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Original Research

A Trial to Assess Environmental Polution by Means of Fluoride Content in Hen Bones

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Abstract

The fluoride content in drinking water and hen ankle bones of 48 localities in northern and central Poland was determined. The mean fluoride concentration in water was 0.1 – 0.4 mg/l, in bones 0.4 – 0.6 mg/g. An insignificat correlation between the fluoride content in hen bones and drinking water was found in this study. Hen bones are not well suited for use as a bioindicator for assessment of environmental fluoride pollution.

Keywords: hen bones; water; fluoride; environmental contamination.

Introduction

Higher fluoride levels in the environment may be of natural or anthropogenic origin. Elevated fluoride levels in water result from water-bearing soil layers containing considerable amounts of soluble fluorides. Especially high fluoride levels in water are found in China, India and Africa [1, 2, 3]. Higher fluoride levels in water of anthropogenic origin are usually found in the vicinity of aluminium or iron foundries, phosphate fertlizer plants, brickyards, glass works and oil refineries. The presence of elevated levels of fluoride in the environment justifies the search for useful indicators of exposure. It has been proved that human urinary fluoride concentration closely parallels intake levels in drinking water [4]. Also, hair provides a useful indicator of environmental and occupational exposure [5, 6]. Machoy [7] found that the bones as well as the antlers of deer may provide a reliable material for assessment of environmental pollution by fluoride. Attempts were also made to evaluate pollution on the basis of fluoride content in hen egg shells [8, 9].

The aim of this study was to determine whether fluoride content in hen bones may be used as an indicator of environmental contamination and also to establish whether a correlation between water fluoride and fluoride in hen bones occurs. The ankle bones of hens were selected as a common material with fluoride accumulation.

Experiment

Collection of Samples

Samples of drinking water and hen bones were collected in different communities of northern and central Poland (Figure 1). Hen bones were collected from 48 individual farms. In each locality at least two samples of both materials (water and bones) were taken.

Preparation of Samples

Fluoride content in samples of drinking water was determined directly after dilution by equal volumes of TISAB buffer.

TISAB buffer: 57 ml of acetic acid, 58 g sodium chloride, and 0.3 g sodium citrate were diluted with water and adjusted with sodium hydroxide to pH 5.2 and made up to 1 liter.

The ankle bones of hens (aged about 1 year) were boiled and cleaned from soft tissues and bone marrow, dried at 100°C to constant weight and pulverised in a mortar. Specimens (0.05 g) placed in poliethylene tubes were extracted with 3 ml of 3 M perchloric acid for 1 hr. at room temperature.

The samples were then centrifuged and 0.5 ml of 0.5



Fig. 1. Locations of sampling.

M sodium citrate solution and 6.5 ml of redistillated water were added to the supernatant.

Determination of Fluoride

Fluoride concentrations were measured by a fluoride – specific electrode against a Ag/AgCl reference electrode with a double jacket [5]. The coefficient of variation in bone samples was 1.4%, in water 5%. Recoveries from bones were 100 ± 7%, from water 100 ± 1%. The accuracy of measurements was tested with *Behring* and *Nycomed* reference samples. The determined levels fell within the assigned 5% confidence range.

Results and Discussion

The concentrations of fluoride in water and bones are presented in Table I. The dispersion of results in both investigated materials is considerably high. The obtained results confirm our previous findings that in most localities the fluoride level in water in northern and central Poland was within the range 0.2 – 0.3 mg/l [10]. Similar results in this area were also found by other authors [11]. Only in a few communities did the estimated fluoride level in water surpass the Polish standard value of 1.5 mg/l.

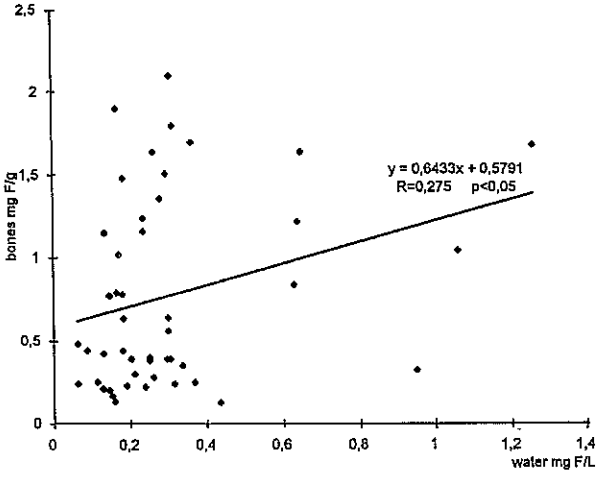


Fig. 2. Correlations between fluoride contents in bones and water.

The most common fluoride level in hen bones was within the range 0.4 – 0.5 mg/g. However, in many samples fluoride content was higher (1.0 – 2.0 mg/g). No significant differences in the bone fluoride content were found between the samples collected in urban and rural regions.

Table 1. Fluoride content in drinking water and hen bones.

	Water		Bones	
	mg F/l	number of samples	mg F/g	number of samples
1	0.1	3	0.2	4
2	0.2	16	0.4	16
3	0.3	15	0.6	6
4	0.4	7	0.8	5
5	0.5	1	1	1
6	0.6	0	1.2	4
7	0.7	3	1.4	4
8	0.8	0	1.6	2
9	0.9	0	1.8	5
10	above 9.0	3	above 1.8	2
		Σ 48		Σ 48

An insignificat correlation (r = 0.275) between the fluoride concentrations in hen bones and drinking water was found in this study (Figure 2). This seems to indicate that despite the fact that fluoride intake in animals derives chiefly from drinking water, other variables like feed, soil, and the emission of volatile fluorine compounds strongly influence fluoride level in bones.

Age also influences this parameter. The fluoride level in human bones is distinctly age-dependent [12]. We found a similar interrelationship in hens, but the number of birds in this study does not allow a generalization. The age of birds used in this study was defined only by a statement of the respective farmers and could not be controlled otherwise.

Vikoren and Stuve [13] in a study performed in Norway on Canada geese (*Branta canadiensis*) determined the fluoride level in bones of birds originating from areas with different exposures to fluoride pollution. They found that this species is not well suited for use as a bioindicator for monitoring fluoride exposure.

The results of this study seem to indicate that more variables than could ever be sufficiently controlled influence fluoride content in bones. Therefore, the use of hen bones as an indicator of environmental contamination would be of little practical value.

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