Pesticide residue monitoring in fruits and vegetables consumed in the Macaronesia (PERVEMAC-II): Canary Islands, July 2017 – June 2019

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ABSTRACT

The Canary Islands, an oceanic archipelago belonging to Spain, is one of the European Outermost Regions. The geographical, climatic and social characteristics of the Canary Islands are considerably different from those of mainland Spain. In this effort we have carried out a monitoring program of pesticide residues in fresh vegetables and fruits in the Islands. For this monitoring program, sampling of products from local origin and import products was carried out in the Islands with the goal of a comparison between the presence of pesticide residues in products of local origin and those of import. The Canary Islands need to import fruits and vegetables to complete local production that is insufficient to meet market demands and supply local markets. The needs of import are higher for fruits than vegetables. A total of 930 fresh fruits and vegetables samples were collected at the consumer sale points during a two years period, from July 2017 through June 2019. The 930 samples corresponds to a total of 87 different commodities sampled following consumption criteria. Among these commodities, 25 of them had more than 10 samples in the monitoring two years, reaching a total of 739, the 79% of the total samples. The average presence of pesticide residues in the total of the 930 samples analyzed was 1,72 residues per sample. Taking into account the origin, local or import, and the commodity, this average shows and strong variability, finding significantly different values from one commodity to another and between local and imported products. The main trend shows lower values for pesticide residues per sample in local products than in imported ones. The presence of pesticide residues in fruits consumed in the Islands is 1,67 times higher than for vegetables. However, attending to the MRLs and the National use authorizations of Plant Protection Products in Spain, a large number of violations of use have been found in the local products, while only a few number of MRL violations have been found in the imported ones. The results of the present effort points towards that in the Canary Islands it is necessary to pay attention to the local cultivation of vegetables and fruits with the objective of minimizing the use of pesticides. This work will continue in the coming years, following the guidelines of the European coordinated program regarding the vegetable products analyzed every year.

ADDITIONAL MONITORING: EU Multiannual Control Programm for Pesticide Residues

An additional monitoring effort has been made in this work, taking the European Union's coordinated multi-year program as a reference. The fresh vegetable products included in the European coordinated program for the years 2017, 2018 and 2019 have been sampled and analyzed, taking into account local and imported materials. The results are listed in Table 3. A total of 13 MRL violations have been found in this additional monitoring, with 11 of them detected in local products (Table 4).
In the Canary Islands it is necessary to reinforce and intensify the work to control the use of plant protection products. In 2020, the monitoring program is being carried out on the same vegetable products monitored in 2017, paying special attention to carrots from local origin.

Table 2. Summary of results: % samples with residues, number of different pesticides detected and ratio residues / sample

ALL SAMPLES	
Samples with residues (%)	65,24%
Different Pesticiides	108
Residues / Sample	1,72

LOCAL Origen	
Samples with residues (%)	59,23%
Different Pesticiides	83
Residues / Sample	1,38

IMPORT	
Samples with residues (%)	75,55%
Different Pesticiides	85
Residues / Sample	2,31

FRUITS	
Samples with residues (%)	80.13%
Different Pesticiides	85
Residues / Sample	2.2

LOCAL - FRUITS	
Samples with residues (%)	71.74%
Different Pesticiides	38
Residues / Sample	1.56

IMPORT - FRUITS	
Samples with residues (%)	88.99%
Different Pesticiides	78
Residues / Sample	2.89

VEGETABLES	
Samples with residues (%)	49.28%
Different Pesticiides	76
Residues / Sample	1.21

LOCAL - VEGETABLES	
Samples with residues (%)	50.16%
Different Pesticiides	71
Residues / Sample	**1.26**

IMPORT - VEGETABLES	
Samples with residues (%)	46.53%
Different Pesticiides	41
Residues / Sample	1.07

LOCAL - VEGETABLES CABBAGE	
Samples with residues (%)	12,50%
Different Pesticiides	2
Residues / Sample	0,25

LOCAL - VEGETABLES CARROT	
Samples with residues (%)	66,67%
Different Pesticiides	9
Residues / Sample	**1,44**

LOCAL - VEGETABLES CUCUMBER	
Samples with residues (%)	60,00%
Different Pesticiides	11
Residues / Sample	**1,40**

