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LEAD IN OCTOPUS (*OCTOPUS VULGARIS*) IN PORTUGAL: A PRELIMINARY STUDY

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Aquatic organisms are good indicators of environmental variations as they may accumulate natural compounds and pollutants in their tissues and organs depending on their bioavailability in the ecosystem.

Anthropogenic activity has contributed to a progressive rise of pollutant levels in estuarine and coastal regions. Among these pollutants, lead (Pb) represents a major public health concern due to its high toxicity (Duc et al., 1994). Lead is a heavy metal that has deleterious effects in cells, can form relatively long-lasting compounds with organic molecules and accumulate in the food chain (Widdows, 1985). Lead and other toxic elements have always been present in the environment, but the industrial growth altered the relative availability of these compounds and the form in which they are dispersed. Although atmospheric lead has decreased in the last decade significant lead levels in marine organisms seem to be maintained.

The importance of cephalopods as a marine resource is reflected in their relative economic status as a high value fishery product in Portugal. Specifically *Octopus vulgaris* is an abundant species on the Portuguese coast and frequently used for human consumption. The octopus is a versatile benthic animal with a high growth rate and relatively short life cycle, present in a range of marine environments and at different depths. They consume crustaceans, bivalves, fish and other cephalopods and may have potential as a bioindicator organism providing a qualitative approach to environment contamination.

Methods

Octopuses were sampled from two important fishing grounds landing from the commercially fishery in Viana do Castelo and Cascais in November 1999. At least 10 animals were randomly collected from each site, ensuring only that an equal number of males and females were included. In this work, three males and three females from each site were analysed. The Cascais region encompasses a capture area on the west coast influenced by the River Tagus estuary, one of biggest in Europe. Viana do Castelo is also located on the west coast in the North, close to the province of Galicia in Spain.

The sex and maturation status, total body weight and length were recorded. From each animal mantle, arm, gill, digestive gland, branchial heart were sampled.

The tissue samples were subjected to acid digestion and three aliquots of 10 μl were analysed their elemental contents such as lead (Pb) by the multielemental technique, Particle Induced X-ray Emission (PIXE) (Pinheiro et al., 1997) with a minimum detection limit of 0.6 mg kg^{-1} dry weight.

Results

The octopus collected from both regions, Cascais and Viana do Castelo were similar in size and total body weight. For each animal, the different tissue Pb contents are shown in Table 1. High Pb concentrations were observed for the digestive gland and branchial hearts. For one animal of each group Pb was determined in mantle muscle and for one female and male animals from Cascais and one male from Viana do Castelo Pb was

Table 1. Pb concentrations, for six animals captured at each zone (C, Cascais, and VC, Viana do Castelo), expressed in mg kg^{-1} of dry weight tissue. The average wet to dry weight ratio (W/D) for digestive gland, branchial heart, gills and mantle is indicated also in the table.

Local/ Animal	Gender	Weight (g)	Digestive gland (mg kg^{-1})	Branchial heart (mg kg^{-1})	Gill (mg kg^{-1})	Mantle (mg kg^{-1})
C-1	F	985	6.7	0.87	<mdl	0.8
C-2	F	1,115	11.3	2.5	<mdl	<mdl
C-3	F	860	13.5	18.6	2.3	<mdl
C-4	M	850	7.5	<mdl	<mdl	4.8
C-5	M	1,695	3.6	11.1	1.1	<mdl
C-6	M	2,160	0.14	<mdl	<mdl	<mdl
VC-1	F	1,040	3.8	4.0	<mdl	1.0
VC-2	F	1,490	6.5	12.8	<mdl	<mdl
VC-3	F	1,280	2.1	<mdl	<mdl	2.3
VC-4	M	1,145	<mdl	<mdl	2.4	<mdl
VC-5	M	1,580	6.7	<mdl	<mdl	5.8
VC-6	M	1,390	5.4	<mdl	<mdl	<mdl
W / D			2.3 ± 0.2	4.4 ± 0.2	5.0 ± 0.3	5.0 ± 0.5

mdl – Minimum detection limit

detected in gill tissue. Levels in digestive gland tissue varied widely between individuals (Table 1).

The Pb concentration levels in branchial hearts varied even more widely than in digestive gland. For all the females animals captured at Cascais and for two females captured at Viana do Castelo Pb was detected in branchial hearts. In contrast only one male from Cascais showed Pb contents in branchial hearts above the detection limit of the technique.

For the arm tissue, Pb was always below the detection limit for the technique (not shown in Table 1).

The wet to dry weight ratio for each tissue is also listed in Table 1, to allow conversion of concentrations listed to a wet tissue weight. The average values for wet to dry weight ratio are based on the total number of animals studied. It should be noted that the mantle wet to dry weight ratio presented in Table 1 is based on the five animals where Pb was detected above minimum detection limit.

Discussion

The presence of high lead concentration in certain octopus organs suggests accumulation of this element preferentially in the digestive gland and branchial heart.

The tendency for higher Pb levels in animals landed at Cascais may be related to the proximity of the estuary of Tagus River as well as other smaller river basins to the fishing ground. The levels of lead in seawater in Cascais region ranged from 0.7 to 1.7 μg L^{-1} (Costa et al., 1999). In contrast the lead level in seawater near Viana do Castelo was reported to be an average 0.17μg L^{-1} (Mucha et al., 1999).

The Pb concentrations detected in mantle tissue were below the limit level proposed by the European Commission for unprocessed foods which is of 1 mg kg^{-1} (wet weight) (EC1254, 1985), but higher than the value for fish indicated by FAO (2.5–3.0 mg kg^{-1},

dry weight) (FAO, 1983). It has also to be taken into account that the concentration determined in mantle tissue is generally applicable to the edible parts (mantle and arms).

The levels of Pb found in octopus are high when compared with other species captured at similar sites such as in *Mytilus galloprovinciallis*, captured at Viana do Castelo where a Pb concentration of 0.6 mg kg^{-1} dry weight was reported (Vale et al., 1985). A wide study in UK of lead values accumulated in shellfish (including squids) showed 0.27 mg kg^{-1} wet weight, and in all marine fishes analysed Pb was at an average of 0.01 mg kg^{-1} wet weight (MAFF, 1998).

Further studies on the Pb variability in different organs and tissues will be required to assess any seasonal influence and therefore to estimate the bioindicator potentiality of octopus for Pb and other heavy metal exposure.

Although Pb levels in octopus can reach quite high values for metabolic and excretion organs for the edible parts, as this preliminary work shows, the Pb contents were systematically below the recommended limit values for food in European Community.

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