Monitoring of Pesticide Residues in Farmgate Vegetables of Central Aravalli Region of Western India 1

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Monitoring of Pesticide Residues in Farmgate Vegetables of Central Aravalli Region of Western India

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Abstract: Central Aravalli region is one of the most important areas of Rajasthan from vegetable production point of view. In order to monitor pesticide residues in vegetables, an attempt has been made to find out severity of such synthetic agrochemicals on human being. A total of 182 samples of six vegetables were collected for pesticide residue analysis from different agricultural fields of central Aravalli region, when they were ready for transportation to market. The analysis of samples for different pesticide residues were carried out on GC-ECD and GC-NPD systems equipped with capillary columns by using a multiple residue method. About 40.11% of total analyzed samples were contaminated with different pesticide residues, among which 35.62% of total contaminated samples were exceeded the maximum residual limit (MRL) values.

Key words: Synthetic agrochemicals · Multiple residue method · GC-ECD · GC-NPD · MRL value

INTRODUCTION

India is an agrarian country. According to the census of India (2001), the total population of the nation is 1.027 billion, in which, 110.7 million are farmers, whereas the cultivated cropped area is about 124.07 million ha [1]. The global share of India, in vegetable production is about 13.4%. Surveys carried out by different institutions spread throughout the nation indicated that 50-70% of total vegetables are contaminated with pesticide residues [2]. In India, farmer uses about 6000 tonnes of active ingredients to control pests of vegetables and fruits [3]. Vegetables consumes 14% of the total pesticides used in India, in which, the share of different types of pesticides in Indian agriculture market shows that organophosphorus (50%) ranked first, followed by pyrethroids (19%), organochlorines (18%), carbamates (4%) and biopesticides (1%) [4]. Central Aravalli region is one of the most important region in Rajasthan from vegetable production point of view. The vegetables grown in this region is not only for meet the needs of locals, but it is also exported to other metro cities like Jaipur and Delhi. Pesticide application is a necessary step for coping with the pest related problems therefore, it is very important to assess their residues in vegetables. A personal interview carried out among cultivators and local pesticide market showed that about 95% of farmers use synthetic pesticides in vegetable fields to protect their crops from different pests. Although, pesticide residues in major water bodies of this region has been carried out [5,6,] but vegetables of central Aravalli region is not much investigated from pesticide contamination point of view. Everyday, about 10 million populations is consuming vegetable grown in the central Aravalli region, hence, a large population at the risk. Therefore, the objective of present research work was to assess the concentration of such deleterious agrochemicals in vegetables of central Aravalli region and to generate awareness about the lethal effects of these synthetic pesticides on human being.

Study Area: The study was conducted for the determination of pesticide contamination in farmgate vegetables of central Aravalli region, which crosses through Ajmer district (26°25'-26°35' North latitude and 74°37'- 74°42' East longitude) (Figure 1). Aravalli is the oldest mountain of the World and it's entire length is about 692 km running from North-East (near Delhi) to South-West of Gujarat. The region has a thickness of argillaceous rocks. Ecologically, the region is interesting due to its situation at the confluence between north-west dry zone and south-east comparatively humid zone. The north-west part is sandy and unproductive while the south-eastern part is clay-loamy fertile and suitable for

