Fish contamination and human exposure to mercury in Tartarugalzinho River, Amapa State, Northern Amazon, Brazil. A screening approach

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Abstract. This study reports for the first time, the Hg concentrations in the fish fauna of the Tartarugalzinho river basin - an important gold mining region in Amapa State, Northern Amazon - and evaluates human exposure to Hg due to fish consumption in the area. We analyzed 16 fish species (carnivorous and omnivorous) common in the aquatic environment of the Tartarugalzinho area and which are mostly consumed by the local population. Mercury concentrations in fish ranged from 35 μg kg⁻¹ to 1,225 μg kg⁻¹. Among the analyzed fish, 8 species (50%) presented Hg concentrations higher than 500 μg kg⁻¹, the U.S. Food and Drug Administration (FDA) Action Level for concentration of Hg in fish. No statistical difference was observed between Hg mean concentrations in carnivorous and omnivorous fish. Within a given species, Hg concentrations were positively correlated with fish size or weight. The Hg concentration ratio between fish and water showed values higher than 50,000. Human exposure was estimated through the daily Hg intake obtained through interviews with the local population on the amount and species of fish consumed and the Hg concentration in the fish. The estimated average daily intake was 114 μg day⁻¹. This amount is approximately one-half of the WHO recommended provisional tolerable Hg weekly intake. At screening level, it assumes that there is a level of exposure (e.g., USEPA's RfD = Reference Dose) below which it is unlikely for even sensitive populations to experience adverse health effects. The estimated exposure level for adult humans (1.6 μg kg⁻¹ day⁻¹) was nearly 5 times greater than Hg RfD (0.3 μg kg⁻¹ day⁻¹). The results suggest a widespread Hg contamination in the local fish fauna. Due to high fish Hg concentrations and high fish intake by local population, environmental exposure to Hg is also high, presenting a health risk to population.

I. Introduction

Gold mining in the Amazon has witnessed intensive migration from traditional sites in southern and western Amazon to new gold fields along the Brazilian-Venezuelan border in recent years. Among these new areas, the Amapa State receives important emissions of Hg from gold mines ("garimpos"). The Tartarugalzinho river basin is located in Amapa State, Brazilian Northern Amazon, approximately at the latitude 00° 00' (Figure 1). 75% of Amapa State is covered by tropical rain forest, 20% by wetlands and flood plain lakes, with low levels of anthropogenic impact. This fact calls for conservation of these very fragile Amazon ecosystems.

According to CONEMA-AP (1994): gold mining employs over 15,000 prospectors, ~5% of the Amapa State population. Gold production reaches c.a. 1 ton yr\(^{-1}\) and 100% of "garimpos" use Hg, with a Hg/Au relationship in the amalgam higher than 2:1. Therefore, Hg emissions to the local environment can be estimated as between 1 and 2 tons yr\(^{-1}\) (Lacerda & Marins, 1996).

The Tartarugalzinho basin is a key area in this process since: (i) the Tartarugalzinho river flows into flood plain lakes directly linked to mangroves with very high biological productivity; (ii) local human groups still depend on fish as major protein source; (iii) local limnological conditions favor Hg methylation; (iv) the Tartarugalzinho constitutes the most important biological reserve in the Amapa State, due to its unique ecosystem types.

The general population is primarily exposed to MeHg through fish consumption. In this study we report for the first time on the Hg concentrations in the local fish fauna and evaluate potential human exposure to Hg due to fish consumption in the area. This work is a screening, i.e., rapidly identifying potentially important factors or phenomena to enable the elimination of those of lesser significance (IAEA, 1990).

2. Materials and Method

The 45 fish samples considered in this study are representatives of the 16 species (9 carnivorous and 7 omnivorous) caught and commercialized in the study area. Fish samples