Pesticide Residues and Arsenic Found in Produce Sold in Connecticut in 2017:
MFRPS ISO 17025:2005 Food Testing

ACCREDITED

Walter J. Krol, Ph.D., Brian D. Eitzer, Ph.D., Christina S. Robb, Ph.D., Terri Arsenault, Craig Musante and Jason C. White, Ph.D.

Department of Analytical Chemistry
123 Huntington Street
New Haven, CT 06504

The Connecticut Agricultural Experiment Station
New Haven, CT

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Technical Bulletin 19

July 2018

Introduction:

The Department of Analytical Chemistry (DAC) at the Connecticut Agricultural Experiment Station (CAES) has tested food samples for pesticide residues for the Connecticut Department of Consumer Protection (DCP) and published the findings since 1963[1]. The CAES is the *de facto* laboratory used by the DCP to provide regulatory enforcement analysis of pesticide residues found on domestic and imported food sold within the state. This program was established: 1) to ensure that pesticides on food products are used in accordance with their label and 2) to ensure that the public is protected from the deliberate or accidental misuse of pesticides.

Violations of Federal law occur when pesticides are not used in accordance with label registration and are: 1) applied in excessive amounts (over tolerance) or 2) when pesticides are accidentally or deliberately applied to crops on which they are not permitted for use (no tolerance). The results of the laboratory findings at the CAES are forwarded to the DCP for all samples submitted, as well as to the US Food and Drug Administration (FDA) through an online reporting platform called eLEXNET. When violations are found on crops grown within Connecticut, the DCP notifies both the grower and the Connecticut Department of Energy and Environmental Protection (DEEP) of the results. The DEEP may perform an audit of the grower's records to ensure proper pesticide use. The DCP may also, at its discretion, recall or destroy the violative commodity or may request re-testing of the sample. For violations occurring in samples produced outside of Connecticut, the DCP notifies the local field office of the FDA in Stoneham MA of the findings. The FDA has the regulatory authority in these instances and in these cases, relies on the laboratory results obtained at the CAES. The DCP notifies the United States Department of Agriculture (USDA) if a violation occurs on a sample labeled as organic. The USDA is responsible for the enforcement of National Organic Program (NOP) violations. A more complete overview of the agencies involved, their roles, and a discussion of tolerances is found in Krol et al. 2006[1]. A comparison of the Connecticut and Federal programs was published by Krol et al. in 2014[2].

Owing in large part to the Food Safety Modernization Act (FSMA) which became law in January of 2011,[3] the DAC at the CAES received FDA funding to gain accreditation to the International Organization for Standardization (ISO) / International Electrochemical Commission (IEC) ISO/IEC 17025:2005(E) standard on December 28, 2016. It is widely recognized that accreditation is a rigorous assessment, conducted by an independent science based organization, which assures the capability and competency of a laboratory and its management systems. The CAES received accreditation for the chemical testing of pesticide residues in food by gas chromatography with mass spectrometry (GC/MS) and liquid chromatography with high resolution mass spectrometry[4] (LC/HRMS). The DAC at the CAES also received accreditation for testing total arsenic in juice by inductively coupled plasma mass spectrometry[4] (ICP/MS). This accreditation ensures that the work produced at the CAES is mutually recognized by other State, Federal and International laboratories, courts, and law enforcement agencies throughout the world.

In the past we have reported concurrent analysis of those food samples tested for pesticide residues for such things as microbial contamination[5], the mycotoxin patulin and the preservatives sodium benzoate and potassium sorbate[6]. These concurrent analyses drew largely to a close by 2015 as our collective laboratory efforts focused upon obtaining ISO 17025 accreditation of our food program.

The current work encompasses the first full year of accredited results generated by the CAES under its scope[4] of accreditation. It reports upon the 104 samples tested in 2017 calendar year for pesticide residues. The results of concurrent ICP/MS testing for arsenic in 24 processed food samples submitted by the CT DCP as part of the 2017 manufactured food regulatory program standards (MFRPS) cooperative agreement testing program are included in this manuscript because arsenic testing falls within our scope of accreditation.

Methods

The DAC developed and implemented a quality system which includes standard operating procedures (SOP's) to gain accreditation to the ISO/IEC 17025 standard. These serve to document the procedures used to generate data and to report data to the customer (DCP). A brief synopsis of the methodology used is provided below.

Sample Collection:

Samples are collected by the CT DCP and delivered to the CAES as test items. These are collected largely without prior knowledge of pesticide application. Information on the inspector's collection report is entered into the electronic Analytical Chemistry Central Database (ACCD). Appropriate analysts are assigned to the samples.

Sample Extraction and Analysis for Pesticide Residue Analysis:

The sample extraction and cleanup procedure is based on QuEChERs chemistry. All measurements are made gravimetrically. Fifteen grams (g) of sample homogenate is shaken with 15 g of acetonitrile. Salts are added: magnesium sulfate and sodium acetate, the mixture is shaken intensely and centrifuged for phase separation. An aliquot of the organic phase is cleaned up by dispersive solid phase extraction (SPE) employing primary secondary amine (PSA) sorbent as well as magnesium sulfate for the removal of water. The extract is concentrated and phase transferred to toluene. The final extract is then analyzed by LC/HRMS and GC/MS.

