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Residues of insecticide in farm and market samples of Eggplant in Bangladesh

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ABSTRACT

In order to assess the residue levels of insecticides, fresh eggplant fruits, leaves, soil and water samples were collected from the farmer's fields and markets of 8 selected locations in intensive eggplant growing areas like Jessore, Bangladesh. The residue analysis of such 28 samples was carried out in the Pesticide Analytical laboratory, Entomology Division of Bangladesh Agricultural Research Institute (BARI), Gazipur. Among these samples, 12 samples contained insecticides residue. Out of these 12 samples, 4 had insecticide residue above Maximum Residue Limits (MRLs). The detected insecticides residues in those samples were of Malathion, Quinalphos, Fenitrothion and Cypermethrin.

Keywords: Residue, Insecticide, Farm & Market Sample, MRL.

1. Introduction

Eggplant is one of the major and most important vegetables in Bangladesh. One of the major factors of low yield of eggplant is insect pest. At least fifteen insect pests and one mite pest attack eggplant. In a growing season of 4 to 6 months in Jessore district, as many as 150 applications of insecticides with at least once a day during peak period were required to suppress the insect pests in eggplant. Even in several instances farmers were reported to use cocktails of 3 to 5 insecticides to control pests in eggplant, which indicated the development of resistance, destruction of natural enemies, resurgence and harmful residues in edible fruits. As a safety measure for the consumers, many developed countries have recommended Maximum Residue Limit (MRL) based on the Acceptable Daily Intake (ADI) and Potential Daily Intake (PDI) of almost all pesticides [1], which should not be exceeded for a food item to be considered safe for consumption. Although it is not documented how much active material could be left in eggplant fruit after washing and cooking, it may be assumed that the use of highly toxic insecticides on the eggplant would widen the possibilities of consumers to be intoxicated. In the context of Bangladesh, since harvesting and selling of eggplant are done without bothering for the pre-harvest interval, pesticide residue levels in such eggplant need to determined. This research work was done to know whether the amount of insecticides residue in the collected eggplant samples are above the Maximum Residue Limits (MRLs) or not & this study may also add information on insecticide residue load on eggplant to safeguard the consumers.

2. Materials & Methods

A total of 28 fresh eggplant, soil and water samples were collected from eight different locations like Dauladihi, Dakatia, Shahabazpur, Momin nagar, Pultadanga, Shantola, Chaugacha and Abdulpur, in Jessore, Bangladesh during the year 2009-2010. At first 8 eggplant fruit samples were collected from the farmers field and market. At 1 month interval, 4 eggplant leaf samples, 4 soil samples and 4 water samples were collected for the second time. Again at 1 month interval, 4 soil samples and 4 water samples were collected for the third time. To quantify and identify the insecticide residue from the collected eggplant fruit, soil and water sample, the analytical work was carried out at the Pesticide Analytical Laboratory of the Entomology Division of BARI, Gazipur. Multi residue analysis was followed to analyze the samples. Six different standards (i.e., Acephate, Diazinon, Malathion, Quinalphos, Fenitrothion and Cypermethrin) were tested against the samples, since insecticides of these groups were widely used by the farmers of the selected areas.

2.1 Chemicals Used in Analysis

Chemicals used in the insecticide residue analysis were: Acetone, n-Hexane (C6H14), Methanol, Silica gel 60, Sodium sulphate [anhydrous granular (Na2SO4)], Florisil (Magnesium silicate, activated), Standard solution of carbofuran in hexane and Standard solution of cypermethrin in hexane.

2.2 Analytical Apparatus Used in Residue Analysis

(a) GC-2010, Shimadzu corporation, Japan
(b) Rotavapor, Model: R-210, Switzerland
(c) Electric balance, Model: AY- 220, Shimadzu Corporation, Japan
(d) Centrifuge machine, model : Sigma 3k 30, Germany
(e) Vortex, Model: Maxi max ii, USA
(f) Homogenizer, Model: Ultraturax, IKA T18 basic, Germany
(g) Orbital shaker, Model: Rexmed, Sweden

In addition to the above instruments the following accessories were also used:

(a) Scissors; (b) Measuring cylinder; (c) Conical flask; (d) Volumetric flask; (e) Tray; (f) Knife; (g) Spatula; (h) Funnel; (i) Test tube; (j) Micro pipette; (k) Aluminum foil; (l) Para film; (m) Glass vial etc.