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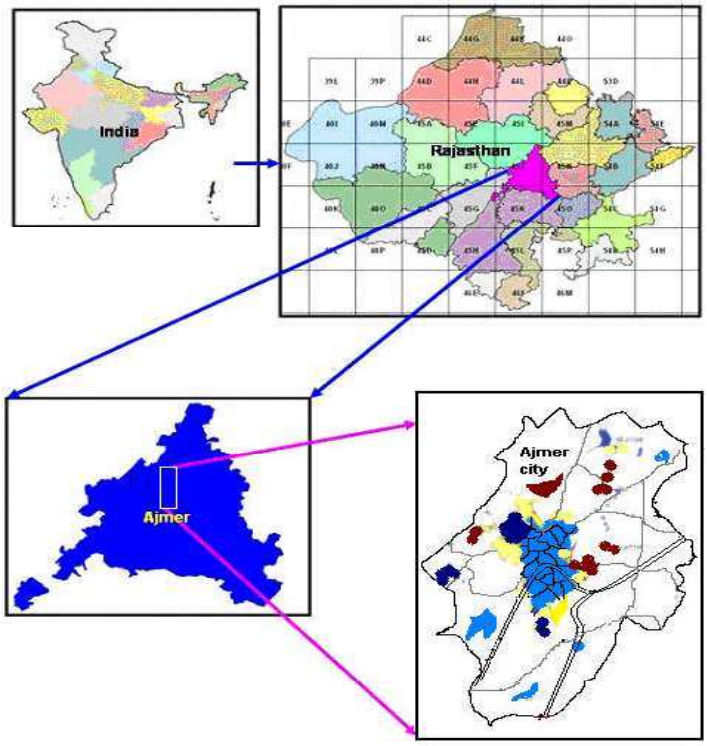

Fig. 1: Map of the study area

vegetable production. The climate of the region is semi-arid with strong seasonality of rainfall. The summer season (April to June) experiences high temperature (max.45.7°C), while in peak winters (December to January) it goes down very low (3.7°C). More than 80% of 784.4 mm annual precipitation occurs during July to September.

MATERIALS AND METHODS

Sampling: Sampling was conducted for the period of two year from September 2006 to August 2008. Total six major vegetables were selected for the assessment of pesticide residues as these vegetables shares about 2/3rd part of total vegetable production of the region. A total of 182 samples of vegetables were collected from agricultural field, when they were ready for transportation to the market. Ninety eight samples were collected during 2006-2007 and 84 samples were collected during 2007-2008. After collection, these samples were kept in polythene bags and then transported on ice to the laboratory where they were analyzed immediately or stored at 4°C until analysis within 24 hours [7].

Extraction and Clean-up: Endosulfan, DDT, Pyrethroids and HCH residues from various vegetables were extracted in acetonytrile and partitioned in n-hexane. Organophosphorus pesticide residues were extracted in acetone and partitioned in dichloromethane (DCM). For organophosphorus pesticide residues analysis, column chromatography was used employing chloroform and acetone as the eluting solvents [8]. HCH and DDT samples were cleaned-up using concentrated H_2SO_4 [9], while Endosulfan and synthetic pyrethroids samples cleaned-up as per standard method [10].

Gas Liquid Chromatography Analysis: The residues of different pesticides were analyzed using a Chemito Gas Chromatograph (Model 8610) equipped with ^{63}Ni ECD and NP detector, equipped with BPX-608 capillary column (25m x 0.32 ID x 0.46μm). The operating conditions were as per method described by Gupta *et al.* [11].

RESULTS AND DISCUSSION

The present study was undertaken to determine the concentration of different pesticides residues in farmgate vegetables of central Aravalli region. Pesticides are known to be present in vegetables due to extensive use of corresponding pesticides in interfiled cultivation. The result of study reveals that the 40.11% of total analyzed samples were contaminated with different pesticide residues. 35.62% of total contaminated samples

Table 1: Prevailing scenario of different pesticides in farmgate vegetables of central Aravalli region during September 2006 to August 2008

