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EFFECTS OF WASHING ON CONCENTRATION OF RESIDUAL PESTICIDES IN SALAD VEGETABLES

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ABSTRAT

The salad vegetable samples (102) of eight kinds (carrot, salad, radish, tomato cucumber, coriander, mint and sugar beat) grown on vast areas in Sindh especially in Thatta, Mirpurkhas, Hyderabad, Badin and Malir in Karachi were analyzed by gas chromatograph (GC) after and before washing with water. These vegetables are not only consumed locally but are exported to different countries especially to Europe, Far East and Middle East and help earn foreign exchange of more than 10 million rupees. Pakistan has already signed WTO and in the near future we would not be able to grow efficiently these vegetables in the pesticide free environment which would mean that the present technique of washing would help us in our export and comply with WTO restrain to some extent. From 15% to 64% average reduction in residues of different pesticides were calculated. A significant reduction (6-100%) in residues was observed in vegetables (carrot, Radish, tomato, cucumber, coriander, mint, and sugar beat. Moreover, a positive correlation (Adj. r^2 = 0.762) was observed between reduction in residues and pesticide's solubility in water (mg/L) i.e. Deltamethrin (DEL), fenitrothion (FEN), cypermethrin (CYP), profenofos (PRO) and malathion (MAL).

Keywords: washing, pesticide, residues, vegetables

INTRODUCTION

The vegetables are grown on vast areas in Pakistan. Thatta, Mirpurkhas, Hyderabad, Badin and Malir (Karachi) are the major vegetable-growing areas of Sindh. These vegetables are not only used locally but are also exported to different countries especially to Europe, Far east and Middle East countries and help earn foreign exchange of more than 10, 000 million rupees annually. The vegetable export of the country during the first quarter of financial year (2009-2010) showed an increase of 45% and about 43,983 million tons of vegetables with a total of US $ 10.842 million was exported as compared to 24,219 metric tons of US $ 7.437 millions during the same period in 2008-2009.

The use of pesticides is common and considered to be essential for boosting agricultural production but their misuse also poses serious threats to public health. The misuse of pesticides has led to tremendous economic losses and hazards to human health. Human exposure to pesticides is usually estimated by measuring the levels in the environment i.e. soil, water and food (Tahir *et al*., 2001 and 2008, Ahmad 2004, Anwar, 2009, Anwar *et al.* 2004, 2005 and 2010, Parveen *et. al*. 2004 & 2005, Ahmad and Anwar, 2007 & Ahmad, 2009 and Hassan et al., 2007). About 60-70% of pesticide poisoning cases were reported due to occupational exposure (Ahmad, 1998 and Tahir, 2000 and Tariq, 2007) and non occupational groups appeared to be at high risk of hazards through the contamination of food chain. Monitoring of pesticide residues should be legalized in developing countries like Pakistan to face the implication of WTO (Anwar *et. al*., 2006) and to control the indiscriminate use of the pesticides in the country and to ensure that the consumers are not exposed to any risk by eating food containing pesticide residues. Violations of the law occur when pesticides are not used in accordance with label registration and are applied in excessive amounts, or when pesticides are applied to crops on which they are not allowed. Besides regulatory management other methods to decontaminate the residues from the agricultural commodities need to be investigated. The most of the pesticide residues appear to reside on the surface of vegetables where it is removed by the mechanical action of rinsing (Krol, 2000). There are numerous studies that have examined the effects of washing agricultural produce to remove pesticide residues as a step in commercial crop processing. These studies are of little practical use to the consumers. However, researchers have reported decontamination process before consumption for general public e.g. warm water reported to be more effective in eliminating pesticide residues as compared to tap water (Uno *et. al*., 1984). Other solution like detergent and alkali solution (Mahesh and Wasthi, 1986), brine solution (Jadhar, 1987), Palmolive® solution (Krol, 2000), Ozone, Hydrogen peroxyacetic acid and Chlorine dioxide (Hwang et al., 2001) have also been reported effective in removing the pesticide from agricultural commodities. Lee *et al.* (1919) found

60% reduction of chlorpyriphos from the rice grain when washed with water. A significant decrease from 56% to 97% was reported with the treatment of ozone in apple (Hwang *et al.* (2001). In the present study the naturally available universal solvent i.e. water was investigated for the removal residual pesticides from vegetables.

