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DETERMINATION OF SELECTED PESTICIDES RESIDUE IN SELECTED FRUITS AND VEGETABLES OF AN AGRICULTURAL AREA OF OKARA

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Abstract

Pesticide residues are the remains of the pesticides after being applied to the crops. The toxicity and persistency of each pesticide greatly depends upon the properties of that pesticide. The purpose of this study was to detect the pesticide residues in the fruits and vegetables i.e. mango, banana, persimmon, grapes, apple, cucumber, tomato, onion and carrot collected from the fields of Okara. A total of 3 pesticides i.e. Bifenthrin, Imidacloprid and Glyphosate were considered because these were sprayed to the crops in that area. The above-mentioned pesticides were analyzed using High Liquid Pressure Chromatography (HPLC). The Maximum Residual Limit of Glyphosate in fruits is 0.1 ppm and the results revealed that all the samples except grapes are exceeding the permissible limit in Mango, Banana, Persimmon and Apple with concentration 1.008 ppm, 0.384 ppm, 0.24 ppm and 0.2 ppm respectively. Similarly, out of all samples Banana and Grapes exceeded the Maximum residual limit i.e. 1ppm in Mango, Grapes, Persimmon and Apple and 0.2 ppm in Banana with concentration 1.12 ppm and 3.13 ppm respectively. The results detected the presence of pesticides, i.e. Glyphosate, Imidacloprid, and Bifenthrin in the vegetable samples as well. The maximum residue limit of Imidacloprid was 0.05 ppm, and in this study tomato and onion tend to have higher value of Imidacloprid of about 0.1777 ppm and 0.1 ppm. The value of Imidacloprid in carrot was 0.04 ppm which is below the MRL. The Imidacloprid was not detected in cucumber and potato. Moreover, the Glyphosate concentration in the cucumber sample was 0.176 ppm, 0.605 ppm in carrot, 0.96 ppm in tomato and 0.651 ppm in onion. All these values were exceeding the MRL. In carrot, tomato and onion, Bifenthrin exceeded the limit by 0.99 ppm, 4.368 ppm and 2.464 ppm respectively, while the Bifenthrin was not detected in cucumber and potato. Such higher levels of pesticides concentration detected in vegetables pose threatening and harmful risks, which needs to be taken care of. High concentration of the pesticide residue in fruits showed the need to focus on the proper monitoring and implementation of the laws; otherwise, it would lead to more severe and alarming health problem.

Keywords

Pesticide, Fruits, Vegetables, Residues, Okara, Bifenthrin

1. Introduction

Pesticides are the chemical substances that are used to control growth of pests on the crops. Pesticide residues are the remains of the pesticides after being applied to the crops (Tan and Tang 2005). The toxicity and persistency of each pesticide greatly depends upon the properties of that pesticide. Total area of Pakistan that is used for crop production is about 22.2 million ha out of which about 4.5 million ha is used for growing fruits and vegetable (Sanborn *et al* 2002). Pakistan is an agricultural country and hence its survival depends upon the quantity and quality of crop that are being grown. Major economy of Pakistan depends upon the export of agricultural products to other countries (Hrleia, 1996). Use of pesticides for the protection of crops is obvious but the type and quantity of pesticide that is being used is the matter of concern. There are certain pesticides that have high persistency hence residues are difficult to be removed no matter how many times the agricultural product is washed out (Ortelli *et al* 2004). Since fruits are the basic component of diet and are highly beneficial for young ones due to high nutritional value. In Pakistan about 4.7 million tons of fruits and grown and then the high quality fruits are exported to other countries. From the total export from the country; fruits comprise of 13.2%. (Fenske *et al* 2002). During the past decade production of fruits has been increased due to increased growth rate and increased domestic consumption demands. There is a great variety of pesticides that are being used in Pakistan including 108 types of insecticides, 39 types of herbicides, 30 types of fungicides, 6 types of rodenticides and 5 types of acaricides (Fenske *et al* 2002). A study revealed that in Pakistan 88.3% of pesticides are being used in Punjab, 82% in Sindh, 2.8% in Khyber Pakhtunkhwa followed by 0.76% in Baluchistan. Out of these stats 11.9% of pesticides are applied to fruit crops (Bai, 2006). The amount of these pesticides applied to the fruit crops were specified increase in the dose and improper handling led to health problems (Rene & Zoonen, 1999). In developing countries approximately 73% of deaths are caused due to pesticide poisoning due to lack of protection during application of pesticides, lack of knowledge or high dose of hazardous pesticides. There have been seen mutagenic, carcinogenic and teratogenic effects upon animals and humans after intake of fruits contaminated by residue of pesticides (Robert., *et al* 2005). (Morasso., *et al* 2001). Ingestion is the direct source of introduction of residue of pesticides in human body. The effects shown can be acute or chronic depending upon the intensity of intake and chemical properties of residue of pesticides ingested (Hodgson & Patrica 1996). There are certain chemicals used in the persistent pesticides that binds with the enzymes of body and instigate changes in CNS of human body leading to nervous breakdown and death if not treated at the initial stage (Hussain., *et al* 2002). Use of pesticides is associated with several concerns especially the health problems that are caused due

