

The gas chromatographic examination of organophosphorus pesticides

IV. The effect of cooking on organophosphorus pesticide residues

The examination of foodstuffs taken at harvest or final stage of production gives a measure of the maximum amount of pesticide residue likely to be ingested by man. However, many foodstuffs are further prepared and cooked before consumption and as part of our present study of methods of determining residues of organophosphorus pesticides it was considered interesting to determine the degree of loss of these compounds during cooking. HEMPILL *et al.*¹ have studied the effect of cooking on DDT and its derivatives, and reviewed much of the previous work on this topic. In a previous paper of this series² we used gas chromatography to follow the hydrolysis of organophosphorus pesticides, and the work described here covers the effect of cooking on a selection of these pesticides covering the observed hydrolysis range.

Experimental

KOIVISTOINEN *et al.*³ have carried out a series of dipping experiments on foodstuffs using organophosphorus pesticides. However as many of these pesticides are systemic by nature we felt that the addition of the organophosphorus pesticide to a vegetable mash prior to cooking would be more realistic: 50 g of vegetable (potato or cabbage) was macerated with 200 ml of water for 5 min, fortified with pesticide at the 2 p.p.m. level and the volume adjusted to 300 ml with water. The mash was transferred to a 2 l round-bottomed flask, heated rapidly to boiling and then allowed to boil gently under reflux for 30 min. The mixture was cooled rapidly, centrifuged to remove suspended solids and a measured aliquot (150 ml) of the supernatant liquid removed and extracted with chloroform (100 ml). The emulsion so formed was centrifuged, a measured aliquot of the chloroform layer removed (40 ml) and dried by passage down a column containing anhydrous sodium sulphate. The solution was then evaporated to dryness, the residue dissolved in acetone and the pesticide content determined by gas chromatography as previously described².

Results and discussion

Table I lists the percentage hydrolysis occurring on boiling for 30 min in a

TABLE I

% HYDROLYSIS OCCURRING ON 30 MIN BOILING IN A VEGETABLE MASH

Pesticide	p.p.m.	% Hydrolysis in potato mash	% Hydrolysis in cabbage mash
Chlorfenvinphos	2.0	37, 49, 53	56, 86, 80
Dimethoate	2.0	32, 22, 39	44, 48, 52
Mecarbam	2.0	66, 52, 54	58, 67, 72
Methyl parathion	2.0	62, 59	78, 76
Parathion	2.0	54, 49, 64	91, 92, 93
Phorate	2.0	100*	100*

* Appreciable quantities of phorate sulphoxide were formed during the cooking process.

cabbage or potato mash. All the pesticides broke down during the course of the cooking experiments, to a degree, dependent upon the pesticide and the vegetable with which the experiment was conducted. Only in the case of phorate was any new compound formed which could be detected by GLC and it is interesting to note that this was the sulphoxide; the work of MUHLMANN AND SCHRADER⁴ and our own previous study² indicated that the sulphoxide is more stable to hydrolysis than the sulphone or parent compound. We found no direct correlation between the hydrolysis rates previously determined at 70° in a pH 6.0 phosphate buffer and the percentage break-down occurring during the cooking experiments.

Conclusion

Where residues of organo-phosphorus compounds persist on vegetables it seems probable that a cooking process such as boiling will lead to a partial reduction in the pesticide level but will not cause complete removal. The possibility also exists that oxidation may occur during the cooking process.

*Ministry of Technology, Laboratory of the Government Chemist,
Cornwall House, Stamford Street, London S.E. 1 (Great Britain)*

J. ASKEW
T. H. MITCHELL
J. THOMSON
B. B. WHEALS

- 1 D. D. HEMPHILL, E. R. BALDWIN, A. DEGUZMAN AND H. K. DELOACH, *J. Agr. Food Chem.*, 15 (1967) 290.
- 2 J. H. RUZICKA, J. THOMSON AND B. B. WHEALS, *J. Chromatog.*, 31 (1967) 37.
- 3 P. KOIVISTOINEN, M. KONONEN, A. KARINPAA AND P. ROINE, *J. Agr. Food Chem.*, 12 (1964) 557.
- 4 R. MUHLMANN AND G. SCHRADER, *Z. Naturforsch.*, 126 (1957) 196.

Received August 10th, 1967

J. Chromatog., 32 (1968) 417-418