Pesticide Residues in Produce Sold in Connecticut in 2012 and 2013

Walter J. Krol, Ph.D., Brian D. Eitzer Ph.D., Terri Arsenault, and Jason C. White, Ph.D.
Department of Analytical Chemistry

Ellen Sloan
Connecticut Department of Consumer Protection
Food and Standards Division
165 Capitol Avenue
Hartford, CT 06106

The Connecticut Agricultural Experiment Station
New Haven, CT

Technical Bulletin 12

April 2015

Introduction:

The Department of Analytical Chemistry at the Connecticut Agricultural Experiment Station (CAES), has collaboratively conducted an annual market basket survey of produce sold in Connecticut for pesticide residues with the Connecticut (CT) Department of Consumer Protection (DCP), and published the findings, at least in part, since 1963 (Krol *et al.*, 2006). The goals of this program were and are: 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.

Enforcement of the Environmental Protection Agency (EPA) mandated pesticide residue tolerances require both the Food and Drug Administration (FDA) and DCP to know the amount of specific pesticide residues present in foodstuffs offered for sale[1]. In Connecticut, the DCP relies upon the analysis performed within the Department of Analytical Chemistry at the CAES to determine these in foods sold within the state. The Connecticut survey concentrates on fresh produce grown in this state, but also includes fresh produce from other states and foreign countries, as well as processed food. In 2012 samples were obtained from 81 Connecticut farms, producers, retailers, and wholesale outlets located in 58 different towns and cities. In 2013 there were five samples were collected from two retailers in one town. The program determines if the amounts and types of pesticides found food products adhere to the tolerances set by the EPA. These tolerances are continually updated and available in the electronic Code of Federal Regulations (e-CFR, 2012).

Violations of the 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. 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 Hartford 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 (*Vide Infra*).

The current work reports upon the results of the 213 samples tested during the 2012 calendar year (January 1st through December 31st). There were 131 samples of fresh and 82 samples of processed food analyzed. An additional five samples were tested in the 2013 calendar year. None of the samples in the current study underwent concurrent microbiological screening at the CT Department of Public Health (DPH) owing to a continued lack of funding. The mycotoxin patulin, which is potentially present in apple ciders or juices prepared from decaying apples, was added to our survey in 2012, and the findings are included in this report. All juice and cider samples are also tested for preservatives, and these findings are also reported herein.

Methods

Sample Collection:

Samples of produce grown in Connecticut, other states, and foreign countries were collected at 81 different Connecticut farms, producers, retailers, and wholesale outlets in 2012 and two in 2013 by inspectors from the DCP. The 213 samples collected in 2013 and five in 2013 were brought to our laboratory in New Haven by inspectors for pesticide residue testing. As with all samples in this survey, test items were collected without prior knowledge of pesticide application.

[1] **For a more complete overview of the Federal Agencies involved, their roles, and a discussion on tolerances see Krol *et al.*, 2006 and the references cited therein.**

A) Pesticide Methods:

i. Sample Homogenization:

In all cases, samples were processed according to the Pesticide Analytical Manual (PAM, 1994). The vast majority of the samples were prepared in their natural state as received, unwashed and unpeeled. Whole food samples were homogenized prior to extraction using a Hobart Food Chopper, a commercial Waring® blender with an explosion proof motor or with a 3 quart robot coupe® food processor. Liquid and powdered samples were mixed thoroughly prior to sub-sampling for extraction. In all cases, a portion of each sample (ca 500 g) was retained in either a refrigerated or frozen state in its original packaging or in plastic Whirl-Pak® bags until analysis and reporting of the results were completed.

ii. Sample Extraction:

The Quick, Easy, Cheap, Effective, Rugged, Safe (QuEChERS; pronounced "catchers") multi-residue extraction methodology described by Anastassiades et al. (Anastassiades, 2003; AOAC, 2007; Method 2007.01) was modified for this work. A 15 g sub sample of homogenized material was weighed into a 50 mL disposable polypropylene centrifuge tube. [U-ring]-$^{13}C_6$-Alachlor Internal Standard (IS) (60 µL of 10 part per million [ppm] solution in toluene; i.e. 600 ng/15g), prepared from material purchased from Cambridge Isotope Laboratories, anhydrous magnesium sulfate (6 g), anhydrous sodium acetate (1.5 g) and acetonitrile (15 mL) all available from Mallinckrodt Baker, Inc., were added. The mixture was shaken on a Burrell Model 75 Wrist Action Shaker (ca 1h). The mixture was centrifuged using a Thermo IEC Centra GP6 Centrifuge at 3000 rpm for 10 min to separate the acetonitrile from the aqueous phase and solids. Acetonitrile (10 mL) was decanted into a 15 mL polypropylene Falcon® centrifuge tube containing magnesium sulfate (1.5 g), together with Primary and Secondary Amine (PSA) bonded silica (0.5 g) and toluene (2.0 mL). The mixture was shaken by hand (ca 5 min) and centrifuged at 3000 rpm for 10 min. Exactly 6.0 mL of the extract was added to a concentrator tube and blown down to just under 1 mL (but not to dryness) under a stream of nitrogen at 50 °C. The concentrated material was reconstituted to a final volume of 1.0 mL with toluene. It should be noted that this extraction method results in a five-fold concentration of the original sample.

iii. Instrumental Analysis:

Samples extracted by the QuEChERS method were concomitantly analyzed by Gas Chromatography (GC) and Liquid Chromatography (LC). In 2012, the GC analysis was performed using an Agilent 6890 plus GC equipped with: dual 7683 series injectors and a 7683 auto sampler (collectively known as an Automatic Liquid Sampler (ALS)); Agilent model number G2397A micro Electron Capture Detector (µECD) and a 5973 Mass Spectral (MS) Detector; a Programmable Temperature Vaporization (PTV) port on the front inlet leading to the MS, and a Merlin MicroSeal® system on the rear inlet leading to the µECD; dual J&W Scientific DB-5MS+DG (30 m x 250 µm x 0.25 µm) columns. Two (2) microliter injections were made simultaneously onto both columns, and all data were collected and analyzed using Enhanced MSD Chemstation Software version E.02.00.493. Deconvolution and identification of pesticides in the mass spectra of samples were aided by the use of the Automated Mass spectral Deconvolution and Identification System (AMDIS) with a user constructed library.

Beginning in 2013, the GC analysis was performed employing a Thermo Scientific Trace GC Ultra GC equipped with a Thermo Scientific TriPlus RSH Auto sampler and Thermo Scientific TSQ Quantum XLS Ultra Triple Quadrapole MS. The GC was equipped with a PTV inlet leading to Thermo Scientific 2m x 530 µm/680 µm silica VSD tubing used for backflush which leads directly into a Restek Rtx®-5MS w/Integra-Guard® (Crossbond® 5% diphenyl / 95% dimethyl polysiloxane) 60 meter; 0.25 mm ID; 0.25 µm column with helium carrier gas at a constant flow of 2.0 mL/min. The column effluent was fed through the transfer line (250 ^{0}C) and into the MS. Data was acquired in both full scan and Selected Reaction Monitoring (SRM) mode, monitoring at least two transitions for all analytes employing either Xcalibur® 2.2 SP1.48 or TraceFinder™ EFS 2.1.366.12 software.

The LC analyses were made using an Agilent 1100 High Pressure Liquid Chromatograph (HPLC) equipped with a Zorbax® SB-C18 (2.1 mm x 150 mm, 5µ) column; 3µL injection volume; flow rate 0.25 mL/min; gradient flow 87.5% A (H_2O/0.1N HCOOH) to B (100% MeOH/0.1N HCOOH) over 20 min; hold

100% B for 10 min. The column eluent was interfaced to a Thermo-Electron LTQ ion trap mass spectrometer. The mass spectrometer was operated in the positive ion electrospray mode with most pesticides being determined using MS/MS selective reaction monitoring. Data were collected and analyzed using Xcalibur® software version 2.0. Alternatively and usually concurrently, LC analyses were also made employing a Thermo Scientific Exactive Orbitrap MS run by Thermo Xcalibur® version 2.1.0.1140 with ToxID® version 2.1.2. The software controlled the MS and the Agilent 1200 Series HPLC used for the chromatographic resolution. The HPLC was equipped with a Zorbax® CB-C18 (2.1 mm x 150 mm, 1.8µ) column; 2µL injection volume; flow rate 0.25 mL/min; column temperature 40 ℃; gradient flow: initial 99% A (water with 0.1% formic acid), 1% B (acetonitrile with 1% formic acid), hold 1 min, 1-10 min 99% A to 5% A, hold 5 min, 15.1 – 21.5 min 99% A. The column eluent was interfaced to the MS. The mass resolution was set to 100,000 with balanced settings and an injection time of 20 milliseconds (ms). The mass range of 75 – 1500 atomic mass units (amu) was monitored.