LOCAL - VEGETABLES LETTUCE	
Samples with residues (%)	63,46%
Different Pesticiides	41
Residues / Sample	**2,15**

LOCAL - VEGETABLES ONION	
Samples with residues (%)	0,00%
Different Pesticiides	0
Residues / Sample	0,0

LOCAL - VEGETABLES POTATO	
Samples with residues (%)	0,00%
Different Pesticiides	0
Residues / Sample	0,0

LOCAL - VEGETABLES PEPPER	
Samples with residues (%)	87.5%
Different Pesticiides	22
Residues / Sample	**2,08**

LOCAL - VEGETABLES TOMATO	
Samples with residues (%)	66.67%
Different Pesticiides	32
Residues / Sample	**2,15**

LOCAL - VEGETABLES ZUCCHINI	
Samples with residues (%)	14,29%
Different Pesticiides	3
Residues / Sample	0,21

Table 1. Monitoring program: list of products and number of samples

Product	Nº samples
Apple	**39**
Apricot	3
Artichoke	3
Asparagus	2
Avocado	7
Banana	**32**
Basil	1
Beans	**16**
Beet	1
Blackberry	1
Blueberries	3
Broccoli	9
Cabbage	**20**
Cantaloupe	**23**
Carrots	**28**
Cauliflower	**10**
Cellery	1
Chard	3
Cherry	2
china Mushroom	2
Coconut	4
Coriander	3
Cucumber	**28**
Curly lettuce	3
Custard apple	2
Eggplant	**17**
Endive	2
Figs	1
Figs (dry)	3

Product	Nº samples
Garllic	8
Ginger	3
Grapefruit	**11**
Grapes	**26**
Guava	2
Khaki	6
Kiwi	**31**
Leek	**14**
Lemon	**26**
Lettuce	**21**
Lettuce (4th)	6
Lime	5
little Patch	2
Mango	**22**
Medlar	2
Mushroom	2
Nectarine	**10**
Onion	**31**
Orange	**33**
Papaya	**18**
Parsley	5
Parsnip	1
Passion fruit	1
Pea	1
Pear	**35**
Pear-melon	3
Pepper	**39**
Peppermint	3
Pineapple	8

Product	Nº samples
Pitaya	1
Plum	**17**
Pomegranate	6
Potato	**37**
Prickly pear red	2
Prickly pears	3
Pumpkin	9
Quince	2
Radish	1
red Peaches	3
Soursop	1
Spinach	7
spring Onion	4
Squash	2
Strawberry	**16**
sugar Beet	3
sweet Potato	**16**
Tangerine	**15**
Tomato	**65**
Tomato "tamarillo"	3
Turnip	1
Vegetables (4th)	6
Watercress	**8**
Watermelon	8
white Peaches	5
Yam	1
yellow Peaches	7
Yucca	2
Zucchini	**35**

RESULTS AND DISCUSSION

An in-depth analysis of the results leads us to focus our attention on the data obtained from vegetable samples, where the average is higher for local than imported vegetables: 1.26 versus 1.07 residues / sample. As discussed in the summary, local agriculture produces more vegetables than fruits. Taking into account the most sampled vegetables in this monitoring program, we can find the results shown in the tables, where we can identify that the carrot, cucumber, lettuce, pepper and tomato are above the average value of everything. the local vegetable package.

EXPERIMENTAL

The pesticide residue analysis was carried out following a multirresidue method (MRM) using acetate buffered Quechers followed by GCMSMS (QQQ) and LCMSMS (QQQ) determination, addressing 140 and 50 different pesticide analytes respectively. The residues of fungicides belonging to the dithiocarbamate family were analyzed following the carbon disulfide single residue method (SRM). The LCMSMS analysis has been carried out only for 2017 samples.

