
LEVELS OF ORGANOPHOSPHATE AND PYRETHROID RESIDUES IN SOME EGYPTIAN FRUITS AND VEGETABLES AND THEIR DIETARY EXPOSURE

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El Sawi, Emtithal, A.⁽¹⁾; Ayoub, M. M.⁽²⁾ and Mohammed, A. S.⁽³⁾

1) Faculty of Women, Ain Shams University 2) Agricultural Research Center (ARC) 3) Egypt Chemicals Company

ABSTRACT

A total of 230 samples of four most public consumed fruits and vegetables, were collected from two wholesale Egyptian markets during 2015. The collected samples were subjected to analysis for 51 pesticide residues of organophosphates (OP's) and pyrethroids (PY's) groups. The standard method (QuEChERS) was followed to the analysis of samples applying LC-MS/MS determination. The obtained data showed that, 17.4% of samples had no detectable residues. Whereas, 82.6% had detectable pesticide residues of which 18.3% contaminated with levels above the MRL's and 64.3% (148 samples) had residues below the permissible limits. The highest contamination percentages were observed in grape followed by pepper, apple and tomato with percentages of 90%, 88.3%, 81.7% and 71.7% respectively of which 18%, 23.33%, 23.3% and 8.3% exceeded the permissible MRL's. The most frequent (OP's) and (PY's) are chlorpyrifos, cypermethrin, lambda cyhalothrin and diazinon.

Risk assessment was evaluated via calculation of chronic and cumulative exposure for total of 17 residues of (OP's) and (PY's). The results indicated that no chronic health risk associated with consumption of studied commodities. The cumulative exposure values of (OP's) pesticides was below 1 (0.059 for adults) in fruit samples and (0.108 for adults) in vegetable samples. Also, cumulative exposure values of (PY's) pesticides were below 1 (0.012 for adults) in fruit samples and (0.017 for adults) in vegetable samples, indicating no hazard to consumers due to presence of OP's and PY's residues in Egyptian fruits and vegetables.

Key words: Pesticide Residues, Fruits, Vegetables, Egypt, EDI (estimated daily intake), Cumulative risk assessment.

Abbreviations: OP (organophosphorus), PY (pyrethroids), EADI (estimated acceptable daily intake), ADI (acceptable daily intake).

INTRODUCTION

Raw fruits and vegetables are considered a follow important source for a healthy and balanced diet since they are rich in carbohydrates, vitamins, fibers, lipids and many of a supplementary nutrients. On the other hand, agriculture crops are subject to attack by many diseases and pests that affect the yield and the quality of foodstuffs. Farmers in wide world use different pesticide groups including organophosphorus and pyrethroids in order to control diseases, protect crops, get high quality foodstuff and to increase the agricultural production in line with population growth demands (Shakhaoat *et al.*, 2013). However many of them spray the same wide range of pesticides on all crops and ignore (PHI) pre-harvest intervals (Ntow *et al.*, 2006).

The use of pesticides is often resulting in the presence of residues in fruits and vegetables that can cause respiratory and neurological damages and alteration in genes which finally may lead to cancers and tumors through dietary exposure (Hayat *et al.* 2011, Choi, *et al.* 2004 & Galloway and Handy, 2003). Furthermore, pesticide residues have harmful and lethal effects on humanity like heart diseases, cancers and Alzheimer's (Khaniki, 2007). Three million cases of chronic and acute poisoning worldwide with estimated 220.000 cases death were announced by WHO in 1990. However much quantities of pesticides are still used in the deveoped countries (Bhanti et al, 2004).

In the developing countries, the main tools for applying the monitoring survey of pesticide residues in fruits and vegetables, from equipment, control programs and training of technical personnel are often lacking (Hjorth *et al.*, and 2011). Therefore the monitor of human exposure to pesticide residues was needed through comparing of residue levels with the international standards such as maximum residue limits (MRLs) that set by the Codex Alimentarius, European (EU) commissions and to acceptable daily intakes (ADIs). The ADI is the amount of chemicals estimated in food (mg kg^{-1} body weight day^{-1}) that the human body can be exposed to it daily over a life time without any risks (FAO, 2002).

