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**Doctoral thesis**

**Fatty acid profile and mineral composition of the bone marrow of cervids  
depending on living or breeding conditions**

### **Summary**

Cervidae is a family of ruminant mammals with high nutritional requirements due to essential needs related to their life strategies, primarily during antler growth. Especially the youngest should reach the appropriate body weight before winter. Adequate body weight, however, does not necessarily reflect the favorable composition of fatty acids in the bonemarrow. Bone marrow is regarded as an indicator of health status because it is not only a fatsource but also contains minerals, vitamins, and fatty acids. It is critical during the skeletal growth and development of young deer to have an adequate supply of essential minerals.

Moreover, metabolic changes indicate that the elements are used for current needs and can be stored and mobilized.

The knowledge about deer nutrition is still insufficient. Despite operating in Poland for 40 years, deer breeding has not been fully optimized yet, especially in the nutritional aspect, resulting from dynamic climate changes. Studies of the bone marrow, plasma, bones, and antlers provide valuable information on the nutritional status, health and future functioning of farmed deer.

The study's main aim was to analyze the content of minerals and the profile of fatty acids in the bone marrow of farmed and wild cervids. The main hypothesis was that the fatty acid profile and mineral composition of the bone marrow and selected tissues reflect the living or breeding conditions of cervids. Indirect hypotheses were that the fatty acid profile of the bone marrow of wild and farmed cervids differed significantly due to the living conditions; concentration and composition of fatty acids depend on age of animals; breeding conditions influence the fatty acid profile and mineral composition of young deer bonemarrow.

Three studies were conducted independently. In the first of them, the impact of the living conditions of red deer (*Cervus elaphus*) and the age of wild animals on the fatty acid profile in the bone marrow was examined. Oleic acid (18:1 c9) was the most abundant in deer bone marrow and comprised approximately 37% of total FAs. The bone marrow of young wild deer was characterized by a significantly higher fat content and saturated Fas proportion. In contrast, the bone marrow of farmed calves contained more moisture and fat-free dry matter, as well as more monounsaturated FAs cis, branched-chain Fas and monounsaturated FAs trans. A significantly higher level of n-3 and n-6 FAs and a more favorable n-6/n-3 ratio in the bone marrow of wild calves were determined. Due to the lower

8 proportion of saturated fatty acids and the higher proportion of monounsaturated fatty acids,

a more favorable fatty acid profile was found in adult animals. In the second study, the composition of fatty acids in the marrow of farmed fallow deer (*Dama dama*) calves after summer and winter feeding was analyzed. After the pasture period, the bone marrow showed a significantly higher amount of saturated fatty acids. In addition, the bone marrow after the grazing period contained significantly higher amounts of trans fatty acids and conjugated linoleic acid and higher levels of monounsaturated fatty acids after the winter-feeding period. The results obtained in the study indicate that providing

the animals with appropriate housing conditions on the farm and their optimal feeding

resulted in better condition and nutritional status of the animals, which is indicated by a more

favourable composition and profile of fatty acids in the bone marrow. The third study aimed to analyze the content of 21 mineral elements (including bulk elements: Ca, P, Mg, K, Na; trace elements: Li, Cr, Mn, Co, Cu, Zn, Se, Mo; and toxic elements: Be, Al, As, Cd, Sb, Ba, Pb, Ni) in bone marrow, plasma, bones and first antlers of farmed fallow deer (*Dama dama*). When comparing soft tissues, higher concentrations of Ca, P, Mg, Cr, Zn, Se, Al, Ba and Ni were found in the bone marrow than in the plasma.

These results are consistent with studies on the circulation of minerals in the body depending on metabolic changes and consumed feed. The blood does not accumulate minerals but only transports them and reflects their amount at a given moment. Between Ca and Cd, Ca and Pb, and P and Pb in the tissues.

The conducted research confirmed all hypotheses. The diet used in deer farming can affect the composition of fatty acids in the bone marrow of young deer. Young wild animals seem better adapted to winter than farm animals. Farmed fallow deer in the first year of life were better nourished after the winter period, which they spent in good living conditions with controlled access to roughage, concentrate and water. The fatty acid profile in the bone marrow changed positively with the age of cervids and, after incorporating appropriate nutrition, positively impacted surviving unfavorable conditions such as winter or famines.

The results confirmed the possibility of the migration and concentration of minerals in the bone tissue by the exchange processes of divalent cations. Keywords: fatty acids; bone marrow; macroelements; trace elements; deer farming