ORGANOCHLORINES IN CULTIVATED SEA BASS AND IN DIET

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Introduction

The main source of organochlorines bioaccumulation seems to be the food[1] and marine species are considered one of the most important sources of organochlorines for human population[2]. Therefore, it is essential to inventory the levels of these contaminants in marine organisms and find ways to reduce these levels.
Aquaculture has been developed in the past decades and sea bass (*Dicentrarchus labrax*) is one of the main species produced in Portugal. The levels of organochlorines of commercial formulations of diets used in fish farming can influence the concentrations of fish produced in these systems of culture[3]. In this study eighteen polychlorinated biphenyl (PCB) congeners and p,p'-DDT compounds were quantified in cultivated sea bass from two farms and the influence of size and diet contamination in bioaccumulation of these compounds was evaluated.

Methods and Materials

In November 2002 sea bass samples were collected in two farms located in distinct zones. Length and weight were measured and selected individuals of two length classes (Table 1). The muscle and liver of individual fish as well as sub-samples of the two different packing lots of commercial feed supplied to fish farming were taken for chemical analysis. PCBs (IUPAC Nos 18, 26, 52, 49, 44, 101, 151, 149, 118, 153, 105, 138, 187, 183, 128, 180, 170, 194) and DDT compounds (p,p'-DDE, p,p'-DDD and p,p'-DDT) were analysed in freeze-dried tissues and in diet pellets following the method described in Antunes and Gil[4]. Samples were Soxhlet extracted with hexane during 6 h. Fat content was determined gravimetrically from aliquots of the extracts. The remaining extracts were cleaned-up with Florisil and sulphuric acid and the determination of PCBs and DDTs was performed by gas chromatography with electron capture detector (ECD).
One way analysis of variance was used to compare concentrations. A 5% significance level was used for the statistical tests.

Table 1: Length (cm) and weight (g) ranges of sea bass from farms 1 and 2.

		n	Length (cm)	Weight (g)
Farm 1	Class II	6	26 – 28	219 – 308
Farm 2	Class I	5	16 – 22	55 – 126
	Class II	5	30 – 31	334 – 456

Results and Discussion

Organochlorine concentrations

In most samples p,p'-DDT was below the quantification limit, while DDE represents 75 to 86% of the quantified metabolites. Therefore, only DDE values will be presented in this paper. The PCB composition in the analysed samples was similar, so it is valid to consider tPCB for the comparison between the samples. Congeners 153 and 138 (hexachlorobiphenyls) were the dominant ones, as usually reported for most fish samples. Figure 1 shows the mean concentration of tPCB (calculated

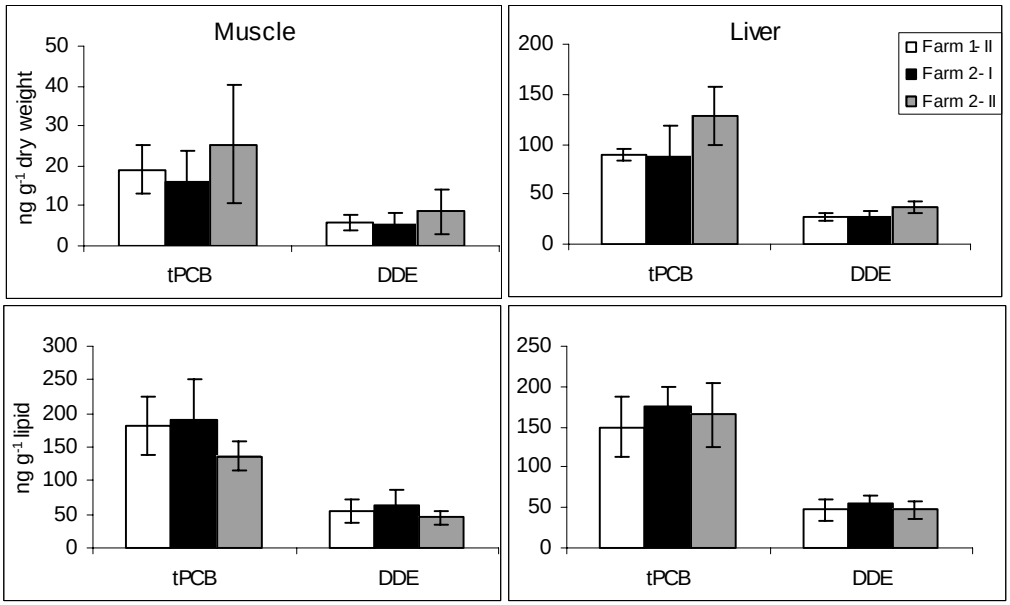

Figure 1: Mean concentration of tPCB and DDE (ng g^{-1}) and standard deviation, in muscle and liver of cultivated sea bass.