The monitoring research studies are always interested in good agriculture practice of pesticides (GAP), the registration and authorization (application and pre-harvest interval) and compliance with MRL's (Claeys *et al.*, 2011).

Levels of pesticide residues and their dietary exposure of Egyptian fruits and vegetables have been reported by many investigators (Gad Alla *et al.*, 2013). However, monitoring results and dietary exposure of pesticide residues should be investigated periodically in order to ensure health safe for the farmers and generate awareness between consumers.

The aim of present study is to assess the residue levels of pesticides in some fruits and vegetables collected from two big wholesale markets of Obour and Six October in Egypt throughout 2015. The compliance of obtained results with MRL's set by Codex and/or EU is determined. It is hoped that monitoring results might check the application of Good Agriculture Practice (GAP) and calculate the dietary exposure compared with safety limits such as the ADI or the acute reference dose (ARfD).

MATERIALS AND METHODS

Sampling:

A total of 230 samples from four of most popular consumed fruits including apple, grapes and two vegetables : pepper and tomato. were collected from two major wholesale markets (Obour & Six October) in Egypt during 2015. The total number of samples were analysed for each commodity as shown in Table (1). One to two kilograms of each plant crop were prepared for examination against fifty one pesticide residues according to CAC, Codex Alimentarius Commission guidelines (1993). The samples were kept in polyethene bags and then transported on ice to the laboratory where they were analyzed immediately and / or grinded with high speed grinder 2 l capacities jar with lid and stored at 0-5 °C for no longer than 2 days before analysis.

Pesticide Residues Analysis:

QuEChERS standard method for food of plant origin: prEN 15662 was followed as recommended by EC/Technical Committee 275 (2007). The method provided the best characteristics for extracting and determination of 51 pesticides of organophosphorus and pyrethroids with the least number of co-extractable for LC-MS MS analysis.

Samples preparation:

A representative portion of each sample was comminuted at room temperature with a blender. A 10 g (W) of homogenized sample was weighed in 50 ml PFTE tube followed by extraction of samples in frozen conditions by adding 10 ml of acetonitrile and shaking vigorously. The mixture was centrifuged for 10 minutes, then buffer-salt-mixture (magnesium sulfate,

sodium chloride and buffering citrate salts (pH 5-5.5) was added. Organic phase aliquot was cleaned by magnesium sulfate, as well as, bulk sorbent for removal of residual water. Finally, cleanup by primary secondary amine sorbent (amino-sorbents) to remove lipids and fats. The mixture was shaken and centrifuged at 4000 rpm for 5 minutes. The final extract was employed for LC-MS/MS analysis. The method was applied to the 51 compounds of organophosphorus and pyrethroids using LC-MS/MS.

Reagents & Chemicals:

Acetonitrile and methanol from Fluka (HPLC grade), formic Acid from Fluka (98-100%). 33% ammonia solution (BDH) 99% purity. Trisodium citrate dihydrates (1 ± 0.05 g), anhydrous magnesium sulphate (4 ± 0.2 g), disodium hydrogen citrate sesquihydrate (0.5 ± 0.03 g) and sodium chloride (1 ± 0.05 g) / QuEChERS kit Part No.: 5982-5650, all salt-mixture for buffering (Agilent Technology). De-ionized water recommended for LC-MS/MS (Millipore). LC mobile phase composition is 10 mM ammonium formate solution prepared into water / methanol (9.8:0.2 v/v) at pH 4 ± 0.1 (A) and 100 % methanol (B). Pesticide reference standards (purity >95%) were certified provided by Dr. Ehrenstorfer (Augsburg, Germany).

Quality Assurance (QA):

Various criteria have been set in order to achieve reliability of the results obtained. The state of the column, sensitivity of the instrument and retention time shifts were checked before injecting every batch of samples. All pesticides have to be detected visually in the chromatogram of a calibration solution to confirm that the acquisition time windows are set correctly.

Calibration curves of all tested pesticides have a good correlation fit with r^2 (>0.995).

Fully validation of analytical method and instruments was done as a part of a Central Food Laboratory (CFL) quality assurance system. The lab was accredited by Laboratory Accreditation Bureau (L-A-B), United Kingdom accreditation body in accordance with the requirements of ISO/IEC 17025:2005.

