Journal of Applied Sciences Research, 9(1): 965-973, 2013
ISSN 1819-544X
This is a refereed journal and all articles are professionally screened and reviewed

ORIGINAL ARTICLES

Dietary Intake of Pesticide Residues in some Egyptian Fruits

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ABSTRACT

A total of 147 domestic samples of thirteen fruits (apple, apricot, banana, cantaloupe, dates, grape, guava, mango, orange, peach, pear, plum and strawberry) were collected from different local markets representing five Egyptian Governorates throughout 2007. All samples were examined for residues of 86 pesticides, including organophosphorus, organonitrogen, organohalogen and certain pyrethroids. Pesticide residues were determined by gas chromatography using a multiresidue method. The compliance of the detected residues with Residue Limits (MRL) and their probable health risks to consumers were evaluated. Of the analysed samples, 53% contained detectable residues whereas 47% had no detectable amounts. The most frequent detected pesticides group was pyrethroids which detected in 58.8 % of contaminated samples followed by organophosphorous (29.4%) and organochlorine (only dicofol) (5.9%). Risk assessments were also performed by calculating Estimated Average Daily Intake (EADI) comparing the figures with acceptable daily intake (ADI). The obtained data showed that consumer's exposure to pesticides do not exceeded the ADI in any of the reported cases and the intakes of the evaluated pesticides were under 20% of the Acceptable Daily Intakes (ADIs). An acute dietary exposure assessment was also performed based on the monitoring results. The intake for each pesticide was compared to an acute reference dose (ARfD). The values of estimated short-term intake (ESTI) as a percentage of ARfD ranged from 0.00 up to 14% indicating a minimum acute risk from the detected pesticides. No health hazard was found associated with the consumption of the studied fruits for adults even with high violation and contamination percentages.

Key words: Pesticide Residues, Fruits, Maximum Residue Limits (MRL), Estimated Average Daily Intake (EADI), Acute Reference Dose (ARfD).

Introduction

Fruits are one of the supplementary sources of carbohydrates, fibers, lipids and vitamins. The consumption of these commodities is almost 93.9 kg/*per capita*/year with daily consumption rate 257.3 g/day in Egypt (Egyptian food balance, 2008) comparing to consumption in Europe and USA of 160 kg/*per capita*/year. Citrus, primarily oranges that represent 85 percent of total citrus production, makes up 50 % of total fruit production. Other subtropical fruits are also grown in Egypt, including grapes, stone fruits and pomes fruits (FAO website).

A number of pesticides have been widely using for pest control in fruits at various stages of cultivation. Pesticides are used for better yields and quality during post-harvest and storage.

However, pesticide residues are of concern, because these substances are potential health hazards (Kwang-Geunt and Suk-Kyung , 2012). In particular, pesticide residues may persist in plant tissues and appear in the pulp and juice of fruits and may result in health hazards.

Pesticide residue levels were evaluated in relation to their Maximum Residue Levels /Limits (MRLs), Acceptable Daily Intakes (ADIs) and Acute Reference Doses (ARfDs) derived from toxicological studies.

The monitoring studies focus on the proper use of pesticides in terms of authorization and registration (application rates and pre-harvested intervals), and on compliance with maximum residue limits or MRLs, (Claeys *et al*; 2011).

Maximum residue limits have been established for agricultural products in many countries to avoid the health hazard caused by pesticide residues. However, Codex Alemintarious MRLs is mainly used in Egypt. Due to lack of MRLs for many pesticide residues combination, European limits or EPA may be used to compare the monitoring results.

The present study was conducted to assess the concentration of pesticide residues in fruits collected from some Egyptian markets and evaluate the compliance of results with MRLs.

The exposure also has been assessed and compared to health safety limits or toxicological endpoint values such as the ADI (acceptable daily intake) or the ARfD (acute reference dose). The daily intake of the detected

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pesticide residues through the studied fruits is also evaluated in detail. Calculations are based on the results of the monitoring.

Materials and Methods

Sampling:

A total of 147 samples of thirteen fruits were collected from different local markets representing five Egyptian Governorates (Qalyubiya- Giza – Ismailia – Minufiya – Beni suef) throughout 2007. Apple, apricot, banana, cantaloupe, dates, grape, guava, mango, orange, peach, pear, plum and strawberry samples that were selected for this survey as the mostly consumed fruits in Egypt.