Detection Limit and Reporting of Pesticide Residues

EPA tolerance levels are established using the mg/Kg (ppm) convention. Residues are reported to the customer (DCP) as mg/Kg (ppm). Based on past FDA enforcement and the enforcement levels in use in the European Union, the CAES defines its Limit of Reporting (LOR) at 0.010 mg/Kg (ppm). Limits of Detection (LOD) levels are established for individual pesticides prior to reporting.

Sample Digestion and Analysis for Total Arsenic:

Samples are digested with acid and analyzed. All measurements are made gravimetrically. Briefly, five grams of sample is digested with 5 g of concentrated nitric acid HNO_3 at 115°C for 20 min. After cooling, 1 g of 30% hydrogen peroxide solution (H_2O_2) is added, the mixture heated an additional 30 min, cooled and diluted to 50 g with water. The digest is then analyzed by ICP/MS.

Detection Limit and Reporting of Total Arsenic:

FDA action levels are established using the µg/Kg or µg/L. Note that one liter (L) of water is, by definition, equivalent to one kilogram (Kg) of water. As such, the units µg/Kg and µg/L are often used interchangeably. Findings are reported to the customer (DCP) as µg/Kg. In 2005, The FDA issued an action level for arsenic in bottled water at 10 µg/L[7]. Draft guidance action levels for inorganic arsenic in apple juice at 10 µg/Kg[8] and rice cereals for infants at 100 µg/Kg[9] were proposed by the FDA in 2013 and 2016, respectively. The proposed levels are those that the FDA considers protective of human health and achievable through good manufacturing processes[8]. These action levels have not been finalized at the time of this writing. The CAES does not quantitate or report arsenic levels lower than10 µg/Kg. If no arsenic or trace levels are found, the CAES reports < 10 µg/Kg.

Quality Assurance and Reproducibility

Working standards are prepared from reference materials that are traceable to the point of manufacture. Analyte spike-recoveries are evaluated with each batch of samples tested. All systems used for analysis are verified prior to use. Balances are calibrated annually and verified when used to ensure accuracy. Verification weights are National Institute of Standards and Technology (NIST) traceable through the Standard International (SI) system of units. Trends in the data produced are reviewed and analyzed. Overall method uncertainty (MU) has been established and is documented. Batch acceptability is determined using various quality control samples (QCS).

Results and Discussion

In 2017 the CAES tested 104 food samples for pesticide residues and 24 samples for total arsenic received from the DCP as part of our MFRPS contract. The results of the two testing schemes are individually described below.

Pesticide Residue Program

There were 71 (68.3%) fresh samples and 33 (31.7%) processed samples tested in 2017 as part of the MFRPS contract with DCP. The 2017 findings are summarized in Table 1. Detailed findings are presented in Table 3 for fresh and Table 4 for processed foods. Of the 104 samples tested, 46 (44.2%) were found to contain at least one pesticide residue greater than the 0.010 mg/Kg (ppm) reporting limit. There were no residues reported in the remaining 58 (55.8%) samples.

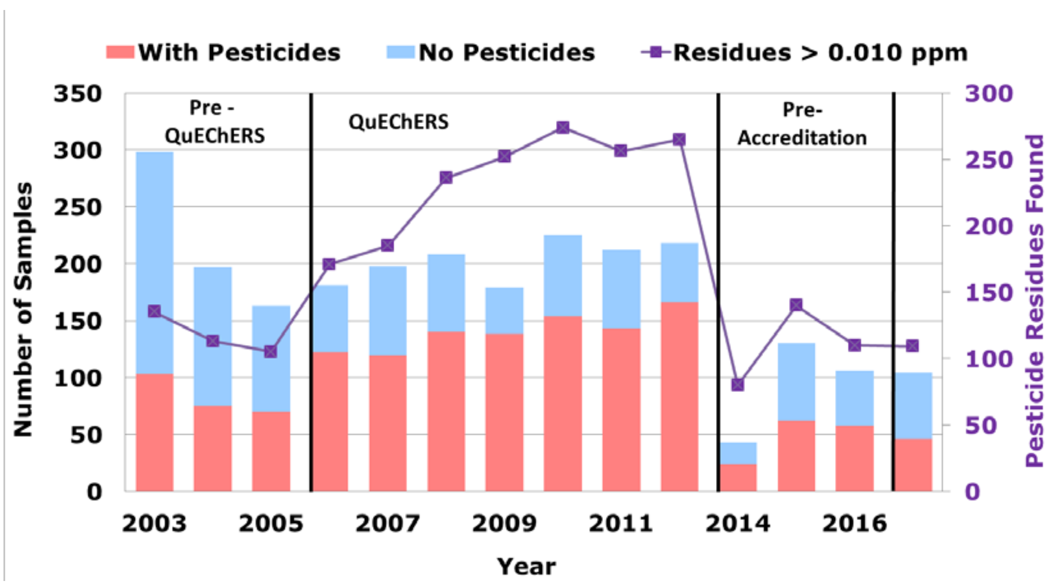
Of the 46 found to contain residues, 44 (42.3% of the total samples) contained permissible (non-violative) residues. There were 2 samples (1.9 % of the total) that contained a total of two residues that were illegal, resulting in two no tolerance violations. There were 22 samples (21.2 % of the total) of organic food tested. Pesticide residues were found in four of the organic samples (18.2% of the organic).