MATERIALS AND METHTODS

All the vegetable samples were collected randomly from the local markets of Karachi. One kilogram each of vegetables (carrot, Radish, tomato, cucumber, coriander, mint and sugar beat.) was brought in ice box to the Pesticide Research Institute (PRI), Southern zone Agricultural Research Centre (SARC), Karachi. These samples were chopped, sub-sampled and preserved in a freezer till further processing. The method of Shahida and Nusrat (2005) was followed for extraction and cleanup of samples. One kg of the sample was chopped and mixed thoroughly.

To estimate pesticides residual concentration 50g of each sample was taken out and blended with 50 ml of acetone, 50 gm of anhydrous sodium sulphate and 50 ml of a mixture of cyclohexane and ethylacetate (1:1). The mixture was allowed to stand for some time until a clear supernatant was formed and 30 ml supernatant was taken into a round bottom flask. A few drops of 10% propandiol in ethylacetate and 4-6 glass beads were added. The solvent was evaporated at 40 °C under vacuum in rotary evaporator. Two ml of this sample was applied on mini-column for further cleanup. The samples were dried under vacuum and reconstituted in 1ml ethylacetate for analysis on Gas Chromatograph (GC). The pesticide concentration in vegetable samples was determined before and after washing.

Table 1. Pesticide residual concentration in selected vegetables before and after washing.

S. No.	Vegetables	Pesticides	Residual pesticide (mg / kg)	
			Before Washing	After Washing
1.	CARROT- *Daucus carrota* L 12)	Cypermethrin	1.25	1.15
		Deltamethrin	0.83	0.57
		Prophenophos	1.07	0.8
2.	RADISH- *Raphanus sativus* L. (14)	Prophenophos	0.7	0
		Cypermethrin	1.15	0
		Malathion	2.15	0
3.	SALAD- *Lactuca sativa* L. (14)	Cypermethrin	1.58	1.2
		Prophenophos	1.35	0.93
		Malathion	2.0	1.8
		Fenvalerate	0.98	0.37
4.	TOMATO- *Lycopersicon esculentum* Mill (16)	Malathion	1.17	0.97
		Fenvalerate	1.2	1.1
		Cypermethrin	1.3	1.0
5.	CUCUMBER- *Cucumis sativus* (16)	Prophenophos	1.33	1.15
		Fenvalerate	1.2	0.9
6.	CORIANDER- *Coriandrum sativum* (10)	Cypermethrin	1.83	1.63
7.	MINT- *Mentha pipprata* L. (10)	Cypermethrin	2.33	1.85
8.	SUGAR BEET- *Beta vulgaris* (10)	Cypermethrin	1.03	0.97

RESULTS AND DISCUSSIONS

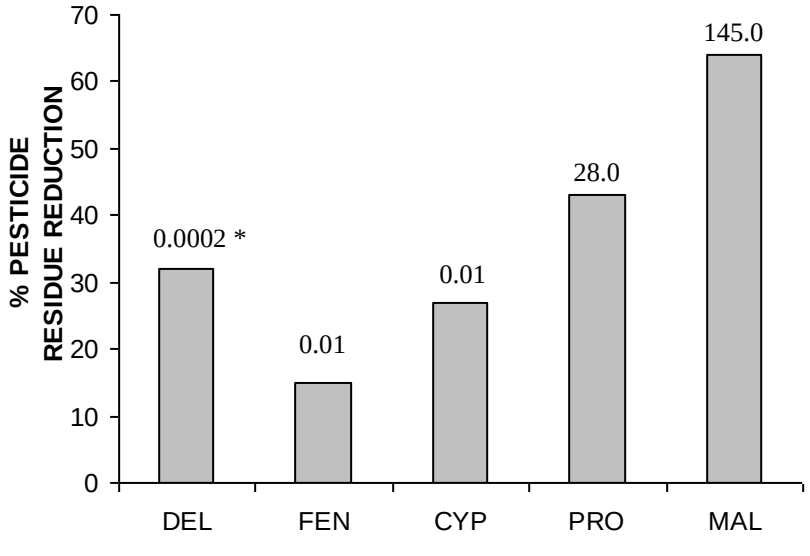
Washing play important role in reducing residue levels. In this study the effects of washing vegetables with water was examined. The results of this study are presented in (Table 1). Salad vegetable samples (102) of eight kinds were analyzed by gas chromatograph (GC) after and before washing with water. The percent reductions in residues of different pesticides were calculated. In carrot 32% reduction in residue of deltamethrin was found when washed with water followed by 25% and 8% in Prophenophos and cypermethrin respectively. A significant reduction (100%) was observed in radish for cypermethrin, Prophenophos, Malathion and fenitrothion. In case of salad 31%, 24%, 11% and 10% reductions were calculated respectively in Prophenophos, cypermethrin, fenitrothion and Malathion. In tomatoes 23%, 17% and 8% reduction was recorded in cypermethrin, Malathion, fenitrothion

