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COMPARISON OF PESTICIDE EXPOSURE FROM CONSUMPTION OF DOMESTIC AND IMPORTED FOOD ON ROMANIAN MARKET FROM 2010 TO 2012[1]

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ABSTRACT. Pesticides include a wide range of products - many used every day. Surveillance is an important public health tool for the control of pesticide monitoring. During the period 2010-2012, a total of 10693 food samples were analyzed for pesticide residues. Commodities were classified in groups (citrus fruits, legumes, vegetables, potatoes, processed products, cereals, and fruits other than citrus) and the outcomes of the analyses were reported by year, origin of the sample and presence/absence of pesticide residues. Results showed that an important part of samples, 21.78 %, contain detectable pesticide residues at concentration below the Maximum Residue Limit (MRL) and 0.81% were above the MRL. Exposure from pesticides in domestic foods exceeds exposure from imported foods in 2010 and 2011 but in 2012, the exposure from third country food exceeds by far the domestic and European Economic Area food

KEYWORDS: pesticides residues, food, surveillance, pesticide exposure, health outcomes

INTRODUCTION

Pesticides include all materials used to prevent, destroy, repel, attract or reduce pest organisms. Insecticides, herbicides, fungicides and rodenticides are some of the more well-known pesticides. Less well-known pesticides include growth regulators, plant defoliants, surface disinfectants and some swimming pool chemicals.

Expansion of the small-scale farming sector is a key government strategy for future economic growth in the country. In this context, key to the control of pesticide-related morbidity and mortality is the need for accurate, timely and effective surveillance systems. Monitoring of specific chemical residues in organic foodstuffs is part of the regular controls on food, aiming to safeguard public's health

In Romania three Competent Authorities are involved in elaboration and implementation of National Control Programme for pesticides residues: National Sanitary Veterinary and Food Safety Authority (NSVFSA), Ministry of Agriculture and Rural Development (MARD) and Ministry of Health (MH). Romanian Agriculture and Rural Development Ministry (ARDM) has the responsibility for national monitoring plan of pesticides residues in fruits, vegetables, cereals. Ministry of Health is responsible for baby food analysis and food for special nutritional purposes. Romanian Agriculture and Rural Development Ministry and National Sanitary Veterinary and Food Safety Authority (NSVFSA) have the responsibility for national monitoring plan of pesticides residues in fruits, vegetables and cereals. Each competent authority draws up one independent annual plan for control pesticide residues in food of plant origin. Implementation of monitoring plans is performed by Agriculture and Rural Development Ministry through Central Laboratory for Pesticides Residues Control in Plants and Vegetable Products, which analyses the samples taken by Counties and Bucharest Phytosanitary Units and Food Safety

Departments within Sanitary Veterinary and Food Safety County Division.

These agencies ensure that residue levels remain below established limits to safeguard human health. Pesticide residues tend to decline as the pesticide breaks down over time, and diminish as the commodities are washed and processed prior to sale. By the time food reaches at grocery store, pesticide residues are generally far below the legal limits. However, low levels of pesticide residues may still remain on some foods. If tested food products contain residues exceeding limits, enforcement action may be taken: removing the food from stores, seizing food stocks, rejecting imports and/or prosecuting offenders.

MATERIALS AND METHODS

Romanian Agriculture and Rural Development Ministry, National Sanitary Veterinary and Food Safety

Authority (NSVFSA) and Ministry of Health have the responsibility for national monitoring plan of pesticides residues in fruits, vegetables, cereals and baby food products. Each competent authority draws up one independent annual plan for control pesticide residues in food of plant origin and baby food products. Implementation of monitoring plans is performed by MARD through Central Laboratory for Pesticides Residues Control in Plants and Vegetable Products, which analyses the samples taken by Counties and Bucharest Phytosanitary Units. National legislation is ensured by the Order of NSVFSA president, of MARD, of the MH and of National Authority for Consumers Protection president, no.118/462/1030/313/2007 concerning the setting of maximum admitted pesticides limits in fruits, vegetables, cereals and other products of vegetable origin, in which were transposed the Regulation (EC) No.396/2005 of the European Parliament and of the Council of 23 February 2005.

This study analyzed the date provided by Pesticide Residue Control Results National summary report on 2010, 2011, 2012.

