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Residues of Organochlorine Insecticides in Delhi Vegetables

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The indiscriminate and injudicious application of pesticides and their subsequent persistence contaminate our environment. Organochlorine insecticides like DDT and BHC have already become universal pollutants and are virtually reported from every component of the environment. Surveys carried out earlier, in various parts of India, showed higher incidence of pesticide residues in food commodities (Agnihotri et al. 1974; Noronha et al. 1980). As the pesticide consumption is on the rise, careful periodic monitoring of residue levels in food commodities is of paramount importance to man. Further, residue studies on vegetables are more important as they are consumed directly without much processing or storage. This paper presents the results of the preliminary survey carried out on the residue levels of organochlorine insecticides in Delhi vegetables.

MATERIALS AND METHODS

One kilogram each of the vegetable was collected from three different markets of Delhi - Tilaknagar, Palam Village and Kingsway Camp from August 1984 to January 1986. The vegetables selected for analysis were - potato, colocasia, radish, onion, cabbage, cauliflower, coriander, spinach, brinjal, lady finger, French beans, tomato, green peas, bottle gourd, smooth gourd, bitter gourd, cucumber, and chillies.

Washed vegetables were cut into small pieces and mixed thoroughly. Twentyfive grams of each vegetable were grinded with 40 to 50 ml of acetone in a waring blender. The acetone extract was filtered by employing vacuum suction and the process was repeated three times for complete extraction. After evaporating acetone in a rotary flash evaporator, 25 ml each of saturated saline and hexane were added to the extract and shaken thoroughly in a separatory funnel. After running off the aqueous phase, hexane layer with residues was collected. The aqueous phase was again subjected to hexane extraction for leftover residues and the pooled hexane fractions were passed through glass columns containing activated charcoal (Darco) and anhydrous sodium sulphate to clean the pigment contents. The hexane fraction was concentrated to known volume and analysed using a Packard 438 gas chromatograph equipped with an electron capture detector and C-R2A Shimadzu

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microprocessor. The operating conditions were as follows: Column, 2 mm x 2m packed with 10% SE 30 on Chromosorb Q(80-100 mesh); column temperature 200°C; detector temperature 220°C; injector temperature 220°C; carrier gas (nitrogen) flow, 20ml/min and sample volume 1 to 5 ul.

The samples were tested for the residues of known persistent organochlorine insecticides like gamma-HCH, heptachlor, aldrin, DDT and its metabolites. Reference standards of these insecticides/metabolites were obtained from Environmental Protection Agency, U.S.A and their purity ranged from 98.5 to 99.84%. Recovery from fortified samples of vegetables varied from 75 to 95%

RESULTS AND DISCUSSION

A total of 125 samples belonging to eighteen commonly used vegetables were assessed inthis study. Of these only 14 samples (11.2%) were devoid of any contamination while the remaining 111 samples (88.8%) showed insecticide residues. Among these 111 samples, 91 samples (82%) contained more than one residue while 30 samples had 5 to 6 residues. Further, half of the vegetables selected showed residues in all the samples analysed. Compared to these, only radish, green peas and coriander leaves showed a lower incidence (60%) followed by tomato (75%), colocasia, cauliflower and bottle gourd (80%). Thus, the present study reveals the widespread contamination of vegetables with insecticide residues. These results were in agreement with the previous surveys conducted in India. Visweswaraiah and Jayaram (1972) reported residues in all the 300 samples of leafy vegetables in Mysore while Kathpal (1980) reported a higher incidence of 90% in vegetables.

Most of the vegetables in this study, were found to be contaminated with either gamma-HCH or DDT and its metabolites. DDE was noticed in 62 while gamma-HCH in 59 out of 125 samples. These were followed by heptachlor (56), DDT (46), aldrin (41) and DDD (39). Thus, DDT together with its metabolites account for half of the contamination. A similar incidence of BHC and DDT was also noticed in Nigerian vegetables (Atuma 1985) confirming the widespread contamination by these insecticides. In India, the use of DDT is restricted to the control of mosquito in Public Health Programme while aldrin is being used against termite attack. Both these insecticides are not directly sprayed on vegetables but their presence in the samples analysed point to the possible transfer from the sites of application to crop fields.

