IJBPAS, December, 2015, 4(12): 6668-6681

ISSN: 2277–4998

International Journal of Biology, Pharmacy and Allied Sciences (IJBPAS)

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

METHODS FOR REMOVAL OF PESTICIDE RESIDUES IN ONION (*ALLIUM CEPA* L)

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ABSTRACT

Pesticides are one of the key inputs used for increasing agricultural productivity of crops. The present study has been designed to determine the effect of household processing on removal of pesticide residues (bifenthrin, diafenthiuron, imidacloprid and emamectin benzoate residues) in

Onion (Allium cepa L). The pesticide residues remained in the food materials subsequent to harvesting that are greater the control of consumer and have poisonous effect on human health. Thus it is necessary to look for cheap and finest method which can be adopted easily at home, therefore, results showed that the, washing with NaCl solution showed higher reduction of residues as compared with tap water. Furthermore, it was also found that blanching effectively reduced residues by 54-78%. Drying the commodities either fruits or vegetables under sun light or thermal dehydration played significant role in the removal of the pesticide residues up to 97 and 96%, respectively. Frying was also observed to be more effective technique in minimizing the residues of pesticides in the study i.e., up to 95%.

Keywords: Household processing, Pesticide residues, Onion, Washing

INTRODUCTION

Onion (Allium cepa L) is one of the most popular and widely grown vegetables in the world. This vegetable eaten raw or cooked and is one of the important ingredients used in daily meals all over Pakistan. Modern research has recommended that onions may play an important role in diet and prevented heart disease and other ailments. The total area under onion crop in Pakistan was 129662 hectares with the production rate was 1817350 tones whereas, the contribution of Sindh province stood at745395 tones on 46505 hectares [1]. The taste of onion is dependent on the varieties because an onion can be spicy, sharp, pungent or mildly sweety and tangyin taste [2].Pesticides can be defined as a group of poisonous unsafe chemicals that applied to vegetables to save them from getting damaged from pests. The effects of pesticides depend on the nature and excessive exposure that may cause acute adverse health effects. Elimination of these pesticides residues is significant before consumption of vegetables. Foods after harvest/slaughter are subjected to different handling and processing operations equally at home or industry level, linking a simple washing to more multistep and complex processing. To evaluate the potential pesticide exposure from contaminated food, it is vital to estimate the level of coverage at the point of consumption. Research reported that commercial and household processing such as washing, peeling, blanching, cooking and concentrating can reduce residue levels in food [3, 4, 5, 6, 7, 8].

Among the vegetables, onions are very common and provide better return over investment to the farmers. But onions are badly affected by pesticides, these residue are

causing chronic disorders to the human health by consuming without processing. In processing treatments, washing is believed to be one of the most proficient methods for the removal of pesticides residues from different vegetables. Several studies have examined the effects of washing on removing pesticide residues [10, 4, 5]. Various studies demonstrates that processing leads to large reductions in residue levels in the prepared food, particularly through washing, peeling and cooking operations [11, 4, 5]

Several washing solutions such as chlorine solution, ozonated water and strong acid have been successfully used in removal of pesticide residues during commercial crop process [12, 5, 13]. Washing process is wide spread; it can be done with plain water and formulated solutions from chemicals readily available in a household kitchen [14]. The recommended chemicals for removing pesticide residues are salt, baking soda, distilled vinegar and potassium permagnate [15].

The increasing amount of pesticide residues in vegetables has been a major concern to the consumers, for the removal of these residues it is important before consumption of vegetables. Therefore, it is compulsory to look for cheap and finest method which can be implemented easily at home, thus keeping the requirement in mind, a study was planned to evaluate the Bifenthrin, diafenthiuron, imidacloprid and emamectin benzoate residue in onions to assess the effect of different household processing to reduced pesticides residues to a safe level for human consumption.

MATERIAL AND METHODS

Sowing and pesticide spray on onion field

Onion crop was grown on university farm for control treatment during the October 2011-2012 using organic farming without pesticide spray. However for the application of pesticides, (Bifenthrin, diafenthiuron, imidacloprid and emamectin benzoate) onion crop was grown in open field in Matiari district which is known for famous onion producing area of Sindh province.