to occupational exposure and non-occupational exposure altering the natural ecosystem. Since fruits are highly recommended for young ones, old people and pregnant women so they become highly susceptible to sickness because of low immunity system. A study was conducted in Boston, US to examine the vulnerability of infertility in the women due to intake of pesticide residue. The data was examined based on eating habits and pregnancy outcomes of 325 women who went through 541 cycles of fertility treatment out of which only 228 of fertility treatment cycle resulted in live birth (Around, 2001). Use of persistent pesticides has led to production of pesticide resistant insects, loss of biodiversity, soil contamination, and water and air contamination. Pesticide applied to the crops could reach to the water body through agricultural runoff to nearby water body and affect the aquatic biodiversity (Parveen & Masud, 2001). In humans' acute effects of intake of contaminated fruits with residue of pesticide include diarrhea, vomiting, salivation, lacrimation, diaphoresis, frequent urination and acceleration of process of meiosis. However, the long term effects include cancer of liver, brain, breast, kidney, skin, pancreas and lungs. The workers who are directly dealing with the chemicals without precautionary measures are highly susceptible to develop cancer. Children are susceptible for developing blood cancer due to exposure of insecticides and herbicides due to low immunity, high metabolism and different behavioral and activity patterns in comparison to adults. The other long term effect of pesticide exposure is neurological disorders. The study conducted in US highlighted that the high dose of pesticide when applied in form of spray on crops lead to neurological defects such as forgetfulness and low ability of concentration/focus (Parveen & Masud, 2001).

1.1 Bifenthrin

Bifenthrin is a pyrethroid pesticide that is largely used in underdeveloped countries. It is a light brown oily liquid with high efficiency when used in controlled quantity. According to Environmental Protection Agency (EPA) Bifenthrin is a class C carcinogen. The permissible limit of this pesticide varies with different fruits as per mentioned in chapter 4 (Results). The intake of pesticide residue of Bifenthrin leads to neurological problems, symptoms include headache, dizziness, muscle spasm, tremors and numbness. It also causes dermal problems such as blisters, rashes, itching, and sores. The respiratory problem that results from the exposure of Bifenthrin is shortness of breath, respiratory irritation, chest pain and asthma (Parveen & Masud, 2001).

1.2 Glyphosate

Glyphosate is one of the popularly and widely used herbicide around the world. In US it is classified into category 3 of toxicity list. According to Environmental Protection Agency (EPA) it is classified in "group E" of the carcinogenicity. Due to inhalation of glyphosate during spraying it cause oral and nasal discomfort, unpleasant taste, and throat irritation.

