



## Decontamination Processes to Reduce Residues of Insecticides in Vegetables

S. Suresh\*, K. Ramaraju and S. Sheeba Joyce Roseleen

Department of Agricultural Entomology  
Tamil Nadu Agricultural University, Coimbatore - 641 003

Among the decontamination methods adopted to reduce the insecticide residues in vegetables, washing brinjal fruits with tamarind solution removed the insecticide to the extent of 50 percent followed by sodium bicarbonate (45 %) and the least removal was observed with water (26 %). Reduction of OP residues to an extent of 20.2 per cent was found when brinjal fruits were washed with water for 30 sec. In cabbage, washing with tamarind solution reduced 51.3 per cent of synthetic pyrethroid compounds followed by 50.8 percent of lindane and endosulfan. Synthetic pyrethroid and organophosphates were comparatively easily removable (33.3 %) than organo chlorinated compounds.

**Key words:** Decontamination, residue, insecticides, vegetables

In Tamil Nadu, most of the food commodities were reported to be contaminated by commonly used insecticides viz., organophosphorus and synthetic pyrethroid residues in vegetables (Chandrasekaran *et al.*, 1997), organochlorine insecticides in vegetables (Rajabaskar *et al.*, 2001), organochlorine insecticides in okra (Sheikh *et al.*, 2012), organochlorine and carbamates residues in vegetables (Beenakumari, 2008). Vegetables contaminated with the insecticide residues pose risk to public health, if they contain them above tolerance limits at the time of consumption. Therefore, proper decontamination methods are to be followed to reduce residues in vegetables for safe consumption. Some of the techniques like peeling of fruits and vegetables washing with water, detergents and water charcoal suspension aid removal of surface residues and steam cooking accelerates decontamination of organochlorine, organophosphorous and carbamate insecticide residues from vegetables and fruits. Present study was undertaken to evaluate various decontamination processes to reduce the residue of certain insecticides in brinjal, bhendi, cabbage and cauliflower.

### Materials and Methods

Supervised trials were carried out in each crop as per the Good Agricultural Practices (GAP). An area of 20 m<sup>2</sup> was sprayed with the insecticides using knapsack sprayer (Tables 1 & 2).

One hour after spraying, one kg each of brinjal and bhendi and 2.5 kg each of cabbage and cauliflower samples were collected from the treated

plot. The collected samples were subjected to decontamination treatments given below.

Treatment	Time	Concentration (%)	Volume required (lit.)	
			Brinjal & Bhendi	Cabbage & Cauliflower
No washing		-	-	-
Water washing	30 sec	-	1	5
Salt solution (Brine) washing	30 sec	1	1	5
Tamarind washing	30 sec	2	1	5
Sodium bicarbonate washing	30 sec	0.05	1	5

One kg capacity plastic tubs were used for washing / treating the brinjal and bhendi. In case of cabbage and cauliflower, a plastic bucket was (5 litre capacity) used for treatment. Sub samples of 50 g were homogenized from each group and subjected to residue analysis.

### Extraction

50 g of chopped sub samples of individual vegetables was mixed with 50 ml water and blended for 3 min. at a moderate to high speed in a warming blender. The homogenate was filtered with acetone (20 ml) through a Buckner funnel under mild suction. Then the residue was transferred to beaker and condensed.

### Liquid - Liquid partitioning

The combined extract was taken into a separating funnel (500 ml). To this extract, 200 ml of 2 per cent aqueous sodium chloride and 50 ml of hexane were added. The funnel was thoroughly shaken for about 10 min. and then the layers were allowed to separate.

The upper organic layers were pooled and collected separately and the aqueous layer was once again re-extracted with 50 ml hexane. Then

\*Corresponding author email: entosuresh2006@yahoo.co.in

the organic layers were pooled and dried by passing through a layer of anhydrous sodium sulphate in a funnel fluted with filter paper. Later, the extract was condensed for further clean up.

