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Decontamination of profenophos and triazophos in/on brinjal

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Abstract
An experiment was conducted at the Instructional Farm of Post Graduate Institute, MPKV, Rahuri to determine the extent of reduction in pesticide residue levels in brinjal fruits through different household decontamination processes. Single application of insecticides viz., profenophos and triazophos was given at the fruit initiation stage with recommended dose by knapsack sprayer. After 2 hr of spraying, harvested brinjal fruits were subjected to five different processing methods viz. washing with tap water, washing with 2% salt solution, washing with 2% tamarind solution, boiling and cooking. Treated samples were analysed for insecticide residues by using validated QuEChERS method on Gas Chromatograph. The results revealed that all the treatments removed the residues of insecticides but, cooking brinjal fruits showed highest reduction in dislodging the residues of profenophos (90.97%) and triazophos (86.5%) from brinjal fruits.

Keywords: profenophos, triazophos, brinjal, Gas Chromatograph

1. Introduction

Brinjal is an important main vegetable in human diet in India. Mostly raw harvested fruits of brinjal are used for preparation of *Curries*, *Bharatas*, etc. In Maharashtra, brinjal crop is grown over an area of 2500 ha with a production of 13443.6 thousand tones and productivity of 19.1 MT ha-^{1}. Cultivation of brinjal is concentrated in Ahmednagar, Nasik, Pune, Jalgaon, Satara and Kolhapur. (Anon., 2014) [2].

Brinjal crop is severely damaged by insects like Jassid, aphid, spider mite and fruit borer. Farmers rely heavily on pesticides for protecting brinjal from these insect pests. Indiscriminate use of insecticides has resulted in the accumulation of insecticide residues in the primary agricultural products (Baig *et al.*, 2009) [3]. Of late brinjal fruits were found to be accumulated with some non recommended insecticides like profenophos, triazophos, chlorpyriphos and malathion (Anon., 2014) [1].

The increasing amount of pesticide residues in vegetables such as brinjal has been a major concern to the consumers. It is therefore necessary to find out the simple decontamination methods which can be adopted at home. The present investigation was undertaken to study the effects of various decontamination processes on the residue levels of profenophos and triazophos in brinjal fruits.

Material and methods

Chemicals

CRMs of profenophos and triazophos of high purity were obtained from Sigma Aldrich and commercial pesticides were purchased from local market of Rahuri. The solvents of HPLC grade were ethyl acetate obtained from Avantor Performance Materials India Limited, Thane (India). PSA and sodium sulphate anhydrous procured from Agilent Technology, Bangalore and SDFCL, Mumbai, respectively. Working standards were prepared by dissolving reference standards in ethyl acetate.

Brinjal was grown on research field of Department of Entomology, PGI, MPKV., Rahuri. All the recommended agronomic practices were followed for raising the cop. The mature brinjal plants were sprayed at recommended doses *i.e.* profenophos 50 EC @ 500 a.i. ha^{-1} and triazophos 40 EC @ 500 a.i. ha-^{1}, respectively. The control plots were left unsprayed. Three replicates were made for each treatment and each insecticide was applied once. The brinjal fruits were collected at 2 hr after insecticide application and subjected to different decontamination processes as given below.

Tr. No.	Decontamination processes
T_1	Washing with tap water for 30 sec.
T_2	Dipping in 2 % salt solution for 15 minutes.
T_3	Dipping in 2 % tamarind water for 15 minutes.
T_4	Boiling
T_5	Cooking
T_6	Untreated control (Without process)

Sample collection

One kg fresh brinjal fruits were collected at 2 hr after spray from field trial. Control plots (unsprayed) were maintained for blank analysis and also recovery experiments.

Extraction and clean up

Treated brinjal fruits were extracted by QuEChERS method (Sharma, 2013) [10]. The entire laboratory sample (1 Kg) was crushed thoroughly in a mixer cum grinder and approximately 10 g homogenized sample weighed in a 50 ml polypropylene tube. Tube was kept in the deep freezer for 10 min. Homogenised sample was extracted with 10 ml ethyl acetate in presence of 10 g anhydrous Na_2SO_4 and centrifuged at 3500 rpm for 5 min. Two ml supernatant was transferred to 15 ml tube containing 50 mg PSA. The content was vortexed for 30 sec and then cetrifuged at 2500 rpm for 2 min. The supernatant was filtered through 0.2 micron filter and estimation was done by using gas chromatography (GC) equipped with FPD. The operating parameters of have been mentioned in Table 1.

