PCDDs/PCDFs IN HUMAN MILK – STILL A MATTER OF CONCERN?

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Introduction

Since the first finding by Rappe in 1984 that polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF) can not only be determined in specimens from polluted areas but also in human milk samples from countries, such as Sweden and Germany, which are not considered as dioxin contaminated, it became obvious that PCDD/PCDF are a global problem that threat all humans. In the past 15 years a number of comprehensive studies were conducted in order to provide an overview of dioxin levels in human milk from various countries and geographical areas as well as to identify highly exposed local populations for immediate risk management actions, including epidemiological follow-up studies. The PCDD/PCDF levels then found in human milk were mainly the driving force behind measures taken by various governments to identify relevant sources as well as to reduce the emissions from well-known sources to levels as low as technically achievable. The success of these measures is nowadays demonstrated by a significant reduction of the dioxin contamination of the environment, including humans. At certain levels of exposure and body burden, dioxins can lead to severe perturbations of immune and endocrine functions and reproduction as well as to the development of malignant tumors. Moreover, subtle changes in neurodevelopmental parameters and hormone levels, presumably caused by in utero exposure rather than postnatal exposure were observed in young babies from mothers being at the higher end of the background exposure[1]. Although the observed changes were within the normal range and considered without clinical relevance, these results found a broad scientific and public interest, because they indicated that the margin of safety between body burden and human effects seems to be relatively small. In 1998, the World Health Organization (WHO) revised its former recommendation from 1990 and proposed a new tolerable daily intake value (TDI) for humans of 1-4 pg WHO-TEq/kg body weight[2]. Besides dioxins, this TDI value includes for the first time also 12 polychlorinated biphenyls (PCB) which show dioxin-like effects. The TDI concept is based on a life time intake and therefore should not be applied to the relatively short period of breast feeding. Nevertheless, it has to be stated that the daily PCDD/PCDF intake for a fully breastfed baby exceeds the TDI value by 1-2 orders of magnitude.

PCDD/F levels in human milk

All samples analyzed so far only revealed the presence of 2,3,7,8-chlorine substituted congeners. This means that all congeners detected belong to the group of toxic PCDDs and PCDFs. From octa-to tetrachlorodibenzo-p-dioxin, the levels in human milk decrease with decreasing degree of chlorination. A somewhat different pattern is found for polychlorinated dibenzofurans. In this group 2,3,4,7,8-P_5CDF is normally the predominant congener followed by the three hexachlorodibenzofurans. An interesting exception is, however, that human milk samples from the United States contain significantly lower levels of 2,3,4,7,8-P_5CDF than specimens from industrialized countries in Western Europe[3]. Field studies organized by WHO/EURO in 1987/1988 and 1992/1993 revealed that the PCDD/PCDF levels in human milk samples from mothers living in industrialized countries are normally higher than those in specimens from developing and less industrialized countries[3,4]. This is exemplarily

depicted in Figure 1 which shows the summarized results of the latest WHO field study. While in most cases the PCDD/PCDF levels in samples from rural and urban areas in the same country were very similar, analyses of some specimens resulted in considerably higher levels indicating a possible influence of a point source in that area.

Parameters influencing the levels

The PCDD/PCDF levels in human milk are mainly influenced by personal data, such as age of the mother, number of breast fed children, and length of nursing period. While the levels are decreasing with the number of breast fed babies and the length of breast feeding, they are slightly increasing with the age of the mother. The area of domicile, whether urban or rural seems to have almost no influence on the body burden with these contaminants. This is not surprising because the main route of human dioxin exposure is through food, making up more than 90% of the daily dioxin intake. Consequently, consumption of highly contaminated food or deviant consumption habits compared to the average population might lead to elevated dioxin levels in human milk. Figure 2 depicts the mean PCDD/PCDF levels in approximately 1000 individual human milk samples from North Rhine-Westphalia in the course of the years 1989-1999. These analyses indicate a dioxin decline in human milk of nearly 60% within the past 10 years. This impressively indicates that the measures to reduce dioxin emissions show positive effects on the body burden of humans. Although the mean levels in 1998 and 1999 are slightly higher than in 1997, this finding is presumably due to the relatively low number of samples analyzed in 1997. On the other hand, it can not be fully excluded, that this small increase might be due to the Brazilian citrus pulp and Belgium dioxin crisis which each led to elevated levels in specific food stuffs.

