LEVELS OF ORGANOCHLORINE PESTICIDES IN MARKET FISHERY PRODUCTS SOLD IN HSINCHU, TAIWAN

Eric M.L. Liou[1], L.P. Chen, F.F. Lei, Y.C. Liu, S.W. Chen, and Y.C. Ling

Department of Chemistry, National Tsing Hua University, Hsinchu, 300, Taiwan. ROC
[1]Environmental Quality Protection Foundation, Taipei, 106 Taiwan, ROC.

Introduction

Increasing population, agricultural activities and industrial development have made chemical pollution an issue of global concern. The chemical wastes from the society will eventually sink in the world ocean. Among these wastes, organochlorine pesticides (OCPs) have received increasing attention because of their extended use, long half-life time, high accumulation potential, harmful biological effects, and inevitable impacts to the environment. This global issue is significant to Taiwan because most Taiwan fisheries products were not locally produced; rather they were mainly imported. This might explain that despite the fact that OCPs were banned in Taiwan since the early 1970, public concern about trace OCPs in seafood is still prevailed.

In 1998, the total fisheries production from Taiwan was 1346326 metric tones volume with an estimated value of $ 95.2 billion NT dollars. The production volume was 839190, 209721, 43609, 24154, 467, 229185 metric tones for deep-sea fishing, offshore fishing, coastal fishing, marine-culture, inland fishing and inland aquaculture, respectively. The estimated production value was $49.2, 14.5, 4.4, 3.8, 0.2, 23.1 billion NT dollars, respectively. Taiwan has a population of 22.1 million. Based on these statistical data, the averaged daily intake of fisheries products by a Taiwanese is estimated to be 167 gram. An estimated 83 % of the consumed fisheries come from marine. It is clear that seafood is a major component of local diet.

The aim of this study was to survey the levels of 16 OCPs (α-, β-, γ-, and δ-benzene hexachloride (BHC), heptachlor, aldrin, heptachlor epoxide, endosulfan I, 4,4'-DDE, dieldrin, endrin, 4,4'-DDD, endosulfan II, endrin aldehyde, endosulfan sulfate, and 4,4'-DDT) in 30 commonly consumed fishery products available from the local market.

Materials and Methods

30 fishery products were purchased from traditional seafood market and supermarket in Hsinchu on September 2000. They are: Whitespotted pigface bream, Crescentgbanded grunter, Doctor fish, Atlantic salmon, Chub Mackerel, Golden thread, Largehead hairtail, Spotted chub mackerel, Razorfish, Red bulleye, Milkfish, Small yellow coaker, Japanese seaperch, Korean mackerel, Sweet fish, Neritic squid, Cuttle fish, Silver sillago, Crag leg, Spear shrimp, Malabar grouper, Yellowfin tuna, Spottail shark, Grass carp, Swordfish, Silver pomfret, Dolphin fish, Tilapia, Red mouthbreeder, and Walleye Pollock.

The sampling is designed to mimic a housewife's daily basket shopping. The purchased amount is enough for one family meal. Some samples, for e.g. salmon, is therefore just a small portion cut from its original body. Some samples, for e.g., shrimp, consist of several ones. The edible portion was removed from the sample. Aliquots of the sample were used to determine the lipid content. The remaining sample was lyophilized at –50℃ for 2 days. The lyophilized sample was ground mechanically to obtain a homogeneous powder. Aliquots of the powder (~ 0.3 g) were extracted using supercritical fluid extraction with on-line cleanup of lipids, followed by gas chromatography with electron capture detection at ng/g levels[1].

Results and Discussion

The OCPs were detected in 14 out of the 30 samples. The detected OCPs concentration expressed as ng/g lipid are shown in Figure 1. They are 1792 (Whitespotted pigface bream), 969 (Crescentgbanded

grunter), 690 (Golden thread), 687 (Doctor fish), 528 (Largehead hairtail), 296 (Razorfish), 250 (Red bulleye), 175 (Chub Mackerel), 149 (Spotted chub mackerel), 133 (Atlantic salmon), 95 (Milkfish), 42 (Small yellow coaker), 33 (Japanese seaperch), and 20 (Korean mackerel) ng/g. The mean concentration is 195 ng/g lipid. A recent study of OCPs in Hong Kong fish found *p,p'*-DDT, *p,p'*-DDD, or *p,p'*-DDE in all 15 fish species[2], which is higher than the 47% positive detection rate of OCPs found in this study.

The detected OCPs, in the order of decreasing probability, are 10 total DDTs (the sum of *p,p'*-DDT, *p,p'*-DDD, and *p,p'*-DDE), 3 endosulfan II, 2 aldirn, 2 dieldrein, and 1 heptachlor. The total DDTs were the major contaminants. The OCPs in 2 fish were greater than the Australian National Food Authority Maximum Residue Limit (MRL)[3], for e.g. the total DDTs found in Whitespotted pigface bream (1.79 ppm) and the dieldrin found in Chub Mackerel (0.18 ppm). The relevant MRLs are 1.00 and 0.10 ppm, respectively.