Samples are taken by: phytosanitary inspectors, inspectors involved in food safety and inspectors from the counties Public Health Directorates.

The sampling procedure is according to the EU Directive no. 2002/63/EEC which has been transposed in national legislation. The priorities of the NSVFSA program's are fresh commodities imported from third countries and intra-community trade, the place of sampling are warehouses of importers, frequency of sampling is minimum 12 samples/product.

The general strategy is detection as many pesticides as possible in one analyses by using Multi-Residue-Methods (MRMs). The extracts are analyzed by chromatographic separation and selective detection of residues. The detection methods are Gas Chromatography (GC) with Electron Capture Detection (ECD) and Gas Chromatography with Nitrogen Phosphorus Detection (NPD. The validity of the analytical results is governed by a quality assurance system under ISO 17025 accreditation. During the studied period the number of active substances has been increased from 66 to 145 for NSVFSA laboratories and from 116 to 179 ARDM laboratories.

RESULTS AND DISCUSSION

Compared to 2010 and 2011, in 2012 the number of samples analyzed for pesticide residues from domestic market increased (from 62% in 2010 to 70% in 2012) and the one from European Economic Aria (EEA) was reduced (from 15% in 2010 to 9,9% in 2012). For samples from Third Countries the number of samples increased (from 15% in 2010 to 18,88% in 2012).Table no 1

Tabel no 1. Origin of samples analyzed for pesticides residues during 2010-2012 in Romania

Origin of samples	2010 (%)	2011 (%)	2012 (%)
Domestic market	62,5	64,2	76.93
European Economic Aria	14,2	16,7	10.96
Third Countries	15,3	18,0	18.88
Unknown	7,5	1,1	0.16

Compared to 2010 and 2011, in 2012 the number of samples with residues below MRL increased (from 83% in 2010 to75% in 2011 to 74% in 2012) and the number of samples non compliant was reduced (from 1,0% in 2011 to 0,9% in 2012) Table no 2

Tabel no 2. Residues content of analyzed samples during 2010-2012 in Romania

Year	2010	2011	2012
Total samples	3551	3775	3367
Without residues	83,1%	75,2%	74,3%
With residues below MRL	16,2%	23,8%	24,7%
Exceeding	0,89%	1,0%	0,9%
Non compliant	0,89	1,0%	0,9%

Observing the origin of non compliant and above MRL's samples, in 2010 and 2011 food from Romanian market exceeded by far the other origin for non compliant samples. In 2012 samples from third county origin was founded non compliant in 96,29 %,and also the number of samples with TC origin increased.

Tabel no 3. Origin of samples containing residues above MRL or non compliant

Origin of samples	2010(%)			2011 (%)			2012 (%)		
	Samples	Above MRL's	Non compliant	Samples	Above MRL's	Non compliant	Samples	Above MRL's	Non compliant
Domestic market	62,33	88.88	88.88	64.41	47.22	50.00	76.93	3.71	3.71
European Economic Aria	14,35	0.00	0.00	16.70	0.55	4.16	10.96	0.00	0.00
Third Countries	15,51	0.00	0.00	18.19	41.66	37.5	18.88	96.29	96.29
Unknown	7,60	11.11	11.11	0.69	0.55	8.33	0.16	0.00	0.00

In 2011 from the 3775 analyzed samples 2812 (74%) were without pesticides residues founding, 926 (25%) had residues below MRL, 37 (1%) had residues exceeding MRL's 9 (0.2%) of them were non-compliant. The most frequent pesticides detected in the analyzed samples were (carbedazim, methidathion, chlorothalomil, procymidone, acetamiprid); the highest concentration was for chlorothalomil 9,820 mg/kg detect in lettuce. From the total number of samples, 211 foodstuffs samples had 2 or more founding. Some products with different number of pesticide residues are:

- grapefruit – 55 samples with a number of residues from 2 up to 5, 40 of them (72,72%) were originated from Turkey;
- lemons – 51 samples with a number of residues from 2 up to 4, 32 of them (62,74%) were originated from Turkey;
- apples – 42 samples a number of residues from 2 up to 5, 24 of them (57,14) were originated from Romania
- wine grapes - 34 samples with a number of different residues from 2 up to 7, all products were from Romania;
- table grapes – 29 samples with 2 to 5 residues, 13 of them (44,82%) were originated from Romania.