Table 1: Gas Chromatographic Parameters

Column	DB-1, 30m x 0.25 µm × 0.25 mm
Column Temperature	170^0 C …… 3 min hold @ 6.5^0 C/min 220^0 C …… 2 min hold @ 10^0 C/min 280^0 C …… 6 min hold
Injector Temperature	250^0 C
Column Temperature	170^0 C
Detector Temperature	300^0 C
Injection Volume	1 µl
Column flow	0.96 ml min^{-1}
Hydrogen Flow	90 ml min^{-1}
Air Flow	120 ml min^{-1}

Linearity

Five linear concentrations (0.05, 0.1, 0.25 0.50 and 1 µg g^{-1}) of working standards of profenophos and triazophos were injected in triplicate and the linearity lines were drawn (Table 2). The response was linear over the range tested and R^2 values were 0.996 and 0.998 for profenophos and triazophos, respectively (Fig. 1and Fig. 2). These results indicated that the GC-FPD analysis is a valid method for residue determination of the tested insecticides in brinjal fruits.

Table 2: Linearity of profenophos and triazophos standard

Insecticide standard	Level of Fortification (µg g^{-1})	R1	R2	R3	Mean
Profenophos	0.05	17631	16534	17424	17196
	0.10	54236	53747	55322	54435
	0.25	138831	138781	139961	139191
	0.50	322045	321071	320662	321259
	1.00	577302	565630	580055	574329
Triazophos	0.05	21170	20522	19548	20413
	0.10	60262	61045	63205	61504
	0.25	182230	186715	179062	182669
	0.50	304638	301600	300256	302164
	1.00	628910	630566	628423	629299