Recoveries are calculated from the spiked samples for all the targeted pesticides at different levels of concentrations and the average was varied between 70-120%. The established limit of quantification was 0.01 mg/kg for all pesticides. The estimation of measurement uncertainty in terms of relative standard deviations and as expressed uncertainty (at 95% confidence) was lower than the EU default value ($\pm 50\%$). The performance of the method was in compliance SANCO/12459/2011.

Calculation of Estimated Daily Intake (EDI):

The exposure to the pesticide residues was evaluated via estimation of daily intake (EDI) and compared with toxicological criteria such as acceptable daily intakes (ADIs). EDI was calculated for each commodity/pesticide combinations using the following equation (Darko and Akoto, 2008).

$$\text{EDI (mg kg}^{-1} \text{ bw day}^{-1}) = (\text{Mean Concentration (mgkg}^{-1}) \text{ of pesticide residue} \times \text{Food consumed (kgd}^{-1}) / \text{body weight (kg)}.$$

The scientific names and the rate of food consumption based on data issued by Global Environment Monitoring System (WHO/GEMS/FOODS, 2006) were shown in the following table.

Table (1): Consumption rate of commodities analysed in g/day based on WHO/GEMS/food

Commodities	Scientific name	Consumption (g/day)
Apple	Malus domestica Borkhausen	18.4
Grapes	Vitis vinifera L.	23.82
Pepper	Capsicum annum	8.8
Tomato	Cyphomandra betacea	118

Consumption rate issued by GEMS/ Food regional diet, WHO (2006).

According to (FAO/WHO, 2010) and (EFSA, 2013), the health risk indices (HI) were calculated by dividing the EDI by their corresponding values of ADI; taking in consideration average adult's body weight of 60 kg. The estimated daily intakes were used as an indication for health risks to consumers on long term. When $HI > 1$; there is a risk to the consumer and the food is unacceptable and vice versa (Hamilton and Crossley, 2004 and Darko and Akoto, 2008).

Cumulative risk (ΣHI 's) equals the summation of HI for detectable pesticide belonging to the same chemical group i.e. organophosphates, and pyrethroids.

RESULTS AND DISCUSSION

Monitoring results:

A total of 230 sample from four most public consumed fruits and vegetables, were collected from (Obour and Six October wholesale markets) Egypt during May to December 2015.

The standard method CEN 275, 2007 was used for monitoring of 51 pesticide residues of organophosphate (OP's) and pyrethroid (PY's) groups (allowed/or banned in Egypt) applying the developed techniques of UPLC-MS/MS Waters Xexo TQ-S that allowed simultaneous quantification of 51 residues at LOQ of 0.01 mg/kg with a specified degree of confidence.

Table (2) shows the number of analysed samples of each commodity, the detectable pesticides with their mean concentration range in mg/kg and violated compounds of each pesticide/commodity.

In the present study, the results of the monitoring were evaluated versus to rules of Egyptian Agriculture Pesticides Committee (APC) and the permissible limits of codex and EU, which are applied in Egypt. These rules stated that " pesticide residue levels should be compared with Codex Alimentarius as it's available and to the EU-MRL's in case of codex MRL's lack". These rules would maintain the safety of agricultural products both consumed locally or exported abroad

Overall, 17.4% (40 samples) of samples analyzed had no detectable residues. Whereas, 82.6% (190 samples) had detectable pesticide residues of which 18.3% contaminated at levels above the MRL's and 64.3% (148 samples) had residues below the permissible limits (Table 3).

However, comparison with available codex MRL's, violation was observed in 2 (4%) and 4 (6.7%) samples of grapes and pepper respectively. Moreover, violation was observed for the residue of dimethoate in 16 samples of apple (26.7%) compared with EU limits due to absence of codex limits. The obtained data also revealed that, no violation observed in tomato samples comparing with both MRL's of codex and EU.

In general, the European and Codex permissible limits are always set far below the safety limits for consumers protection purpose. However, risk exposure should be evaluated based on toxicological end points such as, Acceptable Daily Intakes, (IFOAM, 2008).

The data of Table (3) indicate that 21(19.1%) out of 94 contaminated fruit and 22(18.3%) out of 96 contaminated vegetable samples showed contamination with multiple residues (more than 2 pesticides / sample). Total of 30% apple, 6% grapes, 26.7% pepper and 10% tomato samples are contaminated with multiple residues.

