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Effects of boron, propylene glycol and methionine administration on some hematological parameters in dairy cattle during periparturient period

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ABSTRACT

The aim of this study was to evaluate the potential hematological effects of boron, propylene glycol and methionine in dairy cattle during the peripartum period. For this purpose, 24 healthy Holstein cows in the periparturient period were used. The cows were divided into 4 groups according to oral treatment with sodium borate (30 g/day; group B), propylene glycol (500 g/day; group PG) or methionine (10.5 g/day, group M), whereas cows from the last group were not treated (control group C) were. During the periparturient period there were no differences in the number of white blood cells, lymphocytes, monocytes, neutrophil granulocytes, red blood cells, platelet and mean platelet volume between the groups. A statistically significant difference was established between the groups in the levels of mean cell volume and hematocrit on calving, hemoglobin at 2 weeks postpartum, mean cell hemoglobin concentration at 1 week prepartum and 2 weeks postpartum . This study suggests that boron, propylene glycol and methionine administration had transient effects on some of hematological parameters of ruminants in the periparturient period.

Key words: transition period, dairy cattle, boron, propylene glycol, methionine, hematology

Introduction

Some researchers have reported that the use of propylene glycol, methionine and sodium borate in the periparturient period may be beneficial for a smooth recovery from the periparturient period (OVERTON and WALDRON, 2004; KABU et al., 2008; KABU and CIVELEK, 2012; KABU and AKOSMAN, 2013).

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There have been numerous pieces of research on the effects of propylene glycol (PG) on the metabolism; nonetheless, the amount used, the type of compound, execution time and drenching methods of PG vary (TOGHDORY et al., 2009). Even though former studies reported that it increased milk production in the lactation phase, the use of such additional nutrients to increase energy due to an increase in food consumption of the cattle in the mid and late phase of lactation is controversial (TOGHDORY et al., 2009). Propylene glycol (PG) has been known to be used for protection from ketosis or as a glycogenic precursor for the treatment of ketosis for many years (BOBE et al., 2004; GRUMMER, 2008; NIELSEN and INGVARTSEN, 2004). It has been reported that the application of PG causes some changes in the metabolic parameters of cattle in the periparturient period (MIYOSHI et al., 2001; SHINGFIELD et al., 2002; HOEDEMAKER et al., 2004; JUCHEM et al., 2004; RUKKWAMSUK et al., 2005; CASTAÑEDA-GUTIÉRREZ et al., 2009) however, there are some studies that claim it has no effect (MOALLEM et al., 2007; CHIBISA et al., 2008; CASTAÑEDA-GUTIÉRREZ et al., 2009). Some studies claimed that PG administration in cattle induced optimization of metabolic parameters in the prepartum period, while there was no effect in the postpartum period (GRUMMER et al., 1994; FORMIGONI et al., 1996; LARANJA et al., 1998; JUCHEM et al., 2004).

Some researchers have announced that methionine deficiency may limit liver lipoprotein secretion (DURAND et al., 1992; BERTICS and GRUMMER, 1999; PIEPENBRINK et al., 2004). When the amount of methionine provided is inadequate, the circulation of triglycerides to very low density lipoprotein (VLDL) is depressed and triglycerides cumulate in the hepatic cells. Also, methionine contributes to the synthesis of phospholipids (GRUMMER, 1995). Although there are some studies that report that the use of methionine in dairy cattle in the periparturient period is effective for protection from steatosis hepatis and ketosis (DURAND et al., 1992; BOBE et al., 2004), there are other studies that state such an application has no effect on steatosis hepatis (BERTICS and GRUMMER, 1999).

Recent studies on the biological significance of boron in various metabolic, nutritional, hormonal and physiological processes have indicated that it is essential to plants (BLEVINS and LUKASZEWSKI, 1998), humans and animals (NIELSEN, 1997; HUNT, 1998; HUNT, 2012; KABU and CIVELEK, 2012). It is accepted that boron has a function in mineral metabolism, lipid metabolism, immune response, endocrine system and hematology parameters (NIELSEN, 1997; BASOĞLU et al., 2002; BAŞOĞLU et al., 2010; HUNT, 2012; KABU and CIVELEK, 2012; KABU and AKOSMAN, 2013).