Vegetables (No. of samples studied)	Name of pesticide detected (No. of sample contaminated)	Acute Toxicity*	Total no. of samples contaminated with different pesticides	% of samples contaminated with pesticides	Pesticide detected Range µg/g	MRL µg/g	No. of samples exceeded MRL µg/g
Tomato (28)	Endosulfan (2)	High			ND - 0.28	2.0	NIL
	Cypermethrin (5)	Moderate			ND-0.042	0.5	NIL
	Methyl parathion (3)	High			0.06-0.18	0.2	NIL
	Fenvalerate (2)	Moderate			0.03-0.05	1.0	NIL
	Monocrotophos (1)	High	13	46.43%	0.02	1.0	NIL
Okra (25)	Methyl parathion (3)	High			ND-0.22	0.2	1
	Quinolphos (3)	Moderate			0.02-0.12	0.25	NIL
	Fenvalerate (2)	Moderate	8	32%	ND-0.84	1.0	NIL
Potato (17)	Dichlorvos (DDVP)	High	4	23.53%	0.05-0.82	0.5	2
Cabbage (39)	Methyl parathion (2)	High			ND-0.16	0.2	NIL
	Monocrotophos (3)	High			ND-0.28	0.2	2
	Chlorpyriphos (4)	Moderate			0.02-0.08	0.05	1
	Endosulfan (2)	High	11	28.20%	ND-0.08	1.0	NIL
Brinjal (46)	Monocrotophos (6)	High			ND-1.60	0.5	4
	Methyl parathion (9)	High			ND-1.42	0.2	7
	Cypermethrin (3)	Moderate			ND-0.44	0.2	2
	Endosulfan (2)	High			ND-1.23	2.0	NIL
	Fenvalerate (2)	Moderate			ND-0.73	1.0	NIL
	Quinolphos (1)	Moderate	23	50%	0.22	0.25	NIL
Cauliflower (27)	Methyl parathion (6)	High			ND-0.33	0.2	4
	Quinolphos (3)	Moderate			ND-0.44	0.25	2
	Chlorpyriphos (1)	Moderate			0.04	0.05	NIL
	Endosulfan (3)	High			0.04-1.25	1.0	1
	Cypermethrin (1)	Moderate	14	51.85%	0.18	0.2	NIL

were exceeded the maximum residual limit (MRL) values as per the FAO/WHO [12]. The concentration of pesticide residues were carried out by using following formula-

Concentration of Pesticide Residues in PPM =

$$\frac{\text{Area of sample peak}}{\text{Area of std peak}} \times \frac{\text{Final volume}}{\text{gm of sample taken}} \times \frac{\mu\text{l of std injected}}{\mu\text{l of sampling}} \times \text{Conc. of std.}$$

The range of various pesticides (Table 1) showed that brinjal and cauliflower are the most contaminated vegetables. The MRL values of some pesticides, especially, methyl parathion, monocrotophos, cypermethrin and quinolphos were slightly exceeded from MRL values. It is reported that out of twenty seven sample of cauliflower, only three were found contaminated with Endosulfan and among them, only one (1.25 µg/g) was exceeded from MRL value. The results of the study are in consonance with the earlier studies on farmgate vegetable samples [13]. It is observed that cauliflower and brinjal were most contaminated vegetables in the central Aravalli region. The study revealed that generally vegetable samples showed methyl parathion in excessive concentration, followed by monocrotophos. Similar observation has also been reported in Punjab [14].

It has also reported that majority of fruits and vegetables in India were found contaminated with pesticide residues, although the levels were generally below the prescribed MRL's [15]. The percentage contamination level of pesticide residues in major vegetable crops of central Aravalli region is very significant. The data showed that maximum samples of cauliflower (51.85%) found contaminated with different pesticides followed by brinjal (50%), tomato (46.43%), okra (32%), cabbage (28.20%) and potato (23.53%), respectively (Figure 2). Therefore, periodic monitoring of farmgate vegetables must be carried out to know the prevailing scenario of pesticide contamination of vegetables grown in the central Aravalli region. The present research will not only serve as reference document but also helpful in taking necessary and timely preventive measure to mitigate such problems.

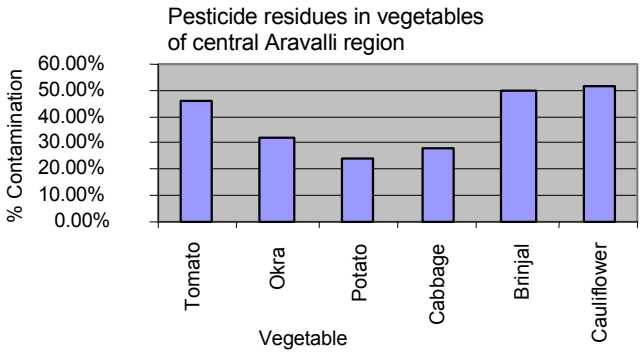

Fig. 2: Level of pesticide residues in major vegetables of central Aravalli region

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