The long term exposure of this pesticide leads to bioaccumulation in organism. High dose could lead to kidney and liver damage in more severe exposure it leads to cancer formation (Scientific Report of EFSA 2013).

1.3 Imidacloprid

Imidacloprid acts upon the nervous system of insects therefore it is classified in neonicotinoids chemicals. The acute health effects due to exposure of imidacloprid include eye irritation, vomiting, nausea and dizziness. High dose exposure of the pesticide leads to degeneration of testes, bone marrow and pancreas and cardiovascular diseases. Long term and low dose effect of imidacloprid includes damage to liver and thyroid and loss of body weight. It is poorly absorbed in the gut and skin but once it enters the body of an organism it moves to the other parts of body damaging the organs (Scientific Report of EFSA 2011). Numerous indices are used in order to predict the pesticide residue intake. Maximum residual limit (MRL) is one of those indexes which are used to predict the pesticide residue in mg/kg. The amount/ value of pesticide residue in fruits that are exceeding the MRL are not permitted to be consumed (Scientific Report of EFSA 2013). There are many programs designed for developing countries that facilitates with the monitoring as well as knowledge of selection and use of pesticides on food crops. These agencies plan out monitoring by looking into the previous dietary data and risk assessment exercise and use of harmful chemicals in fruits. National and International organizations are playing their role in awareness and monitoring of food that would be beneficial for saving many lives (Scientific Report of EFSA 2013).

2. Objective

The objective of the study was to:

- Determine the pesticide residue in selected vegetables and fruits (cucumber, potato, carrot, onion and carrot, mango, banana, apple, persimmon, and grapes.)

3. Methodology

3.1 Study Area

The samples of fruits and vegetables were collected from Okara district, Punjab. Okara District shares boundary on the South Bahawalnagar, on the South-West by Pakpattan, on the west by Sahiwal, on the north by the districts of Faisalabad and Nankana Sahib, on the Near-East & Far-North by Kasur, on the South-East by Fazilka. It is famous for its fertile lands, peaceful natural environment, and green fields. Figure 1 shows the map of study area.

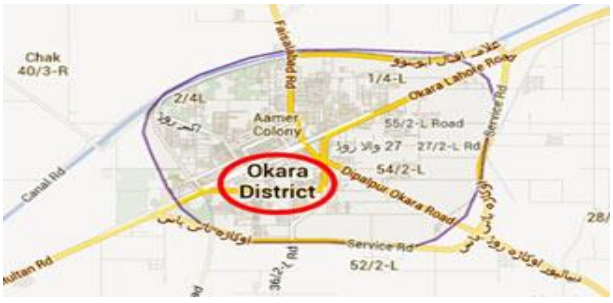

Figure 1: Location Map of Study Area

3.2 Sampling

A total of 40 samples of Mango, Apple, Banana, Grapes, Persimmon, cucumber, potato, carrot, and onion, were collected from the selected areas

of Okara during May 2021 to July 2021. These fruits and vegetables samples were collected from the field of selected area. The sampling was performed in accordance with the general principles and methods of the European Commission (EC) directive 2002/63/EC (Keikotlhaile & Spanoghe 2011). for establishing MRLs in food commodities. Each representative vegetable or fruit sample was a composite of 5 subsamples of the same commodity collected through random sampling. All the samples (1–2 kg each) were placed in sterile polythene bags, in an ice chess box, to avoid contamination and deterioration, labeled, and transported to the laboratory for processing. After that all the samples were chopped and kept in oven for 24 hours at 105 degrees to remove moisture content. Subsequently samples were ground to fine powder.

3.3 Chemicals and Materials

Standard solution of selected pesticides i.e. Glyphosate, Biphenthrin, Imidaclorprid, and other chemicals used were Ethyl Acetate, Dichloromethane, Sodium Anhydrous Sulphate, Sodium Chloride, Methanol, Distilled Water. And the equipment was Round Bottom flask, separating funnel, Funnel, Stirrer, Hot plate, Beaker, Tripod stand, Measuring Cylinder, Weighing Balance, Magnet, Filter Paper and HPLC were used.

