SMILTSĒRKŠĶU BLAKUSPRODUKTU IZĒDINĀŠANAS IETEKME UZ ĶĒVJU UN KUMEĻU ASINS BIOĶĪMISKIEM RĀDĪTĀJIEM
THE INFLUENCE OF FEEDING OF SEA BUCKTHORN BY-PRODUCTS ON THE MARE AND FOAL BLOOD BIOCHEMICAL INDICES

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ABSTRACT

The plant sea buckthorn (*Hippophae rhammoids L.*) primarily is valued for its golden-orange fruits which provide vitamins C and E, other nutrients, flavonoids, oils rich in essential fatty acids, and other healthful components with a potent antioxidant activity.

The aim of the research was to evaluate the influence of feeding of sea buckthorn by-product premixes on the mare and foal blood biochemical indices. Field trials were carried out at the studhorse farms "Burtnieku zirgaudzētava" Ltd (in Burtnieku pagasts of Valmiera region) in the year 2007, and at "Princis" Ltd (in Cenu pagasts of Jelgava region) in 2008, from January to May each year on every farm.

For the trials, 15 Latvian pedigree mares in foal were split into three groups (5 mares in a group). All mares were identical for their genetic and production parameters. Control group was fed with farm routine diet, experimental group II was fed with routine diet plus 0.3 kg of dried sea buckthorn leaves and sprigs, but experimental group III was given routine diet plus 0.3 kg of dried berries residues.

At the beginning of the trial and after foaling, the blood samples of all mares and foals were analyzed for hematological indices (red blood cell count, hematocrit, leucocytes, etc.), as well as for the content of Mg, Zn, Cu, and units of glutathione peroxidase. In the blood samples of mares after foaling, a disparity ($p < 0.05$) between control and experimental group II, and between control and experimental group III was detected for several indices: red cell distribution width index RWD, reduced count of leucocytes, changed ratio between leucocyte types, reduced count of lymphocytes and monocytes, and increased amount of Zn ($\mu g\ dL^{-1}$).
KEY WORDS: sea buckthorn, hematological indices, hemoglobin, leucocytes.

INTRODUCTION

In the last few years, sea buckthorn (*Hippophae rhammoids L.*) has become a very popular plant to prevent soil erosion and serve as an economic resource for food, medicine products, and feedstuffs. As a legend says, the leaves of sea buckthorn were used in Ancient Greece for curing of horses. The horses fed with leaves were known to recover very rapidly and to acquire smooth and glossy hair. Hence, the name of this plant *Hippophae* originates from *hippos* – horse, *phae* – shedding lustre. Sea buckthorn develops an extensive root system rapidly, and is therefore an ideal plant for soil erosion control (Li et al., 1996).

The information on nutritional and medicinal value of sea buckthorn is relatively new. The sea buckthorn industry has been thriving in Russia since 1940s when scientists there began investigating the biologically active substances found in the berries, leaves, and bark. These products were utilized in the diets of Russian cosmonauts and as a cream for protection from cosmic radiation (Xu et al., 2001).

A number of vitamins, flavonoids, and sterols present in the plant are thought to be responsible for its versatile pharmacological activities such as anti-inflammatory, chemical or physical burn wound healing ability, anti-gastroulcerative activity, hepatoprotective, and anti-cancerous and anti-atherosclerotic properties (Varshney et al., 2005). It has been reported that

sea buckthorn contains more than 190 bioactive compounds in the leaves, sprigs, seed pulp, and juice. These compounds include fat soluble vitamins (A, K, and E), water soluble vitamins (C, B_1, B_2, folic acid, etc.), 22 fatty acids, 42 lipids, organic acids, amino acids, carbohydrates, tocopherols, flavonoids, phenols, terpenes, and tannins (Zhang, 1990). Most of the research on sea buckthorn was done on small laboratory animals such as guinea-pigs, rats and rabbits, and directly on humans. As far as domestic animals especially large animals are concerned, not much work has been done therefore we have undertaken a trial project to verify the ability of sea buckthorn by-products to influence the mare and foal blood biochemical indices.

