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Monitoring and Risk Assessment of Pesticide Residues in Some Locally Produced Vegetables and Fruits

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Abstract

The presence of pesticide residues in locally produced fruits and vegetables in Egypt raises health concerns among consumers. The aims of this study were to determine the contamination level of pesticide residues in some consumed local horticultural products such as oranges, potatoes, tomatoes and grapes in the following Egyptian governorates: Dakahlia, Ismailia, Fayoum, Alexandria, Cairo, Gharbia, Kafr El-Sheikh, Sharkia, Port Said, Beheira, Minya, Menoufia, Zagazig and Giza. Potential risk assessment to the human health was assessed in our study. About 175 samples of horticultural crops were analyzed using the QuEChERS method followed by GC-MS/MS and LC-MS/MS analysis. Out of the total 175 samples analyzed, 35 samples (20%) were free from pesticide residues, 140 samples (80%) were contaminated, and 59 samples (42%) from the contaminated samples were exceeded the maximum residue limits (MRL's). The most frequently detected pesticides were chlorpyrifos, cypermethrin, and carbendazim. The risk assessment studies for the only violated samples indicated seemingly that no possible human risks to consumers were observed according to the calculated Health Index (HI). However, pesticide residues must be regularly and widely monitored, in other fresh commodities and other governorates.

Keywords: Horticultural Crops, Monitoring, Pesticide Residues, Estimated Daily Intake, Risk Assessment.

1. Introduction

The application of pesticides has led to an increase in agricultural production worldwide, but some pesticide residues may have potentially adverse impacts on the environment and human health [1]. Residues resulting from the inappropriate use of pesticides on crops have shown to be a major concern worldwide [2]. Fruits and vegetables are rich sources of vitamins, minerals, and fibres and even have beneficial antioxidative effects. They are commonly used to meet the requirement of balanced diet and good health [3]. However it is expected that they contain higher pesticide residue level compared to other food groups since most of them are eaten raw. Therefore, the monitoring of pesticide residues constitute the major way for protection of consumers from possible harmful effects of pesticides. This would help to verify that the levels of pesticides in food that do not exceed the maximum residue limits (MRLs) set by various international organization such as WHO and FAO [4]. Potential contamination of the fruits and vegetables before sending them to the market is usually due to not complying with harvest time of the crops, incorrect application technique or not adhering with the label instructions and legal practices [5]. In Egypt, several previous studies were conducted to determine pesticide residues in horticultural crops [6-10] and others. Previous reports were also conducted in Egypt to assess the risks of pesticide residues in fruits and vegetables in different studies [10-12]. In addition, assessing the risk of pesticide residues in the analysed commodities was estimated on the basis of average consumption, and pesticide residue data. Similar studies on the risk assessmentwere carried out

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in Cameroon, China, Nigeria , Poland and elsewhere [13-18].

In our research, a market-based survey was conducted to investigate the potential level of 436 pesticide residues in the most consumed and sold fruits and vegetables in the local markets from 14 governorates of Dakahlia, Ismailia, Fayoum, Alexandria, Cairo, Gharbia, Kafr El-Sheikh, Sharkia, Port Said, Beheira, Minya, Menoufia, Zagazig and Giza. The aims of this study were to provide data on the contamination level of pesticide residues in fruits and vegetables sold in national markets from some governorates in Egypt. The residues detected were related to a hazard index (HI) through estimated average daily intakes (EADIs) compared to the Acceptable Daily Intake [19]. The results can be used when planning pest control programs for these areas to protect consumers from the negative effects of pesticide residues in such commodities.

2. Materials and methods

2.1. Chemical and Reagents

Solvents and chemicals described in the standard method CEN/**TC** 275/WG4, 2007 were used. All HPLC grade chemicals; (99.8%) toluene, (99.9%) acetonitrile, (99.9%) methanol, (97%) n-hexane, (98-100%) formic acid, (30%) ammonia solution, and (99.8%) glacial acetic acid were purchased from Sigma-Aldrich (USA). QuEChERS reagent kits (1) consisting of 4 g of magnesium sulfate, 1 g of NaCl salts and citrate buffer (pH 5 to 5.5) and reagent (2) 1 g of magnesium sulfate 0.15g primary secondary amine sorbent (PSA) were purchased from Agilent Technologies (USA). Deionized water was produced by a mille Q unit (Mille Pore).