Table (2a): The number of analyzed fruit samples, the frequency of pesticide residues detected with their average rang in (mg/kg) and violation.

Product	Total No.	Detected pesticide	Ferq	< LOQ	Range Min-Max mg/kg		Average mg/kg	MRL EU g/kg	MRL Codex mg/kg	Viol comp.
Apple	60	Bifenthrin	2	1	0.01	0.01	0.01	0.30		
		Chlorpyrifos	36	8	0.01	0.3	0.15	0.50	1.00	
		Chlorpyrifos Me	1		0.02	0.02	0.02	0.50	1.00	
		Cyfluthrin	2	1	0.02	0.02	0.02	0.20	0.10	
		Cypermethrin	25	3	0.01	0.24	0.15	1.00	0.70	
		Deltamethrin	2		0.02	0.05	0.03	0.20	0.20	
		Diazinon	1		0.01	0.01	0.01	0.01	0.30	
		Dimethoate	23		0.01	0.24	0.12	0.02		16
		Fenvalerate	1		0.03	0.03	0.03	0.10		
		L-Cyhalothrin	12	6	0.01	0.03	0.02	0.10	0.20	
		Omethoate	2		0.01	0.01	0.01	0.02		
		Permethrin	1		0.01	0.01	0.01	0.05		
Grapes	50	Chlorpyrifos	36	13	0.01	0.30	0.14	0.50	0.50	
		Cyfluthrin	4		0.03	0.20	0.08	0.30		
		Cypermethrin	10	1	0.01	0.75	0.35	0.50	0.20	2
		Diazinon	1		0.03	0.03	0.03	0.01		1
		Dimethoate	3		0.03	0.40	0.13	0.02		3
		Malaxon	1		0.02	0.02	0.02	0.02	5.00	
		Malathion	5	1	0.01	0.05	0.05	0.02	5.00	
		Omethoate	3		0.02	0.03	0.03	0.02		2
		Profenofos	1		0.01	0.01	0.01	0.01		

Table (2b): The number of analyzed vegetable samples, the frequency of pesticide residues detected with their average rang in (mg/kg) and violation.

Product	Total No.	Detected pesticides	Ferq	< LOQ	Range Min- Max mg/kg		Average mg/kg	EU MRL mg/kg	Codex MRL mg/kg	Viol comp.
Pepper	60	Bifenthrin	1		0.04	0.04	0.04	0.50	0.50	
		Chlorpyrifos	36	6	0.01	7.50	3.5	0.50	2.00	2
		Cyfluthrin	3	2	0.05	0.05	0.05	0.30	0.20	
		Cypermethrin	21	1	0.01	0.23	0.10	0.50	0.10	2
		Deltamethrin	4		0.01	0.10	0.06	0.20		
		Diazinon	8	3	0.01	0.04	0.03	0.05		
		Dimethoate	1		0.05	0.05	0.05	0.02	0.50	
		Fenpropathrin	1		0.13	0.13	0.13	0.01	1.00	
		Fenvalerate	1	1				0.05		
		L- Cyhalothrin	31	2	0.01	0.48	0.25	0.10		7
		Methamidophos	1		0.01	0.01	0.01	0.01		
		Omethoate	1		0.01	0.01	0.01	0.02		
		Parathion Me	1		0.01	0.01	0.01	0.01		
		Permethrin	1		0.03	0.03	0.03	0.05	1.00	
		Profenofos	4		0.03	0.37	0.17	0.01		4
Triazophos	1	1				0.01				
Tomato	60	Chlorpyrifos	31	13	0.01	0.23	0.10	0.50		
		Cypermethrin	4	1	0.08	0.15	0.11	0.50	0.20	
		Diazinon	15	2	0.01	0.10	0.05	0.01		
		L- Cyhalothrin	1		0.01	0.01	0.01	0.10		
		Malathion	1	1				0.02	0.05	
Profenofos	10		0.01	0.25	0.15	10.00	10.00			

Table (3): The number of analyzed fruits /vegetables samples, violated, contaminated, and free samples as well as their percentages and number of samples with more than two pesticides.