The cultivated land was subdivided into four equal pieces and sprayed with each pesticides listed above as per dosage (Table -1). Onion was harvested one week after pesticide application as per routine practices of local farmers.

Procurement of onion samples

Three replicates (20 kg per replicate) samples were randomly collected from supervised farmer's field as per routine practice of local farmers one week from the final application of pesticide for the extraction of pesticide residues. Onions samples were packed in

properly labeled polythene bags and transported to the laboratories of IFST, Sindh Agriculture University, Tandojam. All samples were labeled properly and placed at -20˚C in deep freezer until further traditional processing.

Household processing of onion samples

The onion (20 kg) samples were subjected to different traditional processing techniques (Figure 1). First group was unwashed onion samples. They were unprocessed/ unpeeled and packed in polyethylene bags. The second group (4 kg) was peeled and then divided into 4 subsample i.e. 5 % NaCl washed, 10 % NaCl washed, detergent washed and plain water washed. For detergent washing, onion samples were kept in detergent solution for five min and thoroughly washed under tap water to remove the residues of detergent. The washed samples were sealed in polyethylene bags and stored in the deep freezer at -20^{o}C until further processing. Whereas, plain washed samples (2 kg) were separated and equally divided into plain washed unprocessed, blanched and sliced and subjected to dehydration, sun drying and frying. All the samples (except dried) were labeled properly and placed in a freezer at -20˚C for further analyses.

Table 1: Recommended dose of pesticides per acre

Pesticides	Chemical group	Dose (ml/acre)	
		Formulation	Active ingredient
Bifenthrin	Pyrethroid	250	25
Profenofos	Phenyl organothiophosphate	800	400
Endosulfan	Organoclorine	600	210
Imidacloprid	Pyridylmethylamine	80	16
Emamectin benzoate	Avermectin	200	38
Diafenthiuron	Urea	300	150

