Possibilities to Use Some Indicative Fodder Plants and Animal Organs as a Criterion for Valuation on the Grade of Pollution with Copper and Zinc in Industrial Regions

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SUMMARY

The grade of pollution by copper and zinc in a polluted region was determined systematically by indicative fodder plants (alfalfa, red clover, wheat and rye-grass). The comparison with an unpolluted region confirmed and established the following dependences:

- All indicative plants accumulate 2-6 times more copper and 1.5-2.5 times more zinc than those in unpolluted region;

- Copper and zinc concentrations decrease when the vegetation stage of pasture grass advances (1.8-2.5 times) and between first and third mowing of alfalfa (2-2.5 times);

- Copper concentration in the sheep livers increases abruptly as the Cu content in the fodder plant increase when approaching the emission source;

- The zinc accumulation in the sheep ribs increases, too, but detains and decreases at high Cu levels.

INTRODUCTION

Many factors which are investigated by different authors make difficult the exact and objective evaluation of the grade of pollution by heavy metals. On one hand it is influenced by the kind and composition of the emission and its spread by air-dusting and irrigating way. On the other hand, the polymetal pollution affects not only directly the animal metabolite processes, but some antagonistic and synergistic interactions between the elements can take place (ANKE,1986). And third, there are species, race, age and population differences of animal sensibility to diverse concentrations of heavy metals.

That is why we investigated together the essential elements - Cu and Zn, simultaneously in indicative fodder plants (ANKE et al.,1987; SZENTMIHALYI et al.,1986) and internal animal organs from sensitive to higher Cu and Zn concentrations animals. Except that we must conform with geological structure and origin of the soils (ANKE et al., 1987; FRUHAUF and ZIERDT,1990) as well as with geographic and climatic factors (SCHUMANN and RAUCH, 1990; SHUMANN and HAASE, 1984)

MATERIALS AND METHODS

The investigation has been concentrated on a region with a 20 km diameter where copper-obtaining and ore-dressing factories have been functioning for nearly 25 years with low effectivity of the existing purification systems. We have not conformed with the geological structure of the soils and its origin since it is homogeneous.

One hundred twenty nine materials from fodder plants and 86 from animals have been analyzed. The alfalfa, red clover, wheat and rye-grass have been used as indicators. The plants were collected in May and July, 1990.

The investigation in the unpolluted region has been carried out at the same time and with similar geological origin of the soils. The average age of the sheep was about three years.

The analyses of Cu and Zn concentrations were made by AAS. The statistic treatment of the obtained results was made by Student's t-test.

RESULTS and DISCUSSION

1.Comparative evaluation of the grade of Cu and Zn accumulation in fodder plants:

The quantity of Cu in fodder plants depends not only on Cu content in the soil, but also on the plant species. The different plants are with specific copper accumulation. We selected some plants from the investigated region, which first - can be used as indicators for Cu and Zn pollution and second - they are wide-spread ones (Table 1).

Table 1: **Copper content in indicative plants in two regions (mg/kg DM).**

Plants	Polluted region		Unpolluted region		P	%
	x	s	x	s		
Alfalfa	43,22	17.48	6.54	0.6	<0.001	661
Red clover	22.46	14.79	10.00	0.4	>0.05	225
Wheat	29.00	19.40	8.00	0.4	<0.05	363
Rye-grass	25.71	13.23	6.20	1.5	<0.01	415

All indicative plants accumulate 2-6 times more Cu than those in the unpolluted region. The differences are significant except for the red clover, because of the lower number of the collected materials and the great fluctuation of Cu content (15-59 mg/kg Dry Matter). The highest difference is exhibited in the case of alfalfa - 6.61 times ($p<0.001$).

It turned out that the rye-grass is a very representative plant species. It occupies a considerable part of the pasture grass in the polluted region and considerably influences the sheep.

A similar but weaker dependence has been established for the accumulation of Zn (1.5-2 times). It cannot be concluded that great pollution by Zn is present in this case and eventual positive protective effect with respect to Cu accumulation in sheep should be excluded (Table 2).