In 2017, there were 2 (1.9 % of residues found) illegal pesticide residues found and reported on 2 samples of food. A sample of fresh sage from Mexico was found to contain 0.018 ppm of the plant growth regulator forchlorfenuron, which has limited uses in the United States. Forchlorfenuron is a cytokinin which increases fruit size by promoting cell division especially in table grapes, grape raisins and kiwi fruit. As such it would not be expected nor is there an EPA tolerance for forchlorfenuron on sage. A separate sample of ground (processed) oregano (marjoram) from Turkey was found to contain the 0.119 ppm of the pyrethroid insecticide cyfluthrin.

Summary results of the CAES pesticide residue program from 2003 to 2017 are presented in Figure 1. The three vertical lines represent significant changes made to the program.

Prior to 2006, the CAES used an in house petroleum ether extraction method with gas chromatography and mass spectrometry (GC/MS) analysis. On average, 37 % (1296 samples; 479 with residues) of the samples were found to contain pesticide residues between 2000 and 2005. Of these 479 samples there were 19 (4.0%) samples that contained illegal residues.

Figure 1: Pesticide Residues in Food Sold in Connecticut 2000-2016.



In 2006, several changes were made to our program which included: 1) use of the QuEChERS extraction method to replace our in house method, 2) pesticide analysis by GC/MS *and* LC/MS using new, extremely sensitive instruments, and 3) testing for an increased number of Active Ingredients (AI's).

Between 2006 and 2013, on average 52.9 % (1420 samples; 751 with residues) were found to contain pesticide residues. Of these 751 samples, there were 48 (6.4%) samples which contained illegal residues.

In 2014 as we began to prepare for laboratory accreditation to the ISO/IEC 17025 standard, we thoroughly examined and assessed our program. A large number of changes were made to our program which included: 1) defining the lower limit of reporting (LOR) for a pesticide residue at 10 µg/Kg (ppb) to coincide with the lowest limit at which FDA typically enforces illegal residues[10] and the level employed throughout Europe[11], 2) using multi-level bracketing calibration curves with an internal standard, 3) the use of Guide 34 (now ISO 17034:2016) traceable reference materials to prepare calibration standards, 4) use of appropriately calibrated and verified balances for weighing materials 5) ensuring the GC/MS and LC/HRMS systems used in the analysis are verified prior to use 6) ensuring that method and solvent blanks, sample duplicates, laboratory control samples (LCS) and duplicates (LCSD), and a quality control samples (QCS) are run with each batch of samples on the GC/MS and LC/HRMS systems, 7) tracking the these quality indicators over time.

Between 2014 and 2016, on average 51.6% (279 samples; 144 with residues) of the samples tested were found to contain pesticide residues as can be seen in Figure 1. Of these 144 samples, there were 8 (5.6%) which contained illegal residues.

On December 28, 2016, the Department of Analytical Chemistry (DAC) at the Connecticut Agricultural Experiment Station (CAES) received accreditation to the ISO/IEC 17025:2005 standard from the American Association for Laboratory Accreditation (A2LA) for chemical testing[12] of pesticide residues in food by gas chromatography with mass spectrometry (GC/MS) and liquid chromatography with high resolution mass spectrometry (LC/HRMS). Only the analytes that are tested are reported. Between 2000 and 2005, analysis was performed solely by GC. On average 21 different active ingredients were reported each year. Between 2006 and 2013, the number had risen to 57. By the end of 2016, the CAES routinely tested for 233 different analytes in each sample submitted. Beginning in January of 2017, CAES began testing each sample for approximately 400 individual analytes using ISO 17034:2016 reference materials. The analytes tested are re-verified/validated with each batch of samples tested by determining their percent recovery in spiked LCS, LCSD and QCS samples. This ongoing verification is directly related to our ISO/IEC 17025 accreditation.

It should be noted that the results of all analysis performed at the CAES are reported to the DCP. The DAC at the CAES only performs analytical testing. All regulatory enforcement of illegal samples is performed by the DCP. Enforcement actions (or lack thereof) taken by the DCP, FDA or the USDA are not always communicated back to the CAES. In those cases where CAES is made aware of the outcome (i.e. stop sale, recalls, etc.); details of such are provided in the text. Recalls made by the FDA are available at the FDA Recall, Market Withdrawals and Safety Alerts website[18]. As of this writing, a review of this website indicated that none of the violations in this work related to pesticide residues in food have led the FDA to issue a recall notice in its enforcement reports. Comparisons of the CT program to other Federal programs have been published elsewhere by Krol *et al.* in 2014[2].