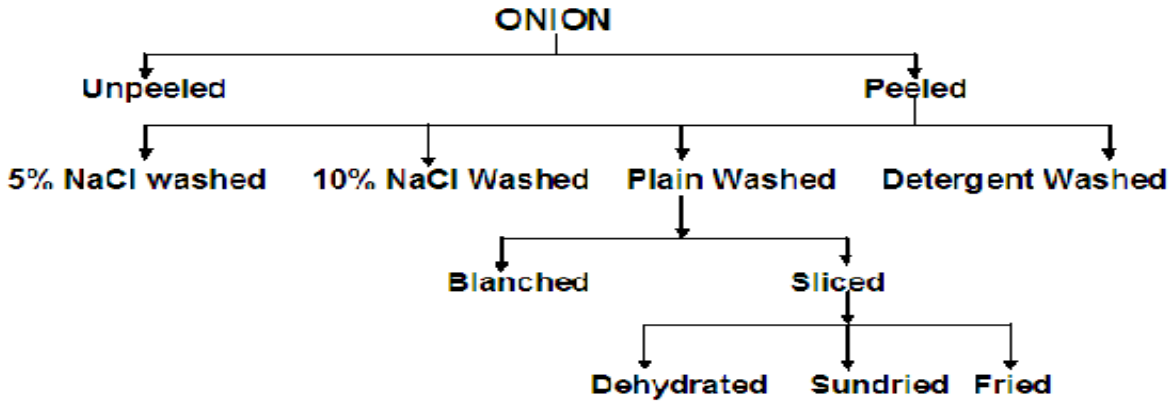

Figure 1: Flow chart of traditional processing of onion

Traditional processing

The residue extraction, cleanup and analysis of four pesticides viz. bifenthrin, diafenthiuron, imidacloprid and emamectin benzoate were extracted as per method of [16]. In order to assess the effects of household processing onions were peeled, cut into small slices and divided into four groups; as peeled unwashed, peeled plain water washed; peeled detergent washed and peeled onion washed with 5 and 10% NaCl solution. Furthermore, each sample was divided into some other groups and labeled according to particular processing. First group was labeled as "peeled unwashed". They were further divided into peeled blanched, peeled sliced sun-dried and peeled sliced dehydrated. For drying the samples of onion were kept in the flat dishes and exposed them in the sun for successful three days whereas for dehydration of onion samples were placed in the trays of dehydration chamber for 12hours. After the removal of moisture the samples were packed and labeled in the transparent polythene bags for further analysis. Second group was named "Plain water washed". These samples were washed in a porous pan by tap water. They were further divided into two groups and labeled as peeled washed with plain water and peeled washed fried. Samples were packed in polythene bags after their respective processing. Third group was named "Detergent washed". Samples were washed in the solution of the detergent. Sliced onions were soaked in the detergent solution for few minutes and washed through tap water in order to remove detergent. Sliced were then packed in polythene bags and stored in freezer till their analysis. Fourth group of peeled sliced onions were soaked in two different concentrations of brine solutions. Some peeled onion samples were soaked in 5% and 10% brine solution and shaked for 5minuts and washed again with tap water. Subsequently, samples were washed with tap water to remove the salt residues; soon after packed in polythene bags and stored in freezer at -20 C˚for further analysis.

RESULTS

Effect of traditional processing treatments on weight loss in onion

The data of weight loss by various treatments is presented in Table 2. The results revealed that weight loss occurred during traditional processing treatments ie. frying, sun drying and thermal dehydration. The onion dried under sunlight or dehydrated in cabinet dehydrator reduced the weight of onion from 50g to 10.70 g and 7.50 g respectively, due to loss of

water. During frying of onion (fresh), it was found that weight of onion was reduced to 20.30 g which was almost equivalent to 59.40 % of weight loss.

The effect of washing on the removal of bifenthrin residue in onion is shown in Figure 2.

The results showed that unwashed unprocessed samples contained bifenthrin residues of 0.101 ppm which are above recommended MRLs. The data further indicated that the reduction percentage of bifenthrin by applying various traditional methods such as plain washing reduced the pesticide residue up to the level of 34.65 %. Whereas, washing by detergent solution further reduced the residues up to the level of 40.59 % followed by sun dried, dehydrated and fried samples i.e. 93.64, 94.21 and 95.17 % respectively. Blanching treatment also reduced the level of pesticide residues up to 56.43 %. The sliced onions were also subjected to brine washing of 5 % and 10 % concentration showed the reduction of bifenthrin residues by 43.56 % and 45.54 %, respectively. Hence, it can safely assumed that the traditional processing effectively reduced the pesticides residues within MRLs.

The effect of washing on the removal of imidacloprid, diafenthiuron and emamectin benzoate residue in onion are shown in Figure 3.

The results for effect of various traditional methods are presented in Fig.3. Imidacloprid is an effective pesticides and it is applied in low dose. Imidacloprid was reduced during plain washing and by detergent washing by 42.68 % and 45.73 % respectively. Sun-dried and dried by dehydration chamber reduced the residues at the level of 97.52 % and 96.79 % respectively. Blanched samples showed the reduction of imidacloprid by 78.66%. However, Frying of onion reduced the pesticides residues of imidacloprid by 92.33%. All the samples of imidacloprid were less than its MRL value because of its low dosage application of 80ml/acre (Fig;3).

Whereas the results for the diafenthiuron showed that unwashed unprocessed samples contained diafenthiuron residues of 0.053ppm which are above recommended MRLs set by FAO. The data further showed that the reduction percentage of diafenthiuron by applying various traditional methods such as plain washing reduced the pesticide residue up to the level of 35.84 %. Washing by detergent solution further reduced the residues up to the level of 47.16 % followed by sun dried, dehydrated and fried samples by 91.52, 85.0 and 88.5% respectively. Blanching treatment further reduced the level

of pesticide residues up to 77.35 %. The sliced onions were also subjected to brine washing of 5 % and 10 % concentration which also reduced the diafenthiuron residues by 67.92 % and 73.58 %, respectively. Hence, the traditional processing effectively reduced the pesticides residues within MRLs.

While the results of emamectin benzoate showed that unwashed unprocessed samples (control) contained residues at the level of 0.592 ppm which is far beyond the level of recommended MRLs set by FAO that is unsafe for human consumption. The data further explained that plain water washing effectively removed the residues by 30.06 %. Washing by detergent solution further reduced the residues up to 31.41% followed by sun-dried, dehydrated and fried samples which showed in the reduction up to 95.01 %, 89.00 % and 92.25 %, respectively. Blanching treatment was also effective traditional method through which residues were reduced up to 54.56 %. Hence, traditional processing was an effective method which played important role in reduction of the residues below MRLs.

