DIOXINS AND DIOXIN-LIKE PCB IN FOOD AND FEED - STILL A MATTER OF CONCERN?

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Polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF), together often shortly termed „dioxins“ are present in the environment since organic matter is burned in the presence of chlorine containing compounds, such as during forest fires. However the dioxin levels started to increase considerably in the environment in parallel with the growth of the chlorine industry in the 1930/1940s. Initially, it was thought that human dioxin exposure is only a matter of concern in specific areas where because of accidents (e.g. Yucho, Yucheng, Seveso) or because of spraying contaminated herbicides (e.g. Vietnam) high levels of dioxins were released into the environment or directly into food. In 1984 the famous Swedish dioxin researcher Christopher Rappe showed that also breast milk samples from nursing mothers in Sweden and Germany, countries which until then were not considered to be affected by dioxins contain trace amounts of these contaminants. This finding triggered a lot of research into the sources of dioxins and their pathways into humans and billions of dollars were spent to close identified sources or at least to release their emissions to levels as low as reasonable achievable. Risk assessments performed by various bodies resulted in extremely low health based guidance values, such as a tolerable daily intake (TDI) proposed by WHO in 1998 of 1-4 pg WHO-TEQ/kg body weight or a tolerable monthly intake (TMI) proposed by JECFA in 2001 of 70 pg WHO-TEQ/kg body weight. Both these assessments included for the first time also the dioxin-like PCB which because of their structure exhibit similar toxicological effects as the dioxins. These assessments also showed that the major pathway of human exposure to dioxins and dioxin-like PCB is food. More than 90% of the daily intake is attributed to food and generally almost 80% of this is coming from food of animal origin which clearly indicates the peculiar role of feed and the specific importance of the bioaccumulation of the lipophilic dioxins and dioxin-like PCB in the food chain. Estimations of human exposure performed in Europe and other areas in the early 1990s showed that a considerable percentage of the respective populations was already above the derived TDI. As a consequence, a comprehensive legislation on dioxins and dioxin-like PCB was passed in Europe, including maximum levels and action levels as early warning tools for various foods and feed commodities. The regulatory limits for food and feed are not toxicologically based but derived from the frequency distribution of occurrence with the aim to prevent those commodities with the highest contaminant levels to reach the market. In addition, source related regulations, such as maximum levels for dioxin emissions from waste incinerators or for the levels in sewage sludge resulted in a significant decline of dioxin and dioxin-like PCB releases into the environment and thus into the food chain. A further consequence on the setting of regulatory levels was the trigger to intensify monitoring programmes on a global scale. These programmes indicated a remarkable decline of human dietary exposure in those areas where measures were taken to minimize the environmental pollution. However, recent data seem to indicate that the strong decline has come to a certain stop and the contaminant concentrations are nowadays levelling out. These results were substantiated by analyses of human breast milk samples within the frame of the worldwide WHO surveys. However, the WHO surveys also showed that the intake of an exclusively breast fed baby generally exceeds the dietary intake of adults by 2 orders of magnitude. Although the health based guidance values by WHO and JECFA were derived for a lifelong intake and should not be applied to the short period of nursing, the intake via breast milk should be considered as a matter of concern. The intensification of the monitoring programmes for food and feed also resulted in the identification of a number of dioxin and PCB incidents, either caused by criminal action or by unintentional contamination of the respective commodities. Examples are the mixing of oils and fats with PCB, the use of kaolinitic clay in food processing, the contamination of citrus pellets or the contamination of food grade guar gum. As these incidents do not only have severe financial consequences but most notably spoil the numerous efforts to minimize human exposure, vigilance remains necessary also in the future to identify hitherto unknown sources and consider dioxins and dioxin-like PCB in food and feed as a continuous matter of concern.