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DECONTAMINATION OF ORGANOPHOSPHORUS INSECTICIDE RESIDUES FROM EGGPLANT AND YARD LONG BEAN

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ABSTRACT

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The present study was undertaken to quantify the residue loss of quinalphos, diazinon and fenitrothion from eggplant and malathion from yard long bean through washing and steam cooking procedures. Samples were collected from the research field of Entomology Division of Bangladesh Agricultural Research Institute (BARI), Gazipur. Eggplant was spiked with 100% pure 1.0 mg/kg of quinalphos, diazinon, malathion and fenitrothion. After 10 minutes of spiking, one sample was washed with water and another was heated at 100^0C. In both cases, 20 minutes waiting period were allowed for proper washing and heating. Extraction and cleanup was done by following standard procedures. The prepared samples were then injected in GC-FTD along with the standard of tested pesticides. Washing with water reduced 34% quinalphos, 28% diazinon and 41% fenitrothion and heating with water at 100^0C reduced 95% quinalphos, 84% diazinon and 100% fenitrothion from eggplant. Washing with water reduced 45% malathion and heating with water at 100^0C reduced 100% malathion from yard long bean. Effect of O_3 sterilizer in reducing pesticide residues from eggplant was also investigated in this study and it was found that O_3 sterilizer reduced 79.00% diazinon and 62.50% quinalphos while washing with only water reduced 60.50% diazinon and 40.00% quinalphos from eggplant.

Key words: *decontamination, organophosphorus insecticide residue, GC-FTD, O_3 sterilizer*

INTRODUCTION

Production of food or agricultural produces is largely associated with pesticides. At present, inappropriate and irrational use of pesticides for the control of insect pest of vegetables is the common practice in Bangladesh (Kabir *et al.* 1996). Considering the serious consequences of indiscriminate, overuse and misuse of insecticides result in disruption in the agro-ecosystem, human health hazard and environmental pollution (McIntyre *et al.* 1989). Since most pesticides are toxic in nature, their continuous ingestion by man even in trace amount, can result in accumulation in body tissues with serious adverse effects on health (Handa *et al.* 1999). McIntyre *et al.* (1989) reported that low level exposures of insecticide to consumers containing food products over time might cause cancer, teratogenesis, genetic damage, and suppression of the immune system.

Different techniques like washing, heating, peeling, dipping in chemical solution (Sodium chloride solution), etc. are used for the removal of pesticide residues. Household washing procedures are normally carried out with running or standing water at moderate temperatures. Detergents, chlorine or ozone can be added to the wash-water to improve the effectiveness of the washing procedure.

The effects depend on the physicochemical properties of the pesticides, such as water solubility, volatility. Washing processes lead to reduction of hydrophilic residues which are located on the surface of the crops. In addition, the temperature of the washing water and the type of washing has an influence on the residue level. As pointed out by Halland *et al*. (1994), hot washing and the addition of detergents are more effective than cold water washing. Washing coupled with gentle rubbing by hand under tap water for 1 min dislodges pesticide residues significantly (Barooah and Yein, 1996). Systemic and lipophilic pesticide residues are not removed significantly by washing.

Cooking procedures at different temperatures, the duration of the process, the amount of water or food additives, and the type of system (open or closed) may have an impact on the residue level. Normally, residues are reduced during the cooking process by volatilization in open systems or by hydrolysis in closed systems. Several studies were reported on the dissipation of pesticides in crop products during cooking. The behavior of the organophosphorus pesticides chlorfenvinphos, fenitrpothion, isoxathion, methidathion and prothiophos during cooking was examined by Nagayama (1996) with green tea leaves, spinach and fruits. These pesticides decreased during the cooking process corresponding to the boiling time. According to the water solubility, some pesticides were translocated from the raw materials into the cooking water (Denis and Stephen, 2004). With these views, this experiment was initiated to quantify the residue loss through washing and cooking.

