TEMPORAL AND SPATIAL TRENDS OF PCDD/F LEVELS IN COW'S MILK IN SWITZERLAND

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Introduction

The ubiquitous contamination of the environment by polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/F) is primarily caused by atmospheric deposition of the emissions from various sources (waste incineration and other industrial thermal processes, production of chemicals, traffic). Due to their physical properties, the bulk of the PCDD/F is adsorbed to dust and soot particles. These particles are deposited by atmospheric sedimentation on soil and leafy vegetation such as grass. Grazing cows can directly ingest contaminated grass. Due to their lipophilic and persistent properties, PCDD/F are transferred into the milk fat of the lactating cow. Therefore, milk constitutes an efficient and rapid elimination pathway of these contaminants. If milk production is exclusively based on grazing, the resulting PCDD/F levels in cow's milk reflect the atmospheric PCDD/F deposition on the pasture[1-5]. Therefore, dioxin levels in the milk can be used as indicators for the actual average local dioxin exposure by atmospheric deposition.

Already in 1984 and 1990/1991, investigations on cow's milk in Switzerland from various locations were conducted to identify strong PCDD/F emittents (e.g. waste incineration and metal recycling plants) and to gain data for a toxicological evaluation of the human exposure through dairy products contaminated by the nearby released PCDD/F[6, 7]. A follow-up investigation was initiated in 2001 aimed at monitoring geographical differences and establishing temporal trends of the atmospheric PCDD/F input in Switzerland as reflected in dairy milk. In order to make the new data comparable to the results collected in 1984 and 1990, the locations of the earlier investigations were maintained where possible. Sampling sites in the vicinity of point sources were maintained in order to document the effect of reduction measures or shut-down of these PCDD/F emitting plants implemented in the meantime.

Levels of PCDD/F were determined in 30 Swiss cow's milk samples collected in summer 2001 at dairy farms in the vicinity to point sources, in rural/alpine areas distant to known sources, and from tanks in large industrial milk processing plants. The data were compared to levels determined in milk samples taken in 1984 and 1990/1991 at the same sites.

Materials and Methods

Collection of cow's milk was organized and carried out by the Swiss Federal Dairy Research Station and the Swiss Dairy Inspection and Advisory Services (DIAS). The samples were taken during the summer period, when the cows are kept outside and their diet is based exclusively on fresh grass

The procedures used for fat extraction, sample preparation, and high-resolution GC/MS were based on methods described elsewhere[8].

In the calculation of I-TEQ for congeners below the detection limits the respective detection limits were used. Generally, these congeners contributed less than 5 % to the total I-TEQ in any sample.

Results and Discussion

The results of the investigation are summarized in Table 1. In 2001, the PCDD/F levels from farms near point sources appeared only slightly higher than milk from remote areas. Milk from collection tanks of industrial processing plants had intermediary levels. Compared to the samples collected in 1984 and 1990/1991, milk in 2001 was significantly less contaminated indicating a downward trend of environmental dioxin immission. This trend is particularly pronounced near point sources but is also apparent in consumers milk and milk from remote areas. The reduction in PCDD/PCDF levels in dairy milk is paralleled by and correlated to the remediation of known PCDD/PCDF emitting industries as enforced by federal authorities.

Table 1. Average PCDD/F levels in cow's milk from different sites in Switzerland 1984[6], 1990/1991[7], and 2001 (ng I-TEQ/kg, milk fat basis).

Type of sample	1984	1990	2001
Pooled milk from industrial milk processing plants	2.3 (n = 1)	1.3 ± 0.23 (n = 8)	0.51 ± 0.19 (n = 6)
Locations with nearby point sources	9.0 ± 2.6 (n = 3)	3.0 ± 0.87 (n = 9)	0.63 ± 0.26 (n = 11)
Rural and alpine locations	2.0 (n = 1)	1.1 ± 0.74 (n = 4)	0.36 ± 0.093 (n = 13)

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