Arsenic Testing Program

Arsenic is a naturally occurring element widely found in nature. It is found in combination with either organic or inorganic substances to form many compounds. As such, arsenic is found in air, soil, rocks, water, plants and animals and thus in some of the food we consume. Unlike pesticides, which are added to food by humans, arsenic is largely present in foods owing to the environment. Pesticides are regulated by the FDA which sets the maximum allowable amount (tolerance) allowed in each food commodity. These may be found in the Code of Federal Regulations (CFR)[13]. The FDA also sets action levels for poisonous or deleterious substances to control the levels of contaminants in food[14]. Action levels, like tolerances, are established based on the unavoidability of substances in food. This does not mean they are permissible levels[14]. To date, the only element that has a published action level for food is mercury[14]. The FDA has issued nonbinding action level recommendations for arsenic in bottled water[7], and draft action levels for apple juice[8], and rice cereals for infants[9]. It is worth pointing out the FDA monitors arsenic in foods including rice and juices through its total diet study[15] and monitors arsenic through its toxic element program[16] including foods children eat or drink such as juices[17].

The DAC at the CAES sought and received accreditation for testing arsenic in juice 1) based upon requests for this analysis from the CT DCP, and 2) based on our collaborative work in the Food Emergency Response Network (FERN), and 3) the availability of an appropriate method. To help monitor the levels of arsenic in food sold within the state, the CT DCP provides the CAES with samples of baby food and juice for arsenic analysis. The CAES tests both baby food and juice, however only the juice is performed using an appropriate method conforming to the ISO 17025 standard.

There were 24 samples tested in 2017 as part of the MFRPS contract with DCP. Of these, there were 12 (50%) samples of baby food and 12 (50%) samples of various juices and ciders. Detailed findings are presented in Table 4. Of these 24 samples tested, four (16.7%) were found to contain arsenic above the 10 µg/Kg (ppb) reporting level. There was no arsenic reported in the remaining 20 (83.3%) samples.

In 2017, there were 3 samples of baby food that were found to contain arsenic. All these samples contained multiple ingredients, and all contained rice, the likely source of arsenic contamination[9]. There were two organic baby foods found to contain arsenic. The first sample of organically labeled baby food from New York was found to contain 518 µg/Kg of total arsenic. The first three ingredients listed on this sample were rice products. The second organically labeled baby food was from China, and found to contain 112 µg/Kg of total arsenic. Organic rice flour was listed as the first ingredient. The third sample which was from Michigan was found to contain 13.6 µg/Kg of total arsenic. It is interesting to note that rice was listed near the end of the ingredients list on the package, and that this sample was not labeled as organic. The proposed action level for inorganic arsenic in rice is 100 µg/Kg. At the time of this writing, the CAES has not fully validated total arsenic in baby food. Results of all analysis were reported to the DCP with the annotation "The method of analysis has not been validated for this sample matrix."

There was one sample of non-organic apple cider from Connecticut that was found to contain 15 µg/Kg of total arsenic. The proposed action level for inorganic arsenic in apple juice is 10 µg/Kg[8]. At the time of this writing, the CAES only determines total arsenic as part of our MFRPS contract with DCP. Additional testing would be is required to determine if all the arsenic in this sample was inorganic arsenic. The results of this and all analysis were reported to the DCP.

Conclusions:

In our continuing effort to provide the best possible analytical results for the residents of Connecticut, the DCP and to our FDA partner at the National level, the DAC at the CAES sought and gained accreditation from A2LA to the ISO/IEC 17025 standard. The DAC at the CAES received accreditation for chemical testing of pesticide residues in food by GC/MS, LC/HRMS and for the determination of total arsenic in juice by ICP/MS on December 28, 2016[4]. The current work serves to summarize the analysis performed during the first full year of accreditation to the standard.

Nearly all the food we eat, with the exception of organically grown produce, has been intentionally treated with pesticides during the course of its production. If the pesticides used during the production of this food have been applied in accordance with the approved use of the product, the levels resulting on the food will be below the EPA tolerance. The results of this work allow the consumer to gain a better understanding of the prevalence and levels of pesticide residues in the food they consume.

The overall results of the analysis performed between 2014 and 2016, prior to gaining our accreditation to the ISO standard, have been shown to be nearly identical to the data produced since 2006. Important QC elements introduced into our program since 2014 allow the data that is produced to be validated with each batch of samples tested, ensuring that the findings are correct.

In 2017, the majority of the total residues found (105, 98.1%) were found to be within the tolerances set by the EPA. Of the 104 samples tested, 46 (44.2%) were found to contain pesticide residues.

From 2014 to 2016, 97.3% (321 residues) of the residues found were within tolerance, and 144 (51.6%) of the 279 samples contained residues. Similarly, between 2006 and 2013, when 1420 samples were tested, 751 (52.6%), were found to contain pesticide residues. In contrast, between 2000 and 2005, there were 1296 samples tested; 479 (37%) were found to contain residues. The approximate 15% increase in samples found to contain pesticide residues is directly attributable to the introduction of LC/HRMS in 2006. This technique has the ability to test for analytes that are not amenable to GC analysis, and has been very beneficial to our program.

