

THE EFFECT OF VITAMIN H IN ASEPTIC LAMINITIS PREVENTION AND ITS IMPACT ON BLOOD INDICATORS IN DAIRY COWS

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Abstract

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The Lameness Syndrome caused by aseptic laminitis is very common in dairy farm cows. In the period between July 2014 and July 2015, a study on laminitis occurrence was conducted in a dairy cow farm in Southwest Kosovo. For this purpose cows were separated in two groups, each group consisting of 30 Holstein cows in the period of early lactation in order to determine the impact of vitamin H on values of hematological and hemato-biochemical indicators and laminitis prevention. In the trial period, animals were treated with equal food rations with excessive rapidly fermentable foods. Animals in the experiment group were additionally fed with vitamin H supplement. Blood samples were analyzed every two weeks in a laboratory during the entire trial period. Blood samples from the cows in the study were collected to assess total protein content, creatinine, bilirubin, magnesium, phosphorus, calcium, leukocytes, and erythrocytes. The results were statistically processed. In the first group, 3 cows (10%) showed signs of Laminitis Syndrome and changes in the values of some of the indicators. Cows with laminitis showed decreased levels of Ca (7.30 ± 0.08 versus 8.78 ± 0.11 mg%), protein (6.61 ± 0.05 versus 7.24 ± 0.05 g%) and inorganic phosphorus (5.46 ± 0.05 versus 6.11 ± 0.11 mg%). Increased values were observed in the number of leukocytes (9.55 ± 0.09 versus $7.23 \pm 0.04 \times 10^3$), creatinine (2.11 ± 0.03 versus 1.3 ± 0.01 mg%) and bilirubin (0.63 ± 0.01 versus 0.42 ± 0.03 mg%), whereas no change was observed in the values of erythrocyte and magnesium indicators.

Key words: food ration; lameness; vitamin H; supplement; biochemical indicators

Introduction

Laminitis in cows, clinically manifested as Lameness Syndrome is the most frequent pathology in cows in the period up to 4 months after calving. The term Laminitis represents an aseptic inflammation of lamellar corium of the hoof wall that can spread to the sole surface (Clarkson et al., 1996). Laminitis is a diffuse aseptic inflammation of the laminar corium of the hoof wall and in bovine includes additionally the sole corium (Bargai et al., 1992; Greenough et al., 1990; Lischer et al., 2002; Midla et al., 1998). The causal factors of this process are numerous and are associated with housing conditions and especially with disorders in the diet of animals. Claw disorders cause over 90% of lame-

ness in dairy cattle (Bergsten, 2003; Murray et al., 1996). A significant impact is caused by Subacute Ruminant Acidosis (SARA), according to (Garry, 2002; Oetzel, 2000). The disease is often considered to be a herd problem associated with environmental, management and nutritional risk factors (Greenough, 1985; David, 1989). This condition is associated with weight loss, reduction in milk production, disorders in reproduction indicators and increase in the incidence of Laminitis (Ceroni, 2005; Ceroni, 2011). The increased presence of Laminitis Syndrome in cows in our farms raised the necessity for a study into experimentally determine the impact of vitamin H supplementation in the diet of dairy cows on laminitis prevention by assessment of the values of some of the hematological and hemato-biochemical indicators.

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Materials and Methods

The study was conducted during July 2014-July 2015 with two groups, each consisting of 30 dairy cows belonging to the same farm, where animals were fed with same diets through the year. Randomly selected cows from both groups and belonged to Holstein breed and had an average milk production of 6000-7000 liters in the period of early lactation. In the trial period, animals were fed with equal rations with excessive rapidly fermentable foods. The structure of diet was processed with table data according to (McDonald, 1995). The experiment group of cows received a supplementation of multivitamin product named Nutrisel, consisting of 24 mg vitamin H. The nutrisel supplement was applied at doses of 5 gr/day per cow during the period of experiment. Blood samples from both groups were collected to evaluate some of the hematological and hemato-biochemical indicators. Blood samples from the jugular vein were collected every 2 weeks in two test tubes, with EDTA and without anticoagulants. Numbers of white blood cells and red blood cells were counted by standard laboratory methods. Using vacutainer tubes, serum was obtained from a centrifuge with 2500 spins per minute, for a total of 20 minutes. Measured hemato-biochemical indicators included total protein, calcium, inorganic phosphorus, magnesium, total bilirubin and creatinine. Cows in the experiment were monitored for possible clinical presence or absence of lameness syndrome from laminitis. The obtained data from cows of control cows, cows from experiment group and cows with laminitis were statistically processed by variance analysis to assess effects on the group and significant statistical differences between animals from the groups to determine the impact of vitamin H supplementation on hematological and hemato-biochemical indicators.

