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OCCURRENCE OF ORGANOCHLORINE PESTICIDE (OCPS) RESIDUES IN FARM VEGETABLES CULTIVATED THROUGH UNTREATED WASTEWATER IN KARACHI

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ABSTRACT

Assessment of organochlorine pesticide (OCPs) levels in vegetables irrigated from wastewater was carried out in agricultural fields of Malir River, Karachi. Tomatoes, Brinjal, Gourd, Okra and Spinach are the popular and extensively grown vegetables in this region and therefore selected for the present research. To assess levels of OCPs, 45 samples of aforementioned vegetables were collected and performed the laboratory analysis on cleaned samples extracts on a Gas Chromatography Electron Capture Detector (GC-ECD). DDT, HCH and Endosulfan were analyzed in the samples, revealed that all the vegetables were contaminated with these obsolete pesticides in the study area. Endosulfan and HCH were found highest in Gourd samples i.e. 1.17 and 0.72 µg/kg but DDT was maximum in Brinjal (2.53 µg/kg). However, the lowest HCH levels were found in Brinjal i.e. 0.06 µg/kg, Endosulfan in Tomato i.e. 0.04 µg/kg and DDT in Okra i.e. 0.09 µg/kg. From the present study, it can be concluded that indiscriminate and extensive use of OCPs causes serious threats to public health quality that feed on vegetables grown in Karachi.

Key-words: Vegetable, Pesticide, DDT, OCPs, Waste Water, Malir,

INTRODUCTION

Worldwide, pesticides are applied on vegetables in food production to control the spread of pests during the process of farming, storage and transportation (EPA, 2005). Besides many advantages, pesticides have adverse toxicological effects on non-target species such as animal, plants and human. Excessive and indiscriminate use of pesticides is highly concerned issue all over the world as these produce acute and chronic human health risks (WHO, 2010).

Even the presence of lower pesticides levels in the environments are indicating towards higher toxicity to the non-target species including human and wildlife (Chiesa *et al*. 2016; Zheng *et al*. 2016). But maximum effects can be observed in human being with short exposure to the high or low doses of pesticides that shows some common symptoms like headache, fever, malaise, vomit, skin irritation and shortness of breath but occupational or field exposure to such pesticides produce chronic illnesses like organs damage, immune and nervous system failure and even death (Wang *et al*., 2011).

The global use of OCPs is always a great concern due to higher toxicity, bioaccumulation in the living organisms and persistence in the natural environment for years (Jiang *et al*., 2009). In Stockholm Convention, the UNEP (United Nation Environment Program) provided the list of twelve POPs (out of which nine are OCPs), named as *dirty dozen.* It is observed that OCPs are the environmental hormones that adversely affect the animal and human reproductive cycles (Zhang *et al*., 2004). One of the widely discussed example of OCPs i.e. DDT, is a potent human carcinogen that harmfully affect reproductive, hepatic and nervous system (Guo *et al*., 2009).

The most abundant organochlorine pesticides in the environment i.e. DDT, HCH and Endosulfan are considered for this research due to higher toxicity, bioaccumulation and high persistence as well as these are listed as banned pesticides (Milun *et al*., 2016; Wong *et al*., 2015). Being a developing country, Pakistan is also facing the problem of pesticide pollution, occupational exposure and bio-magnification of HCH, DDT and Endosulfan in the environment that cause health issues in population (Aamir *et al*., 2016). The ban on hazardous OCPs was imposed many decades earlier but they are still use in the developing world and found in different environmental matrices (Qian *et al*., 2017; Gascon *et al*., 2015; Chourasiya *et al*., 2015; Khairy *et al*., 2014; Mishra *et al*., 2013).

The limited research on pesticide pollution in coastal regions of Pakistan indicates towards the negligence of monitoring in this sector. Entrance of pesticide in food chain is obvious as the disproportionate use of banned pesticide on agricultural land is observed at outskirts of Karachi i.e. Malir and Lyari river based agricultural areas. The issue arise when wastewater is used for farming purpose contain more pests and insects that causes the farmers to use cheaper and banned pesticides all over the fields. Local farmers are relatively less aware about hazards of excessive OCPs usage on the fields. The higher concentrations are then discharged through Malir and Lyari rivers in

to the sea causing marine pollution. This study provides the present profile of pesticides in vegetables in a highly populated megacity.

METHODOLOGY

Sample collection

A total of 45 vegetable samples were picked from the agricultural fields of Malir River i.e. Tomato, Brinjal, Gourd, Okra and Spinach from three pre-identified sites. From each site, 3 replicate samples for each vegetable were selected for the present study.

Laboratory analysis

Approximately 50 g ground vegetable sample was sent for homogenization in a mortar using anhydrous sodium sulfate followed by Soxhlet extraction. The method adopted for pesticide residues in vegetable samples was AOAC 970.52 (AOAC, 2005) and accordingly cleaned, concentrated and eluted with hexane by mean of solid phase extraction column. The elute is then injected to capillary in Gas Chromatography accompanied by Electron Capture Detector. Specifications of the operating conditions of the gas chromatograph are mentioned in Table 1.