There are few illegal residues found in the food tested at the CAES. Of the 107 individual residues found in 2017, only two (1.9%) were illegal. Of the 321 residues found from 2014-2016, only 9 (2.8%) were illegal. Of the 1639 residues found from 2006-2013, 55 (3.4%) were illegal, and of the 652 residues found from 2000-2005, 26 (4.0%) were illegal. For the most part, the number of individual violative residues found in the CAES program has been unchanged since 2000.

In the past, the focus of our market basket program had been primarily on testing roughly equal samples that were grown in Connecticut and those grown elsewhere. This allowed residents of the State to decide if they chose to eat food grown in CT or elsewhere based upon the pesticide burden found. In 2012, for instance, 50.2% (107 of 213 samples) were grown within the state. By 2016 only 3 (2.8%) of the 106 samples had been grown within the State. In 2017, only 12 (11.5%) of the 104 samples tested were grown within the state. We note that the determination of sampling regime is made by our regulatory partner, DCP.

Naturally occurring arsenic may be present in some of the foods we consume. The present work lays the groundwork for monitoring the levels of arsenic in juices and baby food (especially those containing rice) available for sale in Connecticut. The organic designation does not seem to be an accurate reflection on the amount of arsenic in a given sample. The amount of arsenic found in samples of baby food tested seems best correlated to the amount of rice contained in the sample. CAES reports total arsenic in a sample to the DCP. The proposed FDA action levels are for inorganic arsenic. At this time, the CAES does not perform arsenic speciation under our laboratory scope of accreditation; this technique determines both organic and inorganic arsenic in a sample. Although some values of arsenic in samples may seem high, they may not truly represent the true amount of inorganic arsenic contained in a sample.

Acknowledgements:

The authors would like to thank our Quality Assurance Manager (QAM), Kitty Prapayotin-Riveros, for developing a database and an ISO compliant quality system. We would like to thank the FDA for funding to achieve and maintain ISO accreditation.

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Table 1: Pesticide Program Summary.

Table 3 Summary:

2017 FRESH TOTALS:	SAMPLES	71	
	WITH RESIDUES	35	(49.3%)
	VIOLATIVE SAMPLES	1	(1.4%)
	ORGANIC SAMPLES	10	(14.1%)
	ORGANIC WITH RESIDUES	2	(20.0%) of org
	ORGANIC VIOLATIVE	0	
	NATIONAL ORGANIC PROGRAM VIOLATION	0	

TOTAL DIFFERENT ACTIVE INGREDIENTS FOUND:	41	
TOTAL NUMBER OF RESIDUES FOUND:	88	
TOTAL NUMBER OF ILLEGAL RESIDUES FOUND:	1	(1.1%) of fresh residues
CONNECTICUT GROWN SAMPLES	11	(15.5%) of fresh samples

Table 4 Summary:

2017 PROCESSED TOTALS:	SAMPLES	33	
	WITH RESIDUES	11	(33.3%)
	VIOLATIVE SAMPLES	1	(3.0%)
	ORGANIC SAMPLES	12	(36.4%)
	ORGANIC WITH RESIDUES	2	(16.7%) of org
	ORGANIC VIOLATIVE	0	
	NATIONAL ORGANIC PROGRAM VIOLATION	0	

TOTAL DIFFERENT ACTIVE INGREDIENTS FOUND:	19	
TOTAL NUMBER OF RESIDUES FOUND:	19	
TOTAL NUMBER OF ILLEGAL RESIDUES FOUND:	1	(5.3%) of proc. residues
CONNECTICUT GROWN SAMPLES	1	(3.0%) of processed samples

2017 Combined Fresh and Processed Summary:

2017 SUM TOTALS:	SAMPLES	104	
	WITH RESIDUES	46	(44.2%)
	VIOLATIVE SAMPLES	2	(1.9%)
	ORGANIC SAMPLES	22	(21.2%)
	ORGANIC WITH RESIDUES	4	(18.2%) of org
	ORGANIC VIOLATIVE	0	
	NATIONAL ORGANIC PROGRAM VIOLATION	0	

TOTAL DIFFERENT ACTIVE INGREDIENTS FOUND:	48	
TOTAL NUMBER OF RESIDUES FOUND:	107	
TOTAL NUMBER OF ILLEGAL RESIDUES FOUND:	2	(1.9%) of residues found
TOTAL FOREIGN SAMPLES	29	
TOTAL SAMPLES OF UNKNOWN ORIGIN	3	
TOTAL US SAMPLES	72	
TOTAL CONNECTICUT GROWN SAMPLES	12	(11.5%) of all samples tested

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Table 2: Arsenic Program Summary.

Table 4 Summary:

2017 PROCESSED TOTALS:	SAMPLES TESTED FOR ARSENIC	24	
	ARSENIC DETECTED	3	(12.5%)
	VIOLATIVE SAMPLES	0	(0%)
	ORGANIC SAMPLES TESTED	9	(37.5%)
	ORGANIC WITH ARSENIC	1	(11.1%) of org
	ORGANIC VIOLATIVE	0	

CONNECTICUT GROWN SAMPLES	1	(4.2%) of processed samples

Table 3: Summary of Pesticides Found in Fresh Fruits and Vegetables Sold in Connecticut in 2017.