Conclusions

Despite a permanent decline of more than 60% since 1989, the actual average daily intake of dioxins via human milk for a fully breast fed baby in most industrialized countries exceeds the corresponding value for adults by around 1-2 orders of magnitude. This relatively high exposure of babies during the breast feeding period as well as the results of some studies showing that subtle effects in babies are already associated with prenatal exposure clearly indicate that PCDDs/PCDFs are still a matter of concern and therefore justify further measures that will have to be taken to reduce dioxin emissions into the environment.

References

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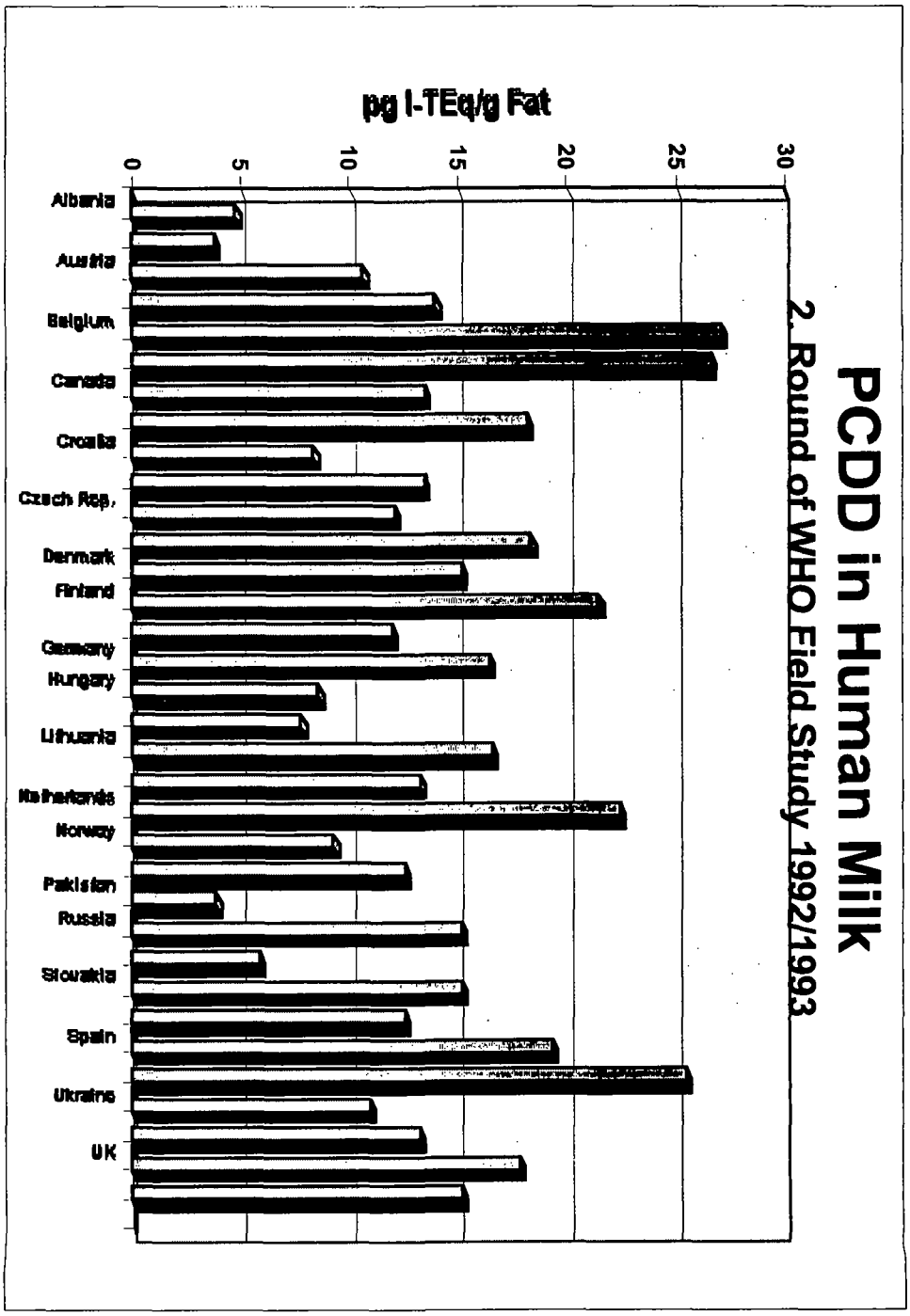
Figure 1