2.3 Detection and quantification of Cypermethrin, Quinalphos, Fenitrothion and Malathion residue in samples

Extraction of eggplant fruit and leaf, soil and water was done to get the concentrated extracts which were subjected to analysis by GC-2010 (Shimadzu) with Electron Capture Detector (ECD) and Flame Thermionic Detector (FTD). The capillary column used was AT-1, length 30 m, ID 0.25 mm and film thickness 0.25 µm. Nitrogen was used as carrier and make up gas in ECD, while Helium was used as carrier and make up gas in FTD. The instrument parameters for quantify insecticide residues are shown in Table 1 & Table 2:

Table 1: Instrument parameters for detecting Cypermethrin

Injection Port SPL			
Injection Mode		Split	
Temperature		280^0C	
Split Ratio		10	
Flow Control Mode Linear Velocity		40 cm/sec	
Column Oven			
Initial temperature		160^0C	
Equilibration time		-	
Column oven temperature progam			
Total Program Time		18.00 min	
	Rate (^{0}C/min)	Temperature (^{0}C)	Hold Time (min)
	-----	160.0	1.00
	10.0	270.0	6.0
Detector Channel 1 ECD			
Temperature		300^0C	
Stop Time		18 min	
Current		1.00 pA	
Makeup Flow		30 ml/min	

Table 2: Instrument parameters for detecting Quinalphos, Fenitrothion and Malathion

Injection Port SPL			
Injection Mode		Split	
Temperature		250^0C	
Split Ratio		-	
Flow Control Mode Linear Velocity		40 cm/sec	
Column Oven			
Initial temperature		150^0C	
Equilibration time		1.0 min	
Column oven temperature programme			
Total Program Time		10.00 min	
	Rate (^{0}C/min)	Temperature (^{0}C)	Hold Time (min)
	-----	150.0	1.00
	10.0	220.0	2.00
Detector Channel 1 FTD			
Injection Mode		Spilt	
Temperature		280^0C	
Current		1.00 pA	
Makeup Flow		30 ml/min	
H_2Flow		2.0 ml/min	
Air Flow		145.0 ml/min	

3. Results

A total of 28 samples of soils, water, eggplant fruit and leaf were collected from eight locations of Jessore region for insecticide residue analysis. The results showed that out of 28 samples 12 samples had detectable level of residue.

Eight eggplant fruit samples were collected at October, 2009 and analyzed. Among these eight samples, four contained insecticides residue and those were Fenitrothion (0.316 ppm), Cypermethrin (0.036 ppm), Cypermethrin (0.728 ppm) and Malathion (0.207 ppm) in JB1, JB2, JB5 and JB6 respectively (Table 3). Out of these, only one sample (JB5) contained residue of Cypermethrin (0.728 ppm) above MRL (0.50 ppm).

Table 3: Quantity of insecticides residue in Eggplant fruit samples collected at October, 2009 from Jessore region.

Sl. No.	Sample code	Detected insecticide	Level of insecticide residue (ppm)	FAO/WHO Recommended MRL (ppm)
1.	JB 1	Fenitrothion	0.316	0.50
2.	JB 2	Cypermethrin	0.036	0.50
3.	JB 3	ND	ND	ND
4.	JB 4	ND	ND	ND
5.	JB 5	Cypermethrin	0.728	0.50
6.	JB 6	Malathion	0.207	0.30
7.	JB 7	ND	ND	ND
8.	JB 8	ND	ND	ND

*JB- Jessore Eggplant Fruit, ND- Not Detected

Four leaf samples were collected after one month of first collection and found only 1 sample (JLb1) contained residue of Fenitrothion, which was 0.282 ppm (Table 4).

Table 4: Quantity of insecticides residue in leaf samples collected after one month of first collection from Jessore region, 2009.

Sl. No	Sample code	Detected insecticide	Level of insecticide residue (ppm)	FAO/WHO Recommended MRL (ppm)
1.	JLb 1	Fenitrothion	0.282	0.50
2.	JLb 2	ND	ND	ND
3.	JLb 3	ND	ND	ND
4.	JLb 4	ND	ND	ND

*JLb- Jessore Eggplant Leaf, ND- Not Detected

Four soil samples and four water samples were collected after one month and analyzed of first collection and found that no soil and water samples had detectable level of residue except one water sample (JW2) contained residue of Quinalphos (0.241 ppm), which was above the MRL (0.20 ppm) (Table 7).