Commodities	Samples analyzed	Cont. samples *	Free samples	< MRL	>MRL	No. of samples with more than two pesticides
Apple	60	49	11	35	14	18
		81.7%	18.3%	58.33%	23.33%	
Grapes	50	45	5	36	9	3
		90%	10%	72%	18%	
Total fruits	110	94	16	71	23	21
		85.5%	14.5%	64.5%	20.9%	19.1%
Pepper	60	53	7	39	14	16
		88.3%	11.7%	65%	23.3%	
Tomato	60	43	17	38	5	6
		71.7%	28.33%	63.33%	8.3%	
Total vegetables	120	96	24	77	19	22
		80.0%	20.0%	64.2%	15.8%	18.3%
Total No.	230	190	40	148	42	43
		82.6%	17.4%	64.3%	18.3%	18.7%

*Contaminated samples include samples with result < MRL & >MRL

Comparison with previous results

Table (3) shows the percentages of contaminated, free and violated samples (samples with residues more than the MRL's) of apple, grapes, tomato and pepper. The highest contamination was observed in grapes followed by pepper, apple and tomato with percentages 90%, 88.3%, 81.7%

and 71.7% of which 18%, 23.3%, 23.3% and 8.3% exceeded the MRL's, respectively.

Comparing the current data with the previous monitoring results of pepper and tomato samples reported by Dogheim *et al.*, (2002) at Egyptian markets whereas the contamination percentages were 34.8% and 31.3 % of which 5.7% and 0.75% exceeded the permissible limits respectively due to the presence of OP's and PY's residues. So, current data had higher contamination and violation percentages than the previous one.

The monitoring results of apple and grapes samples at Egyptian local markets in 2007 obtained by Gadalla *et al.*, (2013) showed higher contamination percentages in apple samples which was 92% but lower contamination percentage was observed in grapes samples which was 64% comparing with the current results.

The rates of outcome in the present study were slightly lower than the residue levels obtained through the study of pesticide residues in apple and grapes samples at Egyptian markets in 2010 reported by Gadalla *et al.*, (2015) whereas the contamination percentages were 88.9% and 100% of which 16.6% and 10.5% exceeding the permissible limits respectively due to the residues of OP's and PY's.

However, the rates of contamination of pepper and tomato in the present study showed higher levels than that obtained at 2011 (Gadalla *et al.*, 2013) whereas the contamination percentages were 30.8% and 38.09 % of which 7.7% and 19.05% violate percentages, respectively due to the residues of OP's and PY's.

Evaluation of pesticides:

Fig (1) illustrates the most frequently detectable pesticides in the Egyptian fruits and vegetables samples analyzed in 2015. There were 19 pesticides detected in the analysed samples, the frequencies of detected pesticides were: Chlorpyrifos (139), Cypermethrin (60), Lambda cyhalothrin (47), Dimethoate (27), Daiazinon (25), Profenofos (15), Cyfluthrin (9) Deltamethrin (6), Malathion (6), and Omethoate (6 samples). Bifenthrin were detected in three samples; Fenvalerate and Permethrin were detected in two samples; and the other pesticides (Chlorpyrifos methyl, Fenpropathrin, Methamodophos and triazophos) were detected only in one sample each. Although cypermethrin was detected in all of fruit and vegetable samples with concentrations ranging from 0.01 to 0.75 mg/kg, there was violated in only two samples of each grape and pepper as shown in Table (2). However, some pesticide concentrations exceeded their MRLs, such as dimethoate (19), L-Cyhalothrin (7), profenofos (4), Cypermethrin (4) chlorpyrifos (2), omethoate (2) samples and diazinon in only one sample as showed in Table (2). The results show that the chlorpyrifos was the most detectable pesticide. The levels of chlorpyrifos in pepper samples ranged from 0.01 to 7.5 mg/kg, with 2 samples having levels above the MRL. This finding is interesting because this level is higher than the chlorpyrifos concentration reported for pepper samples by previous study (Dogheim *et al.*, 2002) which was ranged from 0.04-1.3 mg/kg. The levels of chlorpyrifos in tomato samples ranged from 0.01 to 0.23 mg/kg. These levels were slightly lower than the levels reported by (Dogheim *et al.*, 2002) and higher than the other one reported by

(Gadalla *et al.*, 2013) whereas, ranged from 0.23-0.26 mg/kg and 0.01-0.08 mg/kg, respectively. Also the levels of chlorpyrifos were ranged from 0.01-0.3 mg/kg for both of apple and grape samples. These values are higher than the levels reported for grape samples by (Gadalla *et al.*, 2015) where 0.02 mg/kg and higher than others where were the values from 0.02-0.07 mg/kg and 0.01-0.04 mg/kg in apple and grape samples, respectively.

