BEHAVIOUR OF FENITROTHION RESIDUES IN POTATO TUBERS AS AFFECTED BY SOME PROCESSING STEPS .

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Abstract

Fenitrothion organophosphorous insecticide was dusted on potato tubers which were then kept in the laboratory. Samples were taken for residue analysis 2 hours after treatment and then after 1, 2 and 4 weeks in order to study the persistence of fenitrothion. This study also included the removal effect of some processing steps (i.e. washing, peeling, blanching, cooking and drying) on the residues of fenitrothion. It was found that all of these steps caused significant decreases in fenitrothion residues.

Another part of the study included a survey carried out for monitoring the contamination of potato tubers from some local markets with organophosphorous insectisides. It was found that all organophosphorous residues detected exceeded the MRLs of codex except in one sample for dimethoate insecticide which was below its MRL on potato tubers.

INTRODUCTION

Although the recommendation of the Egyptian Ministry of Agriculture restricted the use of pesticides on the potato pits that stored only for use in planting in the next season, it is observed that treated potatoes existed in the local markets for human consumption, this situation may threat the health of consumers.

Many investigators studied the residual behaviour of pesticides on potato tubers during preparation: Lamb *et al.* (1968), Wei-Tsungchin *et al.* (1976), Diskshit et al. (1985) , Wen *et al.* (1985), Habiba *et al.* (1992) and Shivandar and Kavadia (1992).

In this study the behaviour of fenitrothion organophosphorous insecticide residues on stored potatoes was investigated. Also, the effect of some processing steps

on fenitrothion residues was studied. Another part of the study include a survey for organophosphorous insecticide residues on potato tubers that were collected from some local markets of El-Qalubia, El-Dakahlia and El-Gharbia governorates in 1992 summer.

MATERIALS ADN METHODS

1. Fenitrothion insecticide residues on potato tubers

Potato tubers *Solanum tuberosum* were dusted with fenitrothion 3% dust at the rate of 3 kg/ton on June 18th 1992. Then the tubers were stored at laboratory temperature 25°C ±2. Samples were taken 2 hours after treatment and then after 1,2 and 4 weeks, respectively. Each sample (1 Kg) was divided into 2 parts; one part was washed before taken for analysis. Processing studies were carried out on the initial sample that was taken 2 hours after potato treatment. Potato tubers were washed, peeled, cut into suitable slices and then fried in boiling oil or cooked as at home (using oil and adding onion and tomato juice). For drying process, tubers were washed, peeled and cut as mentioned before, and then blanched in boiling water for 5-7 minutes. This step was followed by exposure to sulphur dioxide (200 - 500 ppm) and drying in a ventilation oven beginning with 115.5°C and ending with 76°C.

Residue analysis

The method of Mollhaff (1975) was adopted for extraction of fenitrothion from potato tubers. Redistilled methanol was used instead of acetone. Sub-samples of 50 g weight were taken for analysis. Then the extract was partitioned with chloroform, drained through anhydrous sodium sulphate and evaporated to dryness.

GC-determination - Pye Unicam 4500 gas chromatograph equipped with flame photometric detector (FPD) 526 nm filter (selective for phosphorous) was used. 1.5 m x 4 mm i.d. Pyrex glass column packed with 4% SE-30 + 6% Ov-210 on gas chromosorb Q 80-100 mesh was operated at 240°C. Injection port temperature 243oC, detector temperature 245°C. Carrier gas (N2), hydrogen and air flow rates were at 30 ml/min. Retention time of fenitrothion under these conditions was 3.78 min.

Rate of recovery of fenitrothion by using this method at the level of one ppm was 97%. The limit of detection was 0.05 ppm.

2. Survey of organophosphorous insecticide residues on potato tubers in some markets

Samples (4 kg) were collected from markets of Benha and Kaha (Qalubia governorate), El-Mansoura and Belkas (Dakahlia governorate) and El-Mahalla (El-Gharbia governorate) in the summer of 1992. The multi-residue method of organophosphorous compounds mentioned in the Manual of Analytical Methods for Residues of Pesticides, Ministry of Welfare, Health and Cultural Affairs Leidschendam-Netherlands (1985) was used for detecting organophosphorous insecticide residues in potato tubers. Sub-samples of 50 g weight were taken for analysis. GC-determination was carried out as for fenitrothion insecticide. Rates of recovery ranged from 80 to 100% for detected organophosphorous.

RESULTS AND DISCUSSION

1. Persistence of fenitrothion on potato tubers

The amounts of fenitrothion residues detected on unwashed and washed tubers are indicated in Table 1. The data show that the initial residues of fenitrothion in unwashed potato tubers were 2.78 ppm then gradually decreased to 1.38 ppm at one week after application revealing 50.36% loss of the initial residues. Two weeks after treatment the insecticide residue detected was 0.72 ppm. This amount droped to 0.31ppm one month after treatment. The residue half-life for fenitrothion on potato tubers was 6.4 days.

Table 1. Fenitrothion residues when applied to whole potato tubers under storage conditions.

Time after treatment	Whole unwashed unpeeled tuber		Whole washed unpeeled tuber	
	ppm	ppm	ppm	ppm
Initial	2.78	0.0	0.60	78.42
One week	1.38	50.36	0.51	63.04
Two weeks	0.72	74.1	0.25	65.28
4 weeks	0.31	88.85	0.11	64.52

2. Effect of some processing steps on fenitrothion residues on and in potato tubers

Table 2 demonstrates the fenitrothion initial residues determined on potato tubers and the effect of different processing steps that were carried out on another

part of the same sample. Washing caused 78.42% removal of the insecticide residues, where 0.6 ppm of fenitrothion residue was determined in the whole washed unpeeled tuber of the initial sample. Different percentages of removal were determined in the whole washed unpeeled tubers of the next intervals of sampling as demonstrated in Table 1.