Pesticide reference standards were purchased from Dr Ehrenstorfer (Augsburg, Germany) with purities > 95%.

2.2 Sampling:

A total of 175 fruit and vegetable samples i.e. 50 tomato, 50 orange, 50 potato and 25 grape were collected from the local Egyptian markets located in the following 14 governorates: Dakahlia, Ismailia, Fayoum, Alexandria, Cairo, Gharbia, Kafr El-Sheikh, Sharkia, Port Said, Beheira, Minya, Menoufia, Zagazig and Giza during the seasons of 2019 and 2020. About 2 kg of each commodity was thoroughly mixed, and prepared according to the generally recommended method for sample processing according to Codex Alimentarius Commission (CAC) [20]. Samples were analyzed immediately upon arrival at the laboratory, or stored at 0-5 °C.

2.3. Sample extraction and clean up

Pesticides were extracted from samples using the QuEChERS method [21]. Approximately 10 g of each sample were weighed in 50 mL polypropylene (PP) tube, 10 mL acetonitrile was added and vigorously shaken for 1 min. After adding reagent (1), the mixture was shaken vigorously for 1 min and centrifuged at 4000 rpm for 5 min to separate the aqueous phase.

An aliquot of the supernatant portion was injected directly into LC-MS/MS. The dispersive solid-phase extraction (DSPE) was performed to clean up the remaining supernatant as magnesium sulfate allowed water residue to be removed. After cleaning with primary secondary amine sorbent (PSA), sample extracts were evaporated and re-dissolved in injection standard solution and subjected to GC-MS/MS analysis. Quantification was performed using Aldrin as an injection standard, Pesticide residues in the samples were detected and confirmed using GC-MS/MS and LC-MS/MS. The used method is valid for the determination of 436 compounds.

2.4. Determination and analysis conditions

2.4.1. GC-MS/MS

Agilent 7980A gas chromatograph with quadrupole 7000B tandem mass spectrometer, electron impact (EI) interface was used to perform analysis with an HP-5MS 5% phenyl methyl siloxane capillary column (30 μm long × 0.25 mm ID × 0.25 μm thick film). The temperature programming of the GC oven was initially kept at 70 °C for 2 min and then increased to 150 °C at 25 °C/min (held for 0 min), and raised to 200 °C at a rate of 3 °C/min (held for 0 min), then rose from 200 to 280 °C at 8 °C/min (holding for 10 min). Samples were injected in non-split mode and the run time was 16 min.

2.4.2. LC-MS/MS

Agilent 1200 series liquid chromatography system equipped with applied biosystems (API 5500 Q trape and API 4000 Q trape) tandem mass spectrometry with electrospray ionization Interface (ESI) source in the positive mode was used. Separation was performed on a C18 ZORBAX Eclipse XDB-C 18 4.6 × 150 mm shaft, 5 mm particle size. A gradient elution program was used at a flow rate of 0.3 ml/min, with one reservoir containing the mobile phase which was 10 mM of ammonium format solution in methanol: water

(1:9 v/v). Nitrogen was used as nebulizer gas, curtain gas, heating gas and impingement gas according to the manufacturer's settings; the source temperature was 450 °C, and the ion spray potential was 5500 V-. The injection volume was 2 µl. Multiple Reaction Monitoring (MRM) mode was used where one MRM was used for quantification and the other was used for confirmation.

2.5. Method validation and quality control

Quality assurance standards were followed to validate the performance of the standard method approved by the Finnish Accreditation Service (FINAS) ISO/IEC Guide 17025. The reproducibility expressed as a relative standard deviation was less than 20%. The quantification limit started at 0.01 mg kg-1 and is dependent on the pesticide type and detection unit
Measurement uncertainty expressed as relative standard deviation (at 95% confidence level) **was** less than the default value set by the EU (±50%).
Blank samples were fortified with pesticide mixture and analyzed as a normal sample with a set of samples. The average recovery percentages of these pesticides at different varied from 70 % to 120%.

