Scientific Papers. Series D. Animal Science. Vol. LXI, Number 1, 2018
ISSN 2285-5750; ISSN CD-ROM 2285-5769; ISSN Online 2393-2260; ISSN-L 2285-5750

THE INFLUENCE OF THE ZEOLITES USE ON BLOOD PARAMETERS OF COWS

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Abstract

Dairy cows' nutrition should be balanced because important quantities of mineral salts, especially calcium and phosphorus, but also magnesium, potassium, sodium, chlorine etc. are eliminated through milk. Also, mineral substances have a training role in the body, participating in a high proportion in the structure of supporting tissues, as well as a functional role by maintaining the main physiological functions. The use of zeolites in the form of volcanic tuff can influence the mineral and hematological parameters in the blood of cows in the calving period, as well as lactating cows. A lower variation in calcium, phosphorus and magnesium in blood is observed when using the volcanic tuff in the cows' feed during the pre-calving period and the first 2 weeks after calving. In the pre-calving and the first 2 weeks after the calcification, the values of erythrocytes, leukocytes and hemoglobin have lower values but are not statistically provided. During the lactation period, the three hematological parameters of the cows were physiologically normal, not being influenced by the administration of zeolite to the ration of dairy cows.

Key words: *cows, volcanic tuff, mineral elements, biochemical and hematological blood parameters.*

INTRODUCTION

Natural zeolites are porous materials characterized by their ability to remove or absorb water through a reversible process, allowing them to adsorb molecules and exchange constitutive cations (Mumpton, 1999). By being based on these characteristics, specialists have begun to use zeolites with good results in many domains, including husbandry.

The use of zeolites may have an effect in the prevention or treatment of certain diseases of animals grown in farms and for which small mineral deficiencies may appear relatively easy (Katsoulos et al., 2005).

In this respect, zeolites can provide the necessary coconut minerals and microelements for cows, thus stimulating their production and improving their health state (Karatzia et al., 2016).

Zeolites can be a valuable source of minerals, such as iron, calcium, phosphorus, magnesium, sodium, zinc, and manganese. As a result, the volcanic tuff, which is a source of natural zeolites, may be a source of minerals for cows, the proportion of use in food varying according to the physiological state, ration structure, gastrointestinal pH (Bosi et al., 2002).

Considering the fact that zeolites can produce ionic changes favorable to the cow's organism (Katsoulos et al., 2005), the aim of the present paper is to test the influence of the addition of volcanic tuff introduced into the ration of cows during the calving period, as well as of lactating cows blood content in macroelements and blood parameters by carrying out blood hematological and biochemical examinations.

MATERIALS AND METHODS

The biological material used was represented by 40 Holstein Fries cows that were divided into two homogeneous batches in terms of weight and physiological status. The analysis period began 2 weeks before calving and continued until the end of the first month of lactation.

During the experimental period all the cows were given the same mixture of compound feed, specific to the physiological condition, and the administration was done *ad libitum*. The difference between the batches was represented by the proportion of volcanic tuff added to the cows' diet, respectively the ratio of the control batch was not supplemented with the tuff, and the experimental batch received in the food 350 g tuff/head/day (Table 1). This amount of volcanic tuff has previously been tested in other experiments that have taken place during the research, proving to be the optimal amount of zeolite for the lactating cows which were analyzed (Drăgotoiu et al., 2017).

Table 1. Experimental scheme

Batch	n	Treatment	Objectives
Control batch (C)	15	Total Mixed Ratio (TMR)	evaluating the effects of the administration of rations with the addition of natural zeolites over the blood parameters by conducting hematological and biochemical examinations
Experimental batch (E2)	15	TMR + 350 g tuff/head/day	

To assess the bioavailability of the mineral elements in the volcanic tuff structure, the blood calcium, magnesium phosphate levels in cows before 2 weeks of calving, 2 weeks post-calving, and lactating cows were measured.

The determination of the blood calcium and magnesium was done through the complexometric method, and phosphorus through the spectrophotometric method.

The hematological examination aimed to determine the number of leucocytes, erythrocytes and hemoglobin, using an automatic analyzer, where the operation was based on the principle of fluorescence flow cytometry, using semiconductor laser and hydrodynamic focusing.

RESULTS AND DISCUSSIONS

The blood levels of macroelements (calcium, phosphorus and magnesium) and the hematological parameters for the calving cows as well as the lactating cows are shown in Tables 2, 3, 4 and 5.

