RESEARCHES ABOUT THE EVALUATION OF STORAGE LEVEL FOR HEAVY METALS IN SOME MACROMYCETES SPECIES HARVESTED FROM FORESTRY ECOSYSTEMS OF DÂMBOVIŢA COUNTY

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This work is part of one research project won by national competition which has as main aim to identify the macromycetes species which can accumulate in high quantities heavy metals in their fruitbody. It were analysed four macromycetes species: Coriolus versicolor, Stereum hirsutum (growing on tree bark), Calvatia caelata and Geastrum triplex (growing on soil), harvested from forestry ecosystems of Dambovita county. In the same time were prelevated substrate samples under each macromycetes species. It were determinated heavy metals as iron, manganese, chromium, copper, lead, zincum, cobalt, nickel. Also was determinated the pH of substrate. So, it were determinated the iron concentrations between 0,32% and 2,46%, minimum obtained in Geastrum triplex and maximum in Stereum hirsutum. The lead was in trace in all cases analysed. The lead content registered was minimum 0,01% in Stereum hirsutum and maximum 0,05% in Coriolus versicolor. The level accumulation for iron was calculated at 89% for Coriolus versicolor and 367% for Stereum hirsutum. The last one species is hyperacculator for iron. Calvatia caelata and Geastrum triplex had a very low affinity for iron accumulation, only 17%. Higher concentration of cobalt and nickel were in Coriolus versicolor and Stereum hirsutum.

***Key words**: macromycetes, heavy metals, hyperaccumulation*

All over the world are developing more and more in the last years the studies concerning chemical, biochemical and physiological features of edible macromycetes (mushrooms) in the view to promot them as a natural source for human nourishment (3,5,7). But in United States of America, Australia, Africa and not in the last in Europe, the studies are focused on those macromycetes species which are hyperaccumulators for heavy metals in the view to be used as natural sources for heavy metals in bioreccuperation technologies (2,3,4,5,6,7).

That's why it were analysed in this study some macromycetes species unknown from the point of view of these aspects. Three macromycetes species are not edible, but one of them could be considered with ornamental value - *Geastrum triplex* (popular name being „*the star of the land*"). Only *Calvatia caelata* is edible in the earlier phenological phase. All studied species are ubiquitarian all over the forestry ecosystems of Dambovita county, but *Calvatia caelata* and *Geastrum triplex* are growing as isolated samples.

MATERIAL AND METHOD

Biological samples consisted in four macromycetes species: *Coriolus versicolor, Stereum hirsutum* (growing on tree bark), *Calvatia caelata and Geastrum triplex* (growing on soil), harvested from forestry ecosystems of Dambovita county. In the same time were prelevated substrate samples under each fruitbody of macromycetes species. It were determinated heavy metals as iron, manganese, chromium, copper, lead, zincum, cobalt and nickel. Also was determinated the pH of their substrate (soil or tree bark).

Biological samples and their substrate samples have been weighed and then dried at 60^0C some hours. After drying the samples have been grinded until to fine powder and weighed again. The samples prepared in this way were analysed by EDXRF (fluorescence –spectrometer) method with ELVA-X. For the evaluation of EDXRF results was used the certified reference sample NIST SRM 1571-Orchard leaves (1). The sensitivity of method is 1ppm. The results were exprimated in percents (%). Every result represent the average of values obtained on some different samples, all of them having the same size approximately. It was calculated the level of accumulation for heavy metals by folowing mathematics equation:

$$L_C\% = \frac{C_m \times 100}{C_s}$$

Were: *Lc%*=level of metal concentration; *Cm* =metal concentration in mushroom; *Cs* = metal content in substrate.

RESULTS AND DISCUSSIONS

It was determinated a higher iron concentration in fruitbody than in substrate only in case of *Stereum hirsutum*. *Coriolus versicolor* accumulated a quantity of iron in lower concentration than that of it substrate. *Geastrum triplex* and *Calvatia caelata* cannot storage iron in important concentrations (*fig. 1*). Concerning chromium accumulation on can say that all the studied macromycetes species had a important concentration, maximum was registered in *Coriolus versicolor* and minimum in *Geastrum triplex* (*fig. 2*). *Calvatia caelata* storage a medium quantity of chromium comparatively to the others.