The results indicate the use of unauthorized pesticides has decreased. High exceedances in lettuce are considered to be due to use of pesticide non-authorized on the specific crops;

In 2012 from the total number of samples, 417 foodstuffs samples had 2 or more founding. Some products with different number of pesticide residues are:

- grapefruit – 72 samples with a number of residues from 2 up to 5, 60 of them (83,33%) were originated from Turkey;
- lemons – 88 samples with a number of residues from 2 up to 5, 80 of them (90,90%) were originated from Turkey;
- apples – 29 samples a number of residues from 2 up to 7, 17 of them (58,62) were originated from Romania
- mandarins - 47 samples with a number of different residues from 2 up to 4, 42 of them (89,36%) were originated from Turkey;
- oranges – 23 samples with 2 to 5 residues, 11 of them (47,82%) were originated from Turkey,
- tomatoes – 30 samples with 2 to 5 residues, 21 of them (70%) were originated from Turkey,

List of all products with pesticide residues are presented in Table no 4

Table no 4 Samples with two or more residues content analyzed during 2010-2012 in Romania

	2010						2011							2012						
Number of pesticides residues	1	2	3	4	5	6	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Product																				
Animal products Bovine Fat	4						2							2	1	2				
Animal products Eggs Chicken	1						5	2						3	1					

	2010						2011							2012						
Number of pesticides residues	1	2	3	4	5	6	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Product																				
Animal products Horses, asses, mules or hinnies Fat														1						
Animal products Milk products	4	2					6	1	0	0	0	1		3	4	3				
Animal products Poultry	3																			
Animal products Poultry Fat	2						25	3	1					4	5					
Animal products Sheep Fat	0						17		3	1	1			1						
Animal products Swine Fat free of lean meat	3						83	1						6	4					
Swine meat							20							2	2					
Baby and infant food	0						3													
Processed cereal-based foods Y							71	3						5						
Cereals Maize	4						46							5						
Cereals Rice							46	4						4						
Cereals Rye	2						1							1						
Cereals Wheat	12	1					11	1	1					8						
Cereals Wheat	1													1						
Fish products Fish and fish products	1																			
Apples	68	16	7	4	1		70	25	11	4	2			45	16	11	1			1
Apricots	5	1					1	2	1					6	2	1				
Bananas	13	3					21	10	1					7	15	1				
Cherries	12	5	1				12	3						10						
Grapefruit	20	17	6	1			37	31	23	2	1			17	31	30	9	2		
Kiwi	3	3					7	1						2						
Lemon							17	34	12	5				20	39	33	15	1		
Mandarins	12	3	2	1			28	14	5	2				18	27	13	7			
Mango							1	1							1					
Oranges	28	6	2				41	15	7	1				8	12	8	2	1		

	2010						2011							2012						
Number of pesticides residues	1	2	3	4	5	6	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Product																				
Oranges Y														4						
Peaches	14	2	2	1			12	10	1					7	4	1				
Pears	17	6	1				17	8	2					11	1	1	1	1		
Pineapples							2							1						
Plums	4						8	2						5						
Pomegranate							5	1						8	3	2				
Quinces							1	2						9	3					
Strawberries	14	1	1				11	5	4					4	5		1		1	
Table grapes	24	5	6	2	1		30	17	7	3	2			17	6		1	1		
Wine grapes	35	17	4	1	1		37	16	10	2	2	1		17	2	2		3	1	
Wine grapes Y	3						6	1												
Vegetables Aubergines (egg plants)	2						2							3	1					
Beans (with pods)	2						2	1						4						
Beetroot																				
Carrots	3	1					9	3	1					16	3					
Cauliflower							1							2						
Celery	5						6	2						5						
Courgettes	1						3							5	2					
Cucumbers	6	1	1				17	4	2	1				12	3	2				
Cultivated fungi							1							7						
Head cabbage							1							2						
Leek							2							2						
Lettuce	12	3	1	1			12	4	5	2				16	2	3				
Lettuce and other salad plants, including Brassica	1																			
Melons	1						2	1												
Onions	3						4							2	1					
Parsley	1						3								3	1				
Parsnips							1													
Peas (with pods)							1							2						
Peas (without pods)							1													
Peppers	6	1					16	1	1	1				29	5	2				

