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# CONTENT OF MICROELEMENTS IN WILD BIRDS IN VOJVODINA

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*Summary:* In the paper the results of determination of Mn, Fe, Cu, Zn, Co, Se and Ni in meat and internal organs of various wild bird species are presented. Particularly interesting are the samples from a grey heron where a high concentration of all analyzed microelement was detected, especially iron (2249 mg/kg in the liver), copper (232 mg/kg in the liver), zinc (66.1 mg/kg in the liver), nickel (0.125 mg/kg in the liver and 0.137 mg/kg in the kidney) and cobalt (0.09 mg/kg in the kidney). It is of great importance to determine the area of origin and to identify possible sources of contamination. The performed measurements show that manganese and selenium were present in measurable quantities in all types of the samples. The highest average content of manganese was in the liver (2.85 ± 0.57 mg/kg) while the highest mean concentration of selenium was, as expected, in the kidneys (1.31 ± 0.45 mg/kg). The increased amount of copper in the samples of swan meat (277 mg/kg) and marsh hen (79 mg/kg) was indicative.

*Key words:* microelements, wild birds

## Introduction

In order to fully understand the exposure of animals to many pollutants originating from the environment and to assess the harmful effect and estimate the risk, it is necessary to carry out a systematic study and gather data on degree and type of pollution, as well as distribution of hazardous chemicals in nature. Nowadays, a number of studies have been based on the determination of chemical contaminants in animal tissues and organs [1]. As the result of these findings, it is possible to estimate the level of human exposure to negative effects of these pollutants.

Many wild animals are exposed to different toxic substances by consuming contaminated plants and animals, or water, soil and air. Since animals can move freely and find their own food, the game (including wild birds) is a link in the chain that accumulates pollutants from the environment. Therefore, wildlife species on certain geographic areas may be a good indicator of pollution, especially of certain chemical elements, as they eat unprocessed plants in a particular habitat [2,3]. It should be noted that the accumulation of chemical elements is affected by endogenous factors (age, sex, health status of animals) and exogenous factors (geography, hydrological conditions, soil, climate, plant life). The importance of this issue is proved by the fact that a completely new discipline is being developed - wildlife toxicology - which includes examining the effects of toxins on wildlife [4].

The consequence of technological development is general pollution of the environment as the result of various contaminants. Swallowing small amounts of a toxic substance over a longer period results in its accumulation in various tissues, causes chronic poisoning and provokes different diseases and death [5]. Thus, the main objective of this study was to determine the number and type of chemical elements that had been accumulated in the samples of wild birds, and, based on these results, determine the sites with increased content of chemical contaminants. This would enable to note possible trends in increasing the monitored concentration and determine possible corrective measures aimed at reducing environmental contamination caused by chemical agents with the purpose to improve the environment and preserve the protected and highly protected wild animals.

## Material and Method

A total of 24 samples were tested on the content of trace elements in wild birds: Swan (Cygnus), Marsh hen (*Gallinula choloropus*), Little egret (*Egretta garzetta*), Buzzard eagle (*Buteo buteo)*, White-tailed eagle (*Haliaeetus albicilla*), Seagull (*Larus ridibundus*), White stork (*Ciconia ciconia*), Wild mallard (*Anas platyrhynchos*), Grey heron (*Ardea cinerea*) [6]. The samples were prepared by wet digestion using Ethos, Labstation Microwave, Milestone. Manganese, iron, copper and zinc were determined using atomic absorption spectrophotometry on the Varian Spectraa-10. Nickel, cobalt and selenium were analyzed by a technique of coupled plasma on the Agilent ICP-MS 7700.

## Results and Discussion

The results of our examination are presented in the Table 1 and Table 2. From the results displayed in Table 1 it can be concluded that the concentration of manganese in all the samples was fairly the same [7]. The highest concentration was in the liver: 2.85 ± 0.57 mg/kg. Iron concentration varied widely. Unusually high concentration was

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measured in swan meat (521 mg/kg) and eagle liver (1147 mg/kg). The highest iron concentration was in the liver of grey herons - 2249 mg/kg [8]. In all the samples the concentration of cobalt was very low - less than 0.1 mg/kg. However, the highest concentration of cobalt was measured in the kidney of a grey heron 0.090 mg/kg. When speaking about nickel, a distinguishing sample was of grey heron: the nickel concentration in the liver was 0.125 mg/kg and 0.137 mg/kg in the kidney [9]. Comparing all the samples significantly higher concentration of copper was detected in the swan meat samples (277 mg/kg) and grey herons liver (232 mg/kg). The zinc concentration was uniformed, with the exception of in the grey heron's liver with a slightly higher value - 66.1 mg/kg. The mean selenium concentration in all the meat samples was 0.37 ± 0.35 mg/kg. The maximum concentration was in the liver (1.33 mg/kg) and kidney of an White-tailed eagle (2.01 mg/kg).