Commodity Origin Pesticide	Samples with Residues (Total)	Found by GC or LC or BOTH	Number of Times Detected	Residue Range (ppm)	Average Residue (ppm)	EPA Tolerance (ppm)
Apples (3 Samples, 1 Foreign, 1 Unknown)						
Connecticut	1 (1)					
Acetamiprid		LC	1	0.053		1
Boscalid		LC	1	0.071		3
Pyraclostrobin		LC	1	0.020		1.5
Foreign (Chile)	1 (1)					
Pyrimethanil		BOTH	1	0.514		15
Unknown (US)	1 (1)					
Acetamiprid		LC	1	0.038		1
Artichoke (1 Sample)						
California	1 (1)					
Imidacloprid		LC	1	0.017		2.5
Beans, green (1 Sample)						
Florida	0 (1)					
Blackberries (1 Sample, 1 Foreign)						
Foreign (Mexico)	1 (1)					
Azoxystrobin		LC	1	0.240		10
Bifenazate		LC	1	0.206		1.5
Blueberries (2 Samples, 1 Foreign)						
New Jersey	1 (1)					
Azoxystrobin		LC	1	0.093		5
Phosmet		BOTH	1	0.026		10
Foreign (Chile)	0 (1)					
Bok Choi (1 Sample, 1 Foreign)						
Foreign (Mexico)	1 (1)					
Acetamiprid		LC	1	0.182		15
Indoxacarb		LC	1	0.215		12
Broccoli (2 Samples)						
California	0 (1)					
Maine	1 (1)					
Cypermethrin		GC	1	0.019		14
Permethrin		GC	1	0.094		2
Cabbage (2 Samples, 1 Unknown)						
Connecticut	1 (1)					
Chlorantraniliprole		LC	1	0.025		11
Cyhalothrin, *lambda*		GC	1	0.012		0.4
Unknown	0 (1)					
Cantaloupe (2 Samples, 2 Foreign)						
Foreign (Honduras)	0 (1)					
Foreign (Mexico)	1 (1)					
Methomyl		LC	1	0.011		0.2

Carrot (1 Sample, 1 *Organic*)						
California, *Organic*	0 (1)					
Cassava (Yuca) (2 Samples, 2 Foreign)						
Foreign (Costa Rica)	0 (2)					
Cauliflower (3 Samples)						
California	0 (2)					
Florida	0 (1)					
Celery (1 Sample)						
Florida	1 (1)					
Methamidophos		LC	1	0.014		1
Pyraclostrobin		LC	1	0.012		29
Cilantro (Coriander) (2 Samples, 1 *Organic,* 1 Unknown)						
Iowa, *Organic*	0 (1)					
Unknown (US)	1 (1)					
Azoxystrobin		LC	1	4.30		30
Corn (1 Sample)						
Connecticut	0 (1)					
Cranberries (1 Sample)						
Massachusetts	0 (1)					
Cucumbers (1 Sample)						
New York	0 (1)					
Dill (dillweed) (1 Sample, 1 *Organic*)						
California, *Organic*	1 (1)					
DCPA (Dacthal)		GC	1	0.028	<5% of EPA Tolerance	5
Eggplant (2 Samples, 1 Foreign)						
Connecticut	0 (1)					
Foreign (Mexico)	1 (1)					
Clothianidin		LC	1	0.012		0.2
Cypermethrin		GC	1	0.017		0.2
Permethrin		GC	1	0.135		0.5
Garlic (1 Sample)						
Florida	0 (1)					
Ginger (1 Sample, 1 Foreign)						
Foreign (Costa Rica)	1 (1)					
Fludioxonil		GC	1	0.088		6
Grapes (2 Samples, 1 Foreign, 1 *Organic*)						
California, *Organic*	0 (1)					
Foreign (Chile)	1 (1)					
Fenhexamid		LC	1	0.128		4
Imidacloprid		LC	1	0.095		1
Iprodione		LC	1	0.264		60
Guava (1 Sample, 1 Foreign)						
Foreign (Mexico)	0 (1)					
Kiwifruit (2 Samples, 2 Foreign)						
Foreign (Chile)	0 (1)					
Foreign (Italy)	0 (1)					