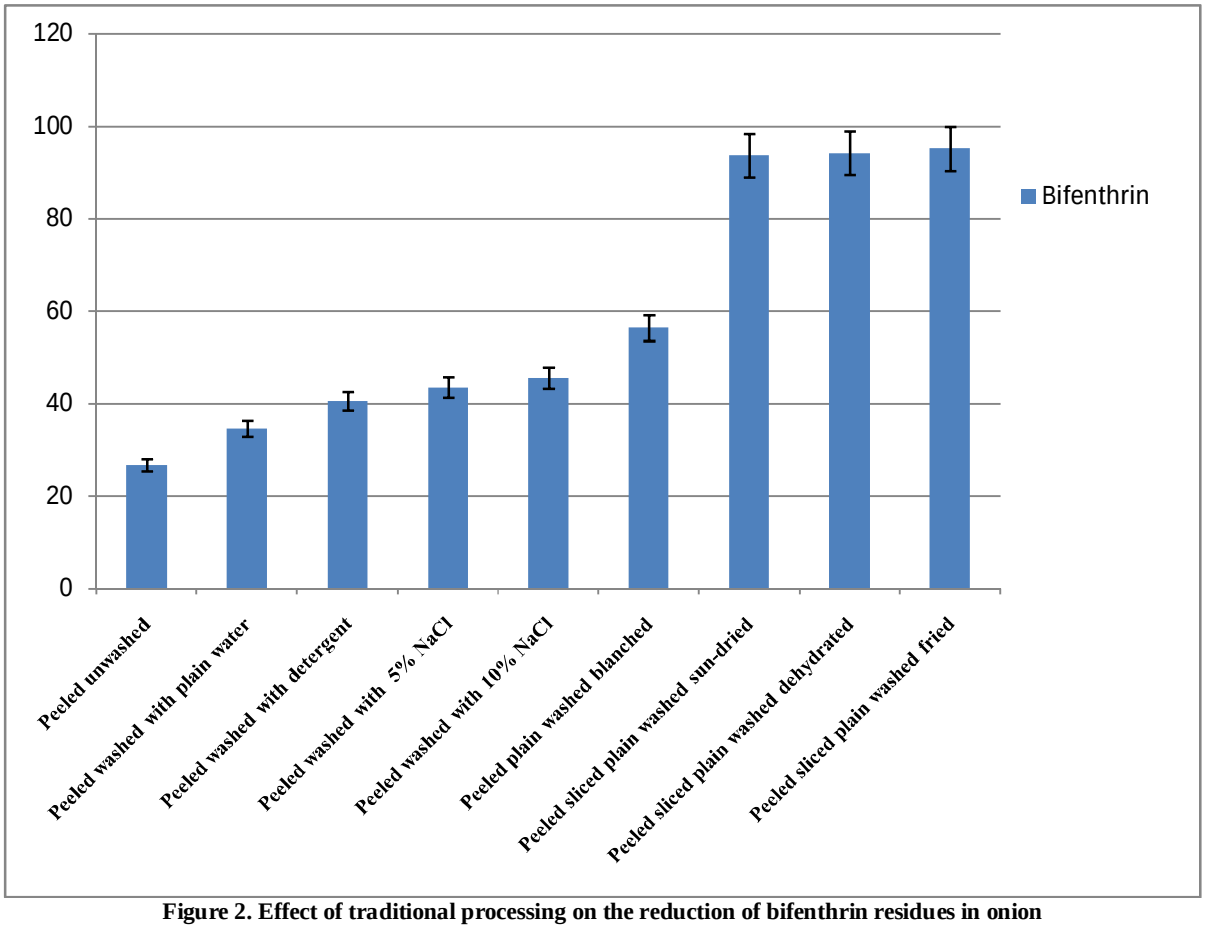

Figure 2. Effect of traditional processing on the reduction of bifenthrin residues in onion