Figure 2 shows the relationship between the OCPs concentration and the source of the fish. The sources of the fish are from deep-sea fishing (15 species), from offshore fishing (7 species), and from inland aquaculturing (8 species). The averaged OCPs concentration is 293, 144, and 56 ng/g, respectively. Fish from deep-sea fishing contains the greatest amount of OCPs. Based on the food-chain viewpoint, the higher burden of OCPs in deepwater biota might be the cause[4]. Fish from inland aquaculturing contains the least amount of OCPs. The ban of the agricultural use of OCPs by the ROC Government in the early 1970s has come into effect.

The DDE/total DDT ratio has been used as an indicator of the past history of DDT use. For e.g., the use of DDT was banned over two decades ago in the Great Lakes, the DDE usually accounted for 50-70 % of the fish collected there[2]. In this study, there are four fish species with DDE/total DDT ratio less 0.5 (Figure 3). The fish, in increasing order DDE/total DDT ratio, is Whitespotted pigface bream, Crescentgbanded grunter, Golden thread, and Largehead hairtail. The corresponding total DDT concentration is 1792, 969, 528 and 690 ng/g. The lower the DDE/total DDT ratio is the higher the total DDT concentration is, indicating these fish were colleted from area that DDT was recently used.

The sample size of this study is limited. Only 2 fish species exceed the relevant MRLs. Results suggest that OCPs in the local market fish should not pose any health hazard for consumption. However, 14 out of the 30 fish species were found to have OCPs. Total DDTs are the major OCPs. Fish species with high DDT contents were collected from area that DDT was recently used. Results suggest that on-going monitoring of OCPs in imported fish species is necessary to safeguard the residents from consuming polluted fish.

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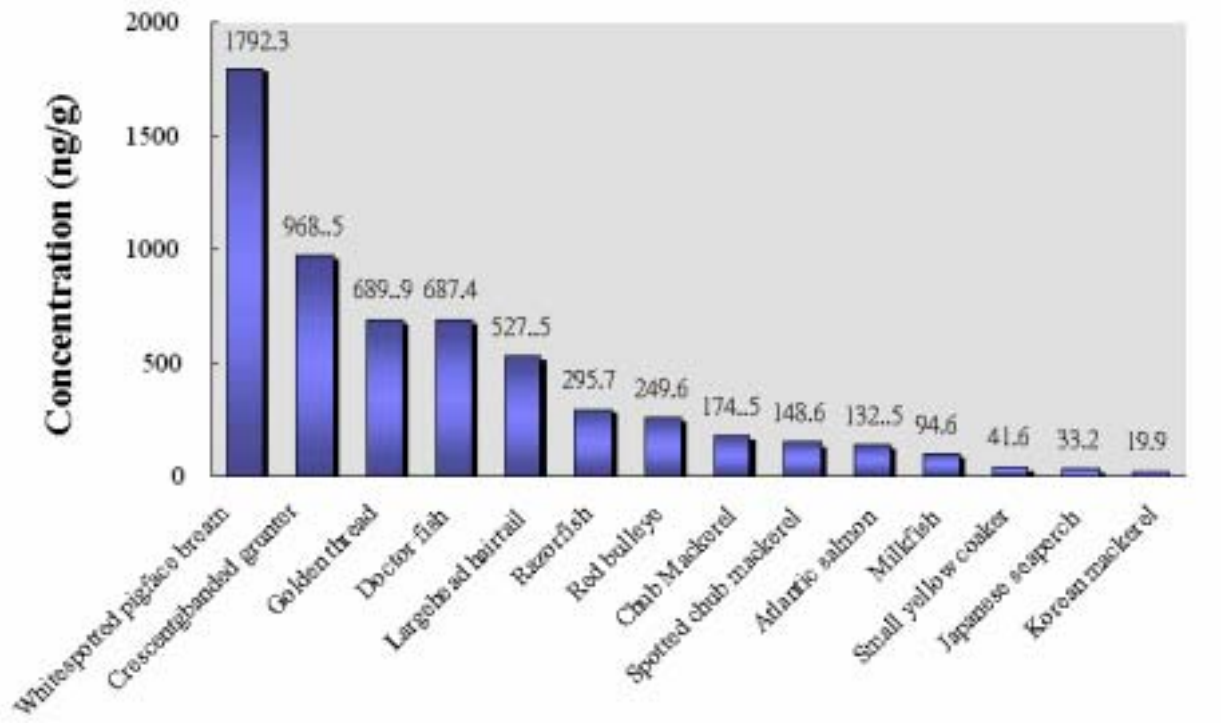

Figure 1. The OCPs concentration in market fish (lipid weight base)