However, the effects of propylene glycole and methionine on hematological parameters have not been sufficiently studied yet. Also, the detailed mechanism of how boron functions in animals has not yet been fully discovered.

The aim of the present study was to determine the comparative effects of propylene glycol, methionine and sodium borate on the same hematological parameters in dairy cattle with similar age, nutrition and productivity characteristics.

Materials and methods

Animals and experimental design. In this study, 24 Holstein dairy cows were used. These cows were healthy, pregnant and 3-5 years of age. Four equal groups of 6 cows were formed according to treatment with cattle similar to each other in terms of milk productivity (29.5 ± 3.7 L/day) and body mass (702.0 ± 49.5 kg), during the periparturient period (2 weeks prepartum and 2 weeks postpartum). Cows in group M were orally treated with 15 g/day Smartamine M (Adisseo, corresponding to 10.5g of Methionine), those in group PG with 500 g/day propylene glycol (Polyenergy, Sinergy Agriculture) and those in group B with 30 g/day sodium borate ($Na_2B_40_75H_2O$, Eti Mine Works Kırka), whereas cows in the last group (group C) served as negative controls.

Blood sampling and hematology analyses. Before and after treatments, blood samples were drawn weekly from the jugular vein into EDTA tubes. Measurements were made of White blood cells (WBC), Lymphocytes, Monocytes, neutrophil granulocytes (NGR), Red blood cells (RBC), Mean cell volume (MCV), Hemoglobin (HB), Hematocrit (HCT), Platelet (PLT), Mean platelet volume (MPV) and Mean cell hemoglobin concentration (MCHC) using commercial kits (MS 9/5 Veterinary Hematology Analyzer Modern Laboratory Services, Inc).

Statistical analysis. After application, ANOVA using SPSS software for Windows was performed (version 16.0) in an electronic environment, and the statistical difference was determined with an inside group Tukey test. The significance of the difference between the groups was determined using Mann Whitney U tests. Differences were considered significant when p values were less than 0.05.

Results

While there were no significant changes in total White blood cells (WBC) and Monocytes count in the control (C) groups (Table 1), there was an statistically significant increase ($P<0.05$) in groups B (WBC: 10.60×10^9/L, Monocytes: 3.36×10^9/L), M (WBC: 12.47×10^9/L, Monocytes: 3.20×10^9/L) and PG WBC: 10.19×10^9/L, Monocytes: 2.95×10^9/L) in calving,. without differences between the groups. Further, there were no statistically significant changes in blood lymphocytes ($\times10^9$/L) (Table 1), red blood cells (RBC) ($\times10^{12}$/L) (Table 2) count and mean platelet volume (MPV) (fL) (Table 3) between the groups. While there were no statistically significant differences in Neutrophil granulocyte (NGR) count between the groups (Table 1), there was a statistically significant increase ($P<0.05$) in group B 1 week (NGR:1.13×10^9/L) prepartum and group PG in

Table 1. Hematology parameters in dairy cows during the periparturient period (Group M; group PG; group B: sodium borate and group C: controls). Results are expressed as means ± standard deviations.