Mango (1 Sample, 1 Foreign)				
Foreign (Guatemala) 1 (1)				
Thiabendazole	LC	1	1.03	10
Mushroom (2 Samples, 1 Unknown)				
Pennsylvania 1 (1)				
Permethrin	GC	1	0.010	5
Unknown (US) 1 (1)				
Permethrin	GC	1	0.036	5
Thiabendazole	LC	1	0.152	40
Mustard greens (1 Sample, 1 *Organic*)				
Connecticut *Organic* 0 (1)				
Onion, green (1 Sample, 1 Foreign)				
Foreign (Mexico) 1 (1)				
Methoxyfenozide	LC	1	0.062	5
Parsley (1 Sample, 1 *Organic*)				
California, *Organic* 0 (1)				
Peaches (2 Samples)				
Connecticut 1 (1)				
Acetamiprid	LC	1	0.077	1.2
Cyfluthrin	GC	1	0.016	0.3
Cyprodinil	BOTH	1	0.077	2
Difenoconazole	LC	1	0.024	2.5
Fenbuconazole	GC	1	0.046	1
New Jersey 1 (1)				
Azoxystrobin	LC	1	0.038	2
Boscalid	LC	1	0.123	3.5
Cyfluthrin	GC	1	0.010	0.3
Cyhalothrin, *lambda*	GC	1	0.057	0.5
Cypermethrin	GC	1	0.016	1
Imidacloprid	LC	1	0.018	3
Pyraclostrobin	GC	1	0.068	2.5
Pyridaben	LC	1	0.017	3
Pear (1 Sample)				
California 1 (1)				
Prallethrin	GC	1	0.055	1
Methoxyfenozide	LC	1	0.021	2
Pear, Asian (1 Sample, 1 Unknown)				
Unknown 1 (1)				
Acetamiprid	LC	1	0.024	1
Chlorantraniliprole	LC	1	0.022	1.2
Cyhalothrin, *lambda*	GC	1	0.010	0.3
Fenpropathrin	LC	1	0.010	5
Methoxyfenozide	LC	1	0.034	2
Spirodiclofen	LC	1	0.063	0.8
Pea, sugar snap (1 Sample)				
California 0 (1)				

Pepper, bell (4 Samples, 3 Foreign)					
North Carolina 1 (1)					
Methomyl	LC	1	0.037		2
Foreign (Mexico) 3 (3)					
Azoxystrobin	LC	1	0.029		3
Boscalid	LC	2	0.053-0.060	0.057	3
Clothianidin	LC	2	0.012-0.068	0.040	0.8
Difenoconazole	LC	1	0.024		0.6
Dinotefuran	LC	1	0.011		0.7
Flonicamid	LC	1	0.023		0.4
Imidacloprid	LC	1	0.013		1
Permethrin	GC	1	0.015		0.5
Propamocarb	LC	1	0.059		2
Pyraclostrobin	LC	1	0.038		1.4
Thiamethoxam	LC	1	0.012		0.25
Persimmon (2 Samples, 1 Foreign)					
California 0 (1)					
Foreign (Spain) 0 (1)					
Potato (2 Samples, 1 *Organic*, 2 Unknown)					
Unknown (US) 0 (1)					
Unk (US) *Organic* 1 (1)					
Chlorpropham (CIPC)	GC	1	0.596	<5% of EPA Tolerance	30
Radish (2 Samples)					
Connecticut 0 (1)					
Florida 0 (1)					
Sage (1 Sample, 1 Foreign, **1 Violation**)					
Foreign (Mexico) 1 (1)					
Azoxystrobin	LC	1	31.9		50
Boscalid	LC	1	0.038		150
Cyprodinil	LC	1	0.054		3
Forchlorfenuron	**LC**	**1**	**0.015**	**NO TOLERANCE**	**0**
Imidacloprid	LC	1	0.427		8
Trifloxystrobin	LC	1	7.10		200
Spinach (1 Sample)					
California 1 (1)					
Clothianidin	LC	1	0.024		3
Cypermethrin	GC	1	0.137		14
Mandipropamid	LC	1	0.426		20
Permethrin	GC	1	0.692		20
Squash, summer (2 Samples, 1 Foreign)					
Connecticut 0 (1)					
Foreign (Mexico) 1 (1)					
Imidacloprid	LC	1	0.04		3.5
Propamocarb	LC	1	0.411		1.5

Strawberries (2 samples, 1 *Organic*)					
California	1 (1)				
Boscalid		LC	1	0.010	3
Bifenazate		LC	1	0.282	1.5
Triflumizole		LC	1	0.036	2.5
California, *Organic*	0 (1)				
Sweet potato (1 Sample, 1 Unknown)					
Unknown (US)	0 (1)				
Swiss chard (Rainbow) (1 Sample, 1 *Organic*)					
Connecticut *Organic*	0 (1)				
Tangelo (Minneola) (1 Sample, 1 Unknown)					
Unknown (US)	1 (1)				
Azoxystrobin		LC	1	0.011	15
Fludioxonil		LC	1	0.769	5
Thiabendazole		LC	1	1.69	10
Tomatillo (1 Sample)					
Connecticut	0 (1)				
Tomato (1 Sample)					
New York	1 (1)				
Acetamiprid		LC	1	0.022	0.2
Turnip greens (1 Sample, 1 *Organic*)					
Connecticut	0 (1)				
Watermelon (1 Sample, 1 Foreign)					
Foreign (Guatemala)	0 (1)				

Table 4: Pesticide Residues and Arsenic Found in Processed Foods Sold in Connecticut in 2017.