Table 1: The amount of trace element in the wild bird samples

| | Analyzed Elements [mg/kg] | | | | | | |
|---|---|---|---|---|---|---|---|
| Type of sample | **Mn** | **Fe** | **Co** | **Ni** | **Cu** | **Zn** | **Se** |
| Swan – meat | 0.85 | 521 | 0.020 | 0.077 | 277 | 37.2 | 0.35 |
| Marsh hen – meat | 0.46 | 208 | 0.020 | 0.026 | 79.0 | 18.1 | 0.33 |
| Little egret - meat | 0.72 | 177 | 0.011 | 0.040 | 4.36 | 24.2 | 0.35 |
| Swan - meat | 0.26 | 77 | 0.012 | 0.039 | 6.01 | 14.3 | 0.18 |
| Swan - meat | 0.28 | 56 | 0.006 | 0.034 | 4.94 | 9.22 | 0.10 |
| Buzzard eagle male – meat | 0.47 | 144 | 0.008 | 0.062 | 5.92 | 17.7 | 0.25 |
| Buzzard eagle male - liver | 3.65 | 1147 | 0.023 | 0.081 | 4.60 | 20.2 | 0.89 |
| Buzzard eagle male - kidney | 0.97 | 169 | 0.039 | 0.097 | 4.19 | 24.5 | 1.08 |
| Buzzard eagle female-meat | 0.54 | 82 | 0.007 | 0.049 | 3.28 | 18.7 | 0.24 |
| Buzzard eagle female - liver | 3.23 | 500 | 0.020 | 0.078 | 5.34 | 26.2 | 0.89 |
| Buzzard eagle female-kidney | 0.82 | 139 | 0.029 | 0.082 | 3.59 | 17.8 | 0.83 |
| White-tailed eagle – meat | 0.69 | 114 | 0.008 | 0.054 | 3.51 | 23.9 | 0.25 |
| White-tailed eagle – liver | 2.38 | 369 | 0.024 | 0.092 | 2.41 | 23.4 | 0.76 |
| White-tailed eagle – kidney | 1.21 | 220 | 0.028 | 0.082 | 4.84 | 16.4 | 2.01 |
| White stork – meat | 0.26 | 105 | 0.012 | 0.040 | 3.86 | 16.3 | 0.22 |
| White-tailed eagle – meat | 0.64 | 62 | 0.006 | 0.040 | 4.04 | 31.2 | 0.33 |
| White-tailed eagle – liver | 2.65 | 162 | 0.026 | 0.087 | 4.92 | 17.7 | 1.33 |
| White-tailed eagle – kidney | 2.00 | 154 | 0.034 | 0.092 | 3.65 | 17.4 | 1.48 |
| White-tailed eagle – heart | 0.72 | 104 | 0.023 | 0.097 | 5.41 | 27.0 | 0.21 |
| Seagull - muscle | 0.68 | 90 | 0.024 | 0.057 | 5.04 | 14.6 | 1.49 |
| Wild mallard - muscle | 0.46 | 84 | 0.008 | 0.051 | 4.08 | 7.26 | 0.39 |
| Grey heron – meat | 0.50 | 206 | 0.018 | 0.065 | 7.22 | 25.1 | 0.33 |
| Grey heron – liver | 2.36 | 2249 | 0.052 | 0.125 | 232.1 | 66.1 | 1.31 |
| Grey heron - kidney | 1.51 | 119 | 0.090 | 0.137 | 4.52 | 19.6 | 1.17 |

From the results given in Table 2 it can be concluded that the highest concentration of iron, copper and zinc in the examined animals were in the samples of liver-with average value of 885 mg/kg for Fe, 49.9 mg/kg for Cu and 30.7 mg/kg for Zn. Our results are in agreement with the current knowledge on bioaccumulation of these elements. After absorption into the blood, distribution of heavy metals to the cells of various tissues and organs is fast [10]. The tolerance of an organism to these metals depends on their concentration and ratio. It was detected that cobalt, nickel and selenium were mostly accumulated in kidney samples. The mean concentration in the kidneys of wild birds was: 1.31 ± 0.45 mg/kg for Se, 0.098±0.023 mg/kg for Ni and 0.044±0.026 mg/kg for Co. It was also obvious that the concentration of all the examined elements, especially iron, cobalt, nickel and copper, was the highest in meat, liver and kidney samples of grey herons, where bioaccumulation was the most intensive [11].