MATERIALS AND METHODS

The standard of diazinon, malathion, quinalphos and fenitrothion were obtained from Sigma-Aldrich, Germany via Bangladesh Scientific Pvt. ltd. Dhaka, Bangladesh. Standards of all pesticides contained 99.6% purity. Marketable size of eggplant and yard long bean were collected from the research field of Entomology Division of Bangladesh Agricultural Research Institute (BARI), Gazipur during 2010-11.

Extraction and separation

The methodology prescribed by William and George (2005) with necessary modification was adopted for extraction, separation and clean-up of the sample. Collected field samples (≥250 g) were grounded thoroughly with the meat grinder (Handmixer M-122, Bamix, Switzerland). A sub-sample of 20 g was taken into a wide mouth jar, then 100 ml of hexane was added to it. Anhydrous sodium sulphate (Na_2SO_4) was also added with sample until water was removed from the sample. The mixture was then macerated with high-speed homogenizer (Ultraturax, IKA T18 Basic, Germany) for 2 minutes. The homogenized material was then poured into 250 ml conical flask and placed into the shaker (Orbital Shaking Incubator, Rexmed, Sweden) for 12hrs continuous shaking. After shaking, the slurry was filtered through a Buchner funnel with suction. The flask and filter cakes were rinsed with 25 ml of hexane for each. The filtrate was then transferred into 250 ml round bottom flask and was dried to 5 ml by evaporation using a rotary vacuum evaporator (Laborota-4001, Heidolph, Germany). The concentrated filtrate was then transferred into 500 ml separatory funnel making 10 ml in volume. Around 20 ml methanol was added with 10 ml filtrate and shaken vigorously for 5 minutes. After shaking, the separatory funnel was set on stand and kept undisturbed for 5 minutes. Then the clear part of the solution from the bottom of the separatory funnel was collected in a vial which was then centrifuged at 1200 rpm for 5 minutes (Laboratory Centrifuges, Sigma-3K30, Germany). After centrifugation, supernatant was collected for injection.

Operating condition of GC-FTD

A Gas Chromatograph (GC-2010 Shimadzu) coupled with Flame Thermionized Detector (GC-FTD) was used for the identification and quantification of quinalphos, diazinon and malathion. Separation was done by ATTM-1 capillary column (30 m long, 0.25 mm i.d. and 0.25 μm film thicknesses), nitrogen was used as carrier (column flow 1.5 ml/min.) and make up gas as well. The injector and detector temperatures were set to 250°C and 280°C, respectively and the column oven temperature was programmed, which was started from 150°C (1 min hold) and went upto 220°C with incremental rate of 10°C (2 min hold). All the injections (1 μL) were done in spit mode. The total run time was 10 min. Identification of the analyte in the samples was done by comparing the retention time of the corresponding calibration standard and quantification was done by external calibration curves made with 5 point calibration standard.

Procedure of sample preparation for washing and steaming of eggplant and yard long bean

Eggplant was spiked with 100% pure 1.0 mg/kg of quinalphos, diazinon, and fenitrothion and yard long bean with malathion. After 10 minutes of spiking, one sample was washed with water and another was heated at 100^0C. In both cases, 20 minutes waiting period were allowed for proper washing and heating. For extraction the above mentioned standard procedures was followed. The prepared samples were then injected in GC-FTD along with the standard of tested pesticides.

Procedure of sample preparation for O_3 sterilization and washing of eggplant

Eggplant was spiked with 100% pure 2 mg/kg of diazinon and quinalphos. After 10 minutes of spiking, one sample was washed with water and another was extracted through O_3 sterilizer by dipping in water. In both cases, 30 minutes waiting period were allowed for proper washing. Standard extraction procedures was followed. The prepared samples were then injected in GC-FTD along with the standard of tested pesticides.

RESULTS AND DISCUSSION

The analytical results are summarized in Table 1-3.