iv. Detection Limit of Pesticide Residues

All pesticide residue levels are reported in parts per million (ppm) based upon the fact that the EPA tolerance levels are established using this convention. The CAES reports all pesticide residues which are confirmed by MS to an arbitrarily set lower limit of 0.001 ppm (one part per billion [ppb]). There are many pesticide residues seen below this level, especially using LC/MS, that are not included in this work. We are currently working to establish limits of detection (LOD) and limits of quantitation (LOQ) for individual pesticide Active Ingredients (AI's) as part of our laboratories' progression toward ISO 17025:2005 accreditation.

v. Reproducibility of Results:

All samples examined in this work were individually homogenized, extracted and analyzed by GC and LC once. Statistical analysis obtained through inter and intra-laboratory studies over a wide range of pesticides, pesticide concentrations, and matrices have demonstrated that this is sufficient to obtain accurate quantitation of pesticide residue concentrations from the extract of a single sample (AOAC, 2007; Method 2007.01). Further proof of this was obtained in unpublished work conducted in our laboratories on violative samples. All violative samples were re-extracted, analyzed, and quantitated in duplicate using portions of the original food sample retained from homogenization step. One of the duplicate samples was spiked with the pesticide(s) in question at a concentration slightly above the originally determined value. Quantitative values of these extracts were compared to the concentration found in the original analysis. High resolution (four decimal) exact mass spectra are obtained, employing the Exactive MS, as confirmation of all violative residues.

Results and Discussion

As part of the 2012 pesticide residue program, a total of 213 samples were tested. There were 131 samples of fresh (61.5%) and 82 samples of processed (38.5%) foods. The findings of the 2012 pesticide residue surveillance survey are detailed in Table 1 for fresh, and Table 2 for processed foods. Of the 213 samples tested, 162 (76.1%) were found to contain residues of at least one pesticide while the remaining 51 (23.9%) were found to be free of any detectible residues. Pesticide residues were found in 112 (85.5%) of the 131 samples of fresh produce and 50 (61.0%) of the 82 samples of processed foods tested. A total of 589 pesticides comprised of 77 different AI's were found during the course of this work; 36 different AI's were determined by GC/MS and 60 by LC/MS. The mycotoxin patulin was found in 10 (58.8%) of the 17 apple cider or juice samples. This testing was performed by LC/MS. In all cases the levels of patulin found were below the allowable levels set by the EPA. The preservative sodium benzoate was not found in any of the 22 cider or juice samples tested, whereas potassium sorbate was found 13 (59.0%) times.

The number of residues and different AI's found in 2012 once again surpass those found in any other previous year of this study. Of the 162 samples containing residues, 136 (63.8% of the total samples) contained permissible (non-violative) residues, and 26 (12.2% of the total samples) contained 33 residues which were not allowed (violative samples). There were 17 (13.0% of the total fresh samples) violative samples of fresh and 9 (11.0% of the total processed food samples) on processed foods. One of the violative fresh samples was marketed as organic and five on processed foods was marketed as such.

It should be noted that the results of all analysis performed at the CAES were forwarded to the DCP. The laboratories at the CAES solely perform the analytical analysis of samples on behalf of the DCP, wherein all regulatory authority lies. 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: http://www.fda.gov/Safety/Recalls/. 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.

There were a total of 33 illegal residues found on the 26 violative samples. All of the illegal residues found were no tolerance violations. Violations were found on an organic fresh sample of basil (1 Columbia), and on fresh samples of beans (1 CT), bok choi (1 CT), broccoli (1 CT), cucumbers (1 CT), eggplant (2 CT), nectarines (2 CT), peaches (1 CT), pears (2 CT), snow peas (1 Guatemala), tomatoes (2 CT), turnips (1 Massachusetts) and yellow yam (1 Jamaica). There were five violations found on organically labeled processed samples of apple baby food (1 Canada), peach baby food (1 US), mushrooms (1 China), peppers (1 China) and soybean or edamame (1 China). The remaining five violations were found on processed arugula (1 Florida), apples (1 Unknown), and black currant juice (1 CT, 1 England, 1 Poland).