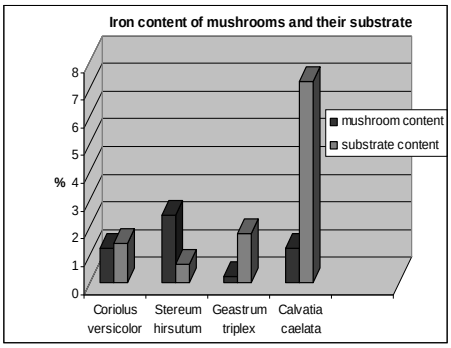

Figure 1 **Iron content of samples**

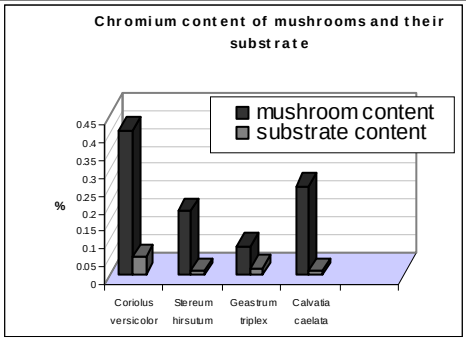

Figure 2 **Chromium content of samples**

About zincum content, on can see that only *Coriolus versicolor* absorbed at half comparing to the substrate content. The others three macromycetes species accumulated more than their substrate concentration, maximum being obtained in *Calvatia caelata* and minimum in *Stereum hirsutum* (*fig. 3*).

The lead was obtained in higher quantities in macromycetes than in their substrate in three cases, minimum being in *Stereum hirsutum* and maximum in *Coriolus versicolor* (*fig. 4*). *Geastrum triplex* had a concentration of lead at half than substrate concentration.

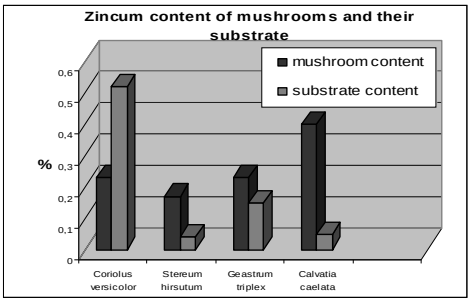

Figure 3 **Zincum content of samples**

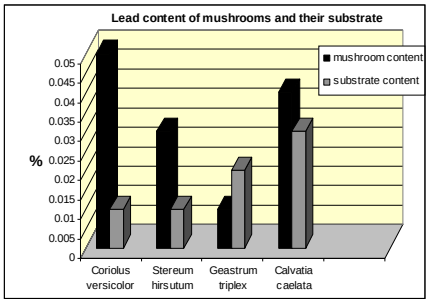

Figure 4 **Lead content of samples**

In case of manganese the analyses show a small quantitity accumulated in plus in fruitbody of *Coriolus versicolor* comparatively with the substrate, in the others three cases the concentrations of this metal being smaller than in their substrates (*fig. 5*).

Only *Coriolus versicolor* and *Stereum hirsutum* stored higher concentrations of cobalt much more comparatively to their substrate (*fig. 6*). *Geastrum triplex* and *Calvatia caelata* had lower quantities of cobalt than the substrate content in all cases.

