DIOXIN LEVELS IN POULTRY EGGS IN VIETNAM

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Introduction

Being lipophilic and persistent in the environment PCDD/F and PCB are able to bio-accumulate intensively [1]. Poultry eggs (particularly chicken eggs) are widely used as bio-indicators of dioxin contamination and for human health risk assessment, for they are common food item, their sampling and transportation is relatively easy compared to the most other biological samples (such as blood, breast milk, meat), and their fat content is appropriate for dioxin analysis. Moreover, free-range hens can easily access and ingest soil particles and soil organisms, and therefore reflect environmental levels [2].

The aim of present study was to assess current levels of free-range poultry eggs contamination with dioxins in Vietnam. Large territories in the southern part of Vietnam were subjected to Agent Orange spraying, while northern territories were not. It is also worth-mentioning that northern part of Vietnam is generally less industrialized than southern.

Materials and methods

Chicken and duck eggs were collected from private housings from the following Vietnam provinces: Lao Cai, Yen Bai, Phu Tho and Vihn Phuc in northern part of Vietnam and Dong Nai, Binh Thuan, Ninh Thuan, Khanh Hoa, Dak Nong and Kon Tum in southern (fig. 1) A total of 22 chicken egg samples consisting of 2-6 individual eggs and 4 duck egg samples consisting of 3-4 individual eggs were analyzed. After sampling all eggs were hard boiled and freezed.

Prior to extraction samples were spiked with a mixture of 13C-labelled standards (EPA-23 ISS). Two extraction methods were used: pressurized liquid extraction [3] (1:1Hexane:Ethanol) and $(NH_4)_2SO_4$ salting-out extraction [4]. Clean-up procedure consisted of three steps: activated carbon column AX-21, multi-layer column and aluminum oxide column. Following purification recovery standards (EPA-23RS) were added. Extracts were then analyzed for PCDD/F and co-planar PCB using HRGC-HRMS method [4]. Lipid content was determined gravimetrically. Calculation of total TEQ was based on WHO-TEF_{2005} [5]. For values below the detection limit the respective detection limits were used.

Results and discussion

To assess background levels of dioxin contamination eggs from private housings in Sa Pa district Lao Cai province were chosen, for this district is located in mountainous area away from main traffic arteries and other evident dioxin sources. Mean value was 0.67 pg WHO-TEQ_{2005} g^{-1}lipid. For comparison, in the IPEN study the range from 0.2 to 1.2 pg WHO-TEQ_{1998} g^{-1}lipid was used as background level [2].

Total TEQs and 2,3,7,8-TCDD concentrations of analyzed chicken eggs are shown in fig.2.

All samples from the northern part of Vietnam were below the current EC limit of 2.5 pg WHO-TEQ_{2005} g^{-1}lipid. Whereas in the southern part of Vietnam PCDD/F concentrations in chicken egg samples from 8 sites exceeded this value.

The highest dioxin concentration was found in chicken eggs from private housing located near the Bien Hoa airport (107.6 pg WHO-TEQ_{2005} g^{-1}lipid), which is actually among the highest dioxin concentrations ever reported in chicken eggs (713.1, 125.8 and 121.6 pg WHO-TEQ_{1998} g^{-1}lipid 1 in Belgium [6], Egypt [2] and France [7] respectively). TEQs in eggs sampled in this area previously in 2007 and 2008 years were 39.3 and 50.2 pg WHO-TEQ_{2005} g^{-1}lipid respectively. Such a high level is due to the fact that during the Vietnam War a large US Air Force base and Agent Orange storage were located in the area. 2,3,7,8-TCDD contribution to total TEQ amounted to 84.5 %. Another dominant contributor was 1,2,3,7,8-PeCDD (8.4 %), while contributions of other congeners were lower than 2 % of total TEQ. Second highest concentration was found in housing in Ma Da logging site (16.3 pg WHO-TEQ_{2005} g^{-1}lipid), with 2,3,7,8-TCDD, 1,2,3,7,8-PeCDD and 2,3,4,7,8-PeCDF being dominant contributors to TEQ (59%, 21% and 6% respectively). Almost all other samples TEQs were