2.6. Risk Assessment

Food consumption plays a major role in the dietary risk assessment of residues in commodities. Therefore, an exposure evaluation was conducted to determine the level of risk by the pesticide residues according to obtained monitoring results. The risk assessment is calculated by comparing the established acceptable daily intake (ADI) with the relevant estimated acceptable daily intake (EDI) that depends on the concentration of pesticide residues and food consumption. The risk assessment was specified only for pesticide residues that exceed the maximum residue limits.
The EDI (mg kg-1 bw-1 day) for each violated pesticide residue was calculated by multiplying the mean concentration of pesticide residues (mg kg-1), by food consumption and then divided by body weight (kg day-1) for each commodity,

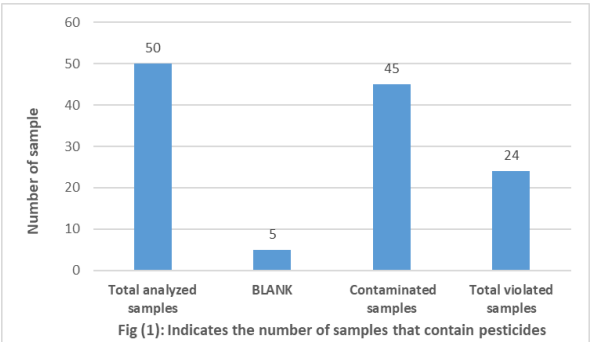


Fig (1): Indicates the number of samples that contain pesticides residues detected in tomato

$$EADI = \Sigma \frac{\text{Concentration of the pesticide residue}\boldsymbol{b} \text{ x Food consumption}}{\text{mean body weight}}$$

EADI= estimated acceptable daily intake
assuming that the average adult's body weight is 60 kg. The estimated acceptable daily intake was based on WHO/Global Environment Monitoring System-food [22].
All maximum residue limits (MRL's) and established acceptable daily intake (ADI) values were from EU Pesticides Database. The food consumption figures used were based on the 2006 GEMS/Food [22]. The long-run risk assessment of pesticide residues was performed by calculating EDI as a percent of ADI, and so dividing the estimated daily intake by the corresponding acceptable daily intake (ADI) in keeping with the EU Food Safety Authority [23] as follow: HRI= EDI / ADI. When the health risk index (HRI) >1; this indicates that food is considered a risk to the consumers. When the index <1, this indicates that food is considered acceptable[24, 25].

3. Results and Discussion

3.1. Pesticide residues

Table (1) and Figure (1) show the level of pesticides residues detected in tomato samples and the percentage of samples, exceeded the maximum residue level. Out of 50 samples, no pesticide residues were detected in 5 tomato samples (10%). whereas, the remaining 45 samples (90%) were contaminated, in which 24 samples (53%) out of the 45 tomato samples were violated according to MRLs set by the Codex Alimentarius. The most frequent residues in tomato samples were chlorpyrifos, acetamiprid, imidacloprid, chlorpropham and propargite, as repeated by 15, 13, 11, 9 and 9 times, respectively. However, the highest concentration of pesticide residues that exceeded MRL was propargite as detected in 20% of tomatoes from each of the following governorates: Dakahlia, Fayoum, Cairo, Gharbia and Behairy, followed by chlorpyrifos detected in 13% from Dakahlia, Alexandria, Cairo, Kafr El-Sheikh, Minya and Zagazig then chlorpropham found in 9% of samples from Dakahlia, Cairo and Sharqia. No violation of acetamiprid and imidacloprid was detected. The highest violated concentration in tomato samples was in Dakahlia governorate for chlorpyrifos and propargite with values of 0.38 and 0.031 mg kg-1, respectively,

Table (2) and Figure (2) show that out of 50 samples of potato tubers, no pesticide residues were detected in 20 samples (40%), while, the remaining 30 samples

(60%) contained detectable pesticide residues, and only 3 potato samples (10%) out of the contaminated 30 samples exceeded MRL based on Codex Alimentarius.

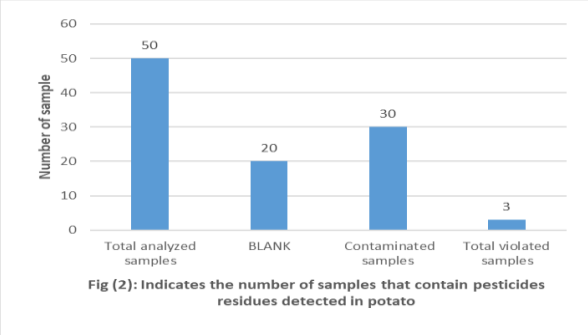


Fig (2): Indicates the number of samples that contain pesticides residues detected in potato

Despite the high frequency of chlorpropham (21 times) with the concentration of 3 mg kg-1, no violation was present. Whereas, profenofos which was found only 3 times with concentration of 0.51 mg kg-1, had a violation of 10%. The highest violated concentration of profenofos was found in the Fayoum governorate.