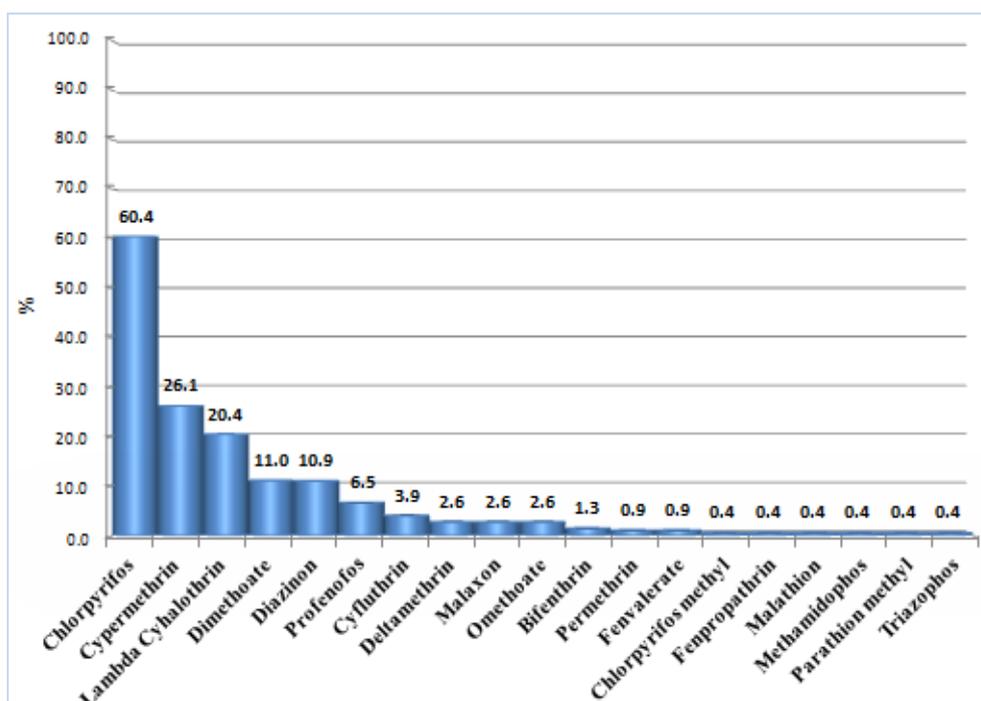


Fig (1): The frequencies of each detected pesticide residue in analyzed samples of fruits and vegetables collected from Egyptian markets during 2015

Risk assessment:

Exposure to pesticide residues over a lifetime and their effects on health was taken into consideration in the assessment of chronic exposure studies as

well as the mean of exposure level in relation to the ADI values that were developed for each individual pesticide. Human health is subject to be at risk if the exposure to the residues of chronically toxic pesticides and their dietary intake exceeded the acceptable daily intake for an extended period of time.

Dietary exposure to pesticide residues was calculated on a total of 16 residues taking into consideration the levels that were higher than LOQ to avoid overestimation of EDI. The estimation of chronic exposure was calculated based on the daily consumption of food with pesticide residues over a life time. The total exposure was calculated by summing exposures of all pesticide residues/food combinations. Table (4) shows the estimated average daily intake (EDI $\mu\text{g kg}^{-1}\text{bw}^{-1}$) and the ratio of EDI to ADI for each pesticide residues i.e. hazard index (HI).

The data of Table (4) reveal that, the highest intake for pesticide was observed for organophosphates group followed by pyrethroids in both of fruits and vegetables. However, the calculated intake indicating that, there was no risk associated with the consumption of vegetable samples whereas, all calculated HI for individual pesticides have values less than one indicated also negligible risk.