dominated mostly by 1,2,3,7,8-PeCDD and 2,3,4,7,8-PeCDF. Eggs from housings in the northern part of Vietnam as well as those from three housings in the southern part of Vietnam (viz. Ma Da national park, Dak Nong and Kon Tum provinces) had lower dioxin concentration, but still exceeded levels observed in free-range eggs from Greece (the highest concentration of 0.45 pg WHO-TEQ_{1998} g^{-1}lipid) [8].In all samples OCDD made the main contribution to the total PCDD/F concentration (30-88%), which is in line with other studies [9, 10]. However, its contribution to the total toxicity did not exceed 1.5 %.

Samples from several housings were also analysed for co-planar PCB. Dominant contributors to PCB TEQ were PCB-126 and PCB-169. As shown in fig.3 PCB-126 concentration was substantially higher than that of PCB-169. TEQ values of sum of these two PCB ranged from 0.3 to 15.3. No significant correlation was found between PCB and PCDD/F concentrations, which suggests different sources for these contaminants.

Toxic equivalency for duck eggs ranged from 7.3 (Ma Da logging site) to 0.8 (Kon Tum province) pg WHO-TEQ_{2005} g^{-1}lipid. The value observerd in eggs from Ma Da logging site corresponds to the level reported for China (7.8 pg WHO-TEQ_{1998} g^{-1}lipid) [11].

Fig. 1. Vietnam provinces, where sampling was carried out.
(Original map downlowded from http://d-maps.com/m/asia/vietnam/vietnam34.gif)