Table 2: **Zinc content in indicative plants in two regions (mg/kg DM).**

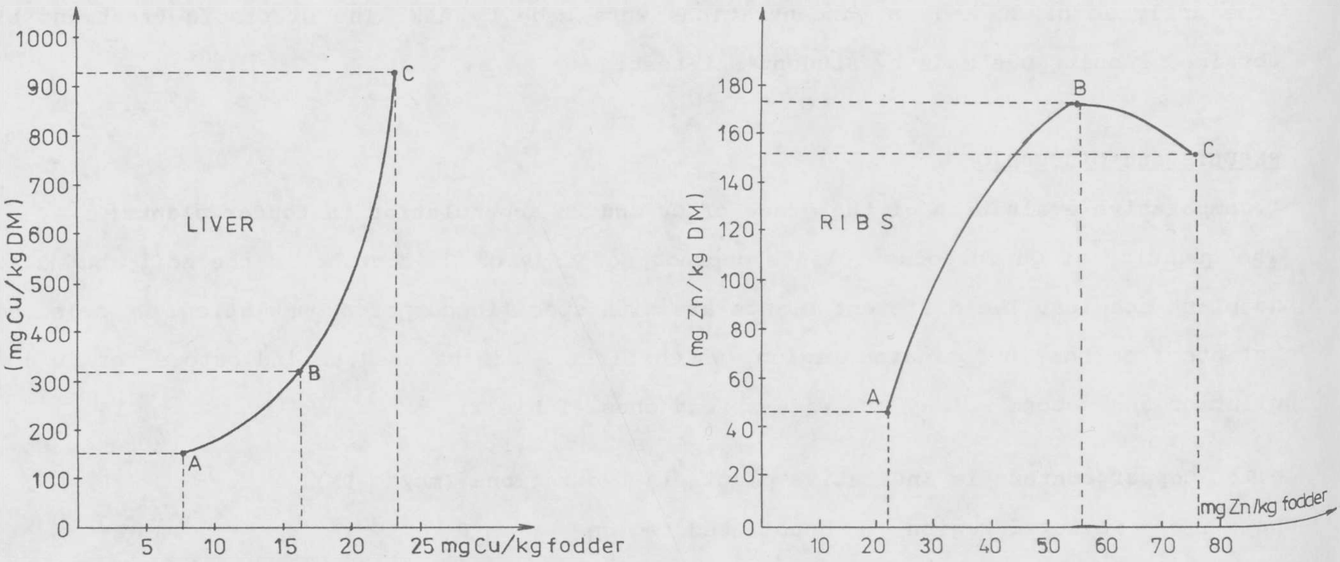
Plants	Polluted region		Unpolluted region		p	%
	x	s	x	s		
Alfalfa	62.69	25.73	40.01	3.07	<0.05	156
Red clover	42.71	12.67	40.03	3.44	>0.05	107
Wheat	50.85	25.19	20.07	1.73	<0.01	254
Rye-grass	54.47	6.17	22.66	3.07	<0.001	240

The difference in the increase of Zn content in rye-grass is more weaker than that in alfalfa. The data is compared with the results of SZENTMIHALYI et al.,1985.

2. Influence of mowing number and vegetation stage on Cu and Zn content in the polluted region:

Tables 3 and 4 show that the significant decrease of Cu and Zn concentrations is approximately twice between first and the third mowing of alfalfa and between different influence of Cu antagonists (S, Mo, Cd, Zn) on its resorption and absorption from animal organism is reduced (UNDERWOOD,1977).

Fig. 1 and 2: **Relationships between Cu and Zn levels in fodder and in sheep liver and ribs.**



In this investigation we used 3 objects (marked as A, B and C), which are at different distance from the emission source. Figure 1 shows that with increase of Cu content in fodder plants (when approaching the emission source) the concentration of Cu in the sheep livers increases, too. Above the critical level of 20 mg/kg DM Cu in fodders abrupt accumulation in vegetation stages of the pasture grass. There is an analogical effect in the polluted region (ANKE et al.,1987; SZENTMIHALYI et al.,1985), but the decrease is not so well pronounced.

These results are very important for sheep bred in polluted regions. The importance is justified by the practical possibilities to decrease the Cu consumption. From a practical point of view the changes in the Cu content in different alfalfa mowing are more important than those in different vegetation stages.

Table 3: **Influence of mowing of alfalfa on Cu and Zn content (mg/kg DM).**

Elements	First mowing x	s	Third mowing x	s	p	%
Copper	43.22	17.48	16.91	4.83	<0.01	255
Zinc	62.69	25.73	35.30	4.22	<0.05	178

Table 4: **Influence of vegetation stage of pasture grass on Cu and Zn content (mg/kg DM).**

Elements	May, 16-th x	s	July, 19-th x	s	p	%
Copper	22.82	9.58	9.07	3.13	<0.001	252
Zinc	68.42	34.34	34.12	10.57	<0.01	201

3. **Investigation of the relationship between Cu and Zn content in fodders, fed in farms, which are at different distance from emission source and the same content in indicative internal organs from sheep, bred in these farms:**

The liver is an indicative organ for Cu poisoning in sheep (ANKE and GRÜN,1982). This organ presents very well the Cu status of sheep. This dependence gets stronger as the

the liver starts, which is an indicator for chronic copper poisoning. The data correlates with the results from other authors (ZERVAS et al.,1989; HILL,1974), obtained in experimental conditions with varying Cu parameters and at constant level of Cu antagonists.

The ribs are indicative for the animal zinc status (ANKE and GRÜN,1982). Figure 2 compares the Zn content in the same fodder plants on the objects and Zn concentration in the ribs from the corresponding sheep. Zinc content in the ribs increases from 47 mg/kg DM in object "A" (where are some symptoms of Zn deficiency) to 173 mg/kg DM in object "B". In object "C", although the Zn content in the fodder plants is the largest, there is a decrease of Zn concentration in the ribs, owing to depressing of the Zn resorption at the high Cu levels.

CONCLUSIONS

The industrial pollution by copper and zinc can be determined by indicative plants and internal organs from sheep. The obtained relationships could be used as a basis for ecological evaluations and for preventive actions in similar polluted regions.

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