Table 5: Quantity of insecticides residue in soil samples collected after one month of first collection from Jessore region, 2009.

Sl. No.	Sample code	Detected insecticide	Level of insecticide residue (ppm)	FAO/WHO Recommended MRL (ppm)
1.	JS 1	ND	ND	ND
2.	JS 2	ND	ND	ND
3.	JS 3	ND	ND	ND
4.	JS 4	ND	ND	ND

*JS- Jessore Soil, ND- Not Detected

Table 6: Quantity of insecticides residue in soil samples collected after two months of first collection from Jessore region, 2009.

Sl. No.	Sample code	Detected insecticide	Level of insecticide residue (ppm)	FAO/WHO Recommended MRL (ppm)
1.	JS 5	ND	ND	ND
2.	JS 6	Malathion	8.127	0.30
		Cypermethrin	0.60	0.50
3.	JS 7	Malathion	0.024	0.30
		Cypermethrin	0.396	0.50
4.	JS 8	ND	ND	ND

*JS- Jessore Soil, ND- Not Detected

Table 7: Quantity of insecticides residue in water samples collected after one month of first collection from Jessore region, 2009.

Sl. No.	Sample code	Detected insecticide	Level of insecticide residue (ppm)	FAO/WHO Recommended MRL (ppm)
1.	JW 1	ND	ND	ND
2.	JW 2	Quinalphos	0.241	0.20
3.	JW 3	ND	ND	ND
4.	JW 4	ND	ND	ND

*JW- Jessore Water, ND- Not Detected

Lastly four soil samples and four water samples were collected after two months and analyzed again. Among four soil samples, 2 samples contained both Malathion and Cypermethrin residue. One sample (JS6) contained residue of Malathion (8.127 ppm) and Cypermethrin (0.60 ppm). Both of these were above the MRL (Malathion 0.30 ppm, Cypermethrin 0.50 ppm). Another sample (JS7) contained residue of Malathion (0.024 ppm) and Cypermethrin (0.396 ppm). Both of these were below the MRL (Table 6). Among the four water samples only two sample (JW5 and JW7) contained malathion (0.057 ppm) and cypermethrin (0.047 ppm) and both of these residue levels were below the MRL (Table 8).

Table 8: Quantity of insecticides residue in water samples collected after two months of first collection from Jessore region, 2009.

Sl. No.	Sample code	Detected insecticide	Level of insecticide residue (ppm)	FAO/WHO Recommended MRL (ppm)
1.	JW 5	Malathion	0.057	0.30
2.	JW 6	ND	ND	ND
3.	JW 7	Cypermethrin	0.047	0.50
4.	JW 8	ND	ND	ND

*JW- Jessore Water, ND- Not Detected

4. Discussion

From the above result, it is revealed that among the eight eggplant fruit samples, one sample contained residue of cypermethrin above the Maximum Residue Limit (MRL) recommended by FAO/WHO. In case of soil samples, no residue was detected after one month of first sample collection. But among four soil samples, which were collected after two months of first collection, two samples contained residue of malathion and cypermethrin above MRL. This might occurred due to accumulation of pesticides in soil from time to time. On the other hand, among the four eggplant leaf samples collected after one month of first sample collection, one sample contained residue of quinalphos above MRL. The results are more or less same in argument with that [2] who observed the leftover residue of Fenitrothion in eggplant sample was detected up to 7 days after spraying, of which up to 3 days after spraying the quantities were above MRL [3-4]. Also found detectable level of residue of cypermethrin up to 7 days of spraying of recommended dose [5] Reported that, there was no detectable insecticides residue in collected eggplant samples from such survey. In contrast, [5] found no detectable insecticides residue in collected eggplant sample.

5. Conclusion

Based on the results of the above study, the following conclusions were drawn:

- Farmers have little knowledge about insecticides residue and they use different insecticides at an alarming frequency.
- Most of the farmers harvest and market eggplant without bothering pre-harvest interval (PHI) of insecticides spray while there is great chance of consumers to be intoxicated by the highly toxic insecticides.
- Maximum residue levels of insecticides detected in a number of samples show environmental and public health concern.

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