3.4 Preparation of standard solution

For the preparation of standard solution 10 gram of pesticide was added into 20ml of Methanol. The solution was stirred for 20 minutes after which it was filtered. The standard solution was poured into the vial and run through HPLC (Tahir *et al.*, 2001). Chemical formulas of pesticides are given in table 1.

Table 1: Detected Pesticides in samples along with chemical formula

Sr	Chemical name (Pesticide)	Chemical Formula
1	Glyphosate	$C_3H_8NO_5P$
2	Biphenthrin	$C_{23}H_{22}ClF_3O_2$
3	Imidaclorprid	$C_9H_{10}ClN_5O_2$

3.5 Sample Preparation

After the process of drying, 5g of each sample was weighed separately and placed in the beaker. Then 5g of NaCl, 20ml of dichloromethane and 20ml of ethyl acetate were added to the beaker. Magnet was placed in each beaker and the sample was allowed to stir over the stirrer for 20 minutes. After stirring the sample was allowed to stand for 5 minutes and then it was filtered. Again 20ml of dichloromethane and 20 ml of ethyl acetate were added to the sample. Then it was allowed to separate in the separating funnel. Two layers were formed one was of organic content and the other was of aqueous content. The organic layer was separated and placed in rotary evaporator. For this purpose, the rotary evaporator was allowed to heat up for 20 minutes after which the sample was put into the rotary flask setting the

rotator and vacuum. After completion of evaporation of sample vacuum was released and 10 ml of methnol was added to the flask and after shaking it was stored in the vial for further analysis on High Pressure Liquid Chromatography (HPLC) [EPA method no. RAM] (Tahir *et al.*, 2001)

4. Results

4.1 Pesticide Detection

High Pressure Liquid Chromatography (HPLC) technique was used to detect pesticide concentration in the fruits samples. Pesticides Biofenthrin, Glyphosate and Imidaclorprid were detected in samples. In the table 2,3 and 4, show the peak areas of selected pesticides.

Table 2: Peak area of Glyphosate (Standard**)**

Peak	Ret Time (Minutes)	Type	Width (min)	Area (mAU*s)	Height (mAU)	Area %
1	2.24	BV	0.11	913.09	110.51	44.6
2	2.43	VV	0.22	368026	23.07	18.0
3	2.99	VV	0.12	720.35	84.44	35.2
4	3.47	VB	0.16	33.30	2.72	1.62
5	4.62	VB	0.13	10.72	1.13	0.52
Total				2045.74087	219.89526	

Table 3: Peak Area of Bifenthrin (Standard)

Peak	Ret Time (Minutes)	Type	Width (min)	Area (mAU*s)	Height (mAU)	Area %
1	2.042	BB	0.1011	10.77347	1.40993	2.9826
2	2.959	BB	0.0668	314.39474	72.27355	87.0379
3	3.709	BB	0.0793	6.61049	1.30069	1.8301
4	4.124	BV	0.1084	14.02239	1.84998	3.8820
5	6.771	BB	0.1712	15.41481	1.43622	4.2675
Total				361.21591	78.27037	

Table 4: Peak Area of Imidacloprid (Standard)

Peak	Ret Time (Minutes)	Type	Width (min)	Area (mAU*s)	Height (mAU)	Area %
1	2.098	BV	0.0968	153.80745	23.98020	1.7724
2	2.535	BV	0.0612	6.96997	1.72231	0.0803
3	2.657	VV	0.0804	294.96732	53.40038	3.3990
4	2.944	VV	0.0784	7721.55273	1543.09326	88.9782
5	3.197	VB	0.0934	31.61734	4.76739	0.3643
6	6.295	BB	0.1248	99.11594	12.46343	1.1421
7	7.919	BV	0.1428	107.35834	11.51280	1.2371
8	8.119	VB	0.1558	140.28760	13.65994	1.6166
9	10.211	BV	0.2318	68.75613	4.36366	0.7923
10	10.582	VB	0.1840	53.59476	4.59824	0.6176
Total				8678.02758	1673.56161	

4.2. Quantitative Analysis

After detecting the peaks of both standards and samples, the concentration of pesticide in the samples of fruits were determined by quantitative analysis. For analysis the peak areas were considered.