#### Column clean up

For column chromatography, 50 X 1.5 cm (id) glass columns were used. The drip tip of the chromatographic column was plugged with cotton wool. Anhydrous sodium sulphate was placed to a height of about 2 cm, over which activated Florosil® was packed and again it was topped with anhydrous sodium sulphate. After prewetting the column with n-hexane, it was loaded with the concentrated extract obtained after partitioning. The column was eluted with acetone: hexane mixture and finally 100ml elutant was collected, condensed and reconstituted with hexane to 10 ml and injected in GC-ECD/TID.

#### Final determination

GC was operated for multi residue analysis and monitoring of pesticide residues as per the operating conditions suggested by Chandrasekaran *et al.* (1997).

#### End analysis

The final determination of the cleaned up extracts was carried out with (GC) Chemito model 8610 and Varian 3810 equipped with ECD.

Detector	GC Varian model 3810		GC Chemito model 8610
	ECD		TID
	OC	SP	OP
Column	Capillary column	Capillary column	Capillary column
Temperature	160°C -Inj,250-Det	160°C -Inj,250-Det	160°C -Inj,250-Det
Software	Varian Star 0.5	Varian Star 0.5	Chemito,2000 1.7

### Results and Discussion

Brinjal fruits treated with lindane (2.5ml/l) left an initial deposit of 4.4, 3.9 and 2.9 mg/kg residues on 0, 1 and 3 days after treatment (DAT). The per cent reduction of residues was maximum in tamarind washing (50.5%) and minimum in salt solution washing (35.5%) (Table 1). When treated with endosulfan (2ml/l), 5.5 mg/kg of initial deposit was detected. Tamarind washing resulted in 50.9 per cent reduction of residues and minimum of 35.9 per cent reduction occurred in salt washing on the day of treatment. In case of lambda cyhalothrin (0.5ml/l), initial deposit of 0.48 mg/kg was detected. Maximum per cent reduction was observed in tamarind washing with 49.2, 45.2 and 42.0 per cent after 0, 1 and 3 days of treatment, respectively. Reduction of OP compounds to an extent of 25 per cent was recorded when brinjal fruits were washed with water for 30 sec. Similar results were reported by Dinabandhoo and Sharma (1994) with water washing of monocrotophos, where residual removal was to an extent of 10.92-20.03 per cent in cauliflower. Beena Kumari (2008) reported that washing with water reduced the OC compounds to an extent of 27-44 per cent. Singh (1995) observed

45.76 per cent removal of monocrotophos in water washing of okra.

Bhendi fruits treated with lindane (2.5ml/l) left an initial deposit of 4.2 mg/kg residues on the day of treatment (Table 1). The residue level was reduced to the maximum of 50.1 per cent in tamarind washing and minimum of 35.5 per cent in salt solution washing on the day of treatment. Endosulfan (2ml/l) applied on bhendi fruits resulted in 5.5 mg/kg of initial deposit. Maximum percent reduction of residues occurred in tamarind washing (47.5%) and minimum (34.9%) in salt solution on the day of treatment. Lambda cyhalothrin (0.5ml/l) recorded an initial deposit of 0.45, 0.39 and 0.29 mg/kg of residues on 0, 1 and 3 days after treatment, respectively. The observed reduction was 25.3- 49.2, 29.3- 46.2, 25.3 and 35.5 per cent in tamarind washing, sodium bicarbonate washing and water washing, respectively. Washing with 2 per cent tamarind solution (30 sec) reduced the OD insecticides to an extent of 50.0 per cent and washing with 0.01 per cent sodium bicarbonate (30 sec) to 45.0 per cent and water washing reduced to 26.0 per cent. Sheikh *et al.* (2012) reported that pesticide residues from okra reduced to the extent of 36.42 percent by water washing.