In orange, no residue levels were detected in 10 samples (20%) out of 50, but the other 40 samples (80%) contained measurable residues. Out of the 40 samples, 12 samples (30%) exceeded the MRL set by the Codex Alimentarius Commission As shown in Table 3 and Figure 3. The most frequent pesticides found in the orange samples were: cypermethrin, L-cyhalothrin, chlorpyrifos and malathion as repeated 20, 18, 15, and 9 times. However, only two pesticides namely L-cyhalothrin and chlorpyrifos, were violated. L-cyhalothrin was violated by 3% and detected in samples from Cairo governorate, while chlorpyrifos was violated by 13% in Dakahlia, Alexandria, Cairo, Kafr Sheikh and Ismailia governorates. The lowest frequent residues were cyfluthrin, dimethoate and omethoate, which had a violation rate of 5% per each and were detected in Cairo and El-Behaira. While omethoate was found in Cairo and Fayoum governorates.

The largest violation was measured in L-cyhalothrin, cypermethrin and thiabendazol with concentrations of 0.6, 0.47 and 0.22 mg kg-1, respectively. The highest concentration of L-cyhalothrin and thiabendazole was found in Cairo and cypermethrin was detected in Gharbia.

As shown in Table (4) and Figure (4) 100 % of the 25 analyzed grape samples contained detectable residues, and 20 out of 25 samples (80%) exceeded the MRL. The most frequent residues were thiophanate methyl, carbendazim, cypermethrin, chlorpyrifos and omethoate, as repeated by 15, 15, 12, 11 and 11 times, respectively. The violation percentage of thiophanate methyl and carbendazim was 56 and 56 % in Dakahlia, Ismailia, Fayoum, Alexandria, Cairo, Gharbia and Sharkia. Chlorpyrifos exceeded the MRL limits by 36% in Ismailia, Cairo, Fayoum, Gharbia and Kafr El-Sheikh, while the value in omethate was 28% in Dakahlia, Ismailia, Alexandria, Cairo and Gharbia. Dimethoate was found in 28 % but in lower frequency and in Dakahlia, Ismailia, Gharbia and Kafr El-Sheikh. Whereas, propiconazole with 32% violation was presentage in Dakahlia, Fayoum, Cairo, Sharkia, Kafr El-Sheikh and Sharkia

The highest violateding concentration in grape fruits was detected in case of boscalid (0.55 mg kg-1) in Dakahlia, carbendazim (0.62 mg kg-1) in Alexandria, cyprodinil (0.31 mg kg-1) in Kafr El Sheikh, imidacloprid (0.62 mg kg-1) in Ismailia, propiconazole (0.41 mg kg-1) in Gharbia and thiophanate methyl (0.94 mg kg-1) in Cairo governorate.

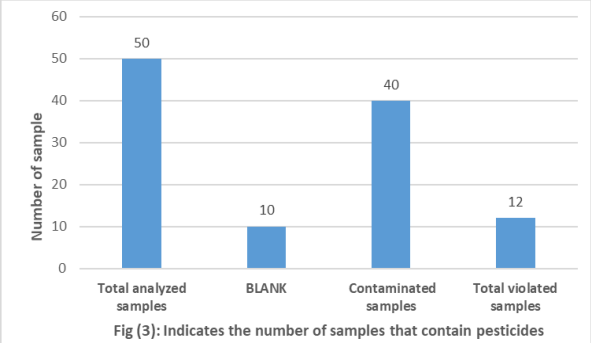


Fig (3): Indicates the number of samples that contain pesticides residues detected in orange

Several previous studies were conducted in Egypt to determine pesticide residues in vegetables and fruits. For tomato samples, the violated detected analytes were (chlorpyrifos, chlorpropham and propargite) that were similar to those reported by Dogheim and et al. [7] and Ibrahim and et al. [10]. However, our results were inconsistent with them in the case of buprofezin and phenthoate as they didn't report these analytes in their survey while we did.

