Effect of Selected Factors on Hematological and Trace Blood Traits of Cows

Miloslav Soch¹, Pavla Vydrova¹, Jan Broucek², Mihal Uhrincat², Jana Stastna¹, Peter Kisac², Bohuslav Cermak¹

¹University of South Bohemia in Ceske Budejovice, Czech Republic; ²Animal Production Research Centre, Nitra, Slovak Republic

Abstract
The objective of the present study was to evaluate the influence of altitude, season of year, management system, and breed on hematological markers and micromineral concentrations in cows. The highest haemoglobin concentration was at the altitude 550 m (128.48 g.L⁻¹) (P<0.001). The lower levels of haemoglobin and haematocrit (102.27 g.L⁻¹ and 0.28 L.L⁻¹) in the spring 2006. Differences among breeds were significant (P<0.001). The highest count of leucocytes was found in Spring 2006 and the lowest in Spring 2005 (9.94 G.L⁻¹ and 6.15 G.L⁻¹). Differences among Breeds were also significant (P<0.01). The percentage of lymphocytes and neutrophiles differed (P<0.001) in Factors Altitude and Breed, the content of monocytes differed significantly in the factors Altitude and Season of Year only (P<0.05, P<0.001). The lowest percentage of eosinophiles was found at the altitude 550 m (4.45 %) and the highest at the altitude 910 m (14.34) (P<0.001). The highest value of phagocytose index was recorded at the altitude 550 m (21.34 %) and the lowest value at the altitude 910 m (14.73 %) (P<0.001). The highest copper and zinc concentrations were found atthe altitude 550 m (13.42 μmol.L⁻¹ and 18.18 μmol.L⁻¹) and the lowest at the altitude 910 m (copper 10.17 μmol.L⁻¹; P<0.001) and 675 m above sea (zinc 12.77 μmol.L⁻¹; P<0.001). Similarly, the highest values of copper and zinc were recorded at the Fall 2005 (14.63 μmol.L⁻¹ and 16.31 μmol.L⁻¹). The lower concentration of the copper (7.54 μmol.L⁻¹) was found at the Spring of 2005. The highest values were found in Holstein breed (13.73 μmol.L⁻¹ and 17.55 μmol.L⁻¹) (P<0.001). We found higher concentrations in non-ecological system in both parameters (13.25 μmol.L⁻¹ and 16.25 μmol.L⁻¹ vs. 9.81 μmol.L⁻¹ and 14.65 μmol.L⁻¹).

Keywords: copper, hematology, sheep, zinc.

1. Introduction

Mineral deficiencies, and in some cases imbalances, cause metabolic disturbances and can produce specific deficiency diseases [1] [2]. Microcytic hypochromic anemia is the one of the outcomes of copper deficiency and may perform several functions in the immune system of which the direct mechanism of action is not clear. Phagocytic activity of neutrophils was increased when copper was administered to deficient calves [3]. Dietary deficiency changes the count of circulating neutrophils and has been linked to a variety of clinical signs [4]. Zinc is characterized by a number of catalytic, structural and regulatory functions. Both these microelements ranking among substances with biological activity in intermediate metabolism. They get into the organism mainly as components of animal diet. The level of absorption and retention of microelements is modulated by their actual levels in the organism and their concentrations in the diet and is generally higher for intake of their organic forms [5].

The efficiency of cattle is obviously dependent on the health and the well-being. More information is needed on their micromineral requirements in relation to nutrition, toxicology, and physiological status of the animal. Appropriate trace mineral
supplementation is essential for maintaining optimum level of growth and performance of the animal [6] [7].

2. Materials and methods

The cows were kept in four herds, two systems, and four altitudes. Blood samples were divided according to factors altitude (400 m above sea level, n=120; 550 m, n=60; 675 m, n=82; 910 m, n=40), seasons of the year (spring 2005, n=38; fall 2005, n=58; spring 2006, n=101; fall 2006, n=105), system (ecological, n=40, non-ecological, n=262), and breed (Angus, n=85; Czech Pied cattle, n=73; Holstein, n=145).

Feed intake was monitored daily in each observation for 3 days. Blood samples were collected in the third day of observation by jugular venipuncture into heparinized tubes and placed on ice immediately after collection, then stored at –24°C until processing.

The haematological parameters were determined as follows: leukocytes count was determined using a Bürker chamber, the content of haemoglobin was estimated photometrically at 540 nm by using a spectrometer UV/VIS Unicam 5625. The haematocrit value was determined by capillary microhaematocrit method according to Janetzki. The phagocytic activity of cattle was determined via phagocytosis percentage using by microsferic hydrophilic particles.

The concentration of copper and zinc in blood plasma, and in dry matter of a diet was analysed by flame atomic absorption method using an AA Spectrometer Unicam 969. The data were analysed with a statistical package STATISTIX, Version 8.0.

Herd 1 was localized 400 m above sea level with the majority of Holstein breed (65 %) and Czech Pied cattle (35 %). Non-ecological beef herd (2) was localized in the hilly region (675 m above sea level). During the grazing season, the cows and calves (90 heads of beef cattle majority of Aberdeen Angus breed (70 %) and Simmental breed (30 %) were grazed in the paddock grazing system. A suckler ecological herd (3) of 210 beef cows and calves (Czech Pied cattle and their crosses with Hereford, Charolais, and Galloway) was kept on pasture (910 m above sea level). Conventional, non-ecological dairy herd (4) was localized 550 m above sea level. There were 350 of dairy cows with the majority of Czech Pied cattle (60 %) and Holstein breed (40 %). Animals were fed ad libitum by Total Mixed Ration.