as the sum of individual CB levels) and DDE in tissues of the two size classes of sea bass, both dry weight and lipid basis. The results show that organochlorine concentrations were comparable in the two length classes of fish from farm 2 and, in general, in fish from the two farms. Only class II organisms from farm 2 showed, in liver, higher levels of tPCB than those from farm 1. Liver

showed higher mean concentrations than muscle, as expected attending to their lipid content (63% in liver and 12% in muscle) and to the influence of lipids in bioaccumulation of organochlorines[5, 6]. Normalization of concentrations to lipid content reduced the variability between muscle and liver. In both tissues the concentration of tPCB was at least 2.6 fold higher than DDE.
Organochlorine concentrations didn't change significantly between the commercial diets used in the two size classes of sea bass (Fig. 2). Like in fish tissues, higher concentrations of tPCB in relation to DDE were also recorded. This fact is not in agreement with observations made by the same authors[7], who recorded similar levels of these contaminants in tissues of sea bass collected in farm 2 in 1999 and in diet pellets.

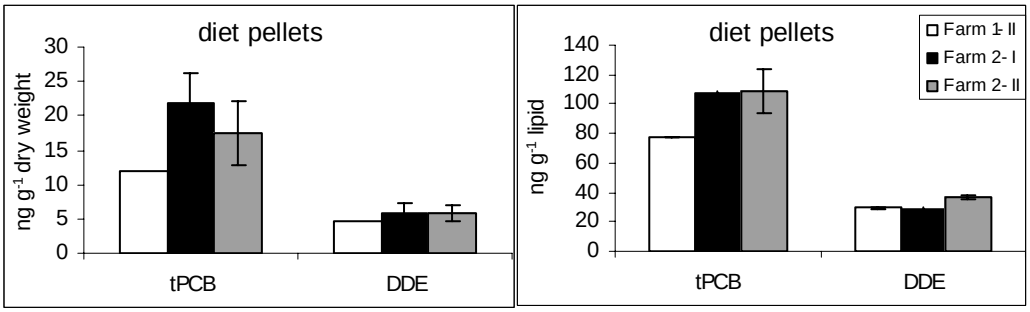

Figure 2: Mean concentration of tPCB and DDE (ng g^{-1}) and standard deviation, in diet pellets supplied to the two length classes of cultivated sea bass.

A high difference in DDE concentrations was also observed between the two studies, in sea bass (1999 [7]: 35 ng g^{-1} and 170 ng g^{-1}; 2002: 6.5 ng g^{-1} and 30 ng g^{-1}, respectively in muscle and liver), as well as in diet pellets (1999 [7]: 24 ng g^{-1}; 2002: 5.6 ng g^{-1}). For tPCB significant differences were only recorded in liver. In the present study, lipids in sea bass muscle were similar to those of the previous study and liver showed higher values, so, lipid content does not explain the observed differences in dry weight concentrations of fish tissues analysed in the two studies.

Biomagnification factors

The bioaccumulation of organochlorines is dependent of numerous factors[1]. Diet contamination has been referred as a factor of major importance[3]. In Table 2, the biomagnification factors (BMF), calculated as the ratio between concentrations in fish tissues and in diet pellets recorded in the two sampling periods (1999 and 2002), are compared. In general, BMF values were higher than 1, indicating biomagnification of PCBs and DDE present in the diet. Younger individuals showed lower values, although significant differences were only observed in liver.

Table 2: Biomagnification factors (BMF = ratio between the concentrations in sea bass tissues and the concentration in the diet pellets). Different letters denote statistical differences within the column (Scheffé test).

		year - Class	BMF	
			tPCB	DDE
Muscle	Farm 2	99 - II	1.5 [a]	1.4 [a]
	Farm 1	02 - II	1.5 [a]	1.2 [a]
	Farm 2	02 - I	0.7 [a]	0.9 [a]
	Farm 2	02 - II	1.4 [a]	1.5 [a]
Liver	Farm 2	99 - II	7.3 [c]	7.1 [c]
	Farm 1	02 - II	7.4 [c]	6.1 [b, c]
	Farm 2	02 - I	4.0 [b]	4.7 [b]
	Farm 2	02 - II	7.2 [c]	6.2 [b, c]

Despite the high difference of DDE concentrations in sea bass tissues and diet pellets observed in the two sampling periods with a high reduction in 2002, it can be seen that, in general, similar BMF values were recorded for PCBs and DDE in the two studies (Table 2), indicating that food has a significant contribution for the organochlorine contamination. These results indicate that a strategy to reduce the levels of organochlorines in fish could be the control of the levels of these contaminants in diet.

References

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