EFSA used Threshold of Toxicological Concern (TTC) as a tool for providing scientific advice about possible human health risks from low level exposure. It was found that the estimated intake of OP's is lower than the established TTC values which is ($0.3\mu\text{g/kg}$ body weight per day) for organophosphate with anti-cholinesterase activity, (EFSA 2012).

However, Organophosphate and pyrethroid pesticides were the major groups used in Egypt for more than 25 years (1980's), which refers to the exposure of consumers to these groups of pesticides for long periods that may be the cause of some chronic health effects, even though exposure to small amounts.

The exposure to lower levels of pesticide residues for long periods was associated with human health effects such as immune suppression, reproductive abnormalities, hormone disruption and cancer, (Gupta ,2004).Which emphasized the need for new strategies in the future to reduce dietary exposure to OP's and PY's pesticides, including a new regulation of the use of pesticides and the introduction of biotechnology, bio-pesticides, and the use of pesticides that have been obtained from natural plants.

Table (4a): The Estimated intake (EDI) and the hazard index (HI) of pesticide residues detected in Egyptian fruits samples.

Substance group	Pesticides	ADI	Reference	EDI	HI
		ug kg ⁻¹ bwday ⁻¹		ug/kg.bw	
Organophosphates	Chlorpyrifos	10	JMPR 1999	0.102	0.010
	Chlorpyrifos Me	10	JMPR 2006	0.006	0.001
	Diazinon	5	JMPR 2006	0.015	0.003
	Dimethoate	2	JMPR 1996	0.089	0.045
	Malathion	300	JMPR 1997	0.02	0.000
	Profenofos	30	JMPR 2007	0.01	0.000
HI=ΣHI's					0.059
Pyrethroids	Bifenthrin	10	JMPR 1992	0.003	0.000
	Cyfluthrin	40	JMPR 2006	0.038	0.001
	Cypermethrin	20	JMPR 2011	0.185	0.009
	Deltamethrin	10	JMPR 2000	0.009	0.001
	Fenvalerate	20	JMPR 2012	0.009	0.000
	L- Cyhalothrin	20	JMPR 2000	0.006	0.000
	Permethrin	50	JMPR 1999	0.003	0.000
HI=ΣHI's					0.012

Only the results >LOQ are involved in calculation.

Table (4b): The Estimated intake (EDI) and the hazard index (HI) of pesticide residues detected in Egyptian vegetables samples.

Substance group	Pesticides	ADI	Reference	EDI	HI
		ug kg ⁻¹ bw day ⁻¹		ug/kg.bw	
Organophosphates	Chlorpyrifos	10	JMPR 1999	0.71	0.071
	Diazinon	5	JMPR 2006	0.102	0.020
	Dimethoate	2	JMPR 1996	0.009	0.005
	Methamidophos	4	JMPR 2011	0.001	0.000
	Parathion methyl	3	JMPR 1995	0.001	0.000
	Profenofos	30	JMPR 2007	0.336	0.011
HI=ΣHI's					0.108
Pyrethroids	Bifenthrin	10	JMPR 1992	0.006	0.001
	Cyfluthrin	40	JMPR 2006	0.007	0.000
	Cypermethrin	20	JMPR 2011	0.231	0.012
	Deltamethrin	10	JMPR 2000	0.01	0.001
	Fenpropathrin	20	JMPR 2012	0.019	0.001
	L- Cyhalothrin	20	JMPR 2000	0.057	0.003
	Permethrin	50	JMPR 1999	0.004	0.000
HI=ΣHI's					0.017

Only the results >LOQ are involved in calculation to avoid overestimation of EDI.

Cumulative risk assessment

It is one of the important approaches to evaluate hazards resulting from multiple residues. The methodology for cumulative risk assessment was used for the first time in 2010 by EFSA. The presence of similar toxicological characteristics on food is the only case for the occurrence of cumulative effects. In order to evaluate cumulative risk of multiple residues in regulatory practice, the Federal Institute (BfR) recommends evaluation by means of the determination and addition of hazard indices (HI) for the individual pesticides

belonging to the same chemical group. It is a simple and fast method which saves the safety for the consumers at the same time and including additional toxicological information (BfR 2013). The hazard index is an indication for the extension of pesticide residues ingestion via food reaches its toxicological limit values (ADI, ARfD). In the present study, the hazard risk index (HI) is calculated to assess the probability of any of risk through consumption of pesticide residues containing foodstuff.