	2010						2011							2012						
Number of pesticides residues	1	2	3	4	5	6	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Product																				
Potatoes	17						19							12	2					
Pumpkins	1																			
Spinach	4						12	2						6	4					
Spring onions	1						4	1						3						
Tomatoes	35	5	3	1			46	6	3					33	14	13	2	1		
Watermelons	2						2													
Total samples	436	110	35	12			574	232	98	25	7	2	2	439	235	129	40	10	2	1
Percent of total samples (%)	12	3.1	1	0	0	0	15	6.1	3	1	0.2	0.1	0.1	13	7	3.8	1	0.3	0.1	0.03

Food contamination results from the use and/or misuse of agricultural pesticides, and is manifested as adverse effects on human health and the environment An agricultural pesticide is any substance or mixture of substances intended for preventing, destroying or mitigating the effects of any pest that may adversely affect the growth and/or productivity of any agricultural product. The term includes defoliants, fruit-thinning substances, substances that are intended to prevent premature fall of fruits, and substances that may be applied (pre- or post-harvest) to prevent deterioration of agricultural products during storage or transportation.

Pesticides exposure can be by inhalation, dermal absorption or oral exposure. Depending on the situation, pesticides could enter the body by any one or all of these routes. Typical sources of pesticide exposure include: food, home and personal use of pesticides, drinking water and professional exposure.

Pesticides can cause short-term adverse health effects, called acute effects, as well as chronic adverse effects that can occur months or years after exposure. Examples of acute health effects include stinging eyes, rashes, blisters, blindness, nausea, dizziness, diarrhea and death. Examples of known chronic effects are cancers, birth defects, reproductive harm, neurological and developmental toxicity, immunotoxicity, and disruption of the endocrine system. Chronic health effects include cancer and other tumors; brain and nervous system damage; birth defects; infertility and other reproductive problems; and damage to the liver, kidneys, lungs and other body organs. Chronic effects may not appear for weeks, months or even years after exposure, making it difficult to link health impacts to pesticides.

Pesticides have been implicated in human studies of leukemia, lymphoma and cancers of the brain, breasts, prostate, testis and ovaries. Reproductive harm from pesticides includes birth defects, still birth, spontaneous abortion, sterility and infertility. Endocrine disruptors are chemicals that -- often at extremely low doses -- interfere with important bodily functions by mimicking or blocking hormones (the chemical messengers that circulate in blood and regulate many body processes including metabolism, brain development, the sleep cycle and stress response). Some pesticides act as endocrine disruptors and have been shown to cause serious harm to animals, including cancer, sterility and developmental problems. Similar impacts have been associated with human exposure to these chemicals. Children are more vulnerable to pesticides exposure because their organs, nervous systems and immune systems are still developing; their higher rates of cell division and lower body weight also increase children's susceptibility to pesticide exposure and risks. Their immature organs and other developing biological systems are particularly vulnerable to toxic contaminants. Exposure during certain early development periods can cause permanent damage.

Current regulatory policy to reduce human cancer risks is based on the idea that chemicals that induce tumors in rodent cancer bioassays are potential human carcinogens. The chemicals selected for testing in rodents, however, are primarily synthetic (Gold et al., 1997a, b, c, 1998, 1999). The enormous background of human exposures to natural chemicals has not been systematically examined. This led to an imbalance in both data and perception about possible carcinogenic hazards to humans from chemical exposures. The regulatory process does not take into account (1) that natural chemicals make up the vast bulk of chemicals to which humans are exposed; (2) that the toxicology of synthetic and natural toxins is not fundamentally different; (3) that about half of the chemicals tested, whether natural or synthetic, are carcinogens when tested using current experimental protocols; (4) that testing for carcinogenicity at near-toxic doses in rodents does not provide enough information to predict the excess number of human cancers that might occur at low-dose exposures; and (5) that testing at the maximum tolerated dose (MTD) frequently can cause chronic cell killing and consequent cell replacement (a risk factor for cancer that can be limited to high doses) and that ignoring this effect in risk assessment can greatly exaggerate risks.