Table 1. Effect of washing in reducing pesticide residue from eggplant and yard long bean

Tested crop	Tested pesticide	Spiking amount (mg/kg)	Level of residue detected after washing (mg/kg)	Residue reduced after washing (%)
Eggplant	Quinalphos	1	0.66	34
	Diazinon	1	0.72	28
	Fenitrothion	1	0.59	41
Yard long bean	Malathion	1	0.55	45

Table 2. Effect of steam cooking in reducing pesticide residue from eggplant and yard long bean

Tested crop	Tested pesticide	Spiking amount (mg/kg)	Level of residue detected after heating (mg/kg)	Residue reduced after heating (%)
Eggplant	Quinalphos	1	0.05	95
	Diazinon	1	0.16	84
	Fenitrothion	1	ND	100
Yard long bean	Malathion	1	ND	100

*ND=Not detected

From the table 1 it is revealed that washing with water reduced 34% quinalphos, 28% diazinon and 41% fenitrothion from eggplant and 45% malathion from yard long bean. From the table 2, it is revealed that heating with water at 100^0C reduced 95% quinalphos, 84% diazinon and 100% fenitrothion from eggplant and 100% malathion from yard long bean.

Table 3. Effect of O_3 sterilizer in reducing pesticide residues from eggplant

Tested crop	**Tested pesticide**	**Spiking amount (mg/kg)**	**Level of residue detected**		**Residue reduced (%)**	
			Washed with water (mg/kg)	**Washed with O_3 sterilizer (mg/kg)**	**Washed with water**	**Washed with O_3 sterilizer**
Eggplant	Diazinon	2.00	0.79	0.42	60.50	79.00
	Quinalphos	2.00	1.20	0.75	40.00	62.50

From the table 3 it is revealed that O_3 sterilizer reduced 79.00% diazinon and 62.50% quinalphos while washing with only water reduced 60.50% diazinon and 40.00% quinalphos from eggplant. The present results indicate that O_3 sterilizer enhance the reduction of pesticide residue. It is recommended that commonly used pesticides may be tested for different type of crops. Then the actual efficacy of O_3 sterilizer will be known for different pesticides on different crops.

Fruits and vegetables are usually washed before consumption. Vegetables are often peeled off and cooked prior to eating. The findings of the present study are supported by several researchers. Washing was the most effective means of removing pesticide residues and minimizing dietary intakes from cabbage (Yuan *et al*. 2009). Elkins *et al*. (1968) also reported that cold water washing removed 96% malathion residue from beans. Deshmukh and Lal (1969) reported that tap water washing of eggplants treated with carbaryl removed residue to a great extent. Bindra (1973) reported 80–83% reduction of carbaryl by washing of tomato. Approximately 50% of fenitrothion residue was removed on washing of apple fruit during production of concentrated juice from apples treated with 0.15% solution of fenitrothion (Lipowska *et al*. 1998). Tejada *et al*. (1990) reported that usual practice of washing rice and maize before cooking reduced chlorpyrifos residues by 59–100% coming from sprays on jute sacks. Decontamination processes such as washing and steaming dislodged the cypermethrin residues in pulses by 37–49% and 63–74%, respectively (Dikshit 2001).

The location of pesticides in different parts of food varies with the nature of molecule and type of food commodity and environmental conditions. Pesticide can be degraded by photolysis, hydrolysis, oxidation and reduction, metabolism, temperature, and pH level. The level of pesticide residues is affected by washing, preparatory steps, heating or cooking, processing during product manufacturing and postharvest handling and storage. The washing of raw materials is the simplest and easy way to reduce pesticide residues from different food materials.

CONCLUSION

Pesticide residues remain in food commodities, as a result of pre-harvest or postharvest application of pesticides. In this study, several experiments were conducted to reduce pesticide residues from eggplant and yard long bean through washing with water, heating and O_3 sterilizer. Pesticide residues were determined by Gas Chromatography with FTD detector. The finding of the present study indicates that washing with water reduced 28-41% and heating with water reduced 84-100% organophosphorus insecticides from eggplant. In case of yard long bean, washing with water and heating with water reduced 45% and 100% malathion, respectively. O_3 sterilizer reduced 79.0% diazinon and 62.50% quinalphos from eggplant. The reduction of pesticide residues varies from pesticide to pesticide. It is recommended that commonly used pesticides may be tested for different types of crops with various types of pesticide.

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