The number of samples analyzed for each fruits is shown in table (1). Two kilograms of each fruit were collected and prepared for residue analysis according to Codex Alimentariuos Commission, CAC (1993). Samples preparation was performed according to the generally recommended method of sampling to achieve a representative part of the material to be analysed (Codex Alimentariuos Commission ,1993). Samples were analysed either immediately upon their arrival to the laboratory or within not more than 2 days of their storage at 0-5 ^{o}C.

Eighty-six pesticide residues belong to organophosphorous , organonitrogen, organochlorine and pyrethroid groups were determined.

Pesticide Residues Analysis:

The official method of AOAC Official Methods of Analysis (1995) was followed. Samples were blended with acetone and filtered; pesticides were transferred from aqueous filtrate to organic phase by shaking with petroleum ether and dichloromethane. Organic phase is concentrated just to dryness and dissolved in injection standard solution; aliquot of concentrated organic phase is injected into various GC systems for determination of wide variety of pesticide residues. GC-NPD is used for determination of nitrogen and phosphorus pesticides and GC-ECD is used for determination of organohalogen and pyrethroid pesticides. The details of the procedure and the validation data were described by Dogheim *et al*. (2002 & 2004). The multi-residue method allowed the determination of 86 pesticide residues.

GC Determination:

Qualitative and quantitative determination of residues in fruits samples depends on the use of two different polarities of chromatography columns. Each GC instrument (NPD-ECD) has two capillary columns with different polarities and consequently two detectors. The internal standard technique was followed for the quantitative determination. Aldrin was used for organohalogen and pyrithroids compounds, ditalimphos for organophosphates and organonitrogen compounds. The internal standard was added before injection on GC.

Quality Assurance:

The analytical method and instruments were fully validated as part of a laboratory quality assurance system and were accredited according to ISO/IEC 17025:2005 by FINAS (Center for Metrology and Accreditation) Finland. Codex quality assurance criteria were followed to determine the performance of the multi-residue method. The average percentage recoveries for the tested pesticides from different commodities ranged from 70-110% at spiking levels of 0.01 -0.1 mg/kg, with coefficients of variation (CV %) of 2-15%.

The reproducibility expressed as relative standard deviation was less than 20%. The limit of quantification ranged between 0.02-0.05 mg/kg. The measurement uncertainty including random and systematic error at 95% confidence level was estimated to be less than 20%. Blank samples were fortified with the pesticides mixture and analyzed as a normal sample with each set of samples. The results were recorded on control charts. Repeated analysis of old samples was regularly carried out to control reproducibility.

Apparatus:

(a) Gas chromatography: Hewlett Packard (HP) 5890 (USA) equipped with double electron capture detector (ECD) with two capillary columns, injector 225 ^{o}C; detector 300 ^{o}C.

Operating condition: nitrogen carrier gas 2.5 ml min $^{-1}$; 75-90 ml min $^{-1}$ (carrier + make up); column head pressure 82 kpa.

(b) Gas chromatography: Hewlett Packard (HP) 5890 (USA) equipped with double Nitrogen Phosphorus Detector (NPD), injector 225 °C, detector 280 °C.

Operating conditions: - Hydrogen 3.5 + 0.1 ml/min, Air 100-200 ml/min, and Nitrogen carrier gas 25 ml/min.

For both GCs, the splitless injection mode was used with injection volume 1 ul.

The information on chromatography columns was as follows:

- PAS-5 ECD tested ultra 2 silicon; 25 m x 0.32 mm film thickness 0.52 um.
- PAS -1701 ECD tested 1701 silicon; 25 m x 0.32 mm film thickness 0.25 um.

Temperature program of GCs instruments was as follow: initial temperature 90 ^{o}C for 2 min; ramp (1) 20 (^{o}C min^{-1}) to 150 ^{o}C. ramp (2) 6 (^{o}C min^{-1}) to 270 ^{o}C held for 15 min.