A sample of green snap beans was found to contain residues of the insecticide fipronil (0.008 ppm). Fipronil is commonly used to manage fleas and ticks on dogs and cats, and has very few food uses. This sample may have been contaminated during harvest by someone that came in contact with an animal to which this had been applied. The bok choi sample contained residues of atrazine (0.002 ppm) and endosulfan (0.060 ppm). Atrazine is widely used in the production of corn to control unwanted weeds. It is also persistent in the soil to which it is applied and based upon unpublished results obtained in this laboratory and others may persist from one growing season to another (see Krol *et al.*, 2006). The broccoli sample was found to contain low levels of the acephate (0.009 ppm) and the cucumbers were found to contain *lambda* cyhalothrin (0.086 ppm). Both these chemicals are insecticides.

The two samples of eggplant were produced by separate growers and contained residues of the fungicide iprodione (0.007 ppm) and the insecticide acephate (0.286 ppm), respectively. It is interesting to note that the broccoli sample above and one of these eggplant samples were produced by the same grower. Both samples contained acephate indicating either intentional misapplication or overspray from crops on which it is allowed. There were two samples of nectarines from two separate growers that contained illegal residues. The first sample contained residues of the fungicide thiophanate methyl (0.145 ppm), and the second contained residues of the synergist piperonyl butoxide (0.174 ppm). Piperonyl butoxide is used to enhance the activity of pyrethroid insecticides. No pyrethroid insecticides were detected during the testing. The grower indicated that no pyrethroids were applied to the crop, and the presence of piperonyl butoxide is a mystery. A sample of peaches grown in Connecticut was found to contain the fungicide diphenylamine (0.013 ppm). Although diphenylamine is approved for use on apples and pears, it has no tolerance on peaches. It appears to have been inadvertently applied to this sample, perhaps through overspray or contamination in the processing of the fruit. Two samples of pears from two separate growers contained three violative residues. The fungicide myclobutanil (0.023 ppm) was found once, and the fungicide fenbuconazole twice (0.002 and 0.005 ppm). Fenbuconazole is allowed on apples and stone fruit, but not on pears. Owing to the low residue levels found, is presence in these samples is likely due to overspray.

A sample of snow peas from Guatemala was found to contain residues of the fungicide tebuconazole (0.017 ppm). Tebuconazole is not permitted on snow peas. We have reported several findings in the past of illegal residues found on snow peas from Guatemala (Krol et al. 2006 and 2007). The consumer should be aware that snow peas from Guatemala have a history of arriving to the US marketplace containing illegal pesticide residues. The results of this analysis were communicated to the DCP, and were in turn forwarded to the FDA.

There were two samples of tomatoes tested that contained three separate violative residues. The first sample contained residues of acephate (0.003 ppm) which is not allowed and resulted in a no tolerance violation. The second sample contained residues of insecticide methiocarb (0.027 ppm) and

diethyltoluamide (DEET) (0.04 ppm). These residues are both highly anomalous. Methiocarb was banned from use in October of 1998 and has no US tolerances. DEET is an insecticide which has no food uses, but is commonly found in insect repellants. Its presence indicates potential worker cross contamination of the sample. When the grower was approached by the DEEP, he proved to be uncooperative regarding an explanation as to how these chemicals got into the food.

A sample of turnips from Massachusetts was found to contain low levels of the plant regulator and herbicide chlorpropham (0.003 ppm). There is no tolerance for chlorpropham on turnips. Chlorpropham may have resulted from cross contamination from an application on potatoes, a commodity on which its use is permitted. This turnip sample also contained residues of the herbicide fenuron (0.002 ppm). There was no standard available for the quantification of this material. While it is a violative residue, it was not reported as such for regulatory evaluation since its concentration in the sample could not be determined. The final violative sample on fresh produce was on a sample of yellow yam from Jamaica which was found to contain residues of the fungicides thiophanate methyl (0.324 ppm) and Dicloran (4.52 ppm). These fungicides are not allowed on yam and resulted in no tolerance violations. The results of these analyses were communicated to the DCP, and were in turn forwarded to the FDA.