4.3. Response Factor

For calculation of response factor following formula was used: Response Factor = Peak Area / Standard Amount Whereas, Peak Area= Peak area of standard Standard Amount=Amount of Standard used in solvent (this is referred in table 5).

Table 5: Response Factor of Pesticides under consideration

Sr	Pesticide	Standard Amount (ppm)	Peak Area	Response Factor
1	Glyphosate	10	913.09	91.30
2	Imidaclopraid	10	7721.552732	772
3	Bifenthrin	10	314.39	31.43

The table 6 shows the concentration of glyphosate in the fruit samples of mango, grapes, banana, persimmon and apple. The concentration of glyphosate is particularly high above the standard limit i.e. 0.1 ppm by 1.008 ppm, 0.34 ppm, 0.24 ppm and 0.16 ppm in all the fruit samples except grapes. the concentration of Glyphosate in cucumber, carrot, tomato and

onion is exceeding the limit of about 0.176 ppm, 0.605 ppm, 0.96 ppm and 0.651 ppm. While in potato the concentration of Glyphosate in potato is within the limit of about 0.092 ppm.

Table 6: Concentration of Glyphosate in fruit and vegetable samples

Sr.	Samples	Peak Area of Sample	Amount of Glyphosate= Peak Area/ Response Factor	Amount of Glyphosate in samples (ppm)
1	Mango	92.06013	92.06012/91.43	1.006
2	Grapes	-	-	-
3	Banana	35.07782	35.07782/91.43	0.384
4	Persimmon	22.08165	22.08165/91.43	0.241
5	Apple	14.67270	14.67270/91.43	0.160
6	Cucumber	16.105	16.105/91.43	0.176
7	Onion	59.5514	59.5514/91.43	0.651
8	Carrot	55.37	55.37/91.43	0.605
9	Tomato	87.9851	87.9851/91.43	0.96
10	Potato	8.41506	8.41506/91.43	0.651

In table 7 the concentration of Imidacloprid is depicted in the fruit samples of mango, grapes, banana, persimmon and apple. All the fruit samples were detected within the standard i.e. 0.5 ppm and 1 ppm.

Table 7: Concentration of Imidacloprid in fruit and vegetable samples

Sr.	Fruits	Peak Area of Sample	Amount of Imidacloprid= Peak Area/ Response Factor	Amount of Imidacloprid in samples (ppm)
1	Mango	23.99014	23.99014/772	0.031
2	Grapes	98.58293	98.58289/772	0.127
3	Banana	164.8435	164.8435/772	0.213
4	Persimmon	-	-	-
5	Apple	31.10062	31.10062/772	0.040
6	Cucumber	-	-	-
7	Onion	77.45	77.459/772	0.10
8	Carrot	31.35	31.35/772	0.04
9	Tomato	137.316	137.316/772	0.177
10	Potato	-	-	-

In some of the samples like carrot, tomato and onion of about 0.04 ppm, 0.177 ppm and 0.1 ppm. The concentration of Imidacloprid in carrot sample is below the limit i.e.0.04 ppm. While the Imidacloprid is not detected in cucumber and potato. Table 8 represents the concentration of Bifenthrin in the fruit samples of mango, grapes, banana, persimmon and apple. Grapes and banana show high concentration as compared to standard limit i.e. 1 ppm and 0.2 ppm by 3.13 ppm and 1.12 ppm. The samples of mango and apple were below the standard limit. It was found out that only in carrot, tomato and onion the concentration of Bifenthrin is exceeding the limit i.e. 0.99 ppm, 4.368 ppm and 2. 464 ppm. While concentration of Bifenthrin is not detected in cucumber and potato.