The peeling process removed 99.28% of fenitrothion residues determined in the initial sample. This indicated poor penetration of organophosphorous in the pulp as previously mentioned by Hegazy *et al.* (1988), Abdel-Razik *et al.* (1984) and Stobwasser (1962).

The peeled potato tubers were found to contain 0.02 ppm of fenitrothion residues that is below the Codex MRL (1993) for fenitrothion residues in potato tubers (0.05 pm). This amount dropped to undetectable amount after cooking, frying and drying processes. Blanching process resulted in undetecable amount of fenitrothion within the limit of detection of the method of analysis (0.05 ppm).

These results agreed with those of Farrow *et al.* (1968) on the removal of residues during commercial and home preparation procedures. The behaviour of DDT in potatoes during commercial and home preparation was studied by Lamb et al. (1968). They concluded that commercial washing operations removed about 20% of the total DDT residue while peeling plus washing removed about 94%. Commercial processing further reduced the residues to insignificant levels. In home preparative procedures, peeling removed more than 91% of the residues. There was no singnificant decrease from the original residues when potatoes with skins were boiled or pressure cooked. Potatoes stored at 45^{o}F for a period of 6 weeks showed no significant loss of residues.

Table 2. Effect of processing on fenitrothion residues on and in potato tubers.

Treament	Residues in ppm	% Removal
Initial sample (Whole unwashed unpeeled tubers)	2.78	
1- Washed tubers	0.60	78.42
2- Peeled tubers	0.02	99.28
3- Blanching (Whole tubers)	UND	100
4- Cooking	UND	100
5- Frying	UND	100
6- Drying	UND	100

UND = Undetectable

3- Survey of organophosphorous insecticides on potato tubers in some local markets :

The obtained results are shown in Table 3. Fenitrothion insecticide residues were detected in samples collected from four markets i.e. Benha, kaha, El-Mansoura and El-Mahalla. They exceeded the MRL of Codex 1993 (0.05 ppm) in all of these markets.

Table 3. Organophosphorous insecticide residues detected in potato samples collected from the local markets (in 1992 summer) in ppm.

Pesticide	Area of collected samples						MRLs of Codex
	Benha	Kaha	El-Mansoura	Benha	Kaha	El-Mansoura	
Fenitrothion	0.431	1.252	0.070	UND	2.006	2.006	0.05
Methamidofos	UND	UND	0.233	0.17	0.19	0.19	0.05
Profenofos	UND	UND	UND	UND	0.632	0.632	0.05
Pirimiphosmethyl	UND	0.119	UND	UND	UND	UND	0.05
Dimethoate	UND	UND	UND	UND	0.015	0.015	0.05

UND = Undetectable

Methamidofos insecticide residues were detected in samples of El-Mansoura, Belkas and El-Mahalla and were exceeding the MRL of Codex (1993). Profenofos insecticide was detected in sample of El-Mahalla market and exceeded the MRL of Codex (1993). Pirimiphosmethyl was detected in the sample of Kaha and exceeded the MRL of Codex (1993). Also, Dimethoate was detected in one sample of El-Mahalla market with a level below the MRL of Codex (1993). The most polluted sample was that of El-Mahalla market.

Bronca and Guighine (1988) analyzed - in Italy - 34 samples of imported potatoes for residues of 14 organochlorine and 24 organophosphate pesticides. Results showed residues of 4 organochlorine and 5 organophosphate pesticides. Levels of the pesticides were not considered a potential health hazard.

Frank *et al.* (1990) detected organochlorine and organophosphorous insecticides in 16 commodities-including potatoes-collected between 1986-1988 from farm deliveries to the market place in Ontario, Canada. They found that 22 % of tested samples had insecticide residues below one ppm.

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سلوك متبقيات الفينيتروثيون فى درنات البطاطس وتأثير بعض عمليات التجهيز عليها

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تم تعفير درنات البطاطس بمبيد الفينيتروثيون وحفظت فى المعمل ليتم أخذ عينات منها على فترات بعد ساعتين من المعامله، ثم بعد أسبوع و أسبوعين وأربعة أسابيع من المعاملة ، وذلك لدراسة بقاء متبقيات الفينيتروثيون على درنات البطاطس وقد وجد أن قيمة نصف العمر لهذا المركب كانت ٤ ، ٦ أيام على درنات البطاطس تحت هذه الظروف.

تضمنت الدراسه تأثير بعض خطوات تجهيز البطاطس فى إزالة متبقيات الفينيتروثيون مثل الغسيل، التفشير، السلق ، الطبخ و التجفيف وقد وجد أن جميع هذه الخطوات تؤدى إلى نقص واضح فى متبقيات هذا المبيد.

شملت الدراسة أيضا حصراً لمتبقيات المبيدات الفوسفورية على درنات البطاطس المعروضة للبيع فى بعض الأسواق المحلية وقد ظهر أن متبقيات المبيدات الفوسفورية التى أمكن تقديرها تجاوزت كلها الحدود المسموح بها من قبل هيئة الكودكس فيما عدا الكمية المقدرة من مبيد الدايمثويت فى عينة واحده فقط.