The average levels of insecticide residues are shown in Table 1. It is evident that the residue levels in most of the samples were well below the maximum residue limits laid down by FAO/WHO (1986). One sample each of green pea (0.389 mg/kg), spinach (0.406 mg/kg), brinjal (0.138 mg/kg) and onion (0.058 mg/kg) had heptachlor above the maximum limit of 0.05 mg/kg. Lindane level also crossed the limit of 0.1 mg/kg in one sample of green pea (0.864 mg/kg). One potato sample showed a very high concentration of DDT (5.01 mg/kg) which was clearly above the maximum limit (1 mg/kg). Excepting these, other samples had the residues only in traces and well below the maximum limits. In contrast, 92 out of 311 samples were reported to contain residues above the limits in Bombay vegetables (Khandekar et al. 1982).

Table 1. Average levels of insecticide residues (mg/kg) in vegetable samples

Vegetable	gamma-HCH	Heptachlor	Aldrin	DDE	DDD	DDT
Potato(9)*	0.004 ±0.002**	0.010 ±0.013	0.012 ±0.002	0.047 ±0.086	0.002 ±0.001	0.636 ±1.653
Colocasia (5)	0.002 ±0.009	0.001	0.004 ±0.001	0.010 ±0.001	0.002 ±0.001	0.012 ±0.007
Radish (5)	0.009	0.020 ±0.017	0.006 ±0.006	0.052 ±0.067	0.039	0.001
Onion (10)	0.260 ±0.005	0.015 ±0.010	0.015 ±0.001	0.004 ±0.002	0.016 ±0.010	0.026 ±0.001
Cabbage (6)	0.004 ±0.005	0.004 ±0.006	0.027 ±0.024	0.015 ±0.020	0.002 ±0.003	0.053 ±0.041
Cauliflower (5)	0.001	0.002		0.002 ±0.001		0.015 ±0.014
Coriander (5)	0.007 ±0.007	0.001	0.016 ±0.016	0.007 ±0.007	0.0003	0.001
Spinach (5)	0.066 ±0.020	0.021 ±0.016	0.009 ±0.001	0.019 ±0.020		0.01 ±0.01
Brinjal (10)	0.021 ±0.011	0.023 ±0.011	0.009 ±0.010	0.003 ±0.003	0.006 ±0.0003	0.048 ±0.005
Ladyfinger (5)	0.016 ±0.010	0.001	0.043 ±0.030	0.014 ±0.020	0.020	0.020

Table 1. Continued

Vegetable	gamma-HCH	Heptachlor	Aldrin	DDE	DDD	DDT
French beans (5)	0.019 ±0.018	0.001 ±0.001	0.008 ±0.010	0.009 ±0.001	0.002	0.002
Tomato (8)	0.008 ±0.011	0.004 ±0.004	0.0001	0.009 ±0.012	0.002 ±0.001	0.018 ±0.013
Green Peas (5)	0.324 ±0.382	0.389	0.022 ±0.022	0.124		0.034 ±0.001
Bottle gourd (10)	0.012 ±0.001	0.023 ±0.012	0.005 ±0.001	0.037 ±0.020	0.009 ±0.001	0.005 ±0.002
Smooth gourd (8)	0.045 ±0.006	0.002 ±0.003	0.008 ±0.009	0.059 ±0.020	0.003 ±0.002	0.031 ±0.020
Bitter gourd (6)	0.001	0.002 ±0.001	0.001	0.001 ±0.001	0.004 ±0.003	0.005 ±0.004
Cucumber (6)	0.010 ±0.015	0.010 ±0.010	0.004 ±0.003	0.053 ±0.020	0.005	0.036 ±0.025
Chillies (12)	0.095 ±0.020	0.042 ±0.010	0.017 ±0.007	0.048 ±0.020	0.002 ±0.0005	0.343 ±0.007

* Data in parenthesis indicate the number of samples analysed.

** Standard deviation.

Lakshminarayana and Menon (1975) also reported these residues above the USFDA levels in 52 of the 192 starchy vegetables. A recent shift to organophosphorus and carbamate insecticides and the restricted use of DDT may partially explain the lower levels of organochlorine residues. Further, in tropical countries like India, half-life of many chlorinated insecticides was much less as compared to temperate regions. Though the residue levels were low, one can- not be complacent as there is a possibility of their getting stored and magnified in the body fat of man. Since the toxicity of the pesticides and their metabolites is well established, it is imperative to educate farmers regarding the potential risks, safe use and disposal of pesticides.

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