The cumulative exposure values (hazard index) of organophosphorus and pyrethroids pesticides were calculated by summing up the HI's for the individual pesticides of the similar group and was found to be <1 (0.059-0.108 and 0.012-0.017 for adults) for organophosphates and pyrethroids respectively. This indicates no hazards to the consumers through the consumption of fruits and vegetables including residues of organophosphorus and pyrethroids as shown in (Table 4).

CONCLUSION

The monitoring study of organophosphate and pyrethroid pesticides in some Egyptian fruits and vegetables still poses special concern. However, possible accumulation of OP's and PY's for many food items causes considerable health problems for both farmers and the consumers

Accordingly, the Egyptian authorization should strengthen their efforts to establish MRL's based on regular monitoring studies, local GAP and supervised trials of the pesticide levels of market foods and promote education on the potential risks and the safe use of pesticides.

Moreover, cumulative risk assessment is considered as an indicator for the lethal effects that related to the human health because of the exposure to pesticide residues over a long period.

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مستويات بقايا المبيدات الفوسفورية العضوية والبيروثرويدات في بعض الفواكه والخضروات المصرية والتعرض الغذائي لها

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امتثال أحمد بهاء الدين الصاوي^(١) - محسن محمد محمد أيوب^(٢) - علي سعد محمد محمد
(١) كلية البنات، جامعة عين شمس ٢) مركز البحوث الزراعية

المستخلص

تم جمع ٢٣٠ عينة من ضمن أكثر أربعة فواكه وخضروات استهلاكاً (التفاح ، العنب ، الفلفل والطماطم) بأسواق الجملة المصرية. استخلص وتحليل العينات كان بواسطة طريقة (QuEChER) لتقصي بقايا (٥١) مبيد من المبيدات الفوسفورية العضوية ومبيدات البيروثرويد باستخدام جهاز كروماتوجرافي السائل عالي الكفاءة، المزود بمطياف الكتلة المتتالي (LC-MS/MS).

أوضحت النتائج أن ١٧,٤% من العينات التي تم تحليلها لا تحتوي علي متبقيات مبيدات في حين ٨٢,٦% ملوثة ببقايا مبيدات حيث كان ١٨,٣% من العينات الملوثة أعلى من الحدود القصوى المسموح بها، ٦٤,٣% (١٤٨ عينة) تحتوي علي بقايا مبيدات أقل من الحدود المسموح بها. أعلى تلوث لوحظ بعينات العنب يليه الفلفل ، التفاح والطماطم بنسب تلوث ٩٠% ، ٨٨,٣% ، ٨١,٧% ، و ٧١,٧% والتي كان منها ١٨% ، ٢٣,٣% ، ٢٣,٣% و ٨,٣% على التوالي ملوثة بمبيدات تفوق الحدود القصوى المسموح بها. كان أكثر المبيدات شيوعاً وتواجداً بالعينات هو الكلوربيريفوس، سايبيرمثرين ، لامبادا سيفلوثرين و ديازينون.

تم تقييم المخاطر عن طريق حساب التعرض المزمّن والتراكمي لإجمالي ١٧ بقايا مبيد فسفوري عضوي وبيروثرويد. أشارت النتائج أنه لا توجد مخاطر صحية مزمنة ترتبط مع استهلاك السلع التي شملتها الدراسة حيث كانت قيم التعرض التراكمي للمبيدات الفوسفورية العضوية أقل من ١ (٠,٠٥٩ للبالغين) في عينات الفواكه و(٠,١٠٨ للبالغين) في عينات الخضار. أيضاً كانت قيم التعرض التراكمي لمبيدات البيروثرويد أقل من ١ (٠,٠١٢ للبالغين) في عينات الفواكه و(٠,٠١٧ للبالغين) في عينات الخضار، ما يدل على عدم وجود أي خطر على المستهلكين بسبب وجود بقايا هذه المبيدات في الفواكه والخضروات المصرية.

الكلمات الدالة: المبيدات الفوسفورية العضوية، البيروثرويدات، تقدير المتناول اليومي المقبول والمتحصل اليومي المقبول.