Reagents:

Solvents and chemicals:

(a) Acetone, dichloromethane, n-hexane, petroleum ether, Pestiscan chromatography grade or similar quality.

(b) Anhydrous sodium sulphate (Riedel-de Haen), sodium chloride.

Pesticides reference standards:

Eighty-six active ingredients including parent compounds and their metabolites were subjected to analysis. Atrazine, benalaxyl, bendiocarb, bromopropylate, buprofezine, bupirimate, captan, carbosulfan, chlorfenpayr, chlorpyrifos, chlorpyrifos-Me, chlorthalonil, cyanophos, cypermethrin, cyfluthrin, cyhalothrin-lambda, deltamethrin, diazinon, dichlofluanid, dicofol, dieldrin, dimethoate, diniconazole, DDE-p,p`, DDT-o,p, DDD-p,p`, DDT-p,p`, edifinophos, endrin, endosulfan-alpha, endosulfan-beta, endosulfan sulfate, esfenvalerate, ethion, ethoprophos, fenarimol, fenoxaprop-P-ethyl, fenvalerate, fenitrothion, fenthion, fenpropathrin, fluazifop-P-butyl, flusilazole, tau-fluvalinate, HCH-alpha, HCH-beta, HCH-gamma, HCH-delta, heptachlor, heptachlorepoxide, heptachlor-endo-epoxide, hexachlorobenzene, imazalil, iprodione, malathion, maloxon, metalaxyl, metribuzin, oxadiazon, paraoxon-ethyl, parathion-Et, parathion-Me, pencycuron, pendimethalin, permethrin, pirimicarb, pirimiphos-Et, pirimiphos-Me, phenthoate, phosalone, phosphamidon, procymidon, profenofos, propiconazole, prothiofos, pyrazophos, pyrazosulfuron-ethyl, pyriproxyfen, tebuconazole, tetradifon, thiobencarb, tolcophos-Me, triadmifon, triazophos, trifluralin, vinclozolin, aldrin and ditalimophos are used as internal standards for GC- ECD and GC-NPD, respectively.

All reference materials are certified and provided by Dr. Ehrenstorfer Gmbh, Gogginger Str. 78 D- 8900 Augoburg and are prepared in n-hexane/ acetone mixture.

Results and Discussion

The purpose of pesticide monitoring studies is to ensure that in fruits or vegetables comply with maximum residues levels (MRLs) allowed, and no misuse of pesticides that could result in unexpected residues in food and that good agricultural practice (GAP) are maintained.

A total of 147 samples of commonly consumed fruits were collected from five Egyptian Governorates during 2007. Thirteen type of commonly consumed fruits including, apple, apricot, banana, cantaloupe, dates, grape, guava, mango, orange, peach, pear, plum and strawberry were identified. All fruits samples are of locally cultivated types.

All samples were subjected to multi-residue analysis for 86 pesticide residues including, organophosphorus and organo-nitrogen, organochlorine, pyrethroids, and other groups of pesticides that are widely used or banned in Egypt.

Table (1) showed the number of samples of each commodity, the number of free samples, the detected pesticide, the range of detected pesticides, the contaminated samples and the maximum residue limits for each detected pesticide residues /commodity combination.

Of the analysed samples 53% contained detectable residues while 47% had no detectable amounts. The detected pesticides could be classified in three groups, pyrethroids, organophosphorous (OPs) and organochlorine, with frequencies percentages of 58.8 %, 29.4% and 5.9%, respectively.

Overall, contaminated samples, pyrethroids including, lambda-cyhalothrin was found in 28.2%, followed by fenpropathrin 15.3% and then cypermethrin 12.9% **(Table 2).**

However, the second most frequent detected group in descending order was organophosphorous which includes, ethion found in (10.6%), chlorpyrifos (8.2%), profenofos, (4.7%), dimethoate (3.5%) and malathion (2.4%). Dicofol was the only detected organochlorine compound in all analysed samples it was detected in 5 samples (5.9%).

The Codex Alimentarious Maximum Residue Limits MRLs were followed to compare the current monitoring data where the Egyptian MRLs were mainly those of the codex limits. According to the available MRLs set by Codex Alimentarious, only 2 samples exceeded the established MRLs with percentage of 1.4%; one grape sample contaminated with cypermethrin, and one plum sample with deltamethrin.