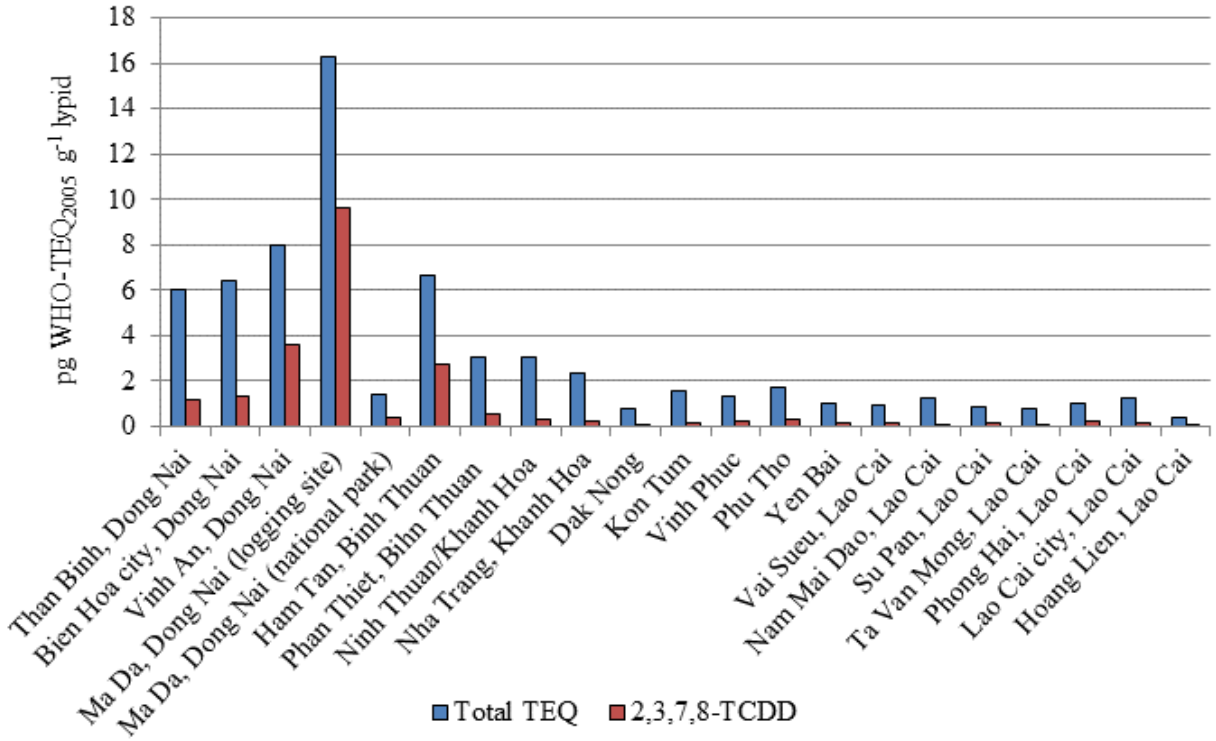

Fig. 2. Total TEQ values and 2,3,7,8-TCDD concentrations in chicken eggs from Vietnam arranged from south to north (except for the site near Bien Hoa airport (Total TEQ -107.6; 2,3,7,8-TCDD - 91.0 pg WHO-TEQ_{2005} g^{-1} lipid)).

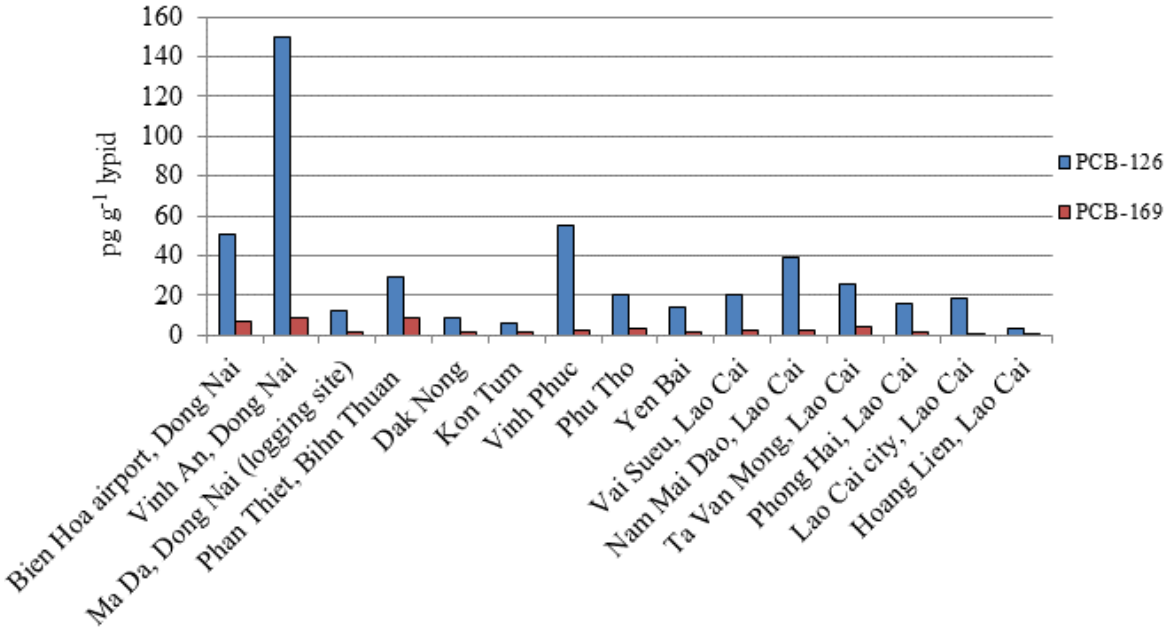

Fig. 1. PCB-126 and PCB-169 concentration in chicken eggs (pg g^{-1} lipid).

On the whole, PCDD/F levels in eggs in the south part of Vietnam are higher than in the northern part, which could be partly explained by contamination related to the Vietnam war.

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