Parameter	Group	- 2 weeks	- 1 week	Calving	+ 1 week	+ 2 weeks	P
WBC (×10^9/L)	C	8.39 ± 1.21	7.78 ± 0.86	11.26 ± 2.72	6.66 ± 0.85	7.34 ± 1.70	*0.341*
	B	8.94 ± 1.17^{ab}	8.56 ± 0.88^{abc}	10.60 ± 1.29^{c}	5.45 ± 0.67^{c}	6.52 ± 0.98^{cb}	***0.012***
	M	9.05 ± 0.94^{b}	8.76 ± 0.88^{b}	12.47 ± 1.11^{a}	8.34 ± 1.30^{b}	7.79 ± 0.25^{b}	***0.018***
	PG	6.65 ± 0.61^{b}	6.89 ± 0.61^{b}	10.19 ± 2.84^{a}	5.26 ± 1.63^{b}	6.79 ± 0.98^{b}	***0.046***
	P	0.346	0.379	0.798	0.260	0.851	
Lymphocytes (×10^9/L)	C	5.23 ± 0.90	5.25 ± 0.71	8.25 ± 1.95	5.43 ± 0.72	5.21 ± 1.07	*0.301*
	B	4.58 ± 0.64	5.10 ± 0.51	6.66 ± 0.67	4.40 ± 0.53	4.95 ± 0.79	*0.131*
	M	6.41 ± 0.82	6.13 ± 0.79	8.45 ± 1.08	7.48 ± 1.17	5.78 ± 0.52	*0.247*
	PG	4.80 ± 0.64	4.46 ± 0.38	6.63 ± 0.75	4.93 ± 1.12	5.38 ± 0.64	*0.310*
	P	0.354	0.331	0.596	0.132	0.897	
Monocytes (×10^9/L)	C	1.90 ± 0.12	2.15 ± 0.23	2.38 ± 0.74	0.96 ± 0.21	1.71 ± 0.64	*0.281*
	B	1.65 ± 0.23^{bc}	2.35 ± 0.18^{ab}	3.36 ± 0.74^{a}	0.91 ± 0.28^{c}	1.36 ± 0.37^{bc}	***0.003***
	M	2.10 ± 0.19^{b}	2.20 ± 0.16^{b}	3.20 ± 0.37^{a}	0.68 ± 0.11^{c}	1.71 ± 0.27^{b}	***0.000***
	PG	1.58 ± 0.33^{bc}	2.03 ± 0.35^{ab}	2.95 ± 0.49^{a}	0.81 ± 0.34^{c}	1.21 ± 0.35^{bc}	***0.003***
	P	*0.182*	*0.836*	*0.691*	*0.867*	*0.799*	
NGR (×10^9/L)	C	0.33 ± 0.55	0.38 ± 0.06	0.66 ± 0.19	0.25 ± 0.05	0.45 ± 0.12	*0.139*
	B	0.73 ± 0.53^{a}	1.13 ± 0.69^{b}	0.56 ± 0.16^{b}	0.13 ± 0.04^{b}	0.20 ± 0.03^{b}	***0.001***
	M	0.51 ± 0.10	0.43 ± 0.42	0.81 ± 0.26	0.21 ± 0.04	0.38 ± 0.07	*0.056*
	PG	0.28 ± 0.04^{b}	0.38 ± 0.11^{ab}	0.60 ± 0.13^{a}	0.16 ± 0.09^{b}	0.20 ± 0.08^{b}	***0.029***
	P	*0.481*	*0.382*	*0.809*	*0.554*	*0.128*	

WBC: white blood cell; NGR: neutrophil granulocytes. Different superscripts a,b in the same row indicate significant differences (P<0.05 or more) according to time during the periparturient period for a given group. Different supercripts A,B in the same column indicate significant difference (P<0.05 or more) according to treatments for a given time.

Table 2. Hematology parameters in dairy cows during the periparturient period (Group M; group PG; group B: sodium borate and group C: controls). Results are expressed as means ± standard deviations.

Parameter	Group	- 2 weeks	- 1 week	Calving	+ 1 week	+ 2 weeks	P
RBC ($\times 10^{12}$/L)	C	6.14 ± 0.35	6.33 ± 0.30	6.51 ± 0.25	5.52 ± 0.48	5.71 ± 0.39	0.305
	B	6.06 ± 0.28	5.84 ± 0.27	6.47 ± 0.40	5.34 ± 0.36	5.22 ± 0.32	0.077
	M	6.06 ± 0.29	5.93 ± 0.28	6.39 ± 0.33	5.44 ± 0.37	5.25 ± 0.36	0.136
	PG	5.67 ± 0.21	5.68 ± 0.19	5.57 ± 0.43	5.01 ± 0.36	4.61 ± 0.43	0.139
	P	0.670	0.386	0.248	0.822	0.270	
MCV (fL)	C	57.46 ± 2.34	58.76 ± 2.23	61.20 ± 1.99^{B}	55.90 ± 2.43	57.03 ± 1.40	0.468
	B	56.96 ± .1.94	62.88 ± 1.95	60.05 ± 1.78^{B}	62.75 ± 1.46	61.36 ± 2.39	0.209
	M	64.38 ± 1.64	63.58 ± 1.52	65.71 ± 1.15^{A}	60.90 ± 3.54	60.10 ± 2.37	0.361
	PG	59.96 ± 2.47	57.50 ± 1.06	59.23 ± 0.59^{B}	60.15 ± 0.94	59.03 ± 1.22	0.699
	P	0.085	0.058	0.027	0.231	0.455	
HCT (%)	C	35.20 ± 1.28^{abc}	36.91 ± 0.75^{ab}	39.71 ± 1.18^{aA}	30.78 ± 2.71^{c}	32.61 ± 2.49^{bc}	**0.019**
	B	34.31 ± 0.87^{ab}	36.65 ± 1.70^{ab}	38.60 ± 1.56^{aA}	33.43 ± 1.99^{b}	31.88 ± 1.59^{b}	**0.047**
	M	36.90 ± 1.42^{a}	37.63 ± 1.64^{a}	41.86 ± 1.87^{aA}	32.50 ± 0.99^{b}	31.23 ± 1.60^{b}	**0.000**
	PG	32.83 ± 0.83	32.61 ± 0.94	32.96 ± 2.52^{B}	30.10 ± 2.04	29.01 ± 2.12	0.086
	P	0.108	0.060	0.019	0.641	0.422	
HB (g/L)	C	120.28 ± 0.29^{AB}	120.11 ± 0.28	130.78 ± 1.51	100.73 ± 0.78	120.06 ± 0.76^{A}	0.214
	B	120.55 ± 0.40^{aAB}	120.56 ± 0.56^{a}	120.78 ± 0.60^{a}	100.66 ± 0.53^{b}	100.26 ± 0.44^{bAB}	**0.003**
	M	130.30 ± 0.39^{aA}	120.85 ± 0.55^{a}	130.76 ± 0.49^{a}	100.38 ± 0.48^{b}	110.10 ± 0.61^{bAB}	**0.000**
	PG	120.25 ± 0.32^{aB}	120.06 ± 0.97^{a}	110.10 ± 0.80^{a}	100.20 ± 0.65^{ab}	90.21 ± 0.68^{bB}	**0.021**
	P	0.105	0.595	0.182	0.923	**0.031**	

RBC: red blood cell; MCV: mean corpuscular volume; HCT: hematocrit; HB: Hemoglobin. Different superscripts a,b in the same row indicate significant differences (P<0.05 or more) according to time during the periparturient period for a given group. Different supercripts A,B in the same column indicate significant difference (P<0.05 or more) according to treatments for a given time.

Table 3. Hematology parameters in dairy cows during the periparturient period (Group M; group PG; group B: sodium borate and group C: controls). Results are expressed as means ± standard deviations.

Parameter	Group	- 2 weeks	- 1 week	Calving	+ 1 week	+ 2 weeks	P
PLT ($\times 10^9$/L)	C	144.83 ± 12.37	148.50 ± 10.56	167.16 ± 28.27	352.50 ± 97.15	228.50 ± 48.42	0.375
	B	128.16 ± 14.85^{bc}	115.66 ± 6.42^{c}	176.50 ± 17.51^{ab}	172.00 ± 16.24^{ab}	201.66 ± 25.46^{a}	**0.009**
	M	143.33 ± 10.85	140.00 ± 11.42	164.00 ± 19.59	185.83 ± 46.61	144.83 ± 17.64	0.667
	PG	151.00 ± 27.56	111.33 ± 13.19	138.83 ± 10.28	188.33 ± 16.98	123.16 ± 18.55	0.058
	P	0.825	0.061	0.593	0.967	0.079	
MPV (fL)	C	5.45 ± 0.06	5.53 ± 0.16	5.35 ± 0.84	5.86 ± 0.33	5.46 ± 0.14	0.360
	B	5.71 ± 0.24	5.53 ± 0.13	5.61 ± 0.13	5.33 ± 0.10	5.25 ± 0.99	0.197
	M	5.28 ± 0.14	5.28 ± 0.47	5.41 ± 0.74	5.33 ± 0.19	5.06 ± 0.12	0.302
	PG	5.51 ± 0.32	5.45 ± 0.14	5.45 ± 0.10	5.21 ± 0.10	5.21 ± 0.11	0.270
	P	NS	NS	NS	NS	NS	
MCHC (g/dL)	C	34.96 ± 0.60	32.81 ± 0.61^{B}	34.45 ± 2.99	33.16 ± 1.32	37.28 ± 1.32^{A}	0.340
	B	36.56 ± 0.84^{a}	34.31 ± 0.34^{bB}	33.08 ± 0.38^{bc}	32.05 ± 0.46^{c}	32.38 ± 0.88^{cC}	**0.000**
	M	34.25 ± 0.24^{ab}	34.10 ± 0.52^{abB}	32.93 ± 0.40^{bc}	31.96 ± 0.86^{c}	35.50 ± 0.51^{aAB}	**0.002**
	PG	34.15 ± 1.00^{b}	36.95 ± 0.66^{aA}	33.76 ± 0.99^{b}	33.91 ± 0.34^{b}	34.20 ± 0.80^{bBC}	**0.050**
	p	0.107	**0.000**	0.903	0.322	**0.010**	

PLT: Platelets; MPV: Mean Platelet volume; MCHC: Mean Corpuscular Hemoglobin Concentration. Different superscripts a,b in the same row indicate significant differences (P<0.05 or more) according to time during the periparturient period for a given group. Differents supercripts A,B in the same column indicate significant difference (P<0.05 or more) according to treatments for a given time. NS: Not significant calving (NGR:0.60×10^9/L). In the boron and PG groups, the blood NGR (B:0.13×10^9/L, PG: 0.16×10^9/L) levels decreased (P<0.05) 1 week postpartum.

There were no statistically differences in MCV during the pre and postpartum period (Table 2) between the groups. While the MCV levels were lowest in the PG group (59.23 fL) (P<0.05), they were highest in calving in the M group (65.71 fL). Blood hematocrit (%) levels showed significant (P<0.05) changes in groups C, B and M; but in the PG group there was no difference in the periparturient period (Table 2). We found that blood hematocrit levels were lower during calving (P<0.05) in the PG group (32.96%). While there were significant changes (P<0.05) in blood hemoglobin concentrations (g/L) in groups B, M and PG (Table 2), there were no statistically significant changes (P<0.05) in group C during the periparturient period. The blood hemoglobin levels were lowest (P<0.05) in the PG group 2 weeks postpartum.

Blood Platelet (PLT) levels (×10^9/L) in group B showed statistically significant (P<0.05) changes during the periparturient period, but there were no differences between the groups. Mean cell hemoglobin concentration (MCHC) showed statistically significant changes in groups B, M and PG during the periparturient period. While blood MCHC levels were observed as lowest (P<0.001) in week 1 (32.81 g/dL) prepartum in group C, they were the highest (P<0.05) in week 2 (37.28 g/dL) postpartum in group M.

Discussion

In our study MCHC levels in cattle administered boron orally did not differ between the control (34.45 g/dL) and boron (33.08 g/dL) groups in prepartum and calving. Boron administration decreased MCHC levels during the postpartum period (BASOGLU et al., 2002). In the present study, the MCHC levels were lower in the postpartum period in cows treated with boron. BASOGLU et al. (2002) have suggested that in the prepartum and postpartum period, WBC levels in the controls were higher than ın cows administered boron. In our study, WBC levels did not differ in the control and boron groups during the periparturient period. In a study conducted on rabbits, no differences were found if hematological parameters between the control group and the group administered boron (BASOGLU et al., 2010). In the present study, there were no significant changes detected in hematological parameters.

Propylene glycol, in high concentrations, increases the rate of aemolysis (WEİL et al., 1971). WEİL et al. (1971) reported that mild hematological changes (slightly decreased hemoglobin, hematocrit and total erythrocyte counts, and slightly increased reticulocyte count) were apparent in dogs fed 5 g propylene glycol/kg/day. Another study reported that feeding a diet containing 12% PG to 6 minks for 1 week resulted in a decrease in hematocrit and RBC count (WEİSS et al., 1994). This situation is compatible with the results in the present study oe hemoglobin (2nd week postpartum PG group: 90.21 g/L) and hematocrit (calving PG group: 32%). In another study on cats, although only slight changes occurred in PCV and hematocrits, hemoglobin concentration, and RBC count, punctate reticulocytes significantly increased in the group fed 6-12% PG (BAUER et al., 1992ab).

WEBB et al. (2003) examined the effects of methionine administration on hematological parameters in rats. Thf lymphocyts, monocyts, neutrophil granulocyts (NGR) and Red blood cels (RBC) counts did not differ between control and methionine administered groups and this situation was similar to our study. WEBB et al. (2003) reported that methionine administration increased platelet and WBC levels in rats which is different from the results of our study. In our study WBC, Platelet (PLT) and Mean platelet volume (MPV) levels did not differ in the control and methionine groups during the periparturient period.

Conclusion

Even though there are some studies on the effects of sodium borate (B), propylene glycol (PG) and methionine (M) on metabolic profiles, no study has been found on the effects of B, M and PG on hematological parameters during the periparturient period. Our study found that boron, propylene glycol and methionine administration had transient effects on some of hematological parameters of ruminants in the periparturient period.

References

BASOGLU, A., N. BASPINAR, A. S. OZTURK, P. P. AKALİN (2010): Effects of boron administration on hepatic steatosis, hematological and biochemical profiles in obese rabbits. Trace Elements and Electrolytes 27, 225-231.

BASOGLU, A., M. SEVINC, F. M. BIRDANE, M. BOYDAK (2002): Efficacy of sodium borate in the prevention of fatty liver in dairy cows. J. Vet. Intern. Med. 16, 732-735.

BAUER, M. C., D. J. WEİSS, V. PERMAN (1992a): Hematologic alterations in adult cats fed 6 or 12% propylene glycol. Am. J. Vet. Res. 53, 69-72.

BAUER, M. C., D. J. WEISS, V. PERMAN (1992b): Hematological alterations in kittens induced by 6 and 12% dietary propylene glycol. Vet. Hum. Toxicol. 34, 127-131.

BERTICS, S. J., R. R. GRUMMER (1999): Effects of fat and methionine hydroxy analog on prevention or alleviation of fatty liver induced by feed restriction. J. Dairy Sci. 82, 2731-2736.

BLEVİNS, D. G., K. M. LUKASZEWSKİ (1998): Boron in plant structure and functıon Annu. Rev. Plant Physiol. Plant Mol. Biol. 49, 481-500.

BOBE, G., J. W. YOUNG, D. C. BEITZ (2004): Pathology, etiology, prevention and treatment of fatty liver in dairy cows. J. Dairy Sci. 87, 3105-3124.

CASTAÑEDA-GUTIÉRREZ, E., S. H. PELTON, R. O. GILBERT, W. R. BUTLER (2009): Effect of peripartum dietary energy supplementation of dairy cows on metabolites, liver function and reproductive variables. Anim. Reprod. Sci. 112, 301-315.

CHIBISA, G. E., G. N. GOZHO, A. G. VAN KESSEL, A. OLKOWSKI, T. MUTSVANGWA (2008): Effects of peripartum propylene glycol supplementation on nitrogen metabolism body composition and gene expression for the major protein degradation pathways in skeletal muscle in dairy cows. J. Dairy Sci. 91, 3512-3527.

DURAND, D., Y. CHILLIARD, D. BAUCHART (1992): Effects of lysine and methionine on in vivo hepatic secretion of VLDL in the high yielding dairy cow. J. Dairy Sci. 75 (Suppl. 1), 279.

FORMIGONI, A., A. M. C. CORNIL, A. PRANDI, A. MORDENTI, A. ROSSI, D. PORTETELLE, R. RENAVILLE (1996): Effect of propylene glycol supplementation around parturition on milk yield, reproduction performance and some hormonal and metabolic characteristics in dairy cows. J. Dairy Res. 63, 11-24.

GRUMMER, R. R., J. C. WINKLER, S. J. BERTICS, V. A. STUDER (1994): Effect of propylene glycol dosage during feed restriction on metabolites in blood of peripartum holstein heifers. J. Dairy Sci. 77, 3618-3623.

GRUMMER, R. R. (1995): Impact of changes in organic nutrient metabolism on feeding the transition dairy cow. J. Dairy Sci. 73, 2820-2833.

GRUMMER, R. R. (2008): Nutritional and management strategies for the prevention of fatty liver in dairy cattle. Vet. J. 176, 10-20.

HOEDEMAKER, M., D. PRANGE, H. ZERBE, J. FRANK, A. DAXENBERGER, H. H. D. MEYER (2004): Peripartal propylene glycol supplementation and metabolism, animal health, fertility, and production in dairy cows. J. Dairy Sci. 87, 2136-2145.

HUNT, C. D. (1998): One possible role of dietary boron in higher animals and humans. Biol. Trace Elem. Res. 66, 205-225.

HUNT, C. D. (2012): Dietary boron: progress in establishing essential roles in human physiology. J. Trace Elem. Med. Biol. 26, 157-160.

JUCHEM, S. O., F. A. P SANTOS, H. IMAIZUMI, A. V. PIRES, E. C. BARNABE (2004): Production and blood parameters of holstein cows treated prepartum with sodium monensin or propylene glycol. J. Dairy Sci. 87, 680-689.

KABU, M., C. C. CINGI, T. CIVELEK (2008): Fatty liver syndrome and prevention in dairy cows. Kocatepe Vet. J. 1, 83-87.

KABU, M., T. CIVELEK (2012): Effects of propylene glycol, methionine and sodium borate on metabolic profile in dairy cattle during periparturient period. Rev. Méd. Vét. 163, 419-430.

KABU, M., M. S. AKOSMAN (2013): Biological effects of boron. Rev. Environ. Contam. Toxicol. 225, 57-75.

LARANJA, D. A., L. F. FONSECA, C. S. LUCCI, P. H. M. RODRIGUES, M. V. SANTOS, A. P. LIMA (1998): Supplementation of propylene glycol to dairy cows in periparturient period: effects on plasma concentration of BHBA, NEFA, and glucose. J. Anim. Sci.76 (Suppl.1), 320.

MIYOSHI, S., J. L. PATE, D. L. PALMQUIST (2001): Effects of propylene glycol drenching on energy balance, plasma glucose, plasma insulin, ovarian function and conception in dairy cows. Anim. Reprod. Sci. 68, 29-43.

MOALLEM, U., M., KATZ, A. ARIELI, H. LEHRER (2007): Effects of peripartum propylene glycol or fats differing in fatty acid profiles on feed intake, production, and plasma metabolites in dairy cows. J. Dairy Sci. 90, 3846-3856.

NIELSEN, N. I., K. L. INGVARTSEN (2004): Propylene glycol for dairy cows a review of the metabolism of propylene glycol and its effects on physiological parameters, feed intake, milk production and risk of ketosis. Anim. Feed Sci. Technol. 115, 191-213.

NIELSEN, F. H. (1997): Boron in human and animal nutrition. Plant and Soil 193, 199-208.

OVERTON, T. R., M. R. WALDRON (2004): Nutritional management of transition dairy cows: strategies to optimize metabolic health. J. Dairy Sci. 87, 105-119.

PIEPENBRINK, M. S., A. L. MARR, M. R. WALDRON, W. R. BUTLER, T. R. OVERTON, M. VÁZQUEZ-AÑÓN M. D. HOLT (2004): Feeding 2-hydroxy-4-(methylthio) butanoic acid to periparturient dairy cows improves milk production but not hepatic metabolism. J. Dairy Sci. 87, 1071-1084.

RUKKWAMSUK, T., S. RUNGRUANG, A. CHOOTHESA, T. WENSING (2005): Effect of propylene glycol on fatty liver development and hepatic fructose 1,6 bisphosphatase activity in periparturient dairy cows. Livest. Prod. Sci. 95, 95-102.

SHINGFIELD, K. J., S. JAAKKOLA P. HUHTANEN (2002): Effect of forage conservation method, concentrate level and propylene glycol on diet digestibility, rumen fermentation, blood metabolite concentrationsand nutrient utilization of dairy cows. Anim. Feed Sci. Technol. 97, 1-21.

TOGHDORY, A., N. TORBATINEJAD, M. MOHAJER, M. CHAMANI (2009): Effects of propylene glycol powder on productive performance of lactating cows. Pak. J. Biol. Sci. 12, 924-928.

WEBB, R. E., D. M. LESLİE Jr, R. L. LOCHMİLLER, R. E. MASTERS (2003): Immune function and hematology of male cotton rats (Sigmodon hispidus) in response to food supplementation and methionine. Comp. Biochem. Physiol. A Mol. Integr. Physiol. 136, 577-589.

WEİL, C. S., M. D. WOODSİDE, J. R. SMYTH HF, C. P. CARPENTER (1971): Results of feeding propylene glycol in the diet to dogs for two years. Food. Cosmet. Toxicol. 9, 479-490.

WEISS, D. J., V. PERMAN, W. WUSTENBERG, T. J. BUCCI (1994): Hematologic response of adult brown mink to oxidative stress. Vet. Hum. Toxicol. 36, 109-111.

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SAŽETAK

Cilj istraživanja bio je procijeniti moguće učinke bora, propilen glikola i metionina na hematološke pokazatelje u mliječnih krava tijekom peripartusnog razdoblja. Za tu svrhu uporabljene su 24 zdrave krave holštajnske pasmine. Krave su bile podijeljene u četiri skupine s obzirom na oralnu primjenu natrijeva borata (30 g/dnevno; skupina B), propilen glikola (500 g/dnevno; skupina PG) ili metionina (10,5 g/dnevno; skupina M). Četvrtu (kontrolnu) skupinu činile su krave koje nisu primile nikakav pripravak. Tijekom peripartusnog razdoblja nisu bile ustanovljene razlike između skupina u broju bijelih krvnih stanica, limfocita, monocita, neutrofilnih granulocita, crvenih krvnih stanica kao ni u broju i prosječnom volumenu trombocita. Statistički značajna razlika između skupina utvrđena je za prosječni volumen eritrocita i hematokrit pri teljenju, hemoglobin dva tjedna nakon teljenja te za prosječnu koncentraciju hemoglobina tjedan prije i dva tjedna poslije teljenja. Istraživanje upućuje na zaključak da primjena bora, propilen glikola i metionina ima prolazne učinke na neke hematološke pokazatelje u preživača tijekom peripartusnog razdoblja.

Ključne riječi: tranzicijsko razdoblje, mliječna goveda, bor, propilen glikol, metionin, hematologija