IJBPAS, December, 2015, 4(12): 6639-6648

ISSN: 2277–4998

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

'A Bridge Between Laboratory and Reader'

www.ijbpas.com

REMOVAL OF PESTICIDE RESIDUES IN BITTER GOURD PEEL BY TRADITIONAL PROCESSING METHODS

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ABSTRACT

The present research was carried out to determine the pesticide residues from bitter gourd peel and effects of processing methods on dislodged the residues. For this purpose, bitter gourd was grown on an experimental field of S.A.U, Tandojam and sprayed with four pesticides viz. endosulfan, diafenthiuron, imidacloprid and emamectin benzoate on the fruiting stage of bitter gourd. The most concentrated formulations were applied to pursuant Good Agricultural Practices and effects of household processing on the levels of four pesticide residues were quantified by using GC-µ-ECD and HPLC-UV. The washing step allowed decreasing the concentration of residues for endosulfan (54.24%), imidacloprid (59.42%), diafenthiuron (20.96%) and emamectin benzoate (9.09%) in the peel. The second process, detergent washing followed by sun dried (photo-degradation by UV- rays) of bitter gourd samples was found helpful in reducing the pesticide residues up to 95%. It was the most effective step to remove pesticide residues from peel.

Keywords: Bitter gourd peel, traditional processing, pesticide residues, GC-µ-ECD, HPLC-UV

INTRODUCTION

Bitter gourd (*Momordica charantia* L.) is a widely grown crop throughout the world, especially in the tropical areas for its edible fruit [1] and belongs to the family

cucurbitaceae. Its centre of origin is Eastern India and Southern China but high species diversity occurs in Africa [2]. Momordica actually means "to bite" referring to the jagged edges of the leaf, which appear as if bitten. The fruit is oblong and resembles a small cucumber, young fruit is emerald green that turns to orange-yellow when ripened [3]. Bitter gourd is cultivated as an important vegetable crop in many areas of Pakistan [4]. Total Area under bitter gourd in Pakistan was 5982 hectares and the total production was 55729 tonnes while at the provincial level of Sindh the total area under vegetable crop was 681 hectares and the production was 2603 tonnes [5].

Vegetables are important ingredient of our food having a high nutritional value. Vegetables, like, okra, eggplant, spinach, cauliflower, tomato, pumpkin, carrots, turnips etc. are produced in the country for local consumption as well as for export purposes (Economic Survey of Pakistan, 2008). For better production and aesthetic value, farmers are using a large amount of insecticides during the entire period of growth of vegetables, even at fruiting stage and sometimes farmers also ignored the recommended waiting period between the harvest and last spray. Owing to this and other injudicious practice related to pesticide usage, pesticides become the inner part of vegetables in the form of residues, which shows hazardous effect on the health of human beings [6,7].

A huge quantity of pesticide is used on crops as well as on vegetable, due to their frequent use becomes the reason of accumulation of pesticide residues in the primary agriculture products. The problem of residues accumulation needs more attention in vegetables because most of time these are consumed either raw or without much storage time [8]. Currently Organophosphorus pesticides (OPs) enjoy wide use in the world for the pest control with Organochlorine pesticides [9,10], which leads to increased world food production. These Organophosphorus pesticides are also widely used in Pakistan for controlling the agriculture pests. In spite of the toxicological problem its efficiency has been demonstrated in fruit flies, aphids and leaf miners. The continued use of organophosphorus pesticides increases the possibility that residues of these compounds could be found in some vegetables [11] affecting the alimentary security; that is the reason for the commitment between the public health and the defense.

