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RESIDUES OF ALDRIN IN POTATO

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Application of aldrin 5% dust @ 25 kg/ha to soil before planting potatoes for the control of soil pests resulted in residues of aldrin+dieldrin to the extent of 0.8 to 1 ppm in the tubers at harvest. Separate analysis of peel and pulp revealed the presence of 1.75 ppm and 0.21 ppm residues, respectively. Both aldrin and dieldrin were found present in the peel whereas only dieldrin was detected in the pulp. Washing and cooking did not have significant impact on the removal of residues. The total residues (aldrin+dieldrin) on the whole potatoes, the peel or the pulp were always more than the tolerance limit set by FAO/WHO (0.1 ppm). It is, therefore, concluded that potatoes grown in aldrin-treated soil are hazardous to consume.

INTRODUCTION

Application of 5% aldrin dust to soil before planting potatoes @ 25 kg/ha has been recommended for the control of cutworms, crickets, white grubs and termites (REDDY, 1968; BANERJEE, 1970) and is being widely followed. In certain cases still higher dosage of 3.36 kg a.i./ha, half applied at the sowing time and half at the earthing time, has also been recommended (ABRAHAM *et al.*, 1972). Very little information is available on its residues in tubers. SINGH & KALRA (1971) studied the residues of aldrin using emulsion @ 2 kg a.i./ha at the time of earthing up. However, such a high dose is rarely used and also this practice is uncommon. Hence it was considered important to study the level of residues following the aforesaid normal recommendation.

MATERIALS AND METHODS

The potato crop was grown on the farm of Indian Agricultural Research Institute in a small area of 1/5 hectare. Aldrin 5% dust at 25 kg/ha was mixed in the soil before planting the tubers. The residues were determined in the harvested crop separately in unwashed and washed potatoes and in peel and pulp before and after cooking. For washing, the potatoes were taken in a tray and washed under tap water for 2 minutes, gently rubbing with hands. The potatoes were cooked in a metallic pan in sufficient water till they became soft. For each estimation a bulk sample of 2 kg potatoes of various sizes taken at random was drawn. Depending upon the type of estimation, the tubers or pulp or peel, were finely dropped and mixed thoroughly. Out of this a representative sample of 50 g was taken and exatracted with hexane and acetore (80:20). The extracts were cleaned up with hyflo-supercel plus anhydrous sodium sulphate plus activated charcoal (5 : 5 : 1) by column chromatography. The residues were determined by bioassay as described by ATTRI & RATTAN LAL (1972) and also by GLC using 63Ni electron capture detector. The GLC parameters were : detector temperature: 250°C, column temp 200°C, inlet post temp 225°C, nitrogen carrier gas flow rate 80 ml / min, attenuation 0.08, column 180 cm long packed with 3% OV-1 on chromosorb W, 80-100 mesh.

RESULTS AND DISCUSSION

Examination of the average residues determined by bioassay and GLC reveals that estimates by the former are 2–3 times higher than those by the latter method. Obviously this could be due to the presence of dieldrin, a more toxic metabolite of aldrin. The presence of considerable residues of dieldrin in the samples has been amply demonstrated by GLC. The bioassay here, therefore, reflects only the presence of more

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TABLE 1. Residues of aldrin in potato estimated by bioassay and GLC

Sample	Replication	Bioassay	Residues (ppm) GLC		
			Aldrin	Dieldrin	Aldrin plus Dieldrin
Whole potatoes unwashed	R1	1.96	0.35	0.59	0.94
	R2	2.35	0.37	0.64	1.01
	R3	2.50	2.24	0.35	0.59
	Average	**2.27**	**0.32**	**0.53**	**0.85**
Whole potatoes washed	R1	2.85	0.31	0.64	0.95
	R2	2.35	0.21	0.38	0.59
	R3	1.17	0.31	0.54	0.85
	Average	**2.16**	**0.28**	**0.52**	**0.80**
Peel uncooked	R1	4.18	0.65	0.85	1.50
	R2	3.06	0.63	0.76	1.39
	R3	5.25	0.97	1.38	2.35
	Average	**4.16**	**0.75**	**1.00**	**1.75**
Pulp uncooked	R1	0.88	ND	0.24	0.24
	R2	1.19	ND	0.19	0.19
	R3	0.84	ND	01.19	0.19
	Average	**0.94**	**ND**	**0.21**	**0.21**
Peel of cooked potatoes	R1	5.64	0.86	1.32	2.18
	R2	5.40	0.79	1.28	2.07
	R3	3.15	—	—	—
	Average	**4.73**	**0.82**	**1.30**	**2.12**
Pulp of cooked potatoes	R1	1.14	ND	0.33	0.33
	R2	1.02	ND	0.35	0.35
	R3	0.98	ND	0.19	0.19
	Average	**1.04**	**ND**	**0.29**	**0.29**

ND — Not detectable.

toxic metabolite(s) rather than the exact magnitude of residues of the original compound and its metabolite(s).