3. Results and discussion

The lowest haemoglobin concentration was at the altitude 400 m (113.40±1.12 g.L⁻¹) and the highest at the altitude 550 m (128.48±1.58 g.L⁻¹) (P<0.001). Differences among individual altitudes were significant. The highest content of haematocrit was recorded in the breeds 2 and 1 (120.08±1.74 g.L⁻¹ and 119.88±1.63 g.L⁻¹), the lowest level was recorded in the breed 3 (112.46±1.22 g.L⁻¹). Differences among breeds were significant (P<0.001). Similarly, the lowest value was found in the breed 3 (0.31±0.01 L.L⁻¹). The highest count of leucocytes was found in the altitude 2 and the lowest in the altitude 3 (8.93±0.37 G.L⁻¹ and 6.64±0.31 G.L⁻¹; P<0.001). The great differences were recorded in factors season of year (P<0.001). The highest count was found in spring 2006 and the lowest in spring 2005 (9.94±0.28 G.L⁻¹ and 6.15±0.45 G.L⁻¹). Differences among breeds were also significant (P<0.01), the highest count was found in breed 2 (8.25±0.37 G.L⁻¹) and the lowest one in breed 1 (6.46±0.35 G.L⁻¹).

Phagocytose index significantly differed in the factor of altitude, the highest value was recorded at the altitude 550 m (21.34±0.91 %) and the lowest value at the altitude 910 m (14.34±0.67 %) (P<0.001). We found the lowest content in the Holstein breed (4.82±0.39 %) and the highest in the Czech Pied cattle (10.41±0.55) (P<0.001). Phagocytose index significantly differed in the factor of altitude, the highest value was recorded at the altitude 550 m (21.34±0.91 %) and the lowest value at the altitude 910 m (14.73±1.17 %) (P<0.001). Differences were found also in the factors of season of year and system.

At the present study, the highest haemoglobin concentration was at the altitude 550 m. Our
The results of Lominadze at the altitude 550 m (13.42±0.41 μmol.l⁻¹ and 18.18±0.49 μmol.l⁻¹) and the lowest at the altitude 910 m (Cu 10.17±0.51 μmol.l⁻¹; P<0.001) and 675 m above sea (Zn 12.77±0.42 μmol.l⁻¹; P<0.001). Similarly, the highest values of Cu and Zn were recorded at the fall 2005 (14.63±0.42 μmol.l⁻¹ and 16.31±0.49 μmol.l⁻¹). The lower concentration of the copper (7.54±0.52 μmol.l⁻¹) was found at the spring of 2005.

In the both microminerals, there were the highest values found in Holstein breed (13.73±0.29 μmol.L⁻¹ and 17.55±0.32 μmol.L⁻¹) (P<0.001). We found higher concentrations in non-ecological system in both parameters (13.25±0.25 μmol.L⁻¹ and 16.25±0.28 μmol.L⁻¹ vs. 9.81±0.64 μmol.L⁻¹ and 14.65±0.73 μmol.L⁻¹).

The highest Cu and Zn concentrations were found at the altitude 550 m and the lowest at the altitude 910 m (Cu) and 675 m above sea (Zn). Cu content in the cows under study was not marginal, we did not find the deficiency in herds with possible exception of herd 3 during spring 2005 observation (5.1 mg.kg⁻¹ in dry matter), but exactly at the altitude of 910 m. However, the trace mineral status of animals depends not only on dietary allowance, but also on the efficiency of digestion and storage, which both can be affected by interactions with other food constituents.

In available literature there is no information about data concerning clear optimal level of Zn and Cu added in organic forms in rations for cows. However, different contents of these elements in feed could develop intake differences. They get into the organism mainly as components of animal diet. The improving of biological functions in high yielding cows increased the interest in different forms of minerals applied in feed rations. However, Cope [13] concluded that supplementation of Zn in the diet of dairy cows was not effective in improving the milk composition, health condition, or blood hematolgy.

The level of absorption and retention of microelements is modulated by their actual levels in the organism and their concentrations in the diet and is generally higher for intake of their organic forms [5] [14]. Hence, trace elements deficiencies are often veterinary suspected and deficient status is considered as the likely cause of disorders [15].

The lowest Zn content in blood plasma was at the altitude 675 m, where really dry matter feed contained the lowest amount of Zn (average of 28.5 mg.kg⁻¹).

Values of these elements in blood plasma were similar to those reported in most other studies. Cu and Zn liver levels increased progressively with soil levels, and the pattern was especially marked...
for Cu [16] [17]. The seasonal variations in forages can have impact on microelements [18]; [19] [20]. Our results of variable impact of seasonal changes on the concentration of minerals in the blood and feed resources suggests the need for supplementation of deficient minerals like Cu, Zn in the available forms.

According to consumption feeds and minerals there were actually the lowest contents of Cu in herd 3 (ecological system). However, we did not recorded low content of Zn. There have been many reports of interactions between Cu and other elements in cattle [21] [22].

The content of minerals in different plant fodders given to cattle could be diversified. Therefore, their deficiency or imbalance in the feed could lead to disturbances, decreasing production and lowest concentration of minerals in blood. Cu deficiency in grazed animals is detected mostly in the spring and summer, when there is the lowest ratio of Cu culminating plants on pastures. In rainy periods, Cu is washed out from soil. Other, a number of factors, such as breed, diet, and the concentration of Cu antagonists may affect responses of cattle to supplemental Cu. The supply of Zn improves performance, fertility, health, and immune function [23].

Conclusions
At the present work were found higher concentrations in non-ecological system in both parameters (Cu, Zn). The mineral supplementation of feed rations is generally well done in dairy herds, but is much less practiced in beef herds. This finding is supported also by our results, contents of Cu and Zn were balanced during seasons of year in dairy herds 1 and 4. We can conclude that hematological markers and trace minerals may be impacted of altitude, season of year, breed, and management system in cows.

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References