Table 8: Concentration of Bifenthrin in fruit and vegetable samples

Sr. no	Fruits	Peak Area of Sample	Amount of Biphenthrin= Peak Area/ Response Factor	Amount of Biphenthrin in samples (ppm)
1	Mango	23.99014	23.99014/31.43	0.76
2	Grapes	98.58293	98.58293/31.43	3.13
3	Banana	35.07782	35.07782/31.43	1.12
4	Persimmon	-	-	-
5	Apple	31.10062	31.10062/31.43	0.98
6	Cucumber	-	-	-
7	Onion	77.45	77.45/31.43	2.464 ppm
8	Carrot	31.35	31.35/31.43	0.99 ppm
9	Tomato	137.316	137.316/31.43	4.368 ppm
10	Potato	-	-	-

5. Discussion

This study highlights the presence of pesticide residue in fruit samples and the health risks that would result due to intake of contaminated fruits. Qualitative and quantitative analysis were carried out. Total of 3 pesticides i.e. Bifenthrin, Imidocloprid and Glyphosate were considered. 5 types of fruits were considered and the above mentioned pesticides were detected in them using. High Liquid Pressure Chromatography (HPLC) technique (Hakme *et al.,* 2018). The quantitative analysis showed that some fruit samples were exceeding the Maximum Residual Limit (MRL) of pesticides under consideration. The Maximum Residual Limit of Glyphosate in fruits is 0.1 ppm table 6 shows that all the samples except grapes are exceeding the permissible limit in Mango, Banana, Persimmon and Apple by 1.008 ppm, 0.384 ppm, 0.24 ppm and 0.2 ppm respectively. Whereas in vegetable samples Highest levels of pesticide concentration is found in tomato with a value of 0.96 as compared to

standard value of 0.1. Carrot, Onion and cucumber have respective values of 0.605, 0.651 and 0.176, which are higher than the standard value. Potato is the only vegetable in the sample that has a lower value for glyphosate concentration, i.e. 0.092. Higher concentration of glyphosate is hazardous for health. Glyphosate is one of the popularly and widely used herbicide around the world. In US it is classified into category 3 of toxicity list. According to Environmental Protection Agency (EPA) it is classified in "group E" of the carcinogenicity. Due to inhalation of glyphosate during spraying it cause oral and nasal discomfort, unpleasant taste, and throat irritation. The long term exposure of this pesticide leads to bioaccumulation in organism. High dose could lead to kidney and liver damage in more severe exposure it leads to cancer formation (Wang *et al*., 2018). Glyphosate is a herbicide, and is widely used pesticide to kill weeds. It is an organophosphate chemical that deters photosynthesis in plants and that's why it is considered as active weed killer. Worldwide, Glyphosate has been used every year estimated of about 826 million kg, and is widely used in most of the developing countries like US. Glyphosate is applied by farmers on crops and even on lawns and gardens for the removal of weeds. It comes in several form like salt and acid and is found in air, soil, rainfall and water. It is also kills most of the plants, preventing them to form such proteins that helps in their growth (report by environmental science equiterre, 2018) (Valavanidis, 2018). The concentration of imidacloprid was detected within the Maximum Residual Limit (MRL) i.e. 0.5 ppm for Mango, Apple, Persimmion and Banana and 1 ppm in Grapes as shown in table 7. All the samples of fruits were found to be within the permissible limits set by Environmental Protection Agency (EPA). Whereas in vegetable samples, the tomato has the highest levels of imidacloprid concentration with values of 0.1777, whereas the standard values of the pesticide concentration are 0.05. Onion has the second highest levels of pesticide concentration with values of 0.1. Sample value of carrot is lower than the standard value, i.e. 0.04, representing that carrot has low levels of pesticide concentration and is safer as compared to tomato and onion. Cucumber and potato have been observed to have zero levels of pesticide concentration. Imidacloprid is an insecticide that interrupts the nervous system, and its ability to send a normal signal. After taken up by plants imidacloprid enter in its stem, leaves and roots which are further ducked by the insects. It is more toxic to the insects because of its ability to easily bind to the nerve cells of insects. and is less toxic to the other birds and mammals (Fact Sheet NPIC 2010). Imidacloprid is applied on crops to prevent them from damages caused by the insects, and is mostly selling product worldwide. It is also considered as steady in environment and water soluble (Wagner. 2016). Due to the acute exposure of imidacloprid several symptoms occurs maximum of about 5 days. Symptoms like fatigue, muscle weakness, convulsions,