Commodity Origin Analyte	Samples with Residues (Total)	GC - LC or BOTH or ICP	Number of Times Detected	Residue Range (ppm)	Average Residue (ppm)	EPA Tolerance (ppm)	Validated or Not Validated
Baby Food (11 Samples, 1 Foreign, 4 *Organic*, 6 Unknown, 1 Only Arsenic)							
Apple (3 Samples, 1 *Organic*, 2 Unknown)							
New York, *Organic*	0 (1)						
Arsenic	0 (1)	ICP	1	< 0.010			NV
Unknown (US)	1 (2)						
Acetamiprid		LC	1	0.017		1	
Arsenic	0 (2)	ICP	2	< 0.010			V (1) - NV (1)
Carrots (1 Sample)							
Michigan	0 (1)						
Arsenic	1 (1)	ICP	1	0.014			V
Peach Yogurt (1 Sample for Arsenic Only)							
California							
Arsenic	0 (1)	ICP	1	< 0.010			NV
Pear (1 Sample, 1 *Organic*, 1 Unknown)							
Unknown (US)	0 (1)						
Arsenic	0 (1)	ICP	1	< 0.010			NV
Rice Cakes (2 samples, 2 *Organic*, 1 Foreign, 1 Unknown)							
New York, *Organic*	0 (1)						
Arsenic	1 (1)	ICP	1	0.518		0.1	NV
Foreign, Unk, *Org*	0 (1)						
Arsenic	1 (1)	ICP	1	0.112		0.1	NV
Sweet Potato (2 Samples, 1 Unknown)							
Michigan	0 (1)						
Arsenic	0 (1)	ICP	1	< 0.010			NV
Unknown (US)	0 (1)						
Arsenic	0 (1)	ICP	1	< 0.010			NV
Wheat Cakes (2 Samples, 1 Unknown)							
Michigan	0 (1)						
Arsenic	0 (1)	ICP	1	< 0.010			NV
Unknown (US)	1 (1)						
Pyrimethanil		BOTH	1	0.053		3	
Arsenic	0 (1)	ICP	1	< 0.010			NV
Fruits, Vegetables, Spices (11 Samples, 4 Foreign, 4 *Organic,* 1 Unknown **1 Violation**)							
Blueberries (2 Samples, 1 Foreign, 1 *Organic*)							
North Carolina	0 (1)						
Foreign (Argentina)							
Organic	0 (1)						

Celery (1 Sample)							
California	1 (1)						
Acephate		LC	1	0.168		10	
Methamidophos		LC	1	0.010		1	
Celery, seed (1 Sample, 1 Unknown)							
Unknown	0 (1)						
Chili Powder (1 Sample, 1 Foreign)							
Foreign (Spain)	1 (1)						
Boscalid		LC	1	0.024		3	
Chlorpyrifos		GC	1	0.054		1	
Propiconazole		LC	1	0.027		1.3	
Tebuconazole		BOTH	1	0.105		0.2	
Nutmeg, ground (1 Sample, 1 *Organic*)							
Iowa	0 (1)						
Oregano leaves (1 Sample, 1 Foreign, **1 Violation**)							
Foreign (Turkey)	1 (1)						
Cyfluthrin		**GC**	**1**	**0.119**	**NO TOLERANCE**	**0**	
Pyriproxyfen		LC	1	0.074		100	
Salad Mix (1 Sample, 1 *Organic*)							
California, *Organic*	1 (1)						
Spinosad		LC	1	0.012	<5% of EPA Tolerance	8	
Soybeans (1 Sample, 1 Foreign, 1 *Organic*)							
Foreign (China)	0 (1)						
Sweet Potato (1 Sample)							
North Carolina	0 (1)						
Watermelon (1 Sample)							
Georgia	0 (1)						

Juices/Ciders/Beverages (11 Samples; 1 Foreign; 4 *Organic*, 1 Unknown, 1 Only Arsenic)

Apple Cider (1 Sample)							
Connecticut	1 (1)						
Diphenylamine		Both	1	0.025		30	
Thiabendazole		LC	1	0.104		12	
Arsenic	0 (1)	ICP	1	0.014		0.01	V
Black Currant / Juice (1 Sample, 1 Foreign)							
Foreign (England)	0 (1)						
Arsenic	0 (1)	ICP	1	< 0.010			V
Carrot & Orange / Juice (1 Sample, 1 *Organic*)							
Florida	0 (1)						
Arsenic	0 (1)	ICP	1	<0.010			V
Mango – Passion Fruit / Juice (1 Sample)							
New Jersey	0 (1)						
Arsenic	0 (1)	ICP	1	< 0.010			V

Mixed Natural Fruit Juices (6 Samples, 3 *Organic*)							
California (5 Samples, 3 *Organic*)							
California	2 (2)						
Fludioxonil		GC	1	0.071		20	
Prallethrin		GC	1	0.072		1	
Propyzamide		GC	1	0.027		0.1	
Arsenic	0 (2)	ICP	2	< 0.010			V
California, *Organic*	1 (3)						
Propamocarb		LC	1	0.010	<5% of EPA Tolerance	1.5	
Arsenic	0 (3)	ICP	3	< 0.010			V
California (1 Sample for Arsenic Only)							
Arsenic	0 (1)	ICP	1	< 0.010			V
New York	0 (1)						
Arsenic	0 (1)	ICP		< 0.010			NV
Vegetable Juice (1 Sample, 1 Unknown)							
Unknown (US)	1 (1)						
Bifenthrin		GC	1	0.011		0.45	
Permethrin		GC	1	0.017		2	
Arsenic	0 (1)	ICP		< 0.010			V