MATERIALS AND METHODS

The field trials were conducted on the studhorse farm ”Burtnieku zirgaudzētava” Ltd (Burtnieku pagasts of Valmiera region) from January to May 2007, and ”Princis” Ltd (Cenu pagasts of Jelgava region) from January to May 2008. In each trial, 15 Latvian pedigree mares in foal were used. They were split into three groups (5 mares in a group), identical for genetic and production parameters, and randomly assigned to one of the experimental diets. Mares of all three groups were fed basal diet which consisted of 8 kg of meadow hay and 5 kg of rolled oats. Besides, in the diet of the experimental group II, 0.3 kg of dried sea buckthorn leaves and sprigs were added, and in the diet of the experimental group III, 0.3 kg of dried berries residues were added. All mares were in foal for the last 2.5 – 3 months.

The chemical composition of hay, oats, sea buckthorn leaves and sprigs, and dried berries residues were analyzed in the Scientific Agrochemical laboratory of LLU to evaluate nutritional value of the experimental diets.

At the beginning of both trials, blood samples of all mares were analyzed for blood hematological indices: red blood cell count (erythrocytes), hemoglobin, hematocrit, mean corpuscular volume or mean red blood cell volume MCV, mean corpuscular or cell hemoglobin MCH, mean cell hemoglobin concentration MCHC, red blood cell distribution width RWD, thrombocytes (anucleated cell fragments or platelets), leucocytes or “white blood cells” and different types of leucocytes (granulocytes – neutrophils, eosinophils, basophils; and agranulocytes – lymphocytes and monocytes), erythrocyte sedimentation rate ESR (or in Latvian: EGA), as well as the content of Mg, Zn, Cu, and units of glutatione peroxidase. The same analyses were done on mares and foals after foaling in the laboratory of “E. Gulbja laboratorija” Ltd in Riga.

RESULTS AND DISCUSSION

At the beginning of the trial, in January 2007, no remarkable differences in the mare blood hematological indices between the experimental groups were observed. Biometric verification of the data showed no disparity between the indices (Table 1). The only exception was disparity between the control and experimental group III in the mean cell hemoglobin concentration MCHC ($p < 0.05$), between control and experimental group II ($p < 0.05$) in the units of glutatione peroxidase, and between control and experimental group III ($p < 0.05$) in the content of Cu (µg %). Unfortunately, the number of available resources of animals entered into the trial and of analyzed blood samples was too small to explain this phenomenon.

Substantial alterations in mare blood hematological indices between the control and experimental group II were observed after foaling (Table 2), which was recognized by biometric verification. To the basal diet of mares of that group, 0.3 kg of ground dried sea buckthorn leaves and sprigs were added. A disparity ($p < 0.05$) developed for several indices: red blood cell distribution width RWD, reduced count of leucocytes and, respectively, changes in the ratio between eosinophils and basophils, reduced count of lymphocytes and

monocytes, and increased content of Zn (µg dL^{-1}). All these changes are preferable for the health of mares.

Significant changes ($p < 0.05$) were detected in neonate foal blood hematological indices between the control and experimental groups II and III (Table 3). Erythrocyte count, quantity of hemoglobin, and mean cell hemoglobin concentration MCHC were found to diminish in both experimental groups. Differences between the control and experimental group II were found for erythrocyte sedimentation rate ESR, but between control and experimental group III – for hematocrit, thrombocytes, leucocytes, and content of Zn (µg dL^{-1}).

1. tabula / Table 1

Ķēvju asins vidējo bioķīmisko rādītāju salīdzinājums starp grupām izmēģinājuma sākumā
Comparison of mare blood hematological indices between the groups at the beginning of the trial