However, in many cases pesticide/commodity combination has not MRLs available neither from the codex nor from Egypt organization. In such case the European MRLs was followed. In this case, higher violation has been obtained, 25 samples (17%) exceeded MRLs.

MRLs may be exceeded because of pesticide misuse, false positives due to naturally occurring substances, differences in national MRLs, lack of registered pesticides and incorrect pesticide application (EFSA, 2010).

The data obtained showed wide differences in violation rates due to applying MRLs from different sources such as codex and EU. That is because MRLs are subject to legal requirements in most of the countries. In European countries the MRL setting is based on the national registered good agriculture practice (GAP) data combined with the estimated likely residue from the supervised trials mean residue (STMR), ADI and ARfD.

Accordingly, applying EU and other MRLs should be reconsidered and consequently encourage the Egyptian authorization for establishing national MRLs based on local GAP and local supervised trails.

Applying the Codex MRLs and European limits in case of codex MRLs lacks, it was noticed that, organophosphorous OPs is the most violated residues in all analysed fruits samples; it exceeded MRLs in 17 samples, out of 27 violated samples followed by pyrethroids it exceeded in 8 samples that may reflect the high misuse of OPs and pyrethroids in fruits.

The fruits, for which residue levels exceeded the MRL, were apple (7 samples), grape (5 samples), guava and peach (3 samples for each), apricot, banana, dates (2 samples for each), cantaloupe, plum and strawberry (one sample for each). A monitoring study in Brazil for pesticide residues in fruit samples during 2002-2005 showed higher percentage of detectable residues for strawberry (71.3%), apple (64.3%), pear (54.4%) and peach (52.1%) that is relatively higher or at same levels of current data, (Amir *et al*, 2008).

No organochlorine residue were detected in samples except dicofol. However, In the Brazilian study, the organochlorine pesticides found, were: aldrin, dicofol, endosulfan, HCH, HCB but in low frequency.

Table 1: Minimum, maximum, mean (mg kg $^{-1}$) as well as frequencies, number of contaminated samples, violated samples and detected pesticide residues in analyzed fruits samples collected from the Egyptian local markets during 2007

Product	Total No.	Pesticide detected	Frequency	Range Min-Max mg/kg		Mean mg/kg	Free samples	Contaminated samples **	MRL mg/kg
Apple	13	Cypermethrin	1	0.07	0.07	0.07	1	12	0.7
		Dicofol	1	0.27	0.27	0.27			-
		Dimethoate	1	0.34	0.34	0.34			1
		Ethion	6	0.05	0.46	0.21			-
		Lambda-cyhalothrin	6	0.04	0.81	0.24			5
		Lambda-cyhalothrin	4	0.02	0.17	0.08			0.2
Apricot	8	Chlorpyrifos	1	0.03	0.03	0.03	-	8	0.5
		Cypermethrin	2	0.15	1.3	0.73			-
		Lambda-cyhalothrin	2	0.08	0.08	0.08			-
		Lambda-cyhalothrin	4	0.03	0.14	0.07			0.5
Banana	22	Dimethoate	1	0.35	0.35	0.35	20	2	-
		Lambda-cyhalothrin	1	0.84	0.84	0.84			-
Cantaloupe	15	Dicofol	1	0.02	0.02	0.02	13	2	-
		Ethion	1	0.29	0.29	0.29			-
Dates	2	Chlorpyrifos	1	0.11	0.11	0.11	1	1	-
		Profenofos	1	1.9	1.9	1.90			-

Cont. Table 1:

Grape	25	Chlorfenapyr	1	0.02	0.02	0.02	9	16	-
		Chlorpyrifos	3	0.03	0.07	0.05			0.5
		Cypermethrin	2	0.05	0.34	0.20			0.2
		Diniconazole	1	0.12	0.12	0.12			-
		Ethion	1	0.08	0.08	0.08			-
		Fenarimol	1	0.05	0.05	0.05			0.3
		Lambda-cyhalothrin	2	0.04	0.04	0.04			5
		Fenvalerate	1	0.4	0.4	0.40			2
		Lambda-cyhalothrin	3	0.04	0.12	0.07			0.2
		Metalaxyl	1	0.36	0.36	0.36			1
		Penconazole	1	0.06	0.06	0.06			0.2
		Profenofos	2	0.36	1.3	0.83			-
Guava	10	Cypermethrin	1	0.22	0.22	0.22	6	4	-
		Dicofol	1	0.75	0.75	0.75			-
		Lambda-cyhalothrin	1	0.03	0.03	0.03			-
Mango	10	Not detected	-	-	-	-	10	-	-
Orange	12	Chlorpyrifos	1	0.06	0.06	0.06	3	9	1
		Cypermethrin	1	0.05	0.05	0.05			2
		Lambda-cyhalothrin	3	0.02	0.19	0.08			0.2
		Malathion	1	0.05	0.05	0.05			7
Peach	10	Chlorpyrifos	1	0.03	0.03	0.03	1	9	0.5
		Cypermethrin	1	0.54	0.54	0.54			2
		Dimethoate	1	0.04	0.04	0.04			-
		Lambda-cyhalothrin	3	0.05	0.1	0.08			0.5
		Malathion	1	0.18	0.18	0.18			-
		Profenofos	1	1.3	1.3	1.30			-

Cont. Table 1:

Pear	8	Cypermethrin	2	0.05	0.09	0.07	4	4	0.7
		Lambda-cyhalothrin	2	0.02	0.1	0.06			0.2
Plum	6	Cypermethrin	1	0.2	0.2	0.20	-	6	2
		Deltamethrin	1	0.07	0.07	0.07			0.05
		Dicofol	2	0.42	0.54	0.48			1
		Lambda-cyhalothrin	2	0.07	0.08	0.08			0.2
Strawberry	6	Ethion	1	0.08	0.08	0.08	1	5	-
		Lambda-cyhalothrin	2	0.15	0.23	0.19			-
		Lambda-cyhalothrin	2	0.04	0.04	0.04			0.2
Total	147		85				69(47%)	78(53%)	

* includes the samples contaminated with pesticides with less than LOQ and samples contaminated with pesticides exceeded MRL's
Based on available MRL set by codex Alimentarious, the violated samples were, one grape sample contaminated with Cypermethrin, deltamethrin in plum.

Table 2: Frequencies percentages and chemical group of detected pesticides in analysed fruits samples.

Pesticide group	Detected Pesticides	Frequencies %*
Pyrethroid (58.8%)		
	Cypermethrin	12.9
	Deltamethrin	1.2
	Fenpropathrin	15.3
	Fenvalerate	1.2
	Lambda-cyhalothrin	28.2
Organophosphate (29.4%)		
	Chlorpyrifos	8.2
	Dimethoate	3.5
	Ethion	10.6
	Malathion	2.4
	Profenofos	4.7
Organochlorine (5.9%)		
	Dicofol	5.9
Others		
Phenylamide	Metalaxyl	1.2
Pyrimidine	Fenarimol	1.2
Pyrrole	Chlorfenapyr	1.2
Triazole	Diniconazole	1.2
Triazole	Penconazole	1.2

*The percentages of detection of each pesticide in all analysed samples

Comparing to previous studies carried out at 1995, 1996 and 1997 for monitoring of pesticide residues in fruits samples at Egyptian markets, current data showed higher contamination and violation percentages than all previous results, **Table (3),** (Dogheim *et al*, 1999, 2001 and 2002) .

Frequent occurrence of pesticide residues in fruits may be due to the lack of awareness of the growers about the dosage, right ways of application and the suitable interval between harvesting and pesticide treatment. The carelessness or non-availability of correct guidance concerning the pesticide application may be another reason for pesticide residues in the fruit samples. These contaminated fruits are potential health risks to the consumers. The misuse or overuse of pesticides and casual combinations of pesticides of different groups without any prior guidance and knowledge are become serious problems.

Processing techniques may lead to reduction of residues; however, general processing factors have been derived by many researchers, for washing (0.76), peeling (0.44) and canning (0.74) for fruits and vegetables but they could not find the general processing factor for a group such as organophosphorus, (Keikotlhaile. *et al*, 2010).