In cabbage, reduction of deposits was maximum when decontamination was done with tamarind solution (50.4%) and minimum in water washing (35.3%) on the day of treatment. Tamarind washing resulted in 52.6 per cent reduction of endosulfan residues and minimum of 33.4 per cent reduction in salt washing on the day of treatment. The residue level decreased to 45, 55, 32 and 56 per cent, respectively with salt water, tamarind, sodium bicarbonate and water washing treatment, after 3 DAT. Lambda cyhalothrin (0.05ml/l) registered an initial deposit residues of 0.58, 0.43 and 0.38 mg/ kg on 0, 1 and 3 days after treatment, respectively. Maximum per cent reduction occurred in tamarind washing treatment with 51.0, 51.3 and 49.2 per cent after 0, 1 and 3 days of treatment and minimum reduction was observed in salt solution washing with 33.5, 36.4 and 32.9 per cent, respectively. Cabbage treated with fenvalerate (0.5ml/l) recorded an initial deposit of 0.84 mg/kg. Decontamination with 2 per cent salt solution resulted in 36.1, 37.1 and 35.0 per cent reduction of residues after 0, 1 and 3 DAT. While that were 48.6, 49.9 and 52.2 per cent when washed with tamarind solution. In case of sodium bicarbonate washing, 46.5, 46.1 and 44.8, and in water washing 35.6, 36.1 and 33.2 per cent. The initial deposit of quinalphos was found as 8.4 mg/kg. The percent reduction of residues on 0,1 and 3 DAT was 34.4, 33.3 and 36.7 in salt solution washing, 51.1, 49.5 and 47.6 in tamarind washing, 42.9, 43.0 and 42.5 in sodium bicarbonate treatment and 34.9, 35.6 and 36.0 in water washing, respectively. In case of profenofos washing with salt solution reduced the residue level to 34.8, 33.9 and