In the case of potato samples, the results were inconsistent with Ibrahim and et al. [10]. for Profenofos as they didn't report it in their survey whereas we found it .

For orange samples, the violated analytes detected (Dimethoate and Omethoate) were similar to those reported by Dogheim and et al. and Ibrahim and et al.

[7 and 10] Nevertheless, our results were inconsistent with them in the case of chlorpyrifos, cyfluthrin, L-cyhalothrin and profenofos as they didn't report these analytes in their survey while we did.

But in the grape sample, the violated analytes detected (Dimethoate and Profenofos) were similar to those reported by Dogheim and et al. [7] Though, our results were inconsistent with them in the case of Carbendazim, chlorpyrifos, lufenuron, omethoate, propiconazole and thiophanate methyl as they didn't report these analytes in their survey while we are.

The detected pesticide residues were applied on wide range of different agriculture crops in Egypt according to the approved recommendations of Egyptian agriculture pesticides committee (APC).

The occurrence of pesticide residues may be due to the lack of awareness of the growers/ farmers about the necessity of following the right recommended rate of pesticide use, correct method of application and neglecting of the estimated pre-harvest intervals

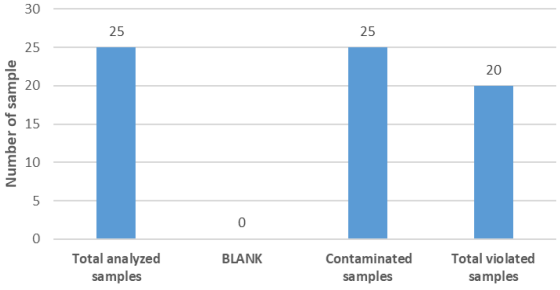


Fig (4): Indicates the number of samples that contain pesticides residues detected in grape

The justification for certain commodities (e.g. grapes) that have a greater amount of pesticides could be attributed to that grape is attacked severely by pests and diseases which in turn requires successive applications of pesticides, leaving higher levels of residues. In addition, pesticides are usually applied directly to the edible part of the fruit or vegetable near the time of harvest to ensure better protection of the plant[26].

Furthermore, the frequency of pesticide application particularly in some vegetable farms ranges from twice a month to once a week. Thus, to avoid detrimental effects of pesticide residues on public health, it is important to establish pest control means that ensure each pesticide should be below MRLs in the fruits and vegetables to be marketed.

3.2. Dietary exposure and dietary risk assessment

Table (5) showed the most frequently detected pesticides, in the analyzed samples. These pesticides were chosen for the dietary intake assessment for all commodities. The average pesticide residues levels were calculated using residue data from the monitoring studies. The results of the EADI calculation were reported separately for each pesticide in an exposure assessment. If the ADI was not exceeded in any commodity, a consumer risk can be excluded.

As shown in Table (5), the intake of pesticide residues in no way exceeds the ADI. Tomatoes had a hazard Index of 0.105% of chlorpropham and 2.687% for propargite.

While in potatoes, the hazard Index of profenofos was 0.935%. The HI values in oranges ranged from 0.042% for profenofos to 1.58% for dimethoate

In grapes, the hazard Index ranged from 0.066%for propiconazole to 1.342%for dimethoate.

It is clear from the data that no apparent risk was found when consuming vegetables and fruits (tomatoes, potatoes, oranges and grapes) under the study Our results are consistent with some studies [10 and 11],

The current study shows that long-term exposure of Egyptian consumers to raw vegetables and fruits contaminated with pesticide residues is not associated with health risks. However, it should be kept in mind that the current study is limited to a small group of vegetables and fruits and based on the toxicological assessment of a single compound and does not depend on the assessment of the cumulative exposure to multiple pesticide residues in crops.

Conclusion

Our research provides important information about the contamination of some fresh <vegetables and fruits with pesticides collected from markets in 14 Egyptian governorates. Although there were significant levels of pesticides, samples that exceeded the permissible limits (MRL) were not associated with health risks to consumers. However, pesticide residues must be constantly monitored, as random samples should be taken regularly for analysis.. Moreover, an extension program should be put in place for the farmers to increase their awareness of the safe use and application of pesticides and the importance of adhering to the pre-harvest interval period. Farmers should also look for other alternative methods of pest control. Consumers should be careful about processing and preparation steps such as washing and peeling to reduce the risk of pesticide residues in fresh produce.