In addition, it was demonstrated by (Claeys, *et al*., 2011) that washing and peeling of fruit and vegetables result in an exposure that is probably five to six times lower.

It was concluded from the previous described results that establishment of new legislations for safety control of the primary production of crops i.e. at cultivation stage should be laid.

Table 3: Comparison between the monitoring data in previous publications

Status/year	1995*	1996*	1997*	2007
Free sample %	46.4	61.4	68.7	47
Contamination %	50.7	35.11	29	53
Violation %	2.7	3.49	2.3	17
Total sample Number	159	487	664	147

*Dogheim *et al*, (1999, 2001 and 2002).

Risk assessment:

Estimation Dietary Intake (chronic dietary exposure):

As concluded from the monitoring results, violation rates may vary depending on MRLs sources. To evaluate the safety of consumers, the exposure needs to be assessed and compared to health safety limits such as the acceptable daily intake (ADI) and the acute reference dose (ARfD).

The results from monitoring data were used for the assessment of the risk assessment to pesticide residues through fruits.

The assessment of consumers' exposure was based on Estimated Daily Intake (EDI) which was compared to Acceptable Daily Intake (ADI) and was expressed as a percentage of it (chronic dietary exposure).

The Acceptable Daily Intake (ADI) which is the estimated amount of a substance in food (expressed on a body-weight basis) that can be ingested daily over a lifetime without appreciable health risk to the consumer could also be used to predict the dietary intake of pesticide residues. The estimated dietary intake of a pesticide residue in a given food is obtained by multiplying the residue level in the food by the amount of that food consumed. The Estimated Average Daily Intake (EADI) of pesticide residues should be less than its established ADI (WHO, 1997).

The calculation of EADI, expressed in mg/kg body weight/day, was based on the following formula: EDI = Fi x Ri x Pi

− Fi = Food consumption of the relevant commodity (kg/day),

− Ri = Pesticide residue level (mg/kg) in the foodstuff, derived from monitoring data

− Pi = Processing factor for that food commodity, Correction factor that takes into account reduction or increase of the residue after commercial processing, preparation or cooking of the food, the influence of processing was not estimated in this study

All calculations for the determination of EDI were according to international guidelines (WHO, 1997). Residue levels used were those derived from the mean detected residues for each food commodity.

Food consumption rates were selected based on the consumption data issued by WHO (2003). However, the consumption rate extracted from Egyptian food balance sheet issued by economic affairs sector, ministry of agriculture (2008) is relatively within the same range of GEMS/food balance sheet **Table (4).** GEMS/ food regional diet is a hypothetical diet prepared by GEMS/Food to represent a regional group of countries in which the quantitative intake of food commodities is similar. Moreover, the effects of processing factors were not taken into account in any case (Pi=1).The body weight used for all calculations was 60 kg. The ADI values for pesticides were taken from FAO/WHO and official EU Pesticides Database.

Table 4: Consumption rate extracted from GEMS/food total diet food balance sheet and Egyptian food balance sheet in g/person/day.

Commodity	Consumption in g/day Egyptian*	Consumption in g/day GEMS/food**
Apple	17.00	18.5
Apricot	3.60	3.9
Banana	21.60	16
Cantaloupe	21.90	22.6
Dates	27.70	31.5
Grape	39.70	27.1
Guava	22.8	-
Mango	9.30	4.6
Orange	32.90	38
Peach	-	3.3
Pear	-	2.8
Plum	-	2.5
Strawberry	-	2

*Egyptian food balance sheet issued by economic affairs sector, central administration for agricultural planning, ministry of agriculture, 2008

** Consumption rate issued by GEMS/ Food regional diet, WHO (2003).

Table (5) presents the Estimated Average Daily Intake (EADI) of pesticide residues for the monitored fruit samples. The intakes of a total of the 15 found pesticides were estimated and the total intake of pesticide residues from fruits was 215.83 ug kg^{-1} $person^{-1}$ day^{-1}. The highest average daily intakes were that of Profenofos 86.60 ug kg^{-1} $person^{-1}$ day^{-1}, Dicofol 23.74 ug kg^{-1} $person^{-1}$ day^{-1}, Fenpropathrin 19.62 ug kg^{-1} $person^{-1}$ day^{-1} and Cypermethrin 18.80 ug kg^{-1} $person^{-1}$ day^{-1}. However, the highest percentages of ADIs were that of Dicofol representing 19.79% of ADI, followed by Ethion 10.61% and Dimthoate 10.01%. However, Dicofol and Ethion is canceled from Egyptian registration system and it may be in the phase out period that means the percentages of their detection expected to decrease in next monitoring studied.