We estimate that about 99.9% of the chemicals which humans ingest are naturally occurring. The amount of synthetic pesticide residues in plant foods are low in comparison to the amount of natural pesticides produced by plants themselves (Ames et al., 1990a, b; Gold et al., 1997a). We estimate that the daily average U.S. exposure to natural pesticides in the diet is about 1500 mg and to burnt material from cooking is about 2000 mg (Ames et al., 1990b).

In comparison, the total daily exposure to all synthetic pesticide residues combined is about 0.09 mg based on the sum of residues reported by the U.S. Food and Drug Administration (FDA) in its study of the 200 synthetic pesticide residues thought to be of greatest concern (Gunderson, 1988; U.S.Food and Drug Administration, 1993a). Humans ingest roughly 5000–10,000 different natural pesticides and their breakdown products (Ames et al., 1990a). Despite this enormously greater exposure to natural chemicals, among the chemicals tested in long-term bioassays in the CPDB, 77% (1050/1372) are synthetic (i.e., do not occur naturally) (Gold and Zeiger, 1997).

In 2013 Ntzani EE and all, published systematic and extensive literature review of epidemiological studies examining the association between pesticide exposure and any health outcome published after 2006. In these studies exposure to pesticides e.g. via inhalation, ingestion, dermal contact or across the placenta has been established as being, or suggested to be, causative for instance for cancer in various organs and tissues, disturbed neurodevelopment of children, allergies, decreased fertility (male and female), birth defects and Parkinson`s disease.

Tabel no 5 List of systematic reviews and meta-analyses identified in the literature review (after Ntzani EE and all, 2012)

Health effects	Nr. Studies	Authors claim association	Author , year
Amyotrophic lateral sclerosis	3	No	Sutedja NA et al, 2009 Kamel F et al , 2012 Malek et al, 2012
Cancers	11		
Breast cancer	1	No	Khanjani N et al, 2007
Childhood cancer	2	Yes	Infante-Rivard C et al, 2007 Vinson F et al, 2011
Childhood Leukemia	6	Yes	Wingle DT et al, 2009 Turner et al, 2010 Van Maela-Fabry G et al, 2010 Van Maela-Fabry G et al, 2011 Bailey HD et al, 2011 Turner MC et al, 2010
Multiple cancers	1	Yes	Cooper et al, 2008
Prostate cancer	1	Yes	Budnik LT et al, 2012
Multiple health outcomes	1	Ves	Koureas M et al, 2012
Neurobehavioral	2	No	Ismail AA et al, 2012 Li AA et al, 2012
Parkinson disease	2	Yes	Van der Mark M et al, 2012 Van Maele Fabry G et al, 2012
Reproductive	1	No	Shirangi A, 2011
Time to pregnacy	1	Yes	Snijder CA et al, 2012

The most important way to prevent the misuse of agricultural pesticides is through education. If more farmers, especially in developing countries, knew about the risks of these pesticides, they would be more careful in the way that they use the pesticides and the protection that the sprayers wear.

In order to reduce the negatives effects of pesticides residues on consumer health, there are some methods: eat a *variety* of fruits and vegetables to minimize the potential of increased exposure to a single pesticide, thoroughly wash all produces under running water, discard the outer layer of leafy vegetables, such as lettuce or cabbage or trim fat and skin from meat, poultry, and fish.

CONCLUSIONS

Exposure from pesticides in domestic foods exceeds exposure from imported foods in 2010 and 2011 but in 2012, the exposure from third county food exceeds by far the domestic and European Economic Area origin food. In 33.94 % of products with detectable pesticide residues was found between 2 and 7 different residues, the highest number in wine grapes from domestic production and also in grapefruits from Turkey. During the studied period the capacity to identify active substances has been increased from 66 to 145 for NSVFSA laboratories and from 116 to 179 ARDM laboratories, and so the number of tips of pesticides detected in one samples increased. The number of samples with 2 or more pesticides is twice in 2012 – 7 % compared with 2010, 3,1%.

The most important way to prevent the misuse of agricultural pesticides is through education. Probabilistic modeling of dietary exposure provides more useful information concerning the relative risks of domestic and imported foods than that obtained from the traditional comparisons of residue detection frequency and violation rates

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