Table 1. Total samples analyzed, contamination %, frequency, minimum, maximum and average pesticide residues detected in tomatoes in Egypt during the years 2019-2020.

Total analyzed samples	Number of Contaminated samples	Contamination %	The detected pesticide	frequency	Min mg/kg	Max mg/kg	Mean mg/kg	MRL mg/kg	No. of violated	violated %	Total violated samples	Total violated samples %
50	45	90%	Acetamprid	13	0.005	0.02	0.010	0.5	0	0%	24	53%
			Azoxystrobin	5	0.005	0.01	0.007	3	0	0%		
			Buprofezin	1	0.03	0.03	0.030	0.01	1	2%		
			Carbendazim	4	0.005	0.01	0.009	0.3	0	0%		
			Chlorantraniliprole	6	0.005	0.06	0.019	0.6	0	0%		
			Chlorpropham	9	0.005	0.04	0.016	0.01	4	9%		
			Chlorpyrifos	15	0.005	0.38	0.048	0.01	6	13%		
			Clothiandin	5	0.005	0.02	0.009	0.04	0	0%		
			Cypermethrin	9	0.005	0.19	0.057	0.5	0	0%		
			Difenoconazole	2	0.02	0.05	0.035	2	0	0%		
			Dimethomorph	2	0.005	0.02	0.013	1	0	0%		
			Famoxadone	1	0.07	0.07	0.070	2	0	0%		
			Imidacloprid	11	0.005	0.12	0.034	0.5	0	0%		
			Indoxacarb	8	0.005	0.08	0.018	0.5	0	0%		
			Lufenuron	3	0.005	0.03	0.022	0.4	0	0%		
			Malathion	2	0.005	0.02	0.013	0.02	0	0%		
			Metalaxyl	1	0.01	0.01	0.010	0.3	0	0%		
			Methomyl	2	0.005	0.01	0.008	0.01	0	0%		
			Methoyfenozide	2	0.01	0.04	0.025	2	0	0%		
			Omethoate	4	0.005	0.03	0.018	0.01	2	4%		
			Phenthoate	4	0.005	0.08	0.034	0.01	2	4%		
			Propamocarb	3	0.005	0.02	0.012	4	0	0%		
			Propargite	9	0.02	0.31	0.137	0.01	9	20%		
			Pyraclostrobin	3	0.01	0.02	0.017	0.3	0	0%		
			Spirodiclofen	4	0.005	0.06	0.021	0.5	0	0%		
			Thiophanate methyl	5	0.005	0.03	0.014	1	0	0%		

Table 2. Total samples analyzed, contamination %, frequency, minimum, maximum and average pesticide residues detected in potato in Egypt during the years 2019-2020.

Total analyzed samples	Number of Contaminated samples	Contamination %	The detected pesticide	frequency	Min mg/kg	Max mg/kg	Mean mg/kg	MRL mg/kg	No. of violated	violated %	Total violated samples	Total violated samples %
50	30	60%	Profenofos	3	0.04	0.51	0.275	0.01	3	10%	3	10%
			Chlorpropham	21	0.01	3	1.220	10	0	0%		
			Imidacloprid	2	0.01	0.01	0.010	0.5	0	0%		
			Thiophenate methyl	1	0.01	0.01	0.010	0.1	0	0%		

Table 3. Total samples analyzed, contamination %, frequency, minimum, maximum and average pesticide residues detected in orange in Egypt during the years 2019-2020.