**Table 1. Effect of decontamination processes on brinjal and bhendi**

Treatment	Residues (mg/kg) (DAT)																	
	Lindane (2.5ml/l)			Endosulfan (2.0ml/l)			Lambda cyhalothrin (0.5ml/l)			Fenvalerate (0.5ml/l)			Quinalphos (2ml/l)			Profenofos (1ml/l)		
	0	1	3	0	1	3	0	1	3	0	1	3	0	1	3	0	1	3
<b>Brinjal</b>																		
Initial deposit	4.4	3.9	2.9	5.5	4.9	3.9	0.48	0.39	0.30	0.62	0.51	0.44	4.5	3.9	3.1	6.5	5.9	4.8
Brine(Salt) washing	2.84 (35.5)	2.52 (35.3)	1.91 (34.2)	3.53 (35.9)	3.19 (35.0)	2.73 (30.0)	0.31 (35.9)	0.26 (34.2)	0.20 (33.0)	0.43 (28.0)	0.37 (28.0)	0.35 (20.0)	2.91 (35.4)	2.61 (33.2)	2.20 (29.0)	4.54 (30.2)	4.25 (28.0)	3.73 (22.3)
Tamarind washing	2.18 (50.5)	1.94 (50.3)	1.48 (48.9)	2.70 (50.9)	2.55 (48.0)	2.34 (40.0)	0.24 (49.2)	0.21 (45.2)	0.17 (42.0)	0.34 (45.0)	0.31 (40.0)	0.29 (35.0)	2.21 (50.9)	2.14 (45.2)	2.01 (35.2)	3.30 (49.2)	3.52 (40.3)	3.59 (25.3)
Sodium bicarbonate	2.40 (45.5)	2.13 (45.4)	1.65 (43.2)	2.98 (45.9)	2.74 (44.0)	2.34 (40.0)	0.27 (43.4)	0.23 (40.0)	0.19 (38.0)	0.37 (40.0)	0.31 (39.0)	0.31 (30.0)	2.43 (45.9)	2.54 (35.0)	2.32 (25.3)	3.50 (46.2)	3.42 (42.1)	3.39 (29.3)
Water washing	2.84 (35.5)	2.53 (35.1)	1.92 (33.9)	3.53 (35.9)	3.25 (33.6)	2.65 (32.0)	0.31 (34.5)	0.26 (32.2)	0.21 (30.0)	0.43 (30.0)	0.36 (30.0)	0.33 (29.0)	2.89 (25.0)	2.76 (35.8)	2.47 (29.2)	4.19 (20.2)	4.17 (29.3)	3.59 (25.3)
<b>Bhendi</b>																		
Initial deposit	4.2	3.5	2.9	5.5	4.5	3.5	0.45	0.39	0.29	0.64	0.55	0.35	4.4	3.5	2.9	4.9	3.5	2.9
Brine(Salt) washing	2.72 (35.3)	2.32 (33.7)	1.97 (32.1)	3.58 (34.9)	3.04 (32.5)	2.61 (25.3)	0.28 (38.7)	0.25 (35.5)	0.21 (28.8)	0.41 (35.9)	0.37 (32.8)	0.25 (28.1)	2.84 (35.4)	2.39 (31.6)	2.13 (26.4)	3.42 (30.2)	2.52 (28.0)	2.25 (22.3)
Tamarind washing	2.10 (50.1)	1.90 (45.6)	1.67 (42.5)	2.89 (47.5)	2.71 (39.8)	2.24 (35.9)	0.22 (50.5)	0.22 (42.7)	0.19 (35.8)	0.31 (51.1)	0.30 (45.7)	0.21 (38.9)	2.15 (51.2)	1.83 (47.8)	1.88 (35.2)	2.49 (49.2)	2.09 (40.3)	2.17 (25.3)
Sodium bicarbonate	2.36 (43.7)	2.11 (39.6)	1.87 (35.5)	3.00 (45.5)	2.63 (41.5)	2.13 (39.2)	0.25 (45.5)	0.24 (38.6)	0.21 (28.5)	0.35 (44.8)	0.33 (40.1)	0.22 (37.2)	2.38 (45.9)	2.11 (39.8)	2.04 (29.8)	2.64 (46.2)	2.03 (42.1)	2.05 (29.3)
Water washing	2.88 (31.5)	2.46 (29.8)	2.16 (25.4)	3.55 (35.3)	2.99 (33.5)	2.50 (28.7)	0.29 (35.6)	0.27 (30.1)	0.22 (25.7)	0.41 (36.4)	0.38 (30.1)	0.26 (25.7)	2.83 (35.7)	2.37 (32.3)	2.23 (23.1)	3.16 (35.5)	2.47 (29.3)	2.17 (25.3)

Values in parentheses are percent reduction, DAT-Days after treatment

34.0 per cent, respectively and the tamarind washing, resulted in 49.5, 48.1 and 47.6 per cent reduction of residues on 0,1 and 3 DAT. Satpathy *et al.* (2012) reported removal on insecticide residues of monocrotophos, fenitrothion and fenvalerate to an extent of 41 percent with 2 percent tamarind solution in vegetables.

The reduction in residue level in cauliflower curds was maximum in tamarind washing (50.6%) and minimum in water washing (34.1%) on the day of treatment. Initial deposit of endosulfan (2ml/l) on

the curds was 6.9 mg/kg after application. Tamarind washing resulted in 51.6 per cent reduction and minimum of 33.6 per cent reduction occurred in salt solution washing on the day of treatment. Maximum reduction occurred in tamarind washing with 50.0, 48.6 and 52.6 per cent after 0, 1 and 3 days of treatment and minimum reduction was observed in salt solution washing with 35.3, 32.9 and 37.1 per cent, respectively. Cauliflower curds treated with fenvalerate (0.5ml/l) showed initial deposit residues of 0.98, 0.87 and 0.78 mg/kg at 0, 1 and 3 DAT, respectively. Washing with 2 per cent salt solution