As can been seen from the data consumers exposure to pesticides do not exceeded the ADI in any of the reported cases and the intakes of the evaluated pesticides were under 20% of the Acceptable Daily Intakes (ADIs).

Table 5: The estimated average daily intake of detected pesticide residues by adults

Detected Pesticides	ADI ug kg^{-1}bw day^{-1}	intake ug kg^{-1} $person^{-1}$ day^{-1}	Source	Intake* ug kg^{-1}bw day^{-1}	%ADI
Chlorfenapyr	15	0.54	JMPR 1999	0.009	3.61
Chlorpyrifos	10	7.41	JMPR 1999	0.123	1.23
Cypermethrin	20	18.80	JMPR 2006	0.313	1.57
Deltamethrin	10	0.18	JMPR 2000	0.003	0.03
Dicofol	2	23.74	JMPR 1992	0.396	19.79
Dimethoate	2	12.02	JMPR 1996	0.2	10.01
Diniconazole	not set	-		-	-
Ethion	2	12.73	JMPR 1990	0.212	10.61
Fenarimol	10	1.35	JMPR 1995	0.023	0.225
Fenpropathrin	30	19.62	JMPR 2006	0.327	1.09
Fenvalerate	20	10.84	JMPR 1986	0.181	0.9
Lambda-cyhalothrin	20	8.14	JMPR 2000	0.136	0.68
Malathion	300	2.49	JMPR 2004	0.042	0.013
Metalaxyl	80	9.76	JMPR 2002	0.163	0.2
Penconazole	30	1.62	JMPR 1992	0.027	0.09
Profenofos	30	86.60	JMPR 2007	1.444	4.81
Total		215.83		3.599	

* The intake of pesticide residues ug kg^{-1} $person^{-1}$ day^{-1} divided by 60 Kg body weight

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Estimation of short term intake :

An acute dietary exposure assessment was also performed based on the monitoring results. In this case intake for each pesticide was compared to an acute reference dose (ARfD). The estimated short-term intake (ESTI) was used to estimate acute dietary exposure. For the calculation of intake the maximum reported values of residues for each pesticide (in mg/kg) were multiplied by previously reported food consumption for each food commodity and was divided by body weight (60 kg) as described by the following equation (Tsoutsi *et al.,* 2008):

*ESTI = HR(Highest residue in mg/kg) * C(daily consumption kg/person/day) /BW(body weight, kg):*

The risk of exposure was considered as insignificant in the cases where the estimated exposure was equal or lower than to ARfD. **Table (6)** presents the estimated short term intake of pesticides residues through fruits. The ARfD values for pesticides were taken from FAO/WHO or official EU Pesticides Database.

The values of ESTI as a percentage of ARfD ranged from 0.00 up to 14% indicating a minimum acute risk from the detected pesticides. The highest reported values of ESTI as a percentage of ARfD for dicofol (0.38-14%) and ethion (0.13-7.9%)

Table 6: Estimated short term intake of residual pesticides by adults (60 kg bw) expressed as percentage of Acute Reference Dose (ARfD)

NO.	Pesticides detected	ARfD in mg/kg/bw/day	% ARfD
1	Chlorfenapyr	not set	-
2	Chlorpyrifos	0.1	0-0.06
3	Cypermethrin	0.04	0.01-0.38
4	Deltamethrin	0.01	0.03
5	Dicofol	0.002	0.38-14
6	Dimethoate	0.01	0.02- 1.05
7	Diniconazole	not set	-
8	Ethion	0.002*	0.13- 7.9
9	Fenarimol	0.02	0.11
10	Fenpropathrin	0.03*	0.02-0.83
11	Fenvalerate	0.02*	0.9
12	Lambda-cyhalothrin	0.0075	0.02-1.6
13	Malathion	0.3	0-0.01
14	Metalaxyl	0.5	0.03
15	Penconazole	0.5	0.01
16	Profenofos	1	0.01-0.1