Total analyzed samples	Number of Contaminated samples	Contamination %	The detected pesticide	frequency	Min mg/kg	Max mg/kg	Mean mg/kg	MRL mg/kg	No. of violated	violated %	Total violated samples	Total violated samples %
50	40	80%	Acetamprid	2	0.01	0.05	0.030	0.9	0	0%	12	30%
			Azoxystrobin	1	0.01	0.01	0.010	15	0	0%		
			Carbendazim	3	0.005	0.11	0.040	0.2	0	0%		
			Chlorpyrifos	15	0.005	0.08	0.021	0.01	5	13%		
			Cyfulthrin	4	0.01	0.07	0.035	0.02	2	5%		
			L-cyhalothrin	18	0.005	0.6	0.051	0.2	1	3%		
			Cypermethrin	20	0.005	0.47	0.039	2	0	0%		
			Dimethoate	2	0.01	0.09	0.050	0.01	2	5%		
			Fenpyroximat	1	0.01	0.01	0.010	0.5	0	0%		
			Imazalil	6	0.39	1.29	0.733	4	0	0%		
			Imidacloprid	5	0.01	0.05	0.032	1	0	0%		
			Malathion	9	0.005	0.06	0.022	2	0	0%		
			Omethoate	2	0.02	0.04	0.030	0.01	2	5%		
			Profenofos	2	0.02	0.02	0.020	0.01	0	0%		
			Propargite	2	0.005	0.04	0.023	4	0	0%		
			Thiabendazol	5	0.07	0.22	0.146	7	0	0%		

Table 4. Total samples analyzed, contamination %, frequency, minimum, maximum and average pesticide residues detected in grape in Egypt during the years 2019-2020.

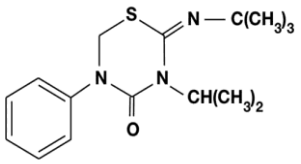
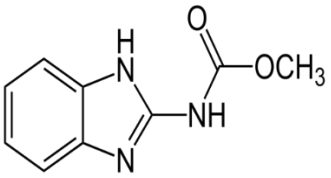
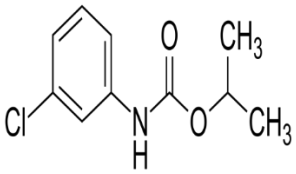
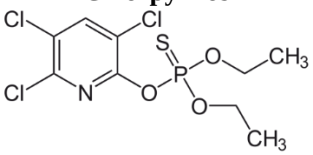
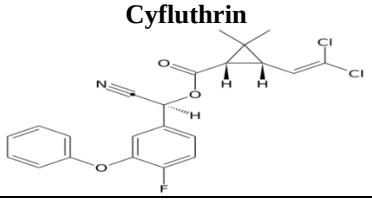
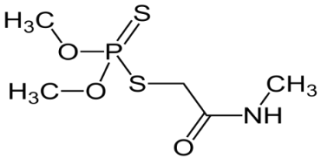
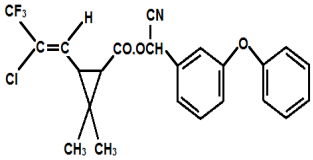
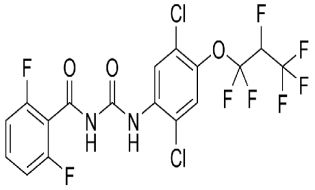
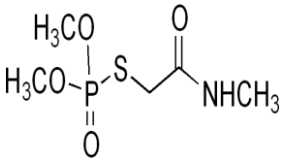
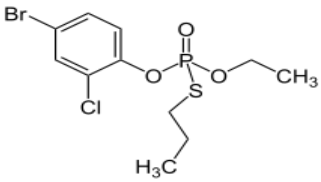
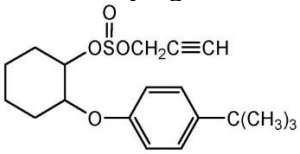
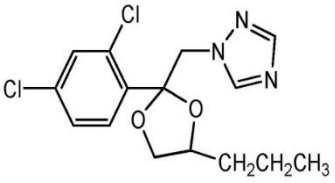
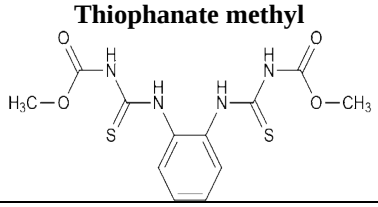
Total analyzed samples	Number of Contaminated samples	Contamination %	The detected pesticide	frequency	Min mg/kg	Max mg/kg	Mean mg/kg	MRL mg/kg	No. of violated	violated %	Total violated samples	Total violated samples %
25	25	100%	Acetamprid	3	0.02	0.1	0.053	0.5	0	0%	20	80%
			Azoxystrobin	3	0.01	0.19	0.127	3	0	0%		
			Boscalid	6	0.02	0.55	0.147	5	0	0%		
			Carbendazim	15	0.01	0.62	0.252	0.01	14	56%		
			Chlorpyrifos	11	0.01	0.14	0.041	0.01	9	36%		
			Clothiandin	1	0.005	0.005	0.005	0.7	0	0%		
			Cyfulthrin	5	0.01	0.27	0.084	0.3	0	0%		
			Cypermethrin	12	0.005	0.17	0.041	0.5	0	0%		
			Cyprodinil	7	0.03	0.31	0.127	3	0	0%		
			Difenoconazol	4	0.005	0.13	0.069	3	0	0%		
			Dimethoate	9	0.005	0.17	0.059	0.01	7	28%		
			Fenhexamid	1	0.01	0.01	0.010	15	0	0%		
			Imidacloprid	10	0.04	0.62	0.174	1	0	0%		
			Indoxacarb	1	0.01	0.01	0.010	2	0	0%		
			lufenuron	3	0.01	0.06	0.027	0.01	1	4%		
			Malathion	2	0.005	0.01	0.008	0.02	0	0%		
			Methomyl	1	0.01	0.01	0.010	0.01	0	0%		
			Myclobutanil	5	0.01	0.7	0.178	1.5	0	0%		
			Omethoate	11	0.01	0.09	0.029	0.01	7	28%		
			Penconazol	2	0.02	0.07	0.045	0.5	0	0%		
			Profenofos	2	0.01	0.03	0.015	0.01	1	4%		
			Propargite	1	0.005	0.005	0.005	0.01	0	0%		
			Propiconazole	10	0.005	0.41	0.103	0.01	8	32%		
			Tebuconazole	2	0.005	0.01	0.008	0.01	0	0%		
			Thiamethoxam	1	0.01	0.01	0.010	0.4	0	0%		
			Thiophanate methyl	15	0.01	0.94	0.311	0.01	14	56%		

