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Arsenic in Norway Lobster (*Nephrophs norvegicus* L.) from Kvarnerić Bay—Northeastern Adriatic

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Arsenic is of concern as environmental pollutant because it is a ubiquitous element known to give rise to adverse human health effects ranging from minor disorders to cancer and acute death. Arsenic occurence in the environment depends on such human activities as coal burning, use of pesticides, glass industry, electric application, veternary medicine, etc. (Hanush et al. 1985). It has long been known that marine fishery products may contain high levels of arsenic (Luten et al. 1982; Mohri et al. 1990). Fortunately, mainly in the organic, non-toxic form, with the average proportion of organic form in total arsenic between 71 - 79% (Dabeka and Lacroix 1987) and 50 - 97% (Vaessen and Van Oik 1989). According to Lawrence et al. (1986), arsenic in marine fish was identified as arsenobetaine and, in shrimp only, arsenocholine.

This paper examines the levels of total arsenic in the sample of the muscle and hepatopancreas of female and male Norway lobser, *Nephrophs norvegicus L.* from the area of Kvarnerić Bay, Northeastern Adriatic (Croatia). The average values of arsenic in muscle from female and male lobster were 13.26 mg (kg and 14.20. mg/kg, respectively. In hepatopancreas the values were 17.12 mg/kg and 13.34 mg/kg for female and male, respectively.

MATERIALS AND METHODS

Ten female and ten male Norway lobster, *Nephrophs norvegicus L.*, were collected by trawler in the area of Kvarnerić Bay, Northeastern Adriatic, at the beginning of June 1991 (Fig. 1). The average length of male (rostum-telson) was 128.3 mm and carpace length 36.8 mm, respectively, with a weight of 41.5 g. The average length of females was 119.6 mm, carpace length measuring 33.9 mm, with a weight of 29.5 g.

The hepatopancreas and muscle were removed and prepared for analysis of total arsenic concentration. Arsenic content was determined by using atomic

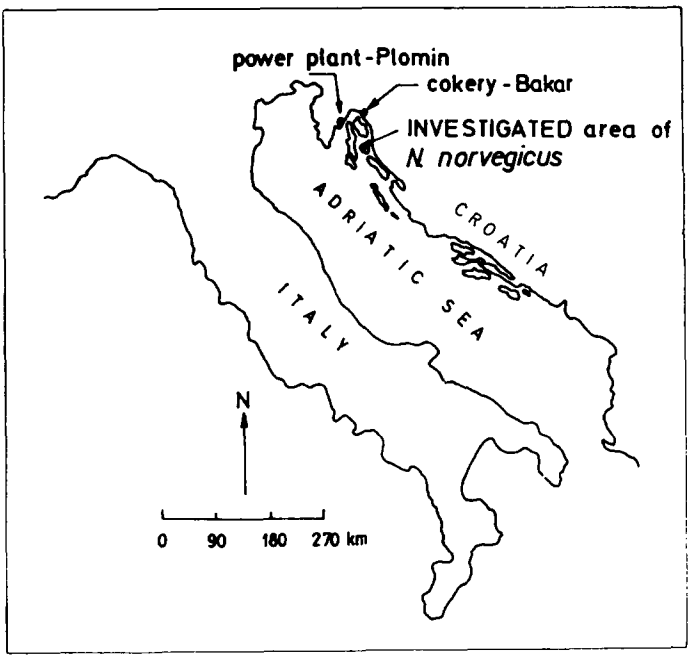

Figure 1. Investigation area of arsenic in Norway lobster (*Nephrophs norvegicus* L.) from Kvarnerić Bay - NE Adriatic

absorption spectrophotometry (AAS) with a hydride technique on a sample of muscle and hepatopancreas weighing 0.5 - 1.0 g. The technique detection limit and recovery values were 0.001 mg/kg, and 90 - 95%, respectively. After the dry destruction of organic matter at 450^{o} C, with a prior addition of magnesium oxide and magnesium nitrate (Skurikhin 1989), the amount of total arsenic was measured in Pye Unicam SP9 spectrophotometer with a

Continuous Flow Vapour System PU 9060. An arsenic holow cathode lamp was used with the measurements being taken at a wavelength of 193.7 nm.

RESULTS AND DISCUSSION

There were several reasons for using the Norway lobster as a test organism in this study. Firstly, it is a semisessile decapod of the sea botoom where all natural and man-made materials are deposited, arsenic included. Secondly, for being a first class delicious food and having the above habitat Norway lobster is according to our previous results (Sekulić et al. 1993) a good bioindicator of environmental arsenic load. The results of analyses are

presented in Table 1. All levels of arsenic are expressed as mg total arsenic/kg fresh weight and have been corrected for recovery efficiency.

Table 1. Concentration of arsenic (mg/kg fresh weight) in muscle and hepatopancreas of Norway lobster, *Nephrophs norvegicus L.* (Kvarnerić - NE Adriatic Sea)

Variable	muscle		hepatopancreas	
	female	male	female	male
Number of samples	10	10	4	9
Range	5.37-21.39	7.56-20.60	6.92-26.86	4.10-23.36
Average	13.26	14.20	17.12	13.34
Standard error	1.39	1.39	5.02	2.11

Hepatopancreas, especially of the female, was found to contain slightly higher, though statistically insignificant, levels of arsenic than the male and female muscle tissues. Muscle tissues, both female and male, values exceeded the maximum allowances set by our regulations (Pravilnik, 1983). In fact, our regulations do not permit more than 4 mg total arsenic/kg in the edible part of such organisms (on fresh weight). According to the results shown in Table 1, the muscle tissues of the analysed samples do not comply with our regulations. Obviously, muscle tissues are, as a rule, a site of rather high arsenic accumulation (Ishinishi et al. 1986). In any case, arsenic levels found in our samples were 10 to 20 times less than those obtained by the x-ray fluorescence method in a pilot sample of *Nephrophs norvegicus* from the same area (Sekulić et al. 1993).

According to Vaessen and Van Oik (1989), the inorganic portion in total arsenic varies between 3% and 50%. From the assumption that the proportion of inorganic arsenic in relation to total arsenic in our Norway lobster is as low as 3%, it may readily be inferred that the amount of inorganic arsenic could vary between 0.16 and 0.64 mg/kg, and from 0.22 to 0.62 mg/kg for female and male muscle, respectively. This means that the tolerable daily intake (2 µg/kg body weight - WHO, 1983), is very easy to exceed if relatively high quantitiy of Norway lobster, especially those which contain larger amounts of arsenic, are consumed.

Future research must clearly be directed to also determining the proportion of the inorganic and organic arsenic in the total arsenic concentration in benthic and pelagic organisms alike, as well as in phyto and zooplankton, in order to establish the distribution of arsenic in the entire trophic chain of the Adriatic Sea.

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