Results

The data obtained throughout the year were divided in groups and statistically processed by group; control group, experiment group and group of cows with occurrence of laminitis. Finally the mean values were calculated for each indicator, standard deviation and the reliability of change of indicator values by individuals in groups. Hematological indicator values and differences among groups are shown in Table 1. Indicators are

expressed as values in their conventional measurement units with the standard deviation (σ) and reliability of change (tD) by groups. Indicators were compared with reference values according to (Radostits, et al., 2005). During the experiment, the Lameness Syndrome was observed in 3 cows (10%) in the control group; where no vitamin H supplement in to feeding was added. Mean values for hematological indicators and significant differences in the group of cows with laminitis are shown in Table 2. The obtained values showed alterations in red blood cells (RBC) numbers with significant differences (not statistically confirmed) among animals in experiment group and laminitis group as compared with normal indicators and value indicators in control group. The number of leukocytes increased in the experiment group (8.15 ± 0.11 versus $7.23 \pm 0.04 \times 10^3/\text{ml}$). Increased values of leukocytes were also observed in laminitis cows group ($9.55 \pm 0.09 \times 10^3/\text{ml}$). The differences in indicator values among groups of animals in the experiment were statistically confirmed ($P < 0.05$). Values for hemato-biochemical indicators of cows by groups including experiment, control and laminitis group are shown in Table 3. Indicator values are also expressed in their conventional measurement units with the standard deviation (σ) and reliability of change (tD) by groups. Indicators by groups are compared to reference values according to (Radostits et al., 2005). Comparative data for mean values of hemato-biochemical indicators in cows in control group, experiment group and cows with laminitis and statistical differences in indicators of cows of the three groups were found statistically significant, when ($P < 0.05$) in Table 4. Our data revealed no significant differences in mean values for magnesium concentrations. Indicators for total protein, total calcium and inorganic phosphorus underwent a slight decrease in animals with laminitis as compared with indicators in animals in experiment group. Total creatinine and bilirubin concentrations increased statistically in the experiment group and laminitis cows group. Thus, in cows with laminitis decreased levels were registered for Ca (7.30 ± 0.08 in cows with laminitis versus $8.78 \pm 0.11 \text{ mg}^0\%$ in control group cows), protein (6.61 ± 0.05 vs. $7.24 \pm 0.05 \text{ g}^0\%$) and phosphorus (5.46 ± 0.05 vs. $6.11 \pm 0.11 \text{ mg}^0\%$). Increased values were found for creatinine indicators (2.11 ± 0.03 in cows with laminitis versus $1.2 \pm 0.01 \text{ mg}^0\%$, in control group cows) and total bilirubin (0.63 ± 0.01 vs. $0.44 \pm 0.03 \text{ mg}^0\%$), whereas no changes were observed for magnesium values.

Table 1

Annual mean values of some hematological indicators in cows according to groups: control, experiment and cows with laminitis

Indicators	Reference values	Control group				Experiment group				Laminitis group			
		M	$\pm m$	σ	tD	M	$\pm m$	σ	tD	M	$\pm m$	σ	tD
WBC($10^3/\mu\text{l}$)	4-12	7.23	0.04	0.24	-23.7	8.15	0.15	0.36	-23.7	9.55	0.09	0.31	-23.7
RBC($\times 10^6/\mu\text{l}$)	5-10	5.95	0.06	0.20	-23.7	7.07	0.06	0.19	-23.7	6.23	0.1	0.31	-23.7

M – the annual average of hematological indicators by groups; $\pm m$ - weighted average (minimum and maximum limit of indicators), σ – standard deviation; tD – reliability of change by groups

Table 2
Hematological indicators and significant differences in cows according to groups: control, experiment and cows with laminitis

Indicators	Normal values	Control group	Experiment group	Laminitis group
WBC (x 10 ³ /μl)	4 - 12	7.23 ± 0.04*	8.15 ± 0.15 ^o	9.55 ± 0.09 ^{ao}
RBC (x 10 ⁶ /μl)	5 - 10	5.95 ± 0.06	7.07 ± 0.06	6.23 ± 0.10

*Significant differences vs. control group (P < 0.05); ^o experiment group (P < 0.05); ^a laminitis group (P < 0.05). Reference values according to (Radostits et al., 2005)

Table 3
Mean values of the hemato-biochemical indicators in cows by groups; control, experiment and cows with laminitis