**Table 2. Effect of decontamination processes in cabbage and cauliflower**

Treatment	Residues (mg/kg) (DAT)																	
	Lindane (2.5ml/l)			Endosulfan (2.0ml/l)			Lambda cyhalothrin (0.5ml/l)			Fenvalerate (0.5ml/l)			Quinalphos (2ml/l)			Profenofos (1ml/l)		
	0	1	3	0	1	3	0	1	3	0	1	3	0	1	3	0	1	3
<b>Cabbage</b>																		
Initial deposit	7.8	6.5	5.4	8.8	6.3	5.5	0.58	0.43	0.38	0.83	0.74	0.58	8.4	7.8	6.9	7.9	6.8	5.5
Brine(Salt) washing	4.99 (36.0)	4.26 (34.5)	3.39 (37.2)	5.86 (33.4)	4.04 (35.9)	3.59 (34.7)	0.39 (33.5)	0.27 (36.4)	0.25 (32.9)	0.53 (36.1)	0.47 (37.1)	0.38 (35.0)	5.51 (34.4)	5.18 (33.3)	4.37 (36.7)	5.15 (34.8)	4.49 (33.9)	3.63 (34.0)
Tamarind washing	3.87 (50.4)	3.17 (51.2)	2.74 (49.2)	4.17 (52.6)	3.26 (48.3)	2.71 (50.8)	0.28 (51.0)	0.21 (51.3)	0.19 (49.2)	0.43 (48.6)	0.37 (49.9)	0.29 (52.2)	4.11 (51.1)	3.94 (49.5)	3.62 (47.6)	3.99 (49.5)	3.53 (48.1)	2.88 (47.6)
Sodium bicarbonate	4.36 (44.1)	3.52 (45.8)	2.95 (45.3)	4.97 (43.5)	3.39 (46.2)	3.07 (44.1)	0.33 (43.8)	0.24 (44.5)	0.22 (43.5)	0.44 (46.5)	0.40 (46.1)	0.32 (44.8)	4.80 (42.9)	4.45 (43.0)	3.97 (42.5)	4.20 (46.8)	3.71 (45.4)	3.10 (43.6)
Water washing	5.05 (35.3)	4.28 (34.2)	3.45 (36.2)	5.69 (35.3)	4.10 (34.9)	3.54 (35.7)	0.38 (34.2)	0.27 (37.0)	0.25 (34.2)	0.53 (35.6)	0.47 (36.1)	0.39 (33.2)	5.47 (34.9)	5.02 (35.6)	4.42 (36.0)	5.25 (33.6)	4.37 (35.7)	3.58 (34.9)
<b>Cauliflower</b>																		
Initial deposit	4.5	3.9	3.1	6.9	5.9	5.1	0.85	0.79	0.54	0.98	0.87	0.78	4.9	4.1	3.9	4.8	3.8	3.4
Brine(Salt) washing	2.90 (35.6)	2.49 (36.1)	1.95 (37.1)	4.58 (33.6)	3.93 (33.4)	3.39 (33.5)	0.55 (35.3)	0.53 (32.9)	0.34 (37.1)	0.64 (35.0)	0.58 (33.3)	0.50 (36.1)	3.26 (33.5)	2.63 (35.8)	2.46 (36.9)	3.15 (34.4)	2.53 (33.3)	2.20 (35.3)
Tamarind washing	2.22 (50.6)	1.93 (50.6)	1.48 (52.1)	3.34 (51.6)	2.88 (51.2)	2.49 (51.1)	0.43 (50.0)	0.41 (48.6)	0.26 (52.6)	0.49 (50.5)	0.44 (48.5)	0.37 (52.2)	2.35 (52.1)	2.04 (50.2)	1.92 (50.8)	2.36 (50.8)	1.82 (52.1)	1.67 (50.8)
Sodium bicarbonate	2.49 (44.6)	2.13 (45.4)	1.71 (44.9)	3.89 (43.6)	3.30 (44.1)	2.81 (44.7)	0.47 (44.7)	0.42 (46.5)	0.29 (46.4)	0.55 (43.8)	0.48 (44.4)	0.42 (46.5)	2.80 (42.5)	2.22 (45.9)	2.10 (46.1)	2.61 (45.7)	2.09 (45.4)	1.88 (44.6)
Water washing	2.97 (34.1)	2.54 (34.9)	1.98 (36.1)	4.45 (35.5)	3.86 (34.6)	3.31 (35.1)	0.54 (35.9)	0.51 (35.5)	0.35 (34.8)	0.63 (35.7)	0.56 (33.8)	0.50 (36.4)	3.24 (33.9)	2.63 (35.9)	2.58 (33.9)	3.12 (35.1)	2.47 (35.0)	2.20 (35.2)

