Abstract

Polychlorinated biphenyls (PCBs) and dichlorodiphenyl trichloroethane (DDT) are persisten organic pollutants (POPs) that can bioaccumulate and present deleterious effects on the ecosystems. POPs are chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissues of living organisms and are toxic to humans and wildlife. POPs circulate globally and can cause damage wherever they travel, particularly in marine environments.

Because the knowledge of bioaccumulation mechanisms of these compounds is still limited, this study intends to contribute to a better understanding of bioaccumulation of PCBs, DDT and metabolites in two fish species with socio-economical relevance in Portugal. Besides the study of accumulation of the organochlorines, we will go further studying some biological factors that may influence the accumulation. For this the two species of fish selected were: sardine (*Sardina pilchardus*, Walbaum, 1792), captured in the Portuguese coast, because it has a long spawning period with a known variation of lipid content; and seabass (*Dicentrarchus labrax,* Linnaeus, 1758) captured both in the wild and in fish farming, which will allow to study two different food chains.

All the samples of sardine and seabass from natural environments and seabass from the wild and from aquaculture analysed in this work presented levels of organochlorines below the existing recommendation limits for human consumption. The accumulation profiles of PCBs and DDTs were in agreement with the generally reported, the most abundant compounds were those which are reported as recalcitrant, PCB congeners 153 and 138, and *p,p'*-DDE. This indicates that there was no recent input of these compounds to the studied environments.

In sardine the influence of the reproductive cycle in the accumulation of PCBs and DDTs was evaluated in several tissues (muscle, liver and gonads) in individuals of both genders over an annual reproductive cycle. The organochlorines accumulation was related to reproductive cycle through the variation of lipid content (that reproduction implies). The uptake of organochlorines usually followed the increase of lipid content. Differences were found between male and female sardines concerning PCB elimination, males showing lower capacity to eliminate PCBs with 2 -4 *ortho* chlorine atoms and without *meta*, *para* vicinal hydrogen atoms. These differences could not be related to the eggs/sperm excretion because differences in gonad composition were not found.

In seabass it was possible to evaluate the influence of food chain and water contamination on the uptake and the biological mechanisms involved in the elimination of the contaminants. It was possible to quantify the effects of respiration and food assimilation

rates on PCBs accumulation, and the differences produced by these factors on seabass of different sizes. In seabass of different sizes were not found significant differences of the total PCB concentrations. However, the lower chlorinated congeners (CB18, 44, 49 and 52) showed higher accumulation in smaller fish than in the adult fish. Usually food was the major source of PCBs to the seabass. However, for lower chlorinated PCBs water had a significant contribution, especially for smaller fish.

PCBs elimination rate constants were higher in juvenile seabass than in adults. This is due to the higher contact of smaller fish with the water and food (in relation to fish weight), because they have higher respiration and food ingestion rate constants. The increase in the concentrations of lower chlorinated PCBs in juvenile seabass verified in coastal lagoon and in fish farming can be justified by the difference in respiratory and feeding rate constants.

The metabolization of PCBs was not significant when compared with the other elimination mechanisms, however, we could verify that metabolization was higher in adults than in juveniles. Accumulation of hydroxilated – PCB metabolites (OH-PCBs) in plasma was slow, and accumulation of these compounds during a short period when the fish were exposed to an acute contamination was lower than the reported in other species for a chronic exposure to lower levels.

The reaction of the analysed biomarkers (ethoxyresorufin O deethylase – EROD and glutathione S-transferase – GST activities) to PCBs was low. In juvenile seabass, EROD activity was reduced when PCB concentrations increased in tissues, and GST activities were higher and correlated to CB levels. In adult seabass, EROD activity was not affected by exposure; GST activity was lower than in juveniles but also increased with exposure.

This work provided relevant tools to environmental risk assessment of organochlorines, validated to the sardines and the seabass in Portuguese environments. This tools may also be used as reference to other species and environments. It is also a positive contribute to the evaluation of food safety, providing information on the good quality (in terms of organochlorines contamination) of Portuguese sardine and seabass.