrate fermentation rates, rumen pH and the rate of passage to the small intestine. Shortage of energy in the diet can lead to increased ammonia levels in the rumen since without energy bacteria can not convert peptides, amino acids and ammonia into microbial protein. Blood ammonia is transported to the liver where it is converted into urea, a part of which is released through milk and urine. The increased release of urea via milk and urine is an indicator for inefficient use of protein

*E-mail: glen62@abv.bg

from feed (Castillo et al., 2000; Frank and Swensson, 2002; Wattiaux and Karg, 2004; Colmenero and Broderick, 2006; Mahr-un-Nisa et al., 2008).

Since a number of non-food factors influence the level of milk urea, it is imperative that all of them are traced to determine the average level of urea in the milk in each herd, the factors and the way of influence, in order to produce relevant food strategies for organic and environmentally safe milk production with a suitable composition for dairy processing.

The purpose of the study is to determine the relationship between the protein level and the amount of energy in the ration on the milk urea content in Bulgarian Brown Cattle breed cows.

Materials and methods

The study was conducted during the regular milk control of BBC breed cows from the Agricultural Institute - Stara Zagora herd for the months of July and October 2014. Animals were divided into two groups according to the daily milk level – Elite group with a daily milking density of over 20 kg, and a First group with a milk density of up to 20 kg. The cow ration of the two groups consisted of a TMR that was provided for free consumption. The animals in both groups received the same volumes of bulky feed. A concentrate mix was used, fed in different amounts to the Elite and First Group animals. Permanent access to drinking water was provided. The composition and nutritional value of the rations and the concentrate mix are shown in Table 1.

The milk urea content was determined in the IA - Stara Zagora laboratory using the Angelov, Ibrisimov and Milashki's method (1999). Milk samples for analysis were taken during the morning milking of the cows and were examined immediately. The results of the survey were statistically processed with STATISTICA for Windows software package.

Results and discussion

An average daily milk yield of 23.1 kg was obtained from the cows included in the Elite group, and of 16.3 kg from the cows included in the First group (Table 2).

In the feeding ration of the Elite group, 24.3 FUM, 3217 g CP (16.4% CP level of DM) and 2154 g PDI were provided. First group cows received 18.5 FUM, 2685 g CP (14.5% CP level of DM), and 1821 g PDI with the ration.

For the Elite group, a milk urea concentration of 20.58 mg/dl was found, and for the First group it was 15.88 mg/dl. The statistical significance of the differences between the groups is $P < 0.001$.

Table 1
Diets composition and concentrate composition

Ration, kg per day	Elite group July	First group July	Elite group October	First group October
Concentrate mix	12	8	12	8
Wheat straw	2	2	2	2
Corn silage	15	15	25	25
Brewers grains, fresh	8	8	8	8
Haylage (barley, rape-seed, alfalfa)	10	10	-	-
Concentrate mix, %				
Wheat		56.1		
Maize		20.0		
Sunflower oil meal		20.0		
Limestone		1.5		
Dicalcium phosphate		0.5		
Sodium chloride		0.6		
Sodium bicarbonate		1.0		
Vitamin Mineral Premix		0.3		

In our studies, these urea values had dietary protein levels of 16.4% and 14.5% in the dry matter, for the Elite group and the First group respectively, and were consistent with studies made by other authors. Kauffman and St-Pierre (2001), Colmenero and Broderick (2006) found similar levels of urea in the milk of cows receiving rations with a CP level of 13.5 to 19.4% of DM. In these trials, increasing the concentration of raw protein in the diet resulted in a linear increase in urea in the milk and blood serum. The resulting urea levels show an excess of dietary protein that is not effectively used to synthesize microbial protein and is extracted through milk and urine. This is done by providing sufficient energy for microbial synthesis in the ration – 24.3 FUM for the Elite group and 20.0 FUM for the First group. The energy provided is significantly above the required FUM for the respective milkiness (Todorov, et al., 2007). Further study is needed to determine the optimal ratio between degradable and non-degradable rumen protein to achieve maximum microbial synthesis since it is a likely cause of the inability to use the digested protein by the rumen microorganisms.

The results from the October milking check (Table 3) indicate that an average daily milk yield of 21.67 kg was obtained from the cows from the Elite group and 13.61 kg was obtained from the First group.

The ration of Elite group animals contained 23.8 FUM, 2998 g CP (15.0% CP level of DM) and 2095 g PDI. First group cows received respectively 20.1 FUM, 2440 g of CP (13.4% CP level of DM) and 1801 g of PDI from their ration.

Table 2
Daily received nutrients, milk yield per a control day and milk urea content – July

Items		DM	FUM	CP	PDI	PBR
Elite group N=10						
Received		19.6	24.3	3217	2154	50
Mean daily milk yield, kg	23.1 ± 1.67					
Milk urea, mg/dl	20.58 ± 1.66***					
First group N=14						
Received		18.5	20.0	2685	1821	28
Mean daily milk yield, kg	16.28 ± 1.26					
Milk urea, mg/dl	15.88 ± 0.97***					

*** The results are statistically significant at $P < 0.001$

Table 3
Daily received nutrients, milk yield per a control day and milk urea level – October

Items		DM	FUM	CP	PDI	PBR
Elite group N=12						
Received		20.0	23.8	2998	2095	- 50
Mean daily milk yield, kg	21.67 ±0.82					
Milk urea, mg/dl	5.93 ± 1.94***					
First group N=14						
Received		18.2	20.1	2440	1801	- 177
Mean daily milk yield, kg	13.61 ±1.17					
Milk urea, mg/dl	5.72 ±0.47***					

*** The results are statistically significant at $P < 0.001$

The concentration of milk urea for the Elite group was 5.93 mg/dl, and for the First group it was 5.72 mg/dl. Differences between groups are statistically significant at P<0.001. The lower levels of milk urea in the October control check are due to a shortage of microorganism-available rumen protein. The protein balance in rumen of the rations fed during this period was negative: -50 and -177 g respectively for the two groups.

By providing a sufficient amount of milk protein according to the standards for the corresponding milkiness, low urea values were obtained in the milk of the cows in our studies. It is believed that milk urea is an indicator for fractions of degradable and non-degradable protein rather than total crude protein (Roseler et al., 1993; Whitaker et al., 1995; Schepers and Meijer, 1998; Kalscheur et al., 1999). According to Roseler et al. (1993) the ration at which the amounts of degradable and non-degraded rumen protein correspond to 100% of the requirements of the NRC results in an average value of carbamide nitrogen in the milk at 11.6 mg/dl. Further studies on the influence of the fraction of degradable and non-degradable rumen protein, which are responsible for the presence of nitrogen for microbial protein synthesis and the level of milk urea, are necessary.

Conclusions

This study provides additional information on the impact of protein and energy levels in rations for maximizing the efficiency of protein feed use and limiting nitrogen losses in animal feed. Concentration of crude protein above 16% in the dairy cow diet with sufficient energy for microbial growth is associated with poor utilization of the protein – increase in urea level in milk above 20.0 mg/dl. Low levels of urea in milk – below 6.0 mg/dl are associated with insufficient amount of microorganism-accessible rumen protein (PBR) despite the availability of enough energy in the diet. Studies on the influence of the ratio of the degradable and non-degraded rumen proteins on milk urea and their relationship to energy in the diet need to be continued to ensure maximal microbial protein synthesis.

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