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A Chromogenic Paper for Ultrarapid Detection of Organochlorine Insecticide Residues in Vegetables

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More than 65% of the pesticides used in India are organochlorine compounds. Due to their persistence organochlorine insecticide residues are present in almost all types of vegetables and other food commodities (AGNIHOTRI et al. 1974, MARTH 1965). In view of the hazardous nature of these pesticides to man, it is necessary to routinely monitor residues in consumer food. Rapid visual color reactions and micro-tlc spot tests have been proposed to detect the pesticides in vegetables (MAJUMDER & PINGALE 1954, LAKSHMINARAYANA & MENON 1954). However, these methods are elaborate, involve laboratory equipment, and technical personnel, and hence, are not convenient for field studies. The objective of the present investigation was to develop a sensitive, one-step method for routine use for detecting organochlorine insecticide residues in vegetables as colored spots on a filter paper.

MATERIALS AND METHODS

Preparation of chromogenic paper. A 1% solution of o-tolidine in acetone was freshly prepared and was sprayed uniformly over Whatman No. 1 filter paper circles (18.5 cm), dried at room temperature and stored in the dark until used.

Vegetables. All vegetables listed in table 1 came from different farms around Mysore and were procured from the local market in Mysore city.

Pesticide extraction from the vegetables and analysis. To confirm the presence of pesticide residues in each of the test vegetables, a 100 g sample was processed and analysed by a tlc method (KARANTH et al. 1981).

RESULTS

Visual color reaction of pesticides with chromogenic paper. Different organochlorine insecticides gave different colored spots when they were applied on the chromogenic paper and exposed for a minute to bright sunlight. The spot intensities increased as the

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concentration of the pesticide applied increased. Among the insecticides tested, HCH was very sensitive because even as low as 0.3 µg gave a Prussian blue spot. A faint green color developed with 0.5 µg DDT which turned leafy-green at concentrations above 5 µg when applied on the treated paper. Other pesticide chemicals produced visible color spots at concentrations above 5 µg. Aldrin gave a yellowish-green color, chlordane gave a greenish-yellow color, and endosulfan gave a yellow color. Neither chlorinated water nor sodium chloride gave any color even at mg levels. Sensitivity of HCH and DDT are due to the availability of more labile chlorine atoms for color reaction at low temperature (MAJUMDER & PINGALE 1955, MAJUMDER & SRINIVASAN 1959, KRISHNA et al. 1964).

One-step method to detect organochlorine insecticide residues in vegetables. Fresh vegetables brought from the local market were cut into 2 cm thick slices and the moist cut end was pressed against the chromogenic paper for 30 sec. After removing the vegetable, the paper was exposed to bright sunlight. Colored spots appeared instantly when the residue level was relatively high and rather slowly at low concentrations.

Pesticide residue in vegetables. Employing the above technique, some commonly available vegetables were tested in order to assess the applicability of the method.

Results presented in table 1 indicate that 4 out of 7 vegetables examined, produced color spots on the chromogenic paper. In vegetables where the fruits from the edible part, only lady's finger contained pesticide residue. However, almost all the tubers showed positive reaction and the residue levels in them were also quite high as judged from the intensity of the color. Beet which is recorded as negative, still might have had residue because the color produced by the pesticide would have been masked by the pink juice.

Several batches of these vegetables on different days were analysed and the results were reproducible, thereby suggesting the general applicability of the method for 'on the spot' detection of residues in the field or in the market.

Table 1. Pesticide residue as revealed by chromogenic paper, in some vegetables obtained from Mysore market.

Common Name	Botanical Name	Pesticide Residue
Amaranthus	Amaranthus paniculata	Present
Chili (red pepper)	Capsicum annuum	Absent
Lady's finger	Hibiscus esculentus	Present
Squash	Sechium edule	Absent
Beet	Beta vulgaris	Absent
Carrot	Daucus carota	Present
Potato	Solanum tuberosum	Present

Confirmation of pesticide residues in vegetables.

(a) Pesticide residues were extracted with organic solvents from each market sample and their presence was confirmed by a tlc-method. Extracts from 100 g samples of chilies, and squash showed no colored spots on tlc plates, thereby supporting the absence of residues in the tissue. In most of the positive cases, the residue was identical with the HCH standard in its color reaction as well as R_f value. Other insecticides were either absent or present in levels below the detectable range of the method (0.5 to 5 µg).

(b) Sliced vegetables which gave positive color spots were washed with pesticide decontaminating solutions (VISWESWARIAH & JAYARAM 1972) and impressions were then made on the chromogenic paper. None of the samples now showed color, thereby confirming again that the color observed earlier was due to the pesticide residue.

DISCUSSION

Several batches of market samples of vegetables comprising 7 botanical species were analysed for pesticide residues employing the one-step chromogenic paper method and the results compared well with those obtained from a tlc-method suggesting the wider applicability of the method.

Apart from its simplicity, the present methodology has distinct advantages over other rapid and micro-methods put forward by others (VISWESWARIAH & JAYARAM 1971, 1973). It is quick (one min) and sensitive enough to detect the pesticide residues in food commodities even when present within the permissible limits (0.1 to 10 ppm). The method does not involve any clean-up procedure, equipment, technical personnel and does not even require either that the food material be damaged or that they be removed for sampling from sale. The chromogenic paper when stored in the dark, remained stable for several days and was thus convenient for use in the field or in Municipal laboratories.

Large number of samples can be rapidly tested resulting in more accurate estimates of the over-all quality of large batches of vegetables meant for consumption.

Different pesticides produce different color shades on the chromogenic paper and as such offer an easy method of detection of polychlorinated insecticides. It is considered that a quantitative evaluation of the pesticide residues can approximately be made by working out a color chart showing various shades and intensities of color formed by graded concentrations of different pesticides. Hence, the ultra-rapid chromogenic paper method appears to show definite promise of being a useful tool for assessing the quality of vegetable and other farm products with respect to pesticide contamination.

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REFERENCES

AGNIHOTRI, N. P., R. B. DEWAN, and A. K. DIXIT: Indian J. Entomol. 36, 160 (1974).

KARANTH, N. G. K., M. JAYARAM, and S. K. MAJUMDER: Pesticides 15, 7 (1981).

KRISHNA, R. V., K. KRISHNA MURTHY, and S. K. MAJUMDER: Indian J. Technol. 2, 212 (1964).

LAKSHMINARAYANA, V., and P. K. MENON: J. Food Sci. Technol. 12, 261 (1975).

MAJUMDER, S. K., and S. V. PINGALE: Indian J. Entomol. 16, 82 (1954).

MAJUMDER, S. K., and S. V. PINGALE: Chem. Ind. (London) 1739 (1955).

MAJUMDER, S. K., and K. S. SRINIVASAN: Chem. Ind. (London) 631 (1959).

MARTH, E. H.: Residue Reviews 9, 1 (1965).

VISWESWARIAH, K., and M. JAYARAM: J. Chromatogr. 62, 479 (1971).

VISWESWARIAH, K., and M. JAYARAM: Pestic. Sci. 3, 345 (1972).

VISWESWARIAH, K., and M. JAYARAM: Pestic. Sci. 4, 283 (1973).