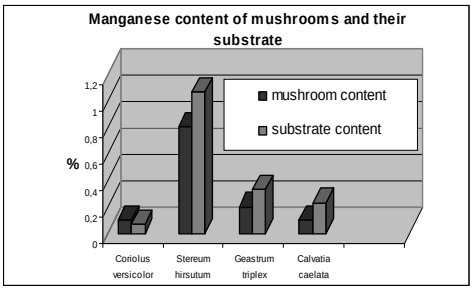

Figure 5 **Manganese content of samples**

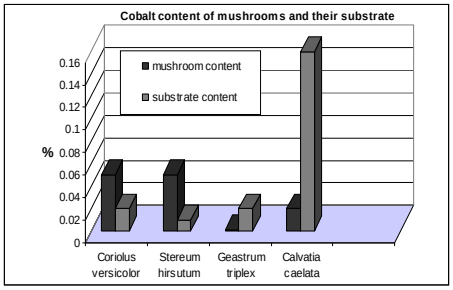

Figure 6 **Cobalt content of samples**

All studied macromycetes species accumulated higher quantities of copper, minimum was detected in *Geastrum triplex* and maximum in *Calvatia caelata* (*fig. 7*). Nickel was in trace in *Geastrum triplex*, *Calvatia caelata* and their substrate. On the contrary, *Coriolus versicolor* and *Stereum hirsutum* absorbed very important quantities than their substrate content (*fig. 8*). The greatest concentration of nickel was registered in *Stereum hirsutum.*

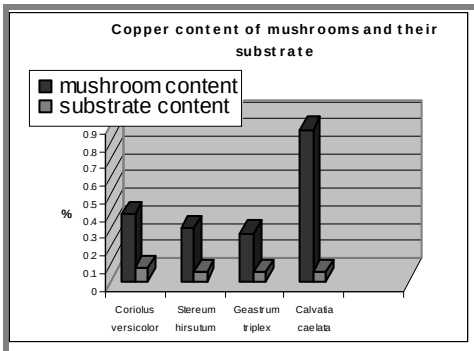

Figure 7 **Copper content of samples**

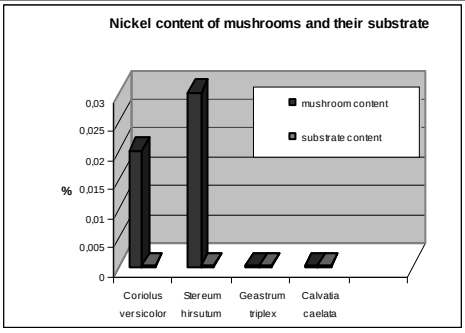

Figure 8 **Nickel content of samples**

In *table 1* there are calculated the percent of storage for each heavy metal species in fruitbody of four macromycetes species studied. On can see that chromium and copper were accumulated in all cases in important quantities mo matter of substrate type. Only *Coriolus versicolor* stored manganese and *Stereum hirsutum* concentrated iron. Concerning cobalt and nickel, they were absorbed in *Coriolus versicolor* and *Stereum hirsutum*. All macromycetes species studied accumulated in high concentration chromium and copper comparatively to substrate content.

Table 1

Accumulation level of heavy metals in four macromycetes species studied

No crt	Macromycetes species	Metal in (%)							
		Fe	Cr	Zn	Pb	Mn	Co	Cu	Ni
1	*Coriolus versicolor*	-	820	-	250	142	2500	750	2000
2	*Stereum hirsutum*	367	1800	425	300	-	500	600	3000
3	*Geastrum triplex*	-	400	153	-	-	-	540	-
4	*Calvatia caelata*	-	2500	800	133	-	-	1740	-

CONCLUSIONS

1. *Coriolus versicolor* accumulated important quantities of chromium, lead, copper and nickel, cobalt and manganese.

2. *Stereum hirsutum* absorbed iron, chromium, zincum, lead, cobalt, copper, nickel and cobalt.

3. *Stereum hirsutum* had a great affinity for chromium and nickel.

4. *Geastrum triplex* stored only chromium, zincum and copper, all in medium quantities.

5. *Calvatia caelata* concentrated chromium, zincum, lead and cobalt.

6. *Coriolus versicolor* and *Stereum hirsutum* stored cobalt and nickel in higher quantities generaly.

7. Iron was determinated only in fruitbody of *Stereum hirsutum*

8. Manganese was registered only in *Coriolus versicolor.*

9. *Stereum hirsutum* and *Calvatia caelata* are obviously hyper accumulation for chromium.

10. *Coriolus versicolor* and *Stereum hirsutum* are hyper accumulators for nickel.

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