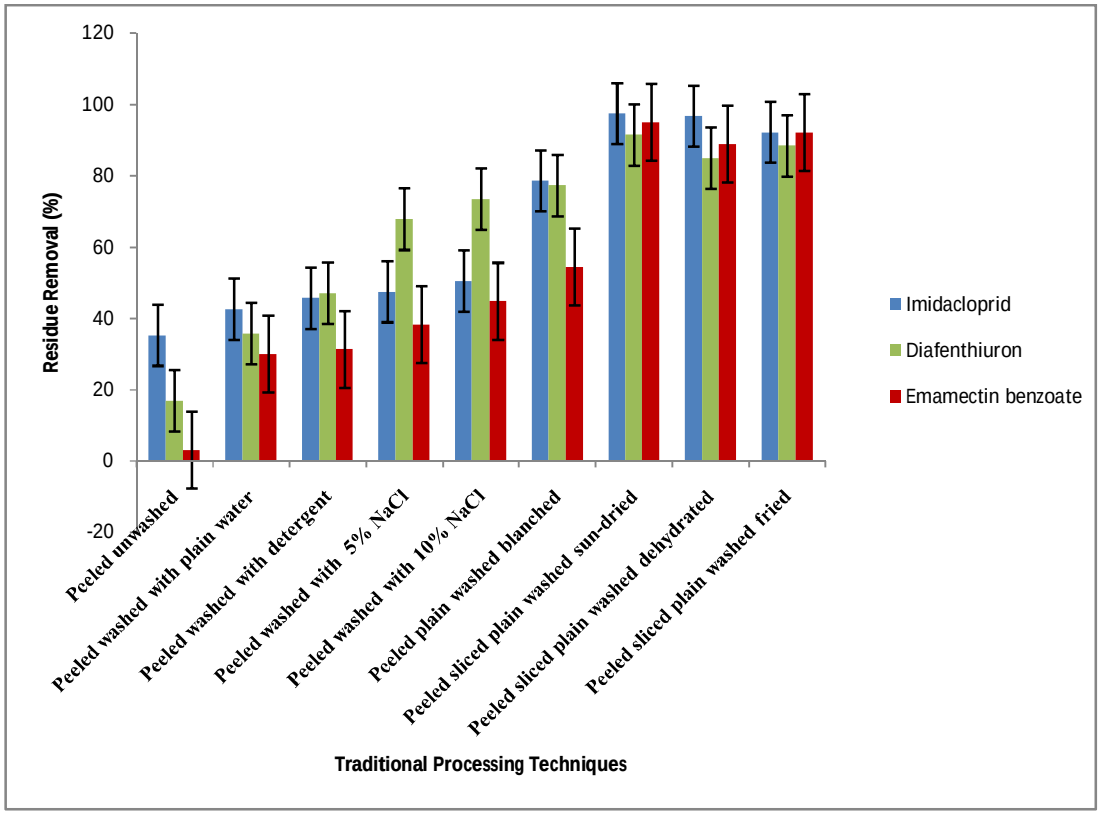

Fig 3: Effect of traditional processing techniques on water soluble pesticide residues in onion

Table 2: Effect of traditional processing on weight loss in onion

Treatment	Weight (gm±se)	% of control	% weight loss	Concentration Factor
Before treatment	50	100	0	1.00
Sun-dried	10.70±0.91	21.40	78.60	4.67
Dehydrated	7.50±0.65	15.00	85.00	6.67
Oil fried	20.30±1.65	40.60	59.40	2.46

DISCUSSION

The data obtained for the estimation of percentage reduction of various pesticides such as dimethoate, chlorpyrifos, quinolphos, profenophos, phosalone, lamda cyhalothrin, malathion and triazophos. A number of vegetables have been found contaminated with insecticides and fungicides. Furthermore, literature reported pesticide residues in cauliflower, cabbage, bean, tomato, okra, pigeon pea, chilli, potato, cluster bean, bottle gourd, cow pea, bitter gourd, pointed gourd, etc. from Gujarat. Worldwide, the issue food safety is an area of growing concern on account of its direct bearing on human health. Extensive literature review demonstrates that in most cases processing leads to large reductions in residue levels in the prepared food, particularly through washing, peeling and cooking operations [11, 4, 5]. From the above vast list it is clear that, almost all the

vegetables contained pesticide residues. An attempt was made to study the persistence of bifenthrin, imidacloprid, diafenthiuron and emamectin benzoate in the vegetables, particularly onion bulbs (Fig-2-3). Analysis was made after 7 days of sprays on onion and found the presence of bifenthrin, imidacloprid, diafenthiuron and emamectin benzoate 0.101, 0.164, 0.053 and 0.592, respectively in onion.