The processed arugula sample from Florida was found to have low, but violative levels of the herbicide bromacil (0.006 ppm). It is interesting to note that this sample also has low levels of the herbicide atrazine present (0.001 ppm). Both these herbicides are known to be persistent in soil (Krol *et al.*, 2006; Leistra *et al.*, 1975). It is likely that both were taken up from the soil following applications which were made in previous growing seasons. There was a sample of apple cider of unknown origin in which the insecticide dimethoate was found (0.002 ppm). The low level suggests that it may have been overspray from an application to pears in the same orchard. This sample was also found to contain the mycotoxin patulin (0.003 ppm). A discussion about patulin is presented below. A sample of black currant juice from Connecticut was found to contain residues of the fungicide thiophanate methyl (0.022 ppm) and a sample from Poland was found to contain the thiophanate methyl metabolite carbendazim (0.004 ppm). Neither of these has a US tolerance on black currant.

Organic Samples

A total of 31 residues of 22 different AI's were found on 16 (37.2%) of the 43 organically grown food samples tested as part of this study. Eight residues on six of these samples were in violation of the National Organic Program (NOP) exclusion from sale provision specifically related to pesticide residue testing. Five of the six organic violations were on processed food. The NOP provision, in general terms, states that pesticide residues are allowed on organic produce provided that the residues are at levels below five percent (5%) of the EPA tolerance for the specific residue on the specific crop[2] *(*NOP, 2004).

The levels of pesticide AI found on the organic samples ranged from 0.001 to 0.089 ppm with an average value of 0.010 ppm. From 2001 – 2005, before the introduction on QuEChERS, on average 13.5% of the total organic samples tested in that timeframe were found to contain residues at an average level of 0.082 ppm. From 2006 – 2011, employing the QuEChERS protocol, on average 23.6% of the organic samples tested were found to contain residues at an average residue level of 0.013 ppm.

Of the 43 organic samples tested, 6 (14.0%) were fresh and 37 (86.0%) were processed. Four of the six fresh samples were found to contain pesticide residues. There was one residue of cadusafos (0.017 ppm) found on fresh, organically labeled basil from Columbia. There is zero tolerance for cadusafos on basil, which resulted in the single no tolerance violation of fresh produce. This residue was also a violation

[2] NOP Title 7 Part 205 § 205.671 Exclusion from organic sale states: 'When residue testing detects prohibited substances at levels that are greater than 5 percent of the Environmental Protection Agency's tolerance for the specific residue detected or unavoidable residual contamination, the agricultural product must not be sold, labeled, or represented as organically produced. The Administrator, the applicable State organic program's governing State official, or the certifying agent may conduct an investigation of the certified operation to determine the cause of the prohibited substance.' See also: Krol *et al.*, 2006 for a more comprehensive discussion of the NOP.

of the NOP provision since it was greater than 5% above the zero tolerance. There were eight residues on three other fresh samples that were below five percent of the EPA tolerance and complied with the NOP provision (see Table 2).

The remaining 22 residues were found on twelve samples of processed food. There were seven residues found on five samples that were in violation of the NOP provision. A sample of sweet potato organic baby food from Canada contained residues of amitraz (0.005 ppm). A sample of peach baby food from the US contained the fungicide thiabendazole (0.003 ppm). There were three samples of frozen food from China that contained the five other violative resides. A sample of soybean, contained residues of chlorantraniliprole (0.002 ppm); a pepper sample contained residues of carbofuran (0.001 ppm), carbosulfan (0.001 ppm) and metolacarb (0.002 ppm); and a mushroom sample that contained residues of carbendazim (0.004 ppm). The remaining fifteen residues were all less than five percent of their respective tolerance.

Mycotoxin Screening

In 2012 we began testing all apple cider and juice samples for the mycotoxin patulin. Patulin is produced by *Penicillium, Aspergillus and Byssochylamys* spp. molds, and particularly by *Penicillium expansum*, which is a common pathogen in postharvest apples and pears (Hopmans, 1997). Fruits decayed by these molds are likely to contain patulin. Patulin is destroyed by fermentation, and as such not found in alcoholic fruit beverages or vinegars produced from fruit juices. Patulin is only moderately degraded by thermal processing, thus when present in apple juice, will survive pasteurization (McKinley, 1981).

Patulin is toxic upon oral administration at doses around 1.5 mg/Kg of body weight (bw), causing premature death in rats (Becci *et al.*, 1981). Following an independent study conducted by the FDA, an action level of 0.050 mg/Kg (ppm) was established (FDA, 2013).

In 2012, there were a total of 17 samples of apple juices and