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Presence of Polychlorinated Dibenzo-*p*-Dioxins in Latex Nipples

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Polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) are two series of aromatic, planar, tricyclic compounds which are a class of widespread environmental pollutants of considerable current concern. Some of these compounds have been recognized as extraordinarily toxic, teratogenic and fetotoxic at low concentrations (McCONNEL et al. 1978, MURRAY et al. 1979).

Some important sources of PCDDs and PCDFs included commercial chlorophenols (FIRESTONE et al. 1972, BUSER 1975a, RAPPE et al. 1978) and related products, e.g., herbicide 2,4,5-T (COURTNEY & MOORE 1971) and germicide hexachlorophene (BAUGHMAN & NEWTON 1972).

In particular, pentachlorophenol (PCP), widely used as a fungicide, herbicide, pesticide and bactericide, can be the main source of PCDDs and PCDFs in direct and indirect contamination of food and edible fats. PCDDs have been found in foodgrade oleic acids, fleshing greases isolated from hides treated with PCP, and some commercially available gelatin samples (FIRESTONE 1977).

In this connection, studies were undertaken to determine the residues of PCDDs and PCDFs in latex used for the production of nipples, various household devices and medical utensils; namely, it is known that in caoutchouc plantations, PCP is widely used as a fungicide and antimicrobial agent.

This paper reports the preliminary results.

MATERIAL AND METHODS

The first studies concerned two kinds of nipples purchased in a Warsaw Department Store. These nipples are produced of high-quality imported latex, in Poland. Nipples were cut into 2-3 mm broad pieces; 10 g of these scraps were 3 times refluxed with n-hexane (3,12 and 3 h, respectively). The pooled extracts were treated with aqueous KOH, with subsequent cleanup on an activated Florisil column (8 g, 10 mm ID) according to BOWES et al. (1973). Final purification of the samples consisted of extraction with concentrated sulfuric acid, whereupon the n-hexane extract was further separated on an alumina micro-column (BUSER 1975).

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Analysis of the latex extracts was conducted on a thin-film, Grob-type glass capillary column (OV-101, OV-17, Silar-10c; 25 m x 0.3 mm ID) mounted in a Pye-104 gas chromatograph equipped with a Ni-63 electron capture detector. The gas chromatograph was modified to minimize the band broadening effects due to dead volumes, this being essential in work with capillary columns. A Grob-type injector of own make was used. All samples were splitless injected, according to the procedure of BUSER (1975b).

Quantitative and qualitative determinations were performed using as reference PCDDs and PCDFs isolated from PCP previously analysed by Dr. H. R. BUSER, Wadenswill, Switzerland.

RESULTS AND DISCUSSION

Analysis of two types of nipples by high-performance gas chromatography (HP GLC-EC) gave results presented in Table 1.

Table 1. Contents of PCDDs and PCDFs in two types of nipples, as determined by HP GLC-EC.

Compound	Content in nipples, ppb	
	Type I	Type II
tetra-CDDs	n.d.[a]	n.d.
penta-CDDs	n.d.	n.d.
hexa-CDDs	0.6 (0.4)[b]	0.03 (0.02)
hepta-CDDs	4.1 (3.2)	0.1 (0.08)
octa-CDDs	11.2	0.8
tetra-CDFs	n.d.	n.d.
penta-CDFs	n.d.	n.d
hexa-CDFs	0.8	0.02
hepta-CDFs	3.1	0.1
octa-CDFs	2.8	0.3

a) Not detected, b) in parentheses, the level of 1,2,3,6,7,8-HCDD is presented for hexa-CDDs, and that of 1,2,3,4,6,7,8-HpCDD is recorded for hepta-CDDs.

The qualitative composition and quantitative ratios of the different isomers of PCDDs and PCDFs, found for the analysed nipples, were typical of the residues of these compounds in technical PCP. The main isomer of hepta-CDDs in the extract of nipples consisted of 1,2,3,4,6,7,8-HpCDD, and the main isomer of hexa-CDDs of 1,2,3,6,7,8-HCDD; they were two toxic isomers of PCDDs in technical PCP.

Extraction of nipples with water (24 h, 100°C) pointed to the absence of PCDDs and PCDFs in water. This fact and the very low residues of PCDDs and PCDFs in nipples suggest that the occurrence of these very toxic substances in nipples represents no real toxicological risk for children. On the other hand, earlier studies performed at the National Institute of Hygiene in Warsaw

(LEWANDOWSKA 1977) have shown that from nipples extracted with water about 90% of PCP from PCP-fortified latex samples were liberated. Thus, it is probable that other, more polar contaminants of technical PCP, e.g., chlorinated o-phenoxyphenols, also so-called predioxins (NILSSON et al. 1974), can be liberated during infant feeding. Some of them have been found to be mutagenic (FAHRIG et al. 1978); however, the level of their residues in nipples has not been determined.

Residues of some contaminants of technical PCP in latex are of interest from still another angle. It is quite probable that in some countries latex is treated by γ-irradiation for its cross-linking. Under these conditions, radiolysis can cause the formation of less highly chlorinated super-toxic isomers from the higher chlorinated isomers of PCDDs. Namely, as shown by BUSER (1976), in contrast to UV-photolysis (during which chlorine atoms are preferably removed from the 2,3,7,8-positions on the carbon rings), γ-radiolysis leads to the formation of the less highly chlorinated super-toxic isomers of PCDDs.

In addition, the level of PCDDs in γ-irradiated latex may increase because of photochemical cyclization of chlorinated o-phenoxyphenols (predioxins) which are very common impurities (1-5%) of technical PCP (NILSSON et al. 1978); in latex, their residues, may be much higher than those of PCDDs. However, it is difficult to specify whether the occurrence of radiolysis and cyclization would increase the level and toxicity of PCDDs in nipples to the point of creating a toxicological hazard.

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