For this reason, there is necessity to developed programs related to the monitoring

of pesticide residues in food to protected consumers. These programs could find out the amount of contaminants and recognized a way to solve the situation. Pesticide (Organophosphorus) residue monitoring studies have been reported in many countries of the world on fruits and vegetables [12-16]. Effects of pesticides have been reported in Pakistan in vegetables, fruits, feed, cotton seed and fish meal at different intervals [17-19]. The above mention studies in Pakistan showed that most of the samples were contaminated by pesticides; some of them were exceeding the maximum residue limits, which can be threatening for the ultimate consumers. Although, a high variation of pesticide residues was observed in fruits and vegetables that could be due to change in the climatic zone (hot, humid and cold) and variation among different species of plants. No study has been carried out in Pakistan to analyzed the residues in vegetables, also the study on pesticide residues in vegetables was also never carried out in the Sindh, Pakistan.

MATERIALS AND METHODS

The entire research work was carried out in the laboratory of Institute of Food Sciences and Technology, Sindh Agriculture University, Tandojam, Sindh.

Traditional Processing of Bitter Gourd

Prior to analysis, the samples of bitter gourd were scraped and separated the peel and subjected to various traditional processing which are commonly used at domestic level. Peel portion was subdivided into three portions unwashed, plain washed and detergent washed. Plain washed was divided into five portions i.e. unprocessed, sundried, sundried fried, dehydrated and dehydrated fried. Detergent washed samples were also divided into five portions ie. unprocessed, sundried, sundried fried, dehydrated and dehydrated fried. All the samples (except dried) were labelled properly and kept in a deep freezer at -20˚C until further process. The samples were then prepared for extraction of pesticides residues and the effects of various household processing treatments on the residues of various pesticides were observed and recorded.

Residues extraction, cleanup and analysis

The residue extraction, cleanup and analysis of four pesticides viz. endosulfan, imidacloprid, emamectin benzoate and diafenthiuron were extracted as per the methods [7] with the slight modification.

Instrumental Analysis

Identification and quantification of pesticide compounds in extracted and cleaned samples were analyzed using gas chromatograph equipped with micro electron capture

detector (μ-ECD) and high performance liquid chromatography coupled with ultra violet detector under specific operational conditions (temperature programming). The operational conditions for detection of endosulfan, imidacloprid, emamectin benzoate and diafenthiuron pesticides are given in Table 1

Stability of standard and working solutions

Standard stock solutions and working solutions were placed in freezer at -18 ^{0}C and were found to be stable for 6–8 months. Repeatability was also found to be satisfactory.

RESULTS AND DISCUSSION

Now a day, different chemicals are in use today in the production of agricultural commodities. Pesticides are chemicals developed and produced for use in the control of agricultural and public health pests. Contamination of fruits and vegetables may result from treatment as well as from conditions such as improper use of pesticide from preceding treatments in the soil and cross contamination. Prevention of health risks, including toxicological risks, due to food intake is central in food safety policy [20].

The findings of the study are also in agreement with those of [21] who carried out their experiments on the evaluation of levels of pesticide residues present and their effective removal by different traditional/house hold processing methods. The removal of pesticides from vegetables and their products had been the hall mark of studies. Literature available indicated their effective removal of these residues. The operational processing includes washing the raw vegetable with high amount of water, using high-pressure sprays and incorporating surfactants or other washing aids. The mechanical removal of peel of the vegetable with knives known as peeling, blanching with hot water and cooking i.e., the product at temperatures at or above the boiling temperature of water also effectively reduces the residues. Thus, the residues that may be available on the surface and subjected to physical removal by water washing or peeling, trimming and involving treatment of acid/base hydrolysis or even thermal degradation usually led to their effective reductions in the study.

The bitter gourd peel treated by various traditional processing on the other hand suggested (Table 2 and figure. 1) that residues of endosulfan, imidacloprid, diafenthiuron and emamectin benzoate pesticide in unwashed unprocessed sample (control) contained high level of 1.51, 1.75,

0.062 and 0.22 ppm, respectively, compared with recommended MRLs by FAO i.e., 0.5, 0.1, 0.02 and 0.01ppm, respectively. The results of unwashed unprocessed (control) samples revealed that bitter gourd peel had high concentration of pesticides residues beyond MRLs which may be due to its uneven surface and hard peel. Comparable results are also reported by Burchat *et al.*, (1998) [22] that for most pesticides, residues are concentrated in the tops. Liu *et al.*, (2006) [23] also reported that this may be attributed to the rough surface of the leaves as compared to smooth surface of the vegetables.