followed by 14% and 25% of Prophenophos and fenitrothion in cucumber. Cypermethrin 11%, 20% and 6% was found to be reduced after washing with water in case of coriander, mint and sugar beat respectively. Saimander *et al.* (2009) recently pointed out that 5 decontaminants were found ineffective in reducing pesticide residues from the surface of egg plants. Whereas, the average of total pesticides was found from 15% for fenitrothion to 64 % for malathion followed by the average total reduction from 6 to 100% in vegetable samples respectively for sugar beat and radish after washing. Studies carried out earlier are in agreement with Schatternberg *et al*., (1996) who reported 19% decontamination from 40% contaminated samples of agricultural commodities after washing, peeling and cooking.

Table 2. Percent reduction of pesticides residues in salad vegetables after washing with water.

S. No.	Vegetables	Pesticides					
		CYP	DEL	PRO	MAL	FEN	Mean
1	Carrot, *Daucus carrota* L. (12)	8	32	25	-	-	21.67 ± 7.13
2	Radish, *R. sativus* L. (14)	100	-	100	100	-	100.0 ± 0.0
3	Salad, *Lactuca sativa* L. (14)	24	-	31	10	11	19.0 ± 5.12
4	Tomato, *Lycopersicon esculentum* (Mill) (16)	23	-		17	8	16.0 ± 4.36
5	Cucumber, *Cucumis sativus* (16)	-	-	14	-	25	19.5 ± 5.50
6	Coriander, *Coriandrum sativum* Linn. (10)	11	-	-	-	-	11
7	Mint, *Mentha pipprata* L. (10)	20	-	-	-	-	20
8	Sugar beat, *Beta vulgaris* L. (10)	6	-	-	-	-	6
Mean		27	32	43	64	15	

Note: CYP, cypermethrin; DEL, deltamethrin; PRO, Prophenophos; MAL Malathion and FEN, fenitrothion.
Figures in parenthesis are the total number of vegetable samples analyzed.



% pesticide removal = 26.968 + 0.26679 Pesticide solubility ± 9.03**

t =5.61 t = 3.72

p < 0.0108 p = 0.0339

$r = 0.906$, $r^2 = 0.821$, Adj. $r^2 = 0.762$; $F = 13.81$ ($p < 0.0339$)

Fig. 1. Relationship of % removal of pesticides on washing of vegetables and their aqueous solubility. *, Solubility ($mg.L^{-1}$). **, Regression between % removal of pesticide on washing and the aqueous solubility of the pesticides irrespective of their kind. Acronyms: DEL, Deltamethrin; FEN. Fenitrothion; CYP, Cypermethrin; PRO, Prophenophos; MAL, Malathion.

Similarly the finding of Ramesh and Balasubramanian (1999) supported the present investigation found 65%-90% reduction in pesticide residues during house hold preparation. The effects depend on the physiochemical properties of the pesticides, such as water solubility as positive correlation (Adj. $r^2 = 0.762$) was observed between reduction in residues and pesticide‘s solubility in water (mg/L) (Fig. 1). Moreover, hydrolytic rate constant, volatility and octanol-water partition coefficient also contribute along with the actual physical location of the residues. The temperature of the washing water and the type of washing has an influence on the residue level (Uno *et al*., 1984). It was concluded that household washing procedures if carried out with water with addition of detergents (Mahesh and Wasthi, 1986) would improve the effectiveness of the washing procedure along with the several washing steps (Uno *et al.,* 1984).

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