DDT AND ITS METABOLITES IN FISHES COLLECTED AT THE PURUZINHO LAKE, AMAZON, BRAZIL

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Introduction

DDT, synthesized in 1874, was the first of the synthetic insecticides when it was rediscovered in 1939 to be used as a mothproof agent in wool. Since them it was largely used both in agriculture and in disease vector control against malaria, yellow fever and leishmaniasis. The first one is considered to be the one of the main focal disease of the world. At the Amazon region it is classified as an endemic disease. Allover the world it is estimated that the production is around 1.8 billion of kilograms[1].

DDT is the one of the most used and studied chemicals during the XX century, and have as its main metabolites DDE (dichlorodiphenyldichloroethilene) and DDD (dichlorodiphenyldicloroethane). It is capable of being accumulated in fat tissues and of biomagnification along the food chain.

Around 1970 the use of DDT was banned at most of the developed world due to its toxicity, environmental persistence and insect resistance [2, 4, 5]. The contamination by DDT is still a problem derived by its high stability that gender to high persistence in the environment, especially body fat. We believe that the majority of the DDT that was aerial sprayed around the globe, mixed to soil or to the seeds, or even that parcels that were used in vector control, found their way throughout the environment and is still cycling around the globe and are reaching different non target wildlife species, insect predators, soil microorganisms and aquatic organisms, potentially may have adverse effects upon them[3].

Among these effects we may cite the reduction on biodiversity, reproductive impairment in raptors, behavioral changes, increasing disease susceptibility that are derived from the biological magnification of this kind of residues[6]. This effect is directly related to the lipophylicity and to the chemical stability of DDT and related residues.

The physic-chemical and biological properties of DDT and its main metabolites, as well as to the other organcohlorinated compounds make them to be readily absorbed by the organisms. The accumulation rates varies among the species and maybe related to the environmental concentration at a given time, to the overall conditions of the site as well as to the time trend of the exposure. As a fat loving compound, DDT and its degradation products accumulate at animal's body fat, including human beings. The more exposed parcels of the population will present higher levels in their fat compartments.

The aquatic biota is an important reservoir of DDT, its metabolites and other organochlorines compounds and is a consequence of the biomagnification process along the food chains[7]. In animals the degradation of DDT follow mainly the dehydrochlorination step via DDE formation, but it may also degraded to DDD, in a minor scale[8]. The study of the DDE residues turns into a relevant one since it is the main metabolite found in animal tissues and its relative toxicity seems to be higher than the one presented by DDT itself.

Material and methods

Study area- The Puruzinho lake is located at Humaitá municipality in the utmost south region of the Amazonas State in Brazil (Fig. 1). It is formed by the Puruzinho river and it is located around 5 km from its mouth at the left margin of the Madeira River, one of the most important tributaries of the right margin of the Amazon River. The lake's area corresponds to 38 km^2 and its perimeter was calculated in 23.195 m [7].