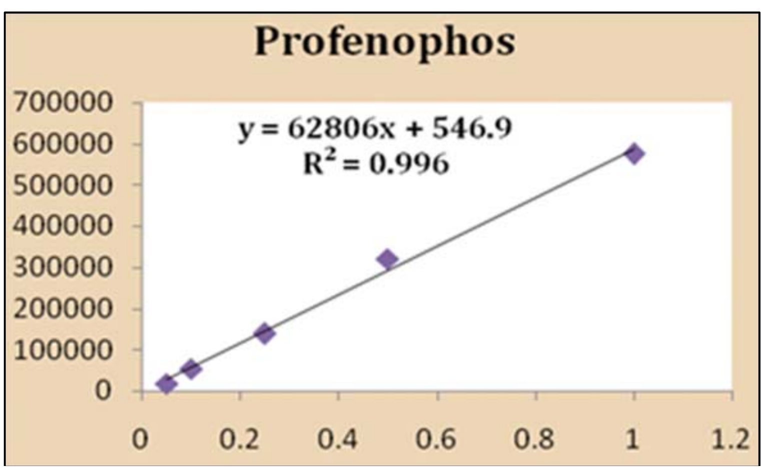

Fig 1: Linearity of profenophos standard

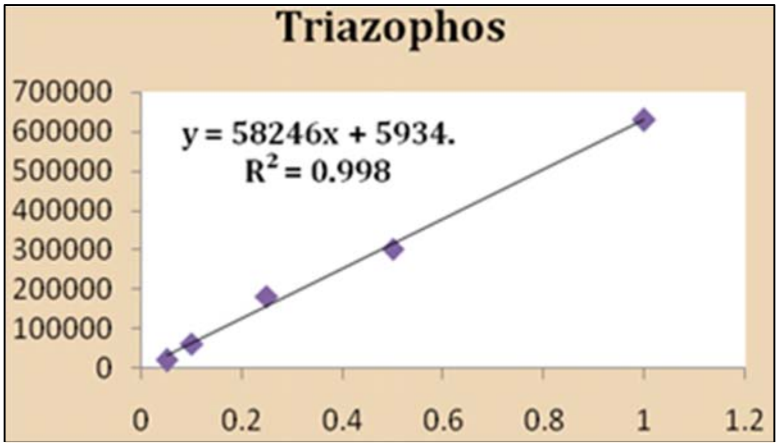

Fig 2: Linearity of triazophos standard

Recovery

Accuracy of the analytical method was determined by recovery studies. The per cent recovery is mentioned in Table 2 and Table 3. The brinjal samples from control plots were used for recovery studies. Ten g homogenized sample was taken in 15 ml polypropylene tube. The samples were spiked with different concentrations *viz.* 0.05, 0.25 and 0.5 µg g^{-1} in triplicate. The extraction and clean up were performed as described earlier.

Table 2: Recovery of profenophos in brinjal fruits

Substrate	Fortification Level (µg g^{-1})	Recovery (%)			
		R-I	R-II	R-III	Mean
Brinjal fruits	0.05	88.23	94.78	81.92	88.31 (±7.28)
	0.25	89.36	89.22	88.23	88.94 (±0.69)
	0.50	85.25	88.16	88.17	87.26 (±1.99)

Table 3: Recovery of triazophos in brinjal fruits

Substrate	Fortification Level (µg g^{-1})	Recovery (%)			
		R-I	R-II	R-III	Mean
Brinjal fruits	0.05	90.42	96.98	98.22	95.21 (±4.40)
	0.25	87.32	80.82	85.09	84.41 (±1.77)
	0.50	88.22	88.59	89.06	88.63 (±0.47)

Results and discussion

The residues of profenophos and triazophos in brinjal revealed substantial reduction by different household methods of decontamination. The per cent reduction and residue levels have been presented in Table 4 and 5.

Effects of different decontamination processes on the residues of profenophos in brinjal fruits

The results on the effect of different processing methods on the residues of profenophos in brinjal fruits are presented in Table 4.

Mean initial residues recorded in unprocessed brinjal fruits were 0.48 µg g^{-1}. The lowest level of residues was recorded in the treatment of cooking *i.e.* 0.05 µg g^{-1}. This was followed by boiling (0.10 µg g^{-1}) and dipping in 2 per cent salt solution (0.15 µg g^{-1}). Whereas in case of treatment of dipping in 2 per cent tamarind solution, the residues recorded was 0.18 µg g^{-1} as compared to 0.38 µg g^{-1} in washing brinjal fruits with tap water. It could be further seen that highest per cent reduction (90.97%) in residues was registered in the treatment of cooking. This was followed by boiling (79.16%) and dipping in 2 per cent salt solution (67.58%) and dipping in 2 per cent tamarind solution (61.36%). Washing in tap water reduced the residues to 20.67 per cent.

Table 4: Effect of different decontamination processes in the removal of profenophos from brinjal fruits

Treatment No.	Treatment Details	Residues levels (µg g^{-1})	Reduction (%)
T_1	Unprocessed control sample	0.48 (± 0.00)	-
T_2	Washing with tap water	0.38 (± 0.01)	20.67
T_3	Dipping in 2% salt solution	0.15 (± 0.01)	67.58
T_4	Dipping in 2% tamarind water	0.18 (± 0.00)	61.36
T_5	Boiling	0.10 (± 0.00)	79.16
T_6	Cooking	0.05 (± 0.02)	90.97

Effect of different decontamination processes on triazophos residues in brinjal fruits.

Data regarding residues of triazophos after subjecting brinjal fruits to different processes are presented in Table 5. The mean initial residues recorded in unprocessed brinjal fruits were 0.42 µg g^{-1}. The lowest levels of residues 0.06 µg g^{-1} were recorded in the treatment of cooking. This was followed by boiling (0.17 µg g^{-1}), dipping in 2 per cent salt solution (0.22 µg g^{-1}) and dipping in 2 per cent tamarind solution (0.23 µg g^{-1}). The residues recorded in the treatment of washing in tap water were 0.36 µg g^{-1}.

It could be seen that almost 86.50 per cent reduction in residues of triazophos was noticed in cooking. This was followed by boiling (60.30%), dipping in 2 per cent salt solution (48.39%) and dipping in 2 per cent tamarind solution (46.03%). By only washing brinjal fruits with tap water there was reduction of residues to the extent of 13.5 per cent.