Table 2. The blood content of macroelements for pre-calving and post-calving cows

Period	Calcium (mg/dl)		Phosphorus (mg/dl)		Magnesium (mg/dl)	
	Control batch	Experimental batch	Control batch	Experimental batch	Control batch	Experimental batch
2 weeks before calving	7.29± 0.03	7.37± 0.03	4.88± 0.01	4.97± 0.02	2.02± 0.004	2.04± 0.006
1 week before calving	7.12± 0.05	7.22± 0.02	4.47± 0.02	4.47± 0.03	1.92± 0.003	1.94± 0.004
calving	7.14± 0.05	7.33± 0.03	3.98± 0.02	4.04± 0.04	1.78± 0.005	1.92± 0.005
1 week after calving	7.69± 0.07	8.08± 0.05	4.38± 0.01	4.78± 0.03	1.91± 0.006	1.99± 0.005
2 weeks after calving	8.05± 0.06	8.26± 0.05	4.67± 0.02	4.98± 0.02	2.06± 0.004	2.14± 0.006

Table 3. The blood content of macroelements for lactating cows

Month	Calcium (mg/dl)		Phosphorus (mg/dl)		Magnesium (mg/dl)	
	Control batch	Experimental batch	Control batch	Experimental batch	Control batch	Experimental batch
March	8.12± 0.02	8.08± 0.03	5.12± 0.02	4.88± 0.05	2.14± 0.006	2.05± 0.008
April	8.34± 0.04	8.29± 0.01	4.37± 0.01	4.47± 0.07	2.47± 0.008	2.51± 0.009
May	7.25± 0.07	7.43± 0.04	4.21± 0.03	3.88± 0.06	2.22± 0.009	2.18± 0.006
June	8.27± 0.09	8.58± 0.08	4.68± 0.04	4. 81± 0.07	1.78± 0.006	1.82± 0.008
July	9.05± 0.07	9.85± 0.07	5.53± 0.02	6.14± 0.09	1.92± 0.004	1.98± 0.009
August	8.52± 0.09	9.34± 0.05	6.01± 0.03	6.32± 0.05	2.11± 0.005	2.03± 0.006
September	8.12± 0.10	9.04± 0.05	5.27± 0.02	5.76± 0.08	2.57± 0.008	2.42± 0.008
October	8.01± 0.04	9.12± 0.07	4.88± 0.01	5.84± 0.02	2.45± 0.007	2.61± 0.007

Table 4. Hematological parameters for cows during the calving period

Period	Leukocytes (x 10^3/mm^3)		Erythrocytes (x 10^6/mm^3)		Hemoglobin (g/dl)	
	Control batch	Experimental batch	Control batch	Experimental batch	Control batch	Experimental batch
2 weeks before calving	10.32±0.04	10.28±0.03	5.72±0.02	5.79±0.03	10.12±0.04	10.05±0.05
1 week before calving	10.26±0.03	10.02±0.05	5.67±0.04	5.98±0.02	10.03±0.03	10.07±0.04
calving	9.63±0.06	9.87±0.05	5.10±0.03	5.21±0.03	9.17±0.06	9.15±0.05
1 week after calving	9.89±0.04	10.14±0.02	5.35±0.02	5.50±0.05	9.54±0.03	9.70±0.03
2 weeks after calving	10.04±0.03	10.20±0.04	5.60±0.01	5.81±0.03	9.98±0.05	10.07±0.04

Table 5. Hematological parameters for cows during the lactation period

Month	Leukocytes (x 10^3/mm^3)		Erythrocytes (x 10^6/mm^3)		Hemoglobin (g/dl)	
	Control batch	Experimental batch	Control batch	Experimental batch	Control batch	Experimental batch
March	10.27±0.03	10.17±0.05	5.68±0.04	5.79±0.04	10.09±0.05	10.21±0.04
April	10.44±0.04	10.31±0.04	5.82±0.03	5.98±0.03	10.17±0.06	10.01±0.06
May	10.75±0.04	10.65±0.07	5.91±0.02	5.98±0.07	9.97±0.08	10.15±0.05
June	11.77±0.07	11.01±0.05	5.48±0.02	5.51±0.07	9.82±0.04	9.87±0.03
July	11.82±0.06	11.77±0.05	5.23±0.05	5.18±0.05	9.76±0.04	9.68±0.06
August	11.62±0.05	11.89±0.08	5.01±0.04	5.09±0.02	9.55±0.07	9.45±0.04
September	11.11±0.06	11.15±0.04	5.87±0.06	5.62±0.05	9.95±0.03	9.78±0.03
October	10.31±0.06	10.41±0.05	6.08±0.01	5.99±0.04	10.11±0.07	10.07±0.08

In order to assess the bioavailability of the mineral elements in the volcanic tuff structure, the blood calcium levels were measured, with a decrease in the blood collected from the cows one week before calving and those on the day of calving, after which the level gradually increased, approaching to the one from the end of March (8.12 mg/dl, Table 3).