PCDD in Human Milk
2. Round of WHO Field Study 1992/1993
pg I-TEq/g Fat
0
5
10
15
20
25
30
Albania
Austria
Belgium
Canada
Croatia
Czech Rep.
Denmark
Finland
Germany
Hungary
Lithuania
Netherlands
Norway
Pakistan
Russia
Slovakia
Spain
Ukraine
UK

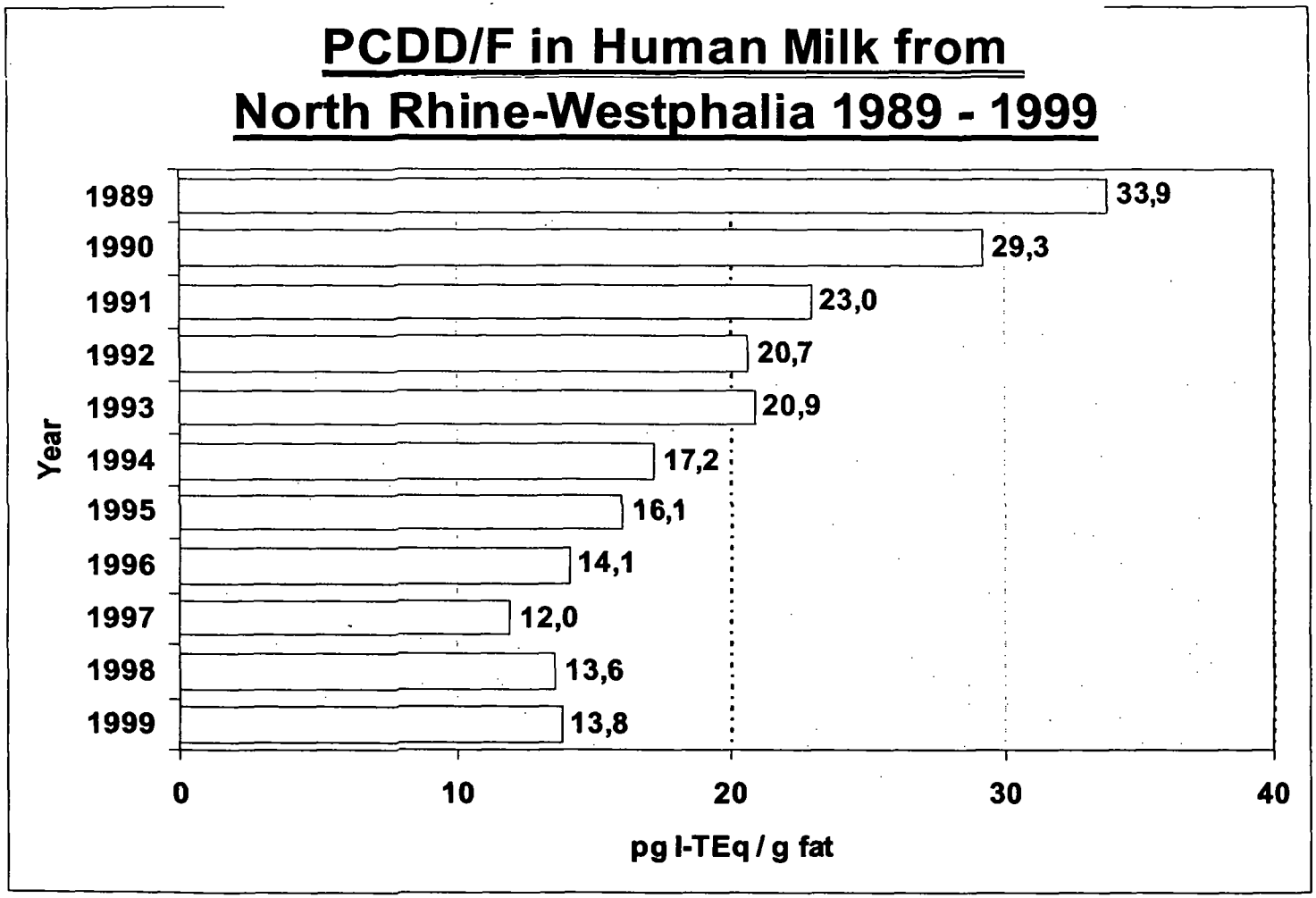

PCDD/F in Human Milk from
North Rhine-Westphalia 1989 - 1999
Year
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
33,9
29,3
23,0
20,7
20,9
17,2
16,1
14,1
12,0
13,6
13,8
0
10
20
30
40
pg I-TEq / g fat

Figure 2