Values in parentheses are percent reduction, DAT-Days after treatment

resulted in 35.0, 33.3 and 33.5 per cent reduction after 0, 1 and 3 DAT, respectively while that with tamarind solution was 50.5, 48.5 and 52.2 per cent. With sodium bicarbonate, residues were reduced to 43.8, 44.4 and 46.5 and with water washing it was 35.7, 33.8 and 36.4 percent, respectively.

Synthetic pyrethroids and organophosphates were comparatively more removable (33.3 %) in cauliflower than the organo chlorinated insecticides of all the decontamination processes. The results are in agreement with Kantamalik *et al.* (1998) who reported that reduction of synthetic pyrethroids to 38.0 per cent in water washing in cauliflower and Dinabandho and Sharma (1994) reported that treating endosulfan and water washing resulted in a reduction of 29.5-34.14 per cent in cauliflower. In contrast, Satpathy *et al.* (2012) reported removal on insecticide residues of monocrotophos, fenitrothion and fenvalerate to an extent of 41, 100 and 100 per cent using 2 per cent tamarind solution in vegetables.

Tamarind solution 2% washing of brinjal, bhendi, cabbage and cauliflower for 30 seconds reduced insecticide deposits to nearly 50% followed by sodium bicarbonate 40% brine and water washing (30%). Sequential washing with these processes may have cumulative residue removal effect, which requires further investigation.

## References

- Beena Kumari., 2008. Effects of Household Processing on Reduction of Pesticide Residues in Vegetables. *ARPJ Agric and Biol. Sci.*, **3**:46-51.
- Chandrasekaran, S., Kuttalam, S. and Regupathy, A. 1997. Investigation on the level of contamination of insecticide residues in ready to market vegetables in Tamil Nadu. *Vegetable Sci.*, **24**: 136-139.
- Dinabandho, C.L. and Sharma, I.D. 1994. Effect of decontamination processes on insecticide residues on cauliflower. *Indian J. Plant Prot.*, **22**: 77-82.
- Kantamalik, Beena Kumari and Kathpal, T.S. 1998. Persistence and decontamination of Alphamethrin residue in / on cauliflower at flower at two different temperatures. *Pestic. Res. J.*, **10**: 246-250.
- Rajabaskar, D., Thangaraju, D. and Murugesan, N. 2001. Residues of endosulfan in bhendi fruits and its removal by washing and cooking. *J. Ecotoxicol. Environ. Monit.*, **1**: 185-189.
- Sheikh, S.A., Nizamani, S.M., Jamali, A.A., Panhwar, A.A., Channa, M.J. and Mirani, B.N. 2012. Removal of pesticide residues from okra vegetable through traditional processing. *J. Basic & Appl. Sci.*, **8**:79-84.
- Satpathy, G., Tyagi, Y.K. and Gupta, R. K. 2012. Removal of organophosphorus (OP) Pesticide Residues from vegetables using washing solutions and boiling. *J. Agric. Sci.*, **4** : 69.78.
- Singh, Y.P. 1995. Persistence and degradation of monocrotophos in and unprocessed and processed cauliflower at medium high altitude hills. *Pestology*, **19**: 16-21.