twitching, diarrhea and cramps. And due to the high dose of the imidacloprid long terms effects occurs that are associated with genetic problems and respiratory problems. Also due to the no evidence of carcinogenicity in humans, imidacloprid is also considered as "Group E" carcinogen (Fact Sheet NPIC 2010). The Maximum Residual Limit (MRL) for Bifenthrin in Mango, Grapes, Persimmon and Apple is 1 ppm and 0.2 ppm in Banana (*Shafi et al*., 2014). Out of all fruit samples Banana and Grapes were exceeding the MRL by 1.12 ppm and 3.13 ppm respectively. The presence of bifenthrin was highest in tomato with values of 4.368, followed by onion and carrot with values of 2.464, 0.99 respectively. The standard value of the pesticide for the current study is 0.01. Moreover, there is an absence of pesticide in potato and cucumber samples. Bifenthrin is a pyrethroid pesticide that is largely used in underdeveloped countries. According to Environmental Protection Agency (EPA) Bifenthrin is a class C carcinogen. The intake of pesticide residue of Bifenthrin leads to neurological problems, symptoms includes headache, dizziness, muscle spasm, tremors and numbness. It also causes dermal problems such as blitters, rashes, itching, and sores. The respiratory problem that results from the exposure of Bifenthrin is shortness of breath, respiratory irritation, chest pain and asthma (Alcantra *et al* 2018). Bifenthrin a known restricted use pesticide belongs to pyrethroid family. This pesticide is known to cause effects in insects altering their central and peripheral nervous system and is known as human carcinogen (Mikolic *et al*., 2018). It is proven to be toxic to insects and aquatic animals while less toxic to insects. Bifenthrin when sucked up by insects' effects them as they have small body size and low temperature. It also occurs in many forms like aerosol, spray and granules. When inhaled by human beings causes acute problems like itching on skin, abdominal pain, throat, vomiting and nausea. When comes in contact with skin causes itching and burning which usually goes away within 48 hours. As from several studies it is examined that it does not properly absorb in skin, while it is absorbed in body after eaten up and take 3-7 days to excrete from body. Bifenthrin when reaches the groundwater also contaminates it because of its ability to bind to soil easily (Fecko, 2016). By the end of 20th century the world population increased and so the food demands which has led to intensification of agricultural activities along with the spread of chemicals/ pesticides. Around the World there is 2 million tons'/ year consumption of pesticides out of which 67% is consumed by Europe and USA and around 31% by the rest of the countries. In 2010 a study was conducted in Germany and the results showed 4% increase in Maximum Residue Level (MRL). A monitoring survey was conducted in the 5 years' duration from 2010-2015 to check the concentration of residue of pesticides in fruits in that research total of 765 samples were collected from the markets of Japan. 51% of imported samples and 31% of domestic samples showed the excess