A similar tendency is observed for phosphorus, respectively for the cows in the first 2 weeks of lactation, where it is observed a recovery of the blood phosphorus level.

For the experimental batch, in the food of which the volcanic tuff was used, it is observed a lower variation of the calcium and phosphorus values before and after the calving, the differences being not statistically assured, respectively, the tuff is a source of macroelements. On the contrary, the control batch shows significant differences between the two periods, especially in the first week after calving.

In the case of magnesium no differences were observed in the pre and post-calving periods.

In the first 3 months of lactation, the values were close, and from the 4th month of administration was increased the value of this index for the experimental batch, the differences being significant from August, respectively after 6 months of natural zeolite administration.

In terms of phosphorus, the values followed the same behavior as of calcium, respectively they increased for the cows belonging to the experimental batch due to the synergism between the two macroelements, the administration of the volcanic tuff favoring the absorption of this mineral element.

The analyzes which were done in order to determine the magnesium in the cow's blood showed that the values were at normal physiological values for both batches, suggesting that taurines eliminated the excess magnesium brought through the volcanic tuff.

Thilsing-Hansen et al. (2002; 2003) appreciated that zeolite-calcium ratios below 5 did not effectively prevent parturient hypocalcaemia, whereas ratios of 10 to 20 proved very efficient in preventing hypocalcaemia. Feeding zeolite in the dry period significantly decreased plasma phosphate before as well as after calving. The phosphate level was normalized within one week after calving. Plasma magnesium was significantly lower among the experimental cows on the day of calving, but stayed within the normal range of plasma magnesium.

Thilsing-Hansen and Jorgensen (2001) demonstrated that serum calcium analysis revealed a greater calcium concentration in zeolite-treated cows.

The hematological examination (Tables 4 and 5) aimed to determine the number of leucocytes and erythrocytes, hemoglobin (Hb) from the blood collected from pre, post-calving and lactating cows.

In the case of blood taken from the cows from the control batch during the pre-calving period, there was a significant decrease ($P<0.05$) in the values of leucocytes, erythrocytes and hemoglobin, after which the values gradually returned to normal within the next 2 weeks.

In contrast, for the experimental batch the differences in values of the three hematological parameters during the pre and the first 2 weeks, the post-calving phase shows slight decreases but which are statistically insignificant (Table 4).

In the lactation period (Table 5), the number of leukocytes ranged between the normal physiological limits, and was not influenced by the administration of the zeolite to the ration of dairy cows, with an increase in values in the summer months due to the increased cortisol secretion and the increased viscosity of blood.

The number of erythrocytes respected the physiological specificity of the species, with no significant differences between the two batches. In the summer months, there was noticed a decrease in the number of erythrocytes in both batches due to the increased water consumption and the reduced oxygen intake that causes the body to maintain its thermal balance at high temperatures.

The hemoglobin level did not show any variation between the two batches, being observed a decrease while increasing the temperature and with a decrease in the number of erythrocytes.

Quiroz-Rocha et al. (2009) has noted the fact that the hematological analyses were not significantly different between the pre-calving and post-calving batches, compared to the biochemical analytes (calcium, and phosphorus), at which the differences were statistically assured.

The obtained results by Găvan et al. (2010) revealed that the values of red cell count, hemoglobin concentration and hematocrit decreased after parturition and them increased again in early to mid-lactation.

CONCLUSIONS

The use of the volcanic tuff in the cows' feed during the pre-calving period and the first 2 weeks after calving determined a lower variation of the calcium and phosphorus values in blood.

In the case of magnesium from the blood samples taken from cows there were no differences noted in the pre- and post-calving periods.

For the experimental batch, the differences in values of the three hematological parameters, erythrocytes, leucocytes and hemoglobin, during the pre-calving and the first 2 weeks post-calving, show slight diminishes but which are not statistically provided.

The number of white blood cells, erythrocytes, and hemoglobin ranged from normal physiological limits in the lactation period, and was not influenced by the administration of zeolite in the ration of dairy cows.

As a consequence, it is necessary to balance the nutrition of dairy cows, being useful to take into account the level at which the mineral elements are not toxic to the organism, the requirements of this category of bulls, as well as the mineral content of the feed structure of the rations.

ACKNOWLEDGEMENTS

This research work was financed from Project PN III Bridge nr.11/2016 „Innovative technologies of using natural zeolites in dairy cows feed with positive impact upon environment and production efficiency”.

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