Table 5: Risk assessment and hazard index:

pesticide	commodity	Mean conc. (mg/kg)	Food consumption (kg/day)	EADI mg/kg.bw /day	ADI (mg/kg)	Hazard Index (EDI as a % of ADI)
Chlorpyrifos	orange	0.021	38	1.35×10^{-5}	0.01	0.135%
Cyfluthrin		0.035	38	2.22×10^{-5}	0.04	0.055%
Omethoate		0.030	38	1.9×10^{-5}	0.002	0.950%
L-Cyhalothrin		0.051	38	3.2×10^{-5}	0.02	0.160%
Dimethoate		0.050	38	3.17×10^{-5}	0.002	1.583%
Profenofos		0.02	38	1.27×10^{-5}	0.03	0.042%
Carbendazim	grape	0.252	27.1	1.13×10^{-4}	0.03	0.379%
Chlorpyrifos		0.041	27.1	1.85×10^{-5}	0.01	0.184%
Dimethoate		0.059	27.1	2.68×10^{-5}	0.002	1.342%
Omethoate		0.029	27.1	1.31×10^{-5}	0.01	0.131%
Propiconazole		0.103	27.1	4.63×10^{-5}	0.07	0.066%
Thiophanate methyl		0.311	27.1	1.4×10^{-4}	0.08	0.175%
Lufenuron		0.01	27.1	4.5×10^{-6}	0.02	0.022%
Profenofos		0.01	27.1	4.5×10^{-6}	0.03	0.015%
Profenofos	potato	0.275	61.2	2.8×10^{-4}	0.03	0.935%
Chlorpropham	tomato	0.016	118.0	3.17×10^{-5}	0.03	0.105%
Chlorpyrifos		0.048	118.0	9.37×10^{-5}	0.01	0.937%
Propargite		0.137	118.0	2.68×10^{-4}	0.01	2.687%
Buprofezin		0.03	118.0	5.9×10^{-5}	0.01	0.590%

*bw: body weigh

Chemical structure of some pesticides:

Buprofezin 	**Carbendazim** 	**Chlorpropham** 
Chlorpyrifos 	**Cyfluthrin** 	**Dimethoate** 
L-Cyhalothrin 	**Lufenuron** 	**Omethoate** 
Profenofos 	**Propargite** 	**Propiconazole** 
	Thiophanate methyl 	

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