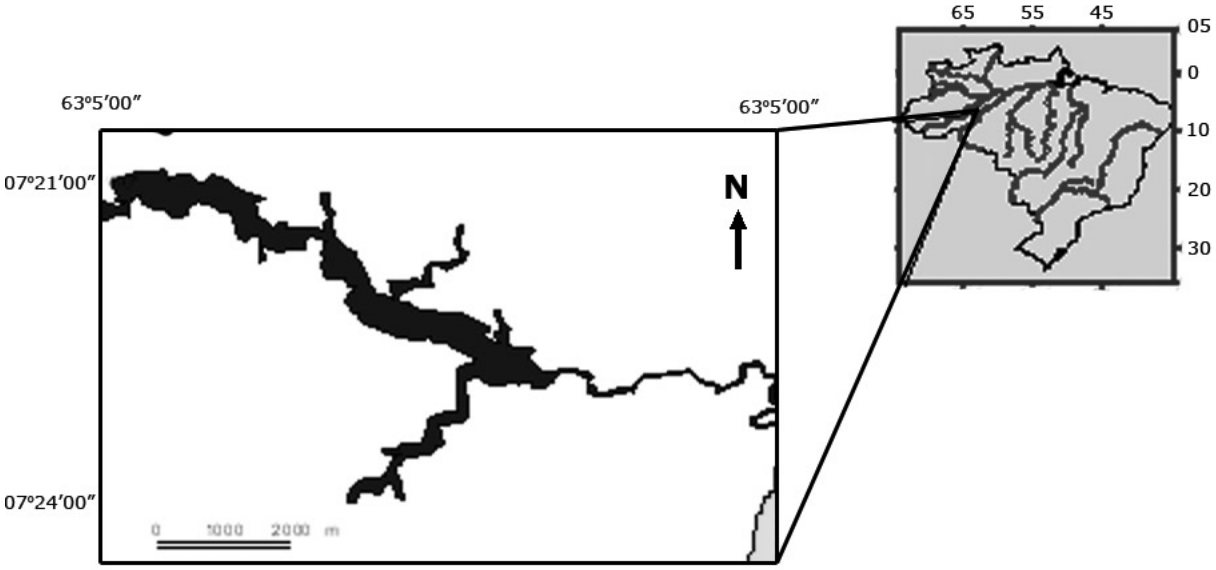

Figure 1: Study area**:** Puruzinho Lake – Humaitá /AM

The fish samples were collected at the Puruzinho Lake using fishing nets. The fishes were captures using 10m long nets, with different sizes (30, 40, 50, 60, 70, 80, 90, 100 and 120 mm)[8]. In total were installed atevery sampling points, three of this nets that were checked every four hours during 24 h.

The samples were collected at 20 points along the Puruzinho lake shore line, all of them where georeferenced using GPS (Garmin 48). Half of the samples comprises soils under or around the older houses of the community. The other 10 samples where collect inside the forest that are located near this houses. All of the samples correspond to the A soil horizon, using acetone rinsed metallic devices and where stored in acetone washed wide mouth glass jars closed with metal caps over an aluminum foil protection.

The determination of the persistent organic pollutants in the soil samples followed the method described by Japenga and co-workers[9], modified by Torres[10], consisting of four distinct consecutive steps: extraction (modified continuous soxleth with hexane and isooctane), clean-up (acid digestion of fat using sulfuric acid), fractionation (dry silica gel column) and automatic injection of 2µl (Shimadzu AOC-17, split less) high resolution gas chromatography coupled to an electron capture detector (Shimadzu GC-14B).

We used ultra-pure hydrogen (35 ml/min) trough the SE-30/SE-52 capillary columns (25 m; 0,2 mm ID; 0,25 µ film thickness) and ultra-pure N_2 was the make-up gas. The injector and the detector temperatures were set in 300°C and 310°C, respectively.

For quantification, an internal standard OCN (octachloronaphtalene) was added prior injection and the results were statistically evaluated and graphically described by box-plots using the software STATISTICA (version 6.0).

Results and Discussion

The Lab work for the determination of the DDT and its metabolites concentration were realized in 86 specimens of 21 different fish species collected at the Puruzinho Lake in march of 2005. All of the analysed samples presented residues of ∑DDT below the maximum limits recommended by the US-FDA in 2002 (United States Food and Drug Administration – 5 ppm)[11].

In the present work the minimum quantity of ∑DDT detected by the used technique was 0,6 $ng.g^{-1}$ while the maximum one was 71,6 $ng.g^{-1}$. The results are quite similar to those found by D'Amato[13] in fishes collected in 1991 (14,0 to 71,1 $ng.g^{-1}$) and higher to the ones collected in 2000 (6,5 to 16,7 $ng.g^{-1}$) .

The ratio DDT/DDE found at the present work was 0,49 (mean) and demonstrated that the residues are old and the ratio is lowering. This is clearer when we compare the present results with the ones of D'Amato[13]: 1,53 (1991) and 1,58 (2000) in fishes obtained at the local Market of Humaitá/AM, the Municipality where the Puruzinho Lake belongs.

Among the fishes with predatory habits the highest concentration of ∑DDT found was 14,1 $ng.g^{-1}$ (*Acestrorincus falcirostris* - Urubarana), while the species that eat preferentially fruits or detritus presented maximum values of 71,4 $ng.g^{-1}$ and 50,7 $ng.g^{-1}$, respectively. The specie that presented the highst levels of ∑DDT was *Potamorihna latior* (n=20), but the variation among this species was very high (<DL to 50,7 $ng.g^{-1}$), and this is an indication that the distribution of DDT and its metabolites is not homogeneous.

The fishes that have a detritivorous habit presented the highest concentrations of ∑DDT on its flesh when it was expected that the carnivorous ones would have more residues due to the biomagnification process. Looking to all of the results together we can affirm that there is a very large variation in the edible tissues of the fishes at the confirming a non homogeneous distribution stated above.

Taken in account the fact that the highest concentrations were found on non-predatory detritivorous fish, that are particularly eaten by the traditional riverine population, one question comes to our minds: at what point should we consider them at risk of being ill because of this pesticide? Does DDT represent a real menace to this people?

The efficacy of DDT on the malaria vector control in urban areas is unquestionable, since DDT was the synthetic molecule that had saved more lives along the last century. However, the study area is not urbanized and the huts were the people live, are not more that temporary housing made of wood and palm leaves. Thus, better housing may represent may be a better solution to improve their life quality and this may make a diference at such a place were people get malaria three time per year.

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