Table 5: Effect of different decontamination processes in the removal of triazophos from brinjal fruits

Treatment No.	Treatment Details	Residues levels (µg g^{-1})	Reduction (%)
T_1	Unprocessed control sample	0.42 (± 0.01)	--
T_2	Washing with tap water	0.36 (± 0.01)	13.5
T_3	Dipping in 2 % salt solution	0.22 (± 0.00)	48.39
T_4	Dipping in 2 % tamarind water	0.23 (± 0.01)	46.03
T_5	Boiling	0.17 (± 0.00)	60.30
T_6	Cooking	0.06 (± 0.01)	86.5

It was observed that irrespective of treatment, the reduction of residues was more in profenophos than triazophos. The highest per cent reduction in residues of profenophos and triazophos was registered in the process of cooking. There was 90.97 per cent reduction in residues of profenophos as against 86.5 per cent in triazophos in brinjal fruits. The present findings are in agreement with those of Parmar *et al.* (2012) [8] who observed cooking as the best culinary process in which greater level of profenophos and triazophos residues were dislodged from okra fruits up to 95.10 and 66.34 per cent, respectively. Effectiveness of cooking was also endorsed by Shashi *et al*. (2015) [11] in brinjal where direct cooking of fruits removed 59 per cent residues of profenophos. While, cooking in pressure cooker led to highest (52.90%) reduction in residues of profenophos in brinjal as reported by Cherukuri *et al.* (2014) [6]. Boiling of brinjal fruits for 15 min was the next best treatment to reduce the residues of profenophos and triazophos to the extent of 79.16 per cent and 60.30 per cent, respectively. The above findings are in agreement with Joshi *et al.* (2014) who reported that residues of organophosphorus insecticides viz., monocrotophos and parathion were decreased in cauliflower on boiling. By the process of boiling reduction of residues of above insecticides was to the extent of 70 per cent in cauliflower. Beena Kumari *et al.* (2008) [4] observed maximum reduction of residues in case of monocrotophos, dimethoate, malathion, chlorpyriphos and quinalphos, where the residues decreased to more than 50 per cent in brinjal, cauliflower and okra, respectively by boiling method.

Dipping of brinjal fruits in 2 per cent salt solution for 15 min could remove residues of profenophos and triazophos to the extent of 67.58 and 48.13 per cent, respectively. The results are in corroboration with Chandra *et al.* (2015) who reported that almost 59.8 and 62 per cent of chlorpyriphos residues were dislodged from treated brinjal and okra fruits by 2 per cent sodium chloride solution wash. However, Shashi *et al.* (2015) [11] observed that washing of brinjal fruits with 2 per cent salt water could remove profenophos up to 88.20 per cent. Radwan *et al.* (2005) also reported that washing solutions prepared from 1 per cent NaCl performed most effectively in reduction of profenophos residues to 97.41 per cent in brinjal.

By dipping of brinjal fruits in 2 per cent tamarind solution, there was reduction in the residues to 61 and 46 per cent. These findings are in agreement with Cherukuri *et al.* (2014) [6] who reported that treatment of brinjal fruits with 2 per cent tamarind solution removed the residues of dimethoate, chlorpyriphos, monocrotophos, quinalphos, profenophos, phosalone, lambda-cyhalothrin and malathion to the extent of 26, 24, 34, 30, 29, 26, 65 per cent, respectively. Washing of brinjal fruits with tap water also helped in reducing the residues of profenophos and triazophos (25.67 and 13.5%). According to Chandra *et al.* (2015) washing of brinjal fruits with tap water was comparatively less effective in reducing pesticide residues of organophosphates. Parmar *et al.* (2012) [8] reported that washing of okra fruits with tap water reduced the residues of organophosphorus insecticides in the range of 41.75 to 93.72 per cent and dipping in normal tap water reduced the residues in the range of 23.95 to 90.80 per cent.

Conclusion

It may be inferred that above decontamination process can be easily adopted at home to reduce the residues in vegetables. In brinjal, washing the brinjal fruits and then cooking may be useful to reduce the residues of above insecticides and thus make it safe for human consumption.

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