*the ADI value selected as no ARfD set

Conclusion:

The monitoring of pesticide residues in food items is required to prevent, control and reduce the pollution and to minimize health risks. The Egyptian authorization should do effort for establishing national MRLs based on local GAP and local supervised trails and also to establish control system of pesticide residues at all production stages, from cultivation stage until the products reach the markets. The output of a pesticide surveillance program (detection frequency and number of exceeding measures) consider preliminary tool for screening of residues levels and can lead to unnecessary concern among consumers since they lack information concerning the actual exposure. The estimation of dietary exposure study becomes more essential requirement. The lack of consumption data for different group of population considered one of the barriers to conduct this study.

References

Amir Bertoni Gebara, Cláudia Helena Pastor Ciscato and Sérgio Henrique Monteiro, 2008. Revista Brasileira de Toxicologia, 21(2): 87-92.

AOAC Official Methods of Analysis 16th Edition, 1995: 985-22.

Claeys W.L., S. Jean-Francois, C. Bragard, G. Maghuin- Rogister, P. Luc and B. Schiffers, 2011. Exposure of several Belgian consumer groups to pesticide residues through fresh fruit and vegetable consumption. Food Cont., 22: 508-516.

Codex Alimentarius Commission, CAC, 1993. Joint FAO/WHO Food Standards Program, 2: 391.

Dogheim, S.M., S.A. Gad Alla, A.M. El-Marsafy, 1999. Monitoring of pesticide residues in Egyptian fruits and vegetables in 1995. Journal of the Association of Official Analytical Chemists, 82: 948-955.

Dogheim, S.M., S.A. Gad Alla, and A.M. El-Marsafy, 2001. Monitoring of pesticide residues in Egyptian fruits and vegetables in 1996. Journal of the Association of official Analytical Chemists, 84: 519-531.

Dogheim, S.M., A.M. El-Marsafy, E.Y. Salama, S.A. Gad Alla and Y.M. Nabil., 2002. Monitoring of pesticide residues in Egyptian fruits and vegetables during 1997. Food Additives and Contaminants, 84: 519-531.

Dogheim, S.M., A.M. El-Marsafy, S.A. Gad Alla, M.A. Khorshid and S.M. Fahmy, 2004. Pesticides and heavy metals levels in Egyptian leafy vegetables and some aromatic medicinal plants, Food Additives and Contaminants, 4: 323-330.

EFSA, 2010. 2008 Annual report on pesticide residues according to article 32 of regulation (EC) No 396/2005. EFSA Journal 2010, 8(6): 1646

Egyptian, 2008. food balance sheet issued by economic affairs sector, central administration for agricultural planning, ministry of agriculture.

FAO, web site, http://www.fao.org/docrep/V9978E/v9978e0e.htm

Keikotlhaile, B.M. and P. Spanoghe, 2010. Ghent University, Pesticide Residues in Fruits and Vegetables, Belgium, www.intechopen.com, Pesticides - Formulations, Effects, Fate., pp: 243-152.

Kwang-Geunt and Suk-Kyung, 2012. Monitoring and risk assessment of pesticide residues in yuza fruits (Citrus junos Sieb. ex Tanaka) and yuza tea samples produced in Korea , Food Chemistry, 135: 2930-2933.

Tsoutsi, C.S., I.K. Konstantinou, & D.G. Hela, 2008. Organophosphorus pesticide residues in Greek virgin olive oil: levels, dietary intake and risk assessment. Food Additives and Contaminants, 25(10): 1225-1236.

WHO, 1997. Guidelines for predicting dietary intake of pesticide residues (revised) global environment monitoring system – food contamination monitoring and assessment programme (GEMS/Food) in collaboration with Codex Committee on pesticide residues. Programme of Food Safety and Food Aid, pp: 1-44.

WHO, 2003. GEMS/food regional diets (regional per capita consumption of raw and semi-processed agricultural commodities). http://www.who.int/foodsafety/publications/chem/regional_diets/en/.