Rādītāji Indices	Kontroles grupa Control group	II grupa Experimental group II	III grupa Experimental group III
Eritrocīti, 10^{12} L^{-1} Erythrocytes, 10^{12} L^{-1}	7.676 ± 0.6	7.958 ± 0.3	8.598 ± 0.3
Hemoglobīns, g L^{-1} Hemoglobin, g L^{-1}	128.4 ± 9.0	134.2 ± 3.4	137.6 ± 5.1
Hematokrīts, % Hematocrit, %	34.0 ± 2.3	35.2 ± 1.1	37.2 ± 1.2
MCV, f L^{-1}	44.2 ± 0.7	44.6 ± 0.9	43.2 ± 0.6
MCH, p g	16.4 ± 0.2	17.0 ± 0.3	16.0 ± 0.3
MCHC, g L^{-1}	379.2 ± 1.5	380.6 ± 1.8	369.6 ± 2.4
RDW, %	19.94 ± 0.4	20.08 ± 0.3	20.26 ± 0.4
Trombocīti, 10^{9} L^{-1} Thrombocytes, 10^{9} L^{-1}	110.2 ± 13.8	106.0 ± 11.2	160.6 ± 30.0
Leikocīti, 10^{9} L^{-1} Leucocytes, 10^{9} L^{-1}	8.568 ± 0.7	8.52 ± 0.8	9.254 ± 0.5
Neitrofīlie, % Neutrophils, %	58.0 ± 4.0	57.8 ± 4.3	53.6 ± 3.5
Eozinofīlie, % Eosinophils, %	2.2 ± 0.96	3.2 ± 0.2	2.0 ± 0.5
Bazofīlie, % Basophils, %	0 ± 0	0.4 ± 0.2	0.2 ± 0.2
Limfocīti, % Lymphocytes, %	33.6 ± 4.3	33.8 ± 4.4	40.4 ± 3.5
Monocīti, % Monocytes, %	6.2 ± 1.3	4.8 ± 0.6	3.8 ± 0.7
EGA, mm h^{-1} ESR, mm h^{-1}	14.2 ± 1.2	15.8 ± 1.6	19.8 ± 0.6
Mg, mmol L^{-1}	0.790 ± 0.02	0.768 ± 0.04	1.006 ± 0.06
Zn, µg dL^{-1}	91.0 ± 5.5	89.6 ± 4.4	92.2 ± 5.2
Cu, serumā, µg % Cu in blood serum	97.2 ± 9.2	107.0 ± 7.6	117.2 ± 7.5
Glutationa peroksidāze, U L^{-1} Glutatione peroxidase	9 385 ± 1797.8	22 714 ± 933.1	14 342 ± 3374.4

The differences between the groups in mare and foal blood hematological indices in the trial of the year 2008 are very closely similar to those of the 2007 trial. This suggests that sea buckthorn by-products premixes for feeding of mares in foal are valuable for improvement of

blood hematological indices in both mare and foal. The results of our trials agree with the data found in scientific proceedings.

2. tabula / Table 2

Ķēvju asins vidējo bioķīmisko rādītāju salīdzinājums starp grupām pēc atnešanās
Comparison of mare blood hematological indices between the trial groups after foaling

Rādītāji Indices	Kontroles grupa Control group	II grupa Experimental group II	III grupa Experimental group III
Eritrocīti, 10^{12} L^{-1} Erythrocytes, 10^{12} L^{-1}	9.432 ± 1.04	7.91 ± 0.3	8.142 ± 0.3
Hemoglobīns, g L^{-1} Hemoglobin, g L^{-1}	136.6 ± 8.1	127.2 ± 5.9	128.0 ± 3.2
Hematokrīts, % Hematocrit, %	37.2 ± 1.7	35.6 ± 1.5	35.6 ± 1.2
MCV, f L^{-1}	41.0 ± 2.6	45.4 ± 0.8	43.8 ± 0.7
MCH, p g	15.0 ± 0.8	16.4 ± 0.2	15.6 ± 0.4
MCHC, g L^{-1}	365.4 ± 6.8	356.0 ± 3.6	359.4 ± 3.1
RDW, %	21.10 ± 0.6	19.14 ± 0.2	20.20 ± 0.3
Trombocīti, 10^{9} L^{-1} Thrombocytes, 10^{9} L^{-1}	172.4 ± 106.4	158.6 ± 28.6	157.2 ± 19
Leikocīti, 10^{9} L^{-1} Leucocytes, 10^{9} L^{-1}	11.956 ± 1.1	9.192 ± 0.8	10.114 ± 1.1
Neitrofīlie, % Neutrophils, %	28.9 ± 2.2	32.84 ± 2.4	35.2 ± 3.8
Eozinofīlie, % Eosinophils, %	4.26 ± 0.4	7.84 ± 1.2	4.8 ± 0.2
Bazofīlie, % Basophils, %	1.24 ± 0.2	2.46 ± 0.5	1.12 ± 0.4
Limfocīti, % Lymphocytes, %	59.3 ± 2.5	52.24 ± 3.7	53.34 ± 4.4
Monocīti, % Monocytes, %	6.26 ± 0.5	4.56 ± 1.0	5.52 ± 1.0
EGA, mm h^{-1} ESR, mm h^{-1}	17.2 ± 2.8	18.6 ± 1.2	24.2 ± 5.7
Mg, mmol L^{-1}	0.924 ± 0.06	0.986 ± 0.07	0.804 ± 0.008
Zn, µg dL^{-1}	56.0 ± 1.5	68.4 ± 3.5	50.2 ± 5.6
Cu, serumā, µg % Cu in blood serum	90.0 ± 12.2	104.6 ± 7.2	91.4 ± 5.4
Glutationa peroksidāze, U L^{-1} Glutatione peroxidase	20203 ± 1798.8	23453 ± 1673.9	16 446 ± 3379.7