Considering the combined residues of aldrin and dieldrin, it is observed in Table 1 that whole potatoes with peel contain residues ranging from 0.6 to 1 ppm with an average of 0.85 ppm when unwashed and 0.8 ppm when washed. In other words, this further means that washing has no effect in removing the residues from the whole tubers. FAO/WHO (1975) recommended tolerance limit for aldrin+dieldrin to be 0.1 ppm on potatoes, which has been accepted for adoption by the Central Committee on Food Standards, Directorate General of Health Services, New Delhi. In this experiment the combined levels of aldrin and dieldrin as mentioned above were far more than the tolerance limit set by FAO/WHO. Therefore, it is concluded that potatoes grown in aldrin-treated soil are hazardous to consume. Similar conclusions were drawn by SINGH & KALRA (1971) who observed that application of aldrin @ 2 kg a.i./ha (which was though much higher than that applied in the present experiment) resulted in aldrin residues ranging from 0.2 to 0.5 ppm and dieldrin residues from 0.6 to 1.5 ppm. Our findings are, however, contrary to those by LICHTENSTEIN & SCHULZ (1965) who observed that potato, radish and carrot grown in soil treated with aldrin @ 1 lb/acre either contained no residues or residues at the concentration of 0.03 to

0.05 ppm. In addition, our results also do not agree with those summarised by FAO/WHO (1971) where most of the data presented by Shell Research Ltd. show the residues to be less than 0.15 ppm. The soil type and climatic factors might be responsible for variation in the results. This further suggests the need for extensive research under Indian conditions even though the data collected over the western world is available at hand.

When the residues were determined separately in peel and pulp, it was interesting to note that the peel contained 8–9 times more residues than the pulp on weight to weight basis. Peel and pulp (uncooked) contained on average 1.75 ppm and 0.21 ppm residues respectively. The bioassay results also show a similar trend so that the residues in the peel were about 5 times higher than those in the pulp. This proportion of the residues in the peel and pulp appears to be maintained in the corresponding cooked sample. Taking into consideration 0.80 ppm residues in whole potato and 0.21 in pulp (Table 1), it may be said that about 80% of the residues remain confind to the peel and only 20% enter the pulp.

Cooking of the samples resulted in slight increase in the average residues both in the peel and in the pulp as is evident from bioassay and GLC estimates. A possible explanation can be that the operation of cooking unlocked the bound residues in the material which became readily extractable.

The analytical data do not show the presence of aldrin in the pulp. Whether aldrin is immediately converted into dieldrin in the pulp or there is selective translocation of dieldrin is immediately converted into the pulp is not known, Both aldrin and dieldrin occur in the peel. Dieldrin was present always in greater amounts than aldrin, the ratio being 1:1.3 to 1:1.5. Cooking did not significantly change this ratio. These results confirm the findings of SINGH & KALRA (1971) who found that in whole potatoes (since the peel was also analysed alongwith) the level of aldrin ranged between 0.2 to 0.5 ppm whereas that of dieldrin between 0.6 to 10.5 ppm.

The water in which the potatoes were boiled was also analysed and was found to contain only dieldrin to the extent of 0.02 to 05 ppm.

GLC measurements on cleaned up extracts from all the samples from the treated plots showed presence of about 4–5 units high unidentified peak having a retention time of 36 seconds. A similar peak was observed by SINGH & KALRA (1971) also. LICHTENSTEIN *et al.*, (1970) and IVIE & CASIDA (1971) observed the formation of photo-aldrin and photo-dieldrin in soil and plants as a result of exposure to sunlight. Number of other metabolites have also been found to occur in plants (KORTE, 1970). The additional peak as observed during the course of present investigation may be, therefore, due to one of such metabolites of aldrin and dieldrin.

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