The samples washed with tap water reduced the residues of endosulfan (54.24%), imidacloprid (59.42%), diafenthiuron (20.96%) and emamectin benzoate (9.09%) in the peel. These results are in line with previous studies, which have demonstrated that washing could remove up to 89% of pesticide residues according to the nature of pesticide and the vegetable or fruit [24-33].

Washing with detergent solution significantly reduced residues from the surface of bitter gourd. These results are in agreement with the findings of Sheikh *et al.*, 2013 [34], that washing by detergent solution reduced the pesticide residues up to 59.7%. These findings are also confirmed by Satpathy *et al.*, 2012 [35] who found that washing vegetables with the chemical enhances the removal of pesticide residues from produce more than that of washing with water alone. Washing with water and/ or detergent solutions was necessary to decrease the intake of pesticide residues. Similarly, Zohair , 2001 [36] observed that acidic detergent solutions are more effective in the elimination of pesticide residues than alkaline and neutral solutions.

Detergent washing followed by sun drying (photo-degradation by UV- rays) of bitter gourd samples was found helpful in reducing the pesticide residues up to 95%. But frying was found most effective in reducing the residues as compared with sun drying and dehydration as frying treatment of bitter gourd peel reduced the residues up to the levels of 96% which might be due to decomposition of residues by heat as reported by Abou-Arab and Abou-Donia, 2001 [37] and due to volatilization, hydrolysis and thermal breakdown of pesticides upon cooking [41].

CONCLUSION

The conclusion of the present study suggested that bitter gourd peel had high amount of residues due to its thick peel, which adhere the majority of pesticide residues on the top. The processing methods

played a major role in reducing the residues from the bitter gourd peel and render the vegetable suitable for human consumption by decreasing the residues within prescribed limits of MRLs by FAO. Since, bitter gourd has extensive uneven surface which retain almost all the sprayed matter, dirt and dust etc. on its surface which gradually get absorbed when left over for prolonged time period, therefore it is suggested that bitter gourd may be washed many times thoroughly to remove dirt, dust and pesticide residues.

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Table.1: Determination of HPLC amenable pesticides (emamectin benzoate, diafenthiuron and imidacloprid residues) Gas chromatography coupled with micro ecd (gc-µecd) parameters for determination of GC amenable pesticides (endosulfan)

Endosulfan	Imidacloprid	Emamectin Benzoate	Diafenthiuron
Oven: 250˚C	Flow rate= 1.2ml/min	Flow rate = 1.2ml/min	Flow rate= 0.7ml/min
Injection port: 280˚C	Ratio: Acetonitrile: Water (de-ionized) 35:65	Ratio: Acetonitrile: Water(de-ionized) 98:2	Ratio:Acetonitrile:Water(deionized) 85:15
Detector: 320˚C	Ratio: Acetonitrile: Water (de-ionized) 35:65	Ratio: Acetonitrile: Water(de-ionized) 98:2	Ratio:Acetonitrile:Water(deionized) 85:15
Injection volume 2µl	Wavelength= 270nm	Wavelength=246nm	Wavelength= 250nm
	Injection volume= 20µl	Injection volume=30 µl	Injection volume=20µl

Table 2: Effect of traditional processing on the reduction of endosulfan, imidacloprid, Diafenthiuron and emamectin benzoate residues in bitter gourd peel