RESULTS AND DISCUSSION

The descriptive statistics for pesticide residues in vegetable samples is represented in Table 2. In tomato samples, the mean concentration of HCH was in a range of 0.53 to 1.38 µg/kg, Endosulfan 0.04 to 0.48 µg/kg and DDT 0.54 to 1.09 µg/kg. The similar findings were observed from vegetables marketed in Ghana having OCPs in Tomato samples (Bempah *et al*., 2012). Recently, about 44% of the tomato samples in Nepal show exceeding values of pesticide residues from European Union Maximum Residue limit (Bhandari *et al*., 2019).

In Brinjal, the maximum average concentration was found from site M-3 i.e. 0.38 µg/kg HCH, 0.77 µg/kg of endosulfan and 2.53 µg/kg of DDT. However, highest concentration of DDT, HCH and endosulfan was reported from vegetables in India (Pathak *et al*., 2016). DDT is responsible for causing cytogenic disorders in humans (Geric *et al*., 2012). Cancers and malignancies are also associated with exposure of DDT and HCH in human being (Xu *et al*., 2010; Wong *et al*., 2015).

Table 1 Operating conditions of the gas chromatograph

S.No.	Parameters	Characteristics
1	System	Perkin Elmer 500
2	Detector	Electron capture
3	Column	DB-5 fused silica capillary column (30 m length 0.32 mm i.d.× .25 µm film thickness)
4	Carrier gas	Nitrogen (99.99%)
5	Carrier gas pressure	10.5 psi
6	Injector temperature	2000C
7	Injection	2 µL
8	Detector temperature	3200C
9	Temperature program	Initial temp 1800C at a rate of 40C min to 1000C (held for 5 min), then at a rate of 500C/min to 3000C

Table 2. OCPs in samples of Malir wastewater grown vegetables (µg/kg).

S.No.	Pesticide	HCH (Mean ± S.E)			Endosulfan (Mean ± S.E)			DDT (Mean ± S.E)		
	Vegetables	M-1	M-2	M-3	M-1	M-2	M-3	M-1	M-2	M-3
1	Tomato	0.53 ± 0.10	1.38 ± 0.20	0.71 ± 0.09	0.04 ± 0.02	0.48 ± 0.04	0.43 ± 0.04	0.54 ± 0.1	1.09 ± 0.07	0.91 ± 0.08
2	Brinjal	0.06 ± 0.02	0.17 ± 0.04	0.38 ± 0.04	0.08 ± 0.01	0.46 ± 0.11	0.77 ± 0.11	1.26 ± 0.12	1.81 ± 0.17	2.53 ± 0.25
3	Gourd	0.34 ± 0.12	0.68 ± 0.06	0.72 ± 0.08	0.08 ± 0.02	0.22 ± 0.03	1.17 ± 0.07	1.21 ± 0.37	2.04 ± 0.04	1.24 ± 0.34
4	Okra	0.68 ± 0.02	0.42 ± 0.21	0.30 ± 0.09	0.35 ± 0.09	0.08 ± 0.06	0.64 ± 0.06	0.27 ± 0.03	0.13 ± 0.13	0.09 ± 0.09
5	Spinach	0.69 ± 0.02	0.39 ± 0.20	0.32 ± 0.07	0.36 ± 0.10	0.27 ± 0.18	0.64 ± 0.06	0.26 ± 0.04	0.21 ± 0.21	0.18 ± 0.09

In the present study, the Gourd samples show concentration in a range of 0.34-0.72 µg/kg HCH, 0.08-1.17 µg/kg Endosulfan and 1.21-2.04 µg/kg DDT. It has been reported in literature that washing process has no significant differences in the pesticide concentrations in vegetables and 97% samples were above the limit in Qatar (Al-Shamary *et al*., 2016).

Okra is extensively used vegetable in this region but the present study revealed HCH was found in a range of 0.30 to 0.68 µg/kg and Endosulfan in a range of 0.08 to 0.64 µg/kg. But interestingly, DDT was found in Okra as lowest of all the vegetables studied i.e. 0.09 µg/kg from M-3. The maximum concentration of HCH found in spinach is 0.69 µg/kg whereas Endosulfan was found as 0.64 but DDT was lower as compared to these two i.e. 0.26 µg/kg.

The vegetables grown in vicinity of Malir River are irrigated with domestic and industrial wastewater that contain various pests and insects hence, require strong pesticides to enhance agricultural productivity. For this purpose, the banned OC pesticides are preferably used by farmers to reduce cost and applied extensively in the field. This source increases the concentration of pesticide in vegetable and other agrarian products and ultimately the agricultural run-off from Malir River enters the sea, causes the coastal pollution and contamination of sea water, sediments and aquatic biota as found in present research.

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