concentration of residue of pesticides in the fruits particularly pyrethriods of which imidocloprid is one of the examples. A similar study was conducted in Lahore in 2014 that results showed that Mango and banana were exceeding the permissible limit for Glyphosate and Bifenthrin. Improper handling of pesticide during spraying and use of exceeding dose resulted in contamination of fruits. As a result, many intestinal problems occurred due to intake of such contaminated fruits (Shafi *et al* 2014). In 2011 a study was conducted in the city of Hyderabad, Pakistan for determination of pesticide residue in the fruit samples of apple, grapes and orange. The samples were analyzed with the help of High Liquid Pressure Chromatography. The results showed that out of 131 samples of mentioned fruits 53 were contaminated with pesticide residue leading to health issues (Saito-Shida *et al*., 2016). Exposure to pesticides can also take place at the occupational place such agricultural workers working in the field, greenhouses and manufacturing industry of pesticides. The people who come in direct contact with pesticides are more susceptible of getting ill. Some illness occurs due to poor handling of chemicals, accidental spillage and faulty spraying device/ equipment. According to WHO there are 220,000 deaths taking place each year with 3 million cases of health defects (Farajzadeh., *et al* 2017). As compare to other studies, a study was carried out in India in 2016 where most if the samples of vegetables were above the MRL, and thus posing harmful risks. Tomatoes, onions and potatoes were found to be exceeding the limit. Which may be due to the carelessness or unawareness of farmers (Fact Sheet NIPC 2010). Another study was examined on Ghanaian vegetables in 2012, and 50% of its samples were contaminated due to over use of pesticides (Nishant & Upadhyay 2016). In Kuwait a study was conducted in 2017 in which 150 samples were analyzed with 34 different pesticides. Sample like potato, carrot and tomato were examined and in all samples imidaclopraid was also detected. In some of the samples it was exceeding the MRL, which may have harmful consequences on human health. As rapid use of pesticides in Kuwait had led to the conclusion that there must be routine monitoring and proper handling of pesticides in agricultural field in order to prevent contamination (Bempah., *et al* 2012). Similarly, in Saudi Arabia in 2016, vegetable samples were collected from jazan market and were analyzed with extraction process, followed by the gas chromatography. From the results it was revealed that most of samples of vegetables like tomato and cucumber were found to be contaminated with pesticide like Glyphosate and Bifenthrin, and were exceeding the MRL. Due to which routine monitoring of pesticide was recommended (Dawood., *et al* 2017). In 2018 a study was carried out in India in which potatoes were examined with different pesticides like Imidaclopraid. From the result it was revealed that samples were contaminated and were exceeding the limit. As potato is important diet and there is an increasing demand day by day. But due to the high use of pesticides there is

an increasing contamination on potatoes, showing some harmful effects on human health. As this problem is not just limited in India but worldwide, and this need to be monitored routinely (Hassan., *et al* 2016) Also in Lahore in 2010 a study was carried out on vegetables one of which is cucumber and tomato. Two samples of tomato and cucumber were contaminated with imidaclopraid pesticide residue but was within the limit. So it does not pose any harmful risks (Kumari & Devi 2018).

6. Conclusion

This study examined the pesticide residues in commonly used vegetables like Cucumber, Onion, Tomato, Potato, and Carrot. So from the results we concluded that most of our samples were contaminated with residue of Glyphosate, Imidaclopraid and bifenthrin pesticides. Some of the pesticides were exceeding the Maximum residue limit (MRL) in samples like onion, cucumber, carrot and tomato. Similarly, the values of tomato and onion was also exceeding the MRL of imidaclopraid. Whereas in bifenthrin values of tomato, onion and carrot was exceeding and absence in potato and cucumber. The study showed that fruit samples are exceeding the maximum residual limit set by Environmental Protection Agency (EPA). Concentration of Glyphosate was high in mango, banana, persimmon and apple. Similarly, concentration of Bifenthrin was high grapes and banana. However, Imidacloprid was not detected in the fruits samples It is also observed that from public health of view there are several health effects on humans and animals due to the use of pesticides. And if no proper management, and handling will take place, then it will further cause more problems.

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