Table 2: Total number of analysed samples (n),– average content in different sample types (σ) [mg/kg] and the interval of measured values (Iv) [mg/kg]

| Analyzed Elements [mg/kg] | | | | | | | |
|---|---|---|---|---|---|---|---|
| Type of sample | **Mn** | **Fe** | **Co** | **Ni** | **Cu** | **Zn** | **Se** |
| Meat | n=13<br>σ=0.52±0.19<br>Iv=0.26-0.85 | n=13<br>σ=148±123<br>Iv=56-521 | n=13<br>σ=0.012±0.006<br>Iv=0.006-0.024 | n=13<br>σ=0.049±0.014<br>Iv=0.026-0.077 | n=13<br>31,4<br>Iv=3.28-277 | n=13<br>σ=19.8±8.4<br>Iv=7.3-37.2 | n=13<br>σ=0.37±0.35<br>Iv=0.10-1.49 |
| Liver | n=5<br>σ=2.85±0.57<br>Iv=2,36-3.65 | n=5<br>σ=885±846<br>Iv=162-2249 | n=5<br>σ=0.029±0.013<br>Iv=0.020-0.052 | n=5<br>σ=0.093±0.019<br>Iv=0.078-0.125 | n=5<br>49.9<br>Iv=2.41-232 | n=5<br>σ=30.7±20.0<br>Iv=17.7-66.1 | n=5<br>σ=1.04±0.26<br>Iv=0.76-1.33 |
| Kidneys | n=5<br>σ=1.30±0.47<br>Iv=0.82-2.00 | n=5<br>σ=160±38<br>Iv=119-220 | n=5<br>σ=0.044±0.026<br>Iv=0.028-0.090 | n=5<br>σ=0.098±0.023<br>Iv=0.082-0.137 | n=5<br>σ=4.16±0.54<br>Iv=3.59-4.84 | n=5<br>σ=19.1±3.2<br>Iv=16.4-24.5 | n=5<br>σ=1.31±0.45<br>Iv=083-2.01 |
| Heart | n=1<br>0.72 | n=1<br>104 | n=1<br>0.023 | n=1<br>0.097 | n=1<br>5.41 | n=1<br>27.0 | n=1<br>0.21 |

## Conclusion

The results presented in this paper indicate that in the examined samples of wild birds the most represented elements were iron, copper and zinc. The highest concentration of manganese was detected in the liver, and selenium in the kidneys. It is important to note that the presence of nickel and cobalt was surprisingly high and all the examined tissues and organs contained measurable amounts. Therefore, in further research special attention should be given to examining the cause and origin of these elements in soils and plants. It is indicated that chemical contamination is present in all parts of biosphere and should be systematically monitored in order to identify possible trends aiming at fulfilling the requirements for producing healthy food and protection of the environment. The hazardous agents should be tested in as many as possible samples in order to protect wild birds by detecting the sources of pollution and gaining a more realistic view of the examined areas.

## References

[1] Milošević M., Vitorović S.: *Osnovi toksikologije sa elemetima ekotoksikologije,* 151-156, Naučna knjiga, Beograd, 1992. [2] Saičić, S., Bastić, Lj., Perović, M., Ristić, S.: *Određivanje arsena i teških metala u mesu i organima divljači*, Tehnologija mesa, 2-3, 223-226, 1995. [3] Mihaljev Ž.,Vesković M., Đurić G.: *Game as bioindicator of the radiocontamination*, Acta Veterinaria, 40, 229-234, Beograd, 1990. [4] Živanov D.: *Veterinarska toksikologija*, Fakultet veterinarske medicine, 10-12, Beograd, 2001. [5] Mašić Z., Kljajić R., Mihaljev Ž., Živkov-Baloš M., Đilas S.: *Teški metali u životnoj sredini kao faktor poremećaja zdravlja životinja*, 13. Savetovanje veterinara Srbije, Zbornik radova, referat po pozivu, 115-126, Zlatibor, 2001. [6] Wüst W.: *Die Brutvögel Mitteleuropas*, Bayerischer Schulbuch-Verlag, München, 1970. [7] Mihaljev Ž., Živkov M., Pavkov S., Kljajić R.: *The radioactivity level of radionuclides and the content of pesticide and toxic metals in pheasants*, XIth International Congress of the World Veterinary Poultry Association, Abstracts, 301, Budapest, Hungarian Branch of the World Veterinary Poultry Association 1997. [8] Mihaljev Ž., Đurić G., Slivka J.: *Ugroženost ždralova radionuklidima i toksičnim hemijskim materijama*, Zbornik radova 4. Simpozijuma ″Divljač i priroda″, 206-210, Brioni, Savez veterinara i veterinarskih tehničara Jugoslavije, 1991. [9] Kljajić R., Pavkov S., Mašić Z., Mihaljev Ž, Mitrović R., Radošević P.: *Levels of radionuclides, toxic metals and organochlorine insecticides in the meat of hunting game*, Archives of toxicology, kinetics and xenobiotic metabolism, 377-378, Tara, 1994. [10] Kastori, R.: *Heavy metals in the environment*, Naučni institut za ratarstvo i povrtarstvo, 261-297, Novi Sad, 1997. [11] Puls R.: *Mineral levels in animal health*, Sherpa International, Clearbrook, Canada, 1990.