Organochlorine Pesticide (HCH and DDT) Residues in Dietary Products from Shaanxi Province, People’s Republic of China

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Organochlorine (OC) pesticides are employed on a massive scale both in agriculture and in public health in China. OC pesticides such as HCH (hexachlorocyclohexanes), and DDT (dichlorodiphenyltrichloroethane), bioaccumulate in the food chain and thus the exposure to OC compounds can occur through the diet, environmental sources, and occupational activities. Due to their high toxicity, lipophilicity, and persistence, the production and use of HCH and DDT have been banned, phased out, or strongly restricted for several decades in most developed countries (Voldner and Li 1995) and it has been the same in China, since 1983 (Chinese Ministry of Agriculture 1989). But the residue levels of HCH and DDT detected in our environment and agricultural produce in some areas of China were higher, as compared with those in developed countries (Li et al. 1998). In recent years, there has been an increase in public concern that chronic low-level exposure to HCH and DDT residues in food might result in serious cancers (Hodgson and Levi 1996) and hormone-disruption activity (Daston 1997).

Shaanxi is one of the largest agricultural areas in China, and plays an important role in national economic development. Although OC pesticide residues in dietary product from Shaanxi Province have been monitored by mixing samples with those from other regions in the Chinese total diet survey at the time intervals since 1973 (Chen and Gao 1993), there is insufficient local documentation, especially for recent years. Thus a growing concern for safer foods has led research into increased monitoring of the pesticide residues. The aim of this study was to investigate the residue levels of HCH, DDT and their metabolites in dietary product from Shaanxi Province of China. The results can help provide a basis for further monitoring so as to take preventive measures to minimize these pesticide residues in dietary product.

MATERIALS AND METHODS

A total of 240 samples of six kinds of dietary product, including cereals, vegetables, fruits, meat, fish, and milk, were collected randomly from the market of Shaanxi Province, China, in 2002 and were stored at 4°C until analysis was performed.
The OC pesticides under investigation were α-HCH, β-HCH, γ-HCH, o,p'-DDT, p, p'-DDT, and p,p'-DDE. All individual standard OC pesticides with a purity of 99.0%-99.9% were provided by the Institute of Food Safety Control and Inspection of the Ministry of Public Health of China. Stock standard solutions of OC pesticides were prepared in hexane at 10 mg/L. All solvents were of pesticide residues analysis grade and the purity of every reagent was carefully checked.

Extraction, clean-up and analysis of HCH and DDT residues in dietary product samples were conducted using the national standard methods (Yang 1998). Samples were analyzed using a gas chromatography (Shimadzu-14B) equipped with a 63Ni electron capture detector (ECD) and 2.5 m column with 1.5% OV-17 and 1.95 QF-1 Chromsorb WAW-DMCS (80-100 mesh). The operating conditions were as follows: column temperature 190°C; injector port temperature 210°C; detector temperature 230°C. The carrier gas was nitrogen (99.99%) at a flow rate of 56 ml/min.

Quality control and quality assurance measures were incorporated in the analytical scheme. Standard curves method was used for the quantification, and good linearity (γ>0.996) was achieved for tested intervals that included the whole concentration range found in samples. Almost every ten samples were spiked with standard solution. In addition, two duplicates were measured for every sample and the concentrations of pollutants in samples were summarized using the mean values. The detection limits for α-HCH, β-HCH, γ-HCH, o,p'-DDT, p,p'-DDT, and p,p'-DDE were 0.002, 0.002, 0.010, 0.020, 0.010, and 0.010 ng/g, respectively. Certified reference materials supplied by the Institute of Food Safety Control and Inspection of the Ministry of Public Health of China were analyzed, and the reliable results of the individual α-HCH, β-HCH, γ-HCH, o,p'-DDT, p,p'-DDT, and p,p'-DDE in our laboratory deviated less than 7% from reference values. All statistical analysis were carried out using SPSS 10.0 statistical software.

RESULTS AND DISCUSSION

240 samples of six kinds of dietary product from Shaanxi Province of China were analyzed for HCH and DDT residues. Dietary product included cereals, vegetables, fruits, meat, fish, and milk. The number of positive samples as well as the incidence of HCH and DDT residues in 240 samples are shown in Table 1.

From Table 1, we can see that HCH was abundant in all samples, and HCH residues were found in 96.7% of meat samples, followed by 80% of milk samples, 63.3% of fruits, 60% of vegetables, 55% of fish samples, and 53.3% of cereals. As far as DDT was concerned, meat samples were highly contaminated, followed by milk and fish. It can also be found that the incidence of HCH was higher than that of DDT in most samples, especially in botanical samples. Moreover, the frequency of HCH and DDT in zoological products were higher than those in