Treatment	Endosulfan MRL= 0.5 ppm Mean(ppm) (Mean±SD)	Imidacloprid MRL= 0.1 ppm Mean(ppm) (Mean±SD)*	Diafenthiuron MRL= 0.02ppm Mean(ppm) (Mean±SD)	Emamectin benzoate MRL= 0.01 ppm Mean (ppm) (Mean±SD)
Unwashed unprocessed	1.51±0.032 a	1.75±0.035 a	0.062±0.004 a	0.22±0.04a
Plain washed unprocessed	0.691±0.047 e	1.01±0.07 c	0.049±0.007 ab	0.2±0.05 ab
Detergent washed unprocessed	0.491±0.025 g	0.661±0.005 e	0.04±0.02 abc	0.16±0.04 abc
Plain washed sun-dried	0.761±0.068 d	0.841±0.028 d	0.027±0.03 abc	0.1±0.04 abc
Plain washed dehydrated	1.41±0.043 b	1.39±0.07 b	0.035±0.01 abc	0.14±0.03 abc
Plain washed sun-dried fried	0.051±0.02 hi	0.051±0.002 g	0.019±0.02 bc	0.05±0.03 abc
Plain washed dehydrated fried	0.099±0.096 h	0.101±0.004 g	*0.021±0.01 bc*	0.09±0.06 abc
Detergent washed sun-dried	*0.561±0.036 f*	0.581±0.086 f	0.015±0.01 bc	0.09±0.02 abc
Detergent washed dehydrated	1.081±0.048 c	0.998±0.074 c	*0.018±0.004 bc*	0.08±0.07 abc
Detergent washed sun-dried fried	0.041±0.087 i	0.039±0.073 g	0.009±0.003 c	0.008±0.004 c
Detergent washed dehydrated fried	0.059±0.018 hi	0.071±0.042 g	0.012±0.003 c	0.03±0.02 bc

Values in bold are within MRL
***Mean followed by same latter are not significant different at 0.05 Scheffe mrt.**

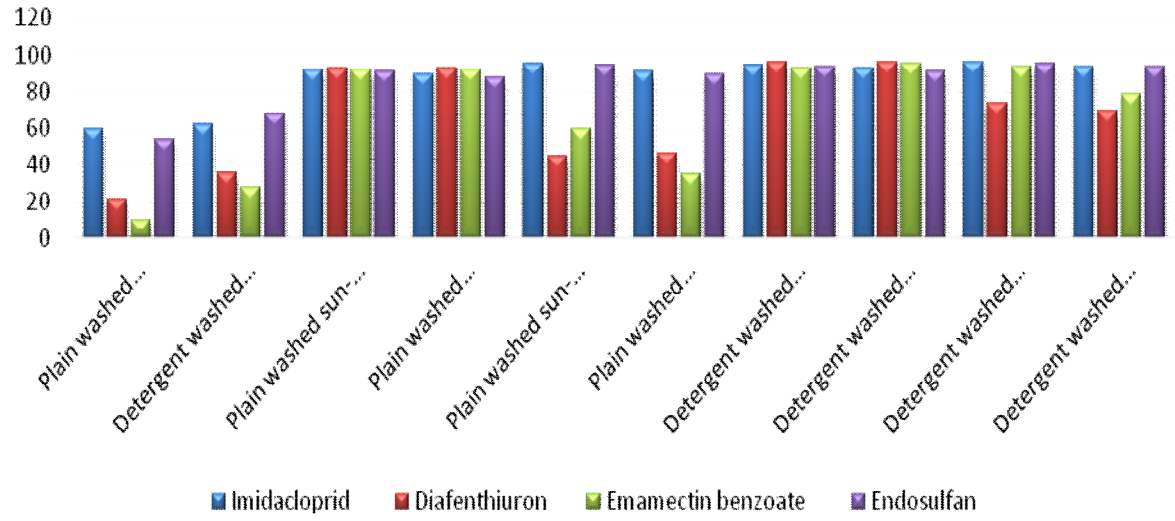

Figure 1: Effect of traditional processing techniques on water soluble pesticide residues in bitter guord peel