6 Bioaccumulation and Biomagnification of Hydrophobic Persistent Compounds as Exemplified by Hexachlorobenzene

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Summary

Information reflecting the present state of knowledge about bioaccumulation of hexachlorobenzene (HCB) and other hydrophobic organochlorines has been compiled. In this critical review, some possible pitfalls in the interpretation of experimental results and field data on bioaccumulation are pointed out. Starting from "the fugacity model" approach, some new hypotheses are presented on the relationship between bioaccumulation and different abiotic and biotic factors. Among the processes discussed, special attention has been given to the uptake of xenobiotics with food. A better understanding of the mechanisms of nutrient absorption in the gut seems to be crucial in this context. Furthermore, biomagnification or food chain transfer resulting in an increase in concentration with trophic level is considered. It is concluded that although biomagnification of some organochlorines may be detected in the aquatic environment, the phenomenon has a low magnitude unless the airbreathing aquatic animals are included in the analysis.

6.1 Uptake and Elimination Via the Water

For many aquatic organisms it has been found that there is a strong correlation between the fresh weight-based bioconcentration factor (BCF) and the octanol/water partition coefficient \( P_{ow} \) when one single species has been exposed via the water to nonpolar slowly metabolized organic compounds with different \( P_{ow} \) values (Sugiura et al. 1978; Veith et al. 1979; Könemann and van Leeuwen 1980; Kanazawa 1981; Oliver and Niimi 1983; Gossett et al. 1983; Geyer et al. 1982, 1984; Bruggeman et al. 1984; Opperhuizen and Jongeneel 1985) (Figs.1 and 2). This supports the idea that the bioconcentration process is mainly controlled by the relation between the water-solubility of a hydrophobic persistent compound and the affinity to the tissues of the organism, and that the distribution is determined by a passive equilibrium partitioning. In this connection it is not the water-solubility of the solid compound but that of its hypothetical subcooled liquid which is of interest. The water-solubility of the latter can be calculated from \( P_{ow} \) and melting point by using the relationship established by Yalkowsky and Morozowich (1980). When steady state of the bioconcentration process has been reached, the passive uptake via the gills and skin is balanced by the passive elimination via the same routes together with metabo-
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Fig. 6.1. Relation between bioconcentration factor (BCF) and octanol/water partition coefficient ($P_{ow}$). (From Bruggeman et al. 1984)

Fig. 6.2. Correlation between bioaccumulation factor of organic chemicals in Chlorella and n-octanol/water partition coefficient. (From Geyer et al. 1984)