Peeling is an important step in the processing of most fruits and vegetables. The effect of peeling also showed the reduction in bifenthrin, imidacloprid, diafenthiuron and emamectin benzoate residues up to 26.73, 35.36, 16.98 and 3.210%, respectively. For most pesticides, residues are concentrated in the tops [17]. Further it is reported that initial diazinon residue levels (0.822 ppm) on cucumbers were reduced up to 67.3% by the process of peeling and 77% [18]. The results of the present study also in agreement with [19] reported that peeling contributes the most in the reduction of difenoconazole level in tomato skins.

Washing is the most common and straightforward form of processing. It is generally the first step in various types of treatments (household and commercial preparation), which is applied to food raw materials. Washing of onion with NaCl solution showed higher reduction of residues as compared with tap water. Furthermore, it is reported by [20] that by washing, residues were reduced to some extent but not completely as pesticide residues after spraying rapidly spread in to wax and cuticulas. Thus, washing the vegetable would be insufficient in removing the pesticides [21, 22].

It is reported [23] that 51.00 per cent reduction of endosulfan residues in brinjal by washing and 74 per cent reduction of endosulfan from brinjal fruits which are in agreement with present results. It is also observed that 15-30 per cent reduction of endosulfan residues on brinjal by washing, whereas, the endosulfan applied at 0.05, 0.10 and 0.20% on cauliflower and observed the reduction from 51.24 to 97.90 per cent on 0 day [24]. Washing can removed 30.62 per cent residues of endosulfan from tomato by washing by [25]. Thus present findings are in confirmation with the earlier reports.

Blanching is more effective than cold and/or cold water washing and effectiveness was further improved by treatments of drying under sun or in cabinet dehydrator and/or cooking/frying and brought the residues below their respective MRLs. The present study also revealed that blanching effectively reduced residues in onion (54-78%) and are

in agreement with the observations of [26] who reported that blanching and frying of egg plant for 5 min totally reduced the profenofos residues that were present in the level of 0.27 ppm may be due to the treatments including heat which may be associated with increased the volatilization, hydrolysis or other chemical degradation and thus reduce residue levels.

Drying the commodities either fruits or vegetables under sun light or thermal dehydration played significant role in the removal of the pesticide residues up to 97 and 96%, respectively. Frying was also observed to be more effective technique in minimizing the residues of pesticides in the study i.e., up to 95%. The decontamination of the commodities by this process could be due to the decomposition by the high temperature, the stronger adsorption of pesticide onto plant tissues and or/the low solubility of these residues of pesticides in water as reported earlier by [27]. The processes that normally occur during cooking are volatilization, hydrolysis and thermal degradation of the compounds [28, 29]. It also reported by [3] that canning at home reduced organophosphorus residual limits higher than organochlorine pesticide residue levels and cooking and frying might help to remove 25-100% of the residues of various insecticides depending upon the nature of pesticides used.

The processes that normally occur with regard to pesticides during cooking are volatilization, hydrolysis and thermal breakdown. Open systems may result in water loss during heating by evaporation, thereby concentrating the pesticide residues if they are not destroyed by heating [30].Similar results were obtained by [31] who reported that 41.3% b-cypermethrin residues reduction on 0 day and 34.6% residue reduction on 3rd day during the cooking of sample fruits.

CONCLUSION

It is clear based on the results obtained in this study pesticide residues remain in the onion, as a result of preharvest or postharvest application. The various household preparations such as washing, salt water washing play a important role in the reduction of pesticide residues. This study concluded that by processing the onion with the traditional processing methods it helps in the removal of pesticide residues below MRL levels, after that it is safe for human consumption. The sun drying and dehydration was found to be most effective in reducing the pesticide residues followed by cooking in oil. Thus, this study suggests that the use of traditional processing can

remove the pesticide residues from onion and there is urgent need to observe the pesticide residues to standardize the application doses.

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