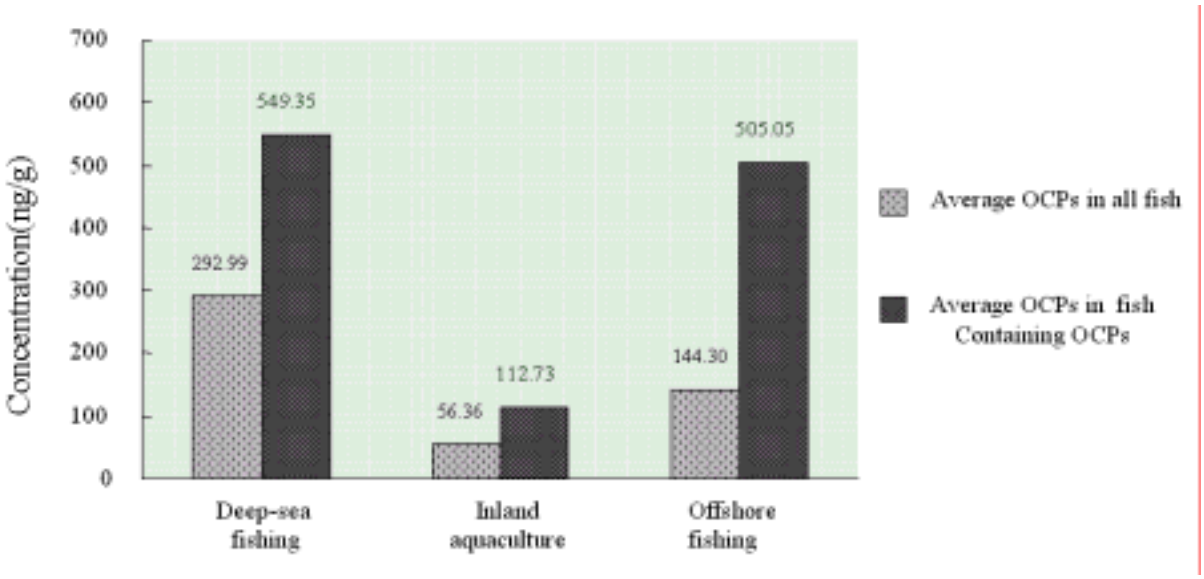

Figure 2. The relationship between OCPs concentration and fishing sources

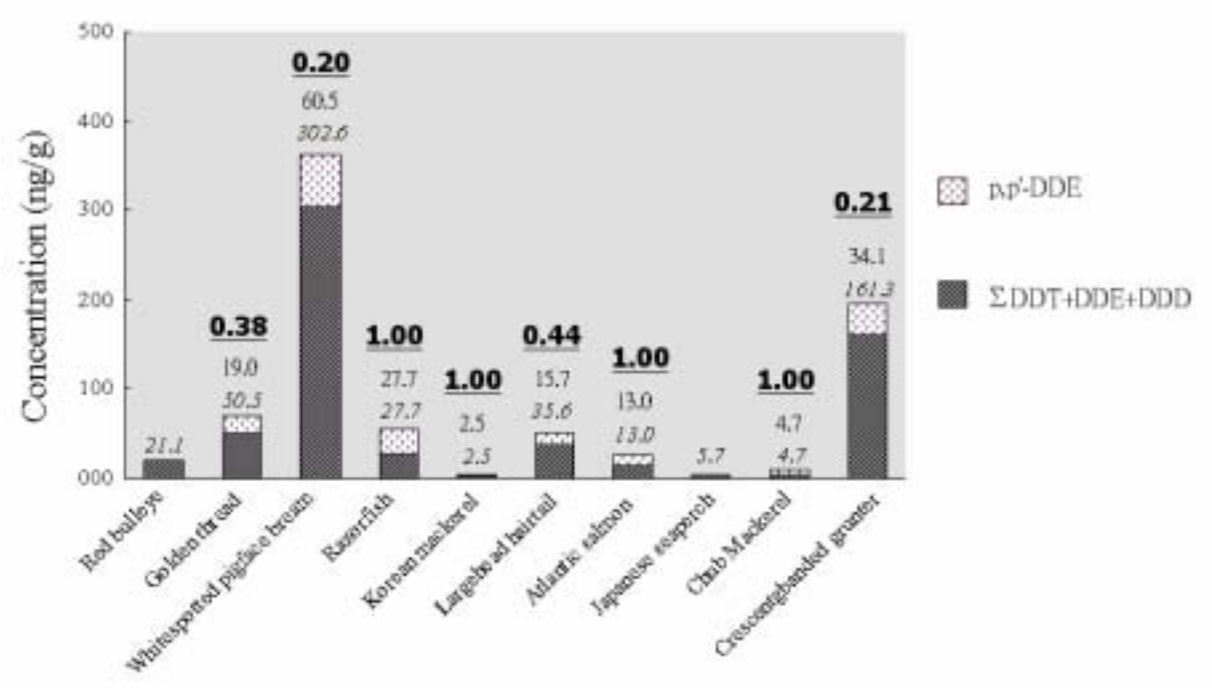

Figure 3. The DDE/total DDT ratio of fish species detected with DDT