Bromine in the delta of the Neretva River environment and increased bladder cancer incidence

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Bromine is often used in agrochemicals, especially for citrus fruit protection, but it is rarely analysed in sediments, water or biota. This is probably because it is generally not considered as a pollutant harmful for human health. However, recent toxicological, epidemiologic and clinical studies have been shown evidences on the bromine role in bladder cancer in relation to humans exposure to brominated trihalomethanes in drinking water and swimming pools were bromine is used as a disinfectant (Cantor et al. 1998; Cantor et al. 2010; King and Marrett 1996; McGeehin et al. 1993; Villanueva et al. 2004; Villanueva et al. 2007, Richardson et al. 2010, Gan et al. 2013).

In this survey we have investigated mortality rates and disease incidences of all malignant neoplasms (C00.0-C97.0) and malignant neoplasms of the bladder (C67.0-C67.9) for the period 1999-2008 in Dubrovacko-Neretvanska County (DNC) and delta of the Neretva River. Neretva delta valley is the largest citrus producing area in Croatia. The results showed that despite a steady increase, the mortality rates of all cancers in the DNC were below the Croatian average, while mortality rates of the bladder cancer were above it. In order to investigate if there is a correlation between concentrations of bromine in the environment and health of the local population, we have collected and analysed 506 samples of sediment and soil and disease incidence data for 7 municipalities in the Neretva delta valley, which are the smallest administrative units for which health data inventory has been conducted.

Samples were dried in an oven at 105°C and analysed by using Energy Dispersive X-ray Fluorescent, which is as a non-destructive method very suitable for bromine analysis. Bromine concentrations in Neretva valley varied between 5 and 5400 mg/kg. Median was 390 mg/kg. Those values are much above concentrations reported in the literature (Kabata, Pendias and Pendias 1984; Lalor 1995). Linear regression analysis of bromine medians in sediments and soils calculated for municipalities Slivno, Zažablje, Kula Norinska, Pojezerje, Ploče, Metkovič and Opuzen and their average bladder cancer incidence for 10 years period showed statistically significant correlation ($r=0,73$, $p<0,05$). Among additionally analyzed elements (K, Ca, Ti, V, Cr, Mn, Fe, Cu, Zn, Ga, As, Rb, Sr, Y, Zr, Pb) only potassium showed positive correlation although not statistically significant ($r=0,62$, $p<0,05$). Since potassium is also an element commonly used in agricultural measures, it could be concluded that both elements have the anthropogenic source of distribution related to intensive agricultural activities in the Neretva valley.

Humans may be exposed to bromine substances in sediment and soil by direct inhalation of air dust or volatiles, indirect consumption of contaminated food and water, or inhalation and dermal absorption during bathing, showering and recreation in contaminated water. Soil salinity, which is often associated with intensive agricultural activities in coastal areas, significantly influences the solubility of some chemicals and increases the threat of human exposure to toxic elements (Romic et al. 2012).

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