Table 4. MRL violations in the additional monitoring program

	COMMODITY	PESTICIDE	MRL	VALUE	ratio	Local / Import
2017	Cauliflower	Methomyl	0,01	0,04	4	local
	Potato	Chlorpyrifos	0,01	0,03	3	local
	Potato	Fosthiazate	0,02	0,07	3,5	local
	Pear	Imazalil	2,00	2,13	1,1	import
	Carrot	Cypermethrin	0,05	0,13	2,6	local
	Carrot	Cypermethrin	0,05	0,07	1,4	local
	Carrot	Chlorpyrifos	0,1	0,33	3,3	local
	Carrot	Chlorpyrifos	0,1	0,3	3	local
	Carrot	Chlorpyrifos	0,1	0,28	2,8	local
	Carrot	Chlorpyrifos	0,1	0,26	2,6	local
2018	Melon	Chlorpyrifos	0,01	0,03	3	import
2019	Spinach	Deltamethrin	0,02	0,05	2,5	local
	Lettuce	**Dimethoate**	**0,01**	**0,16**	**16**	**local**

Table 3. Results for the additional monitoring program carried out following the European Multiannual Control Programm for Pesticide Residues

2017	ONION			CAULIFLOWER			KIWI			ORANGE			POTATO			PEAR			CARROT			ALL SAMPLES		
	local	import	Total	local	import	Total	local	import	Total	local	import	Total	local	import	Total	local	import	Total	local	import	Total	local	import	Total
Samples	14	17	31	12	12	24		14	14	13	14	27	17	12	29		15	15	13	15	28	69	99	168
Samples with residues	0	1	1	1	2	3		8	8	10	12	22	3	1	4		13	13	9	6	15	23	43	66
% with residues	0%	6%	3%	8%	17%	13%		57%	57%	77%	86%	81%	18%	8%	14%		87%	87%	69%	40%	54%	33%	43%	39%
residues	0	1	1	2	2	4		11	11	22	42	64	4	1	5		52	52	22	9	31	50	118	168
residues/sample	0	0,06	0,03	0,17	0,17	0,17		0,79	0,79	1,69	3,00	2,37	0,24	0,08	0,17		3,47	3,47	1,69	0,60	1,11	0,72	1,19	1,00
MRL violations				1		1							2		2		1	1	6		6	9	1	10

2018	EGGPLANT			BROCCOLI			MELON			PEPPER			BANANA			GRAPEFRUIT			GRAPE			ALL SAMPLES		
	Local	Import	Total	Local	Import	Total	Local	Import	Total	Local	Import	Total	Local	Import	Total	Local	Import	Total	Local	Import	Total	Local	Import	Total
Samples	15	6	21	11	11	22	3	15	18	15	12	27	14		14	2	14	16	2	13	15	62	71	133
Samples with residues	7	2	9	4	1	5	2	5	7	11	5	16	12		12		13	13	1	12	13	37	38	75
% with residues	47%	33%	43%	36%	9%	23%	67%	33%	39%	73%	42%	59%	86%		86%	0%	93%	81%	50%	92%	87%	60%	54%	56%
residues	14	4	18	4	1	5	2	7	9	28	12	40	29		29		34	34	7	45	52	84	103	187
residues/sample	0,93	0,67	0,86	0,36	0,09	0,23	0,67	0,47	0,50	1,87	1,00	1,48	2,07		2,07	0,00	2,43	2,13	3,50	3,46	3,47	1,35	1,45	1,41
MRL violations			0			0		1	1			0			0			0			0	0	1	1

2019	SPINACH			STRAWBERRY			LETTUCE			APPLE			PEACH			CABBAGE			TOMATO			ALL SAMPLES		
	Local	Import	Total	Local	Import	Total	Local	Import	Total	Local	Import	Total	Local	Import	Total	Local	Import	Total	Local	Import	Total	Local	Import	Total
Samples	11	12	23	6	2	8	15		15	1	15	16		13	13	15		15	14	15	29	62	57	119
Samples with residues	5	5	10		1	1	8		8		13	13		11	11			0	6	8	14	19	38	57
% with residues	45%	42%	43%		50%	13%	53%		53%		87%	81%		85%	85%			0%	43%	53%	48%	31%	67%	48%
residues	10	9	19		2	2	14		14		23	23		26	26			0	13	15	28	37	75	112
residues/sample	0,91	0,75	0,83		1,00	0,25	0,93		0,93		1,53	1,44		2,00	2,00			0,00	0,93	1,00	0,97	0,60	1,32	0,94
MRL violations	1		1			0	1		1			0			0			0			0	2	0	2

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