

# **Bioaccumulation of PCDD/Fs in Foodstuffs Collected near Bien Hoa and Da Nang Airbases: Assessment for Sources, Environmental Distribution, and Their Intake by Humans**

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**Background/Objectives.** Bien Hoa and Da Nang airbases are located in South and Central Vietnam, respectively. During the US-Vietnam War, the two airbases were bulk storage areas for defoliants such as Agent Orange (AO) which contained polychlorinated-dibenzo-dioxins and polychlorinated-dibenzo-furans (PCDD/Fs) as the byproducts of the herbicide manufacturing process. The two airbases are considered as the most significant AO/Dioxin hotspots remaining in Vietnam. Storage and spilling of herbicides at these airbases resulted in extremely high contamination of PCDD/Fs at several sites both inside and outside the airbases. Weathering processes such as rain, floods, and wind also resulted in transport of the contamination to adjacent areas, leading to bioaccumulation of dioxins in aquatic animals (especially fish), and resulting in increased health risks to the local communities. In this study, selected food items were collected from the vicinity of Bien Hoa and Da Nang airbases to assess the accumulation of PCDD/Fs in biological tissues, their distribution in the environment, and possible risks to local consumers.

**Approach/Activities.** 42 pooled samples of major daily food items were collected from both local households and markets near Bien Hoa and Da Nang airbases in 2013-2014. The samples were determined for seventeen PCDD/F congeners using the isotope dilution method in accordance with the US EPA method 1613B. Concentrations of PCDD/Fs in fish and animal muscles, eggs, vegetables, and other food items from different areas were calculated for the TEQ levels and the PCDD/Fs congener profiles were determined. The human exposure doses to PCDD/Fs were estimated basing on food consumption rate data issued by the 2010 Vietnam National Nutrition Survey.

**Results/Lessons Learned.** PCDD/Fs concentrations were highest in fish, followed by chicken egg, chicken meat, other animal meats (pork and beef), and vegetables. At Bien Hoa airbase, the mean PCDD/F concentrations, presented as TEQs on a lipid basis (except for vegetables), were 26 pg/g for fish tissues, 13 pg/g for chicken eggs, 20 pg/g for chicken tissues, 4.5 pg/g for other animal tissues, and 0.34 pg/g fresh weight for vegetables. At Da Nang airbase, the mean PCDD/F concentrations were slightly lower (12.9 pg/g TEQ for fish tissues, 8.7 pg/g TEQ for chicken eggs, 5.9 pg/g TEQ for chicken tissues, 6.7 pg/g TEQ for other animal tissues, and 0.17 pg/g TEQ for vegetables). An interesting observation was that free-range chicken appear to be exposed to higher levels of dioxins than caged chicken. In some free-range chicken analyzed, the proportion of 2,3,7,8-TCDD in the TEQ is relatively high and suggests recent exposure to dioxins. The PCDD/F congener profiles varied between samples, suggesting that AO and maybe other potential sources of dioxin are present in the areas. Further studies may be needed in order to provide comprehensive data on PCDD/Fs transport and potential health risks of the local communities.