Indicator	Reference value	Mean values by cow groups											
		Control group				Experiment group				Laminitis group			
		M	± m	σ	tD	M	± m	σ	tD	M	± m	σ	tD
TP (g/%)	9.7 – 12.4	7.24	0.05	0.15	- 7.78	7.07	0.08	0.26	1.31	6.61	0.05	0.16	- 4.6
Ca (mg/%)	6.7 – 8.1	8.78	0.11	0.42	- 3.59	9.33	0.07	0.24	- 3.59	7.30	0.08	0.28	- 16.9
P (mg/%)	5.6 – 6.5	6.11	0.11	0.35	- 6.6	6.79	0.11	0.39	- 3.9	5.46	0.05	0.17	- 9.3
Mg (mg/%)	1.8 – 2.3	1.81	0.01	0.05	- 38.8	1.81	0.02	0.08	- 3.4	1.80	0.02	0.06	- 3.3
Creat (mg/%)	1.0 – 2.0	1.2	0.01	0.05	- 42.9	1.6	0.02	0.07	- 15.5	2.11	0.03	0.11	8.06
TB (mg/%)	0.01 – 0.5	0.42	0.03	0.10	- 32.1	0.39	0.01	0.06	1.82	0.63	0.01	0.03	- 5.3

M – The annual average of hematological indicators by groups; ± m- Weighted average (Minimum and maximum limit of indicators), σ – standard deviation; tD – reliability of change by groups

Table 4
Hemato-biochemical indicators and significant differences in cows according to groups: control, experiment and cows with laminitis

Indicator	Reference values	Control group	Experiment group	Laminitis group
TP (g/%)	9.7 – 12.4	7.24 ± 0.05	7.07 ± 0.08	6.61 ± 0.05*
Ca (mg/%)	6.7 – 8.1	8.78 ± 0.11	9.33 ± 0.07	7.30 ± 0.08*
P (mg/%)	5.6 – 6.5	6.11 ± 0.11	6.79 ± 0.11*	5.46 ± 0.05*
Mg (mg/%)	1.8 – 2.3	1.81 ± 0.01	1.81 ± 0.02*	1.80 ± 0.02
Creat (mg/%)	1.0 – 2.0	1.2 ± 0.01	1.6 ± 0.02	2.11 ± 0.03
TB (mg/%)	0.01 - 0.5	0.42 ± 0.03	0.39 ± 1.01	0.63 ± 0.01

*Significant differences vs. control group (P < 0.05). Reference values according to (Radostits, et al., 2005)

Discussion

Animals in the control and experiment groups were homogenous in terms of mean values for days in lactation during the period of blood samples testing. The third group was composed of animals in which we observed clinical signs of aseptic laminitis. The obtained data revealed changes in annual and monthly mean values for some of the hematological and hemato-biochemical indicators in cows of different groups. According to (Oetzel, 2000; Ceroni, 2005), changes in the values of hematological and hemato-biochemical indicators are related to alternating pH values in the rumen contents. In this study changes in the values of some of hematological indicators were presented and impacted by vitamin H supplementation in cows with laminitis syndrome. According to the data from our study, white blood cells were significantly

higher in animals with signs of laminitis. The increase in the numbers of white cells was mainly based on the increase of neutrophiles. Increase in white blood cell counts was also registered in experiment group cows treated with vitamin H. The change in the values of white cells in experiment group cows was statistically confirmed (P < 0.05). The indicator for the number of erythrocytes showed that obtained values registered no significant changes. These conclusions are supported by other authors (Ceroni et al., 2012; Meglia et al., 2001; Morgante et al., 2007). In this study in the experiment group of cows a presence of increased levels of total protein, total calcium and inorganic phosphorus were registered and decreased levels of creatinine and total bilirubin as compared to the same indicators of the control group of cows. The changes in the values of total protein were not statistically significant (P > 0.5), whereas changes in the values of total calcium among the

groups were statistically significant ($P < 0.005$). The opposite was observed in cows with laminitis. Changes in the values of hemato-biochemical indicators might have been in association with supplementation of vitamin H which influences the preserving of the balance of bacterial populations in rumen. Concentration of macro-minerals such as total calcium, inorganic phosphorus in blood serum and concentrations of total protein, creatinine and total bilirubin were interesting findings which suggest that macro-mineral concentrations might be more predicative and revealing than was held before. Based on the acquired data from this study, it can be admitted that concentrations of hemato-biochemical indicators were sensitively affected in cows with laminitis. These conclusions are supported by findings of other authors as well (Ceroni, 2011; Garry et al., 2002; Oetzel et al., 2000).

Conclusions

Changes in some hematological and hemato-biochemical indicators were present in cows in the early period after calving. Supplementation with vitamin H in dairy cow has an impact in improving hematological and hemato-biochemical indicators. Indicators most likely to be impacted are the total of white blood cells, total protein, total calcium and inorganic phosphorus. No case of laminitis was observed in the group of cows treated with supplemental vitamin H. In control group cows we observed 3 (10%) cows with laminitis. In cows with laminitis evident differences in hematological and hemato-biochemical indicators were registered as compared to indicators in animals in the experiment group. Indicators with most evident changes were the total number of white blood cells, total protein, total calcium, inorganic phosphorus, creatinine and total bilirubin. Supplementation with vitamin H in the diet of dairy cows is likely to support the prevention of the occurrence of aseptic laminitis syndrome.

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