CONCLUSIONS

1. All parts of sea buckthorn (*Hippophae rhamnoides*) contain many biologically active compounds – vitamins, fatty acids, amino acids, flavonoids, phenols, terpenes, tannins, etc.
2. Sea buckthorn by-product additives (dried leaves, sprigs, and berries residues ground to dust) fed to mares in foal in the last 2.5 – 3 months of pregnancy produced significant changes in the mare and foal blood hematological indices.
3. The results of both trials indicate favorable impact of feeding of sea buckthorn by-products on several blood hematological indices in foals, which is beneficial to foal further development.

3. tabula / Table 3

Kumeļu asins vidējo bioķīmisko rādītāju salīdzinājums starp grupām
Comparison of foal blood hematological indices between the trial groups

Rādītāji Indices	Kontroles grupa Control group	II grupa Experimental group II	III grupa Experimental group III
Eritrocīti, 10^{12} L^{-1} Erythrocytes, 10^{12} L^{-1}	11.43 ± 0.1	10.74 ± 0.3	9.92 ± 0.3
Hemoglobīns, g L^{-1} Hemoglobin, g L^{-1}	145 ± 1.3	136 ± 3.8	119 ± 3.2
Hematokrīts, % Hematocrit, %	39 ± 0.4	37 ± 1.1	32.3 ± 0.8
MCV, f L^{-1}	34.0 ± 0.9	34.2 ± 0.5	32.5 ± 0.7
MCH, p g	12.4 ± 0.2	12.4 ± 0.2	12.0 ± 0.3
MCHC, g L^{-1}	373 ± 0.9	367 ± 1.8	369 ± 1.1
RDW, %	24.15 ± 0.6	22.34 ± 0.4	22.90 ± 0.4
Trombocīti, 10^{9} L^{-1} Thrombocytes, 10^{9} L^{-1}	492.5 ± 81.2	552.4 ± 51.0	795.0 ± 142.8
Leikocīti, 10^{9} L^{-1} Leucocytes, 10^{9} L^{-1}	10.014 ± 0.7	11.832 ± 1.6	13.042 ± 1.4
Neitrofīlie, % Neutrophils, %	32.05 ± 0.07	31.34 ± 3.4	30.0 ± 3.4
Eozinofīlie, % Eosinophils, %	1.24 ± 0.4	0.60 ± 0.1	2.65 ± 1.1
Bazofīlie, % Basophils, %	1.1 ± 0.04	1.02 ± 0.06	1.075 ± 0.3
Limfocīti, % Lymphocytes, %	59.9 ± 1.2	61.5 ± 3.3	61.0 ± 2.4
Monocīti, % Monocytes, %	5.7 ± 0.8	5.5 ± 0.6	5.24 ± 0.7
EGA, mm h^{-1} ESR, mm h^{-1}	7.0 ± 1.3	11.6 ± 1.2	10.0 ± 1.4
Mg, mmol L^{-1}	0.85 ± 0.002	0.86 ± 0.02	0.85 ± 0.03
Zn, µg dL^{-1}	68 ± 1.8	71 ± 3.7	61 ± 2.7
Cu, serumā, µg % Cu in blood serum	93 ± 5.4	87.4 ± 14.7	86.4 ± 8.2
Glutationa peroksidāze, U L^{-1} Glutatione peroxidase	15621 ± 165.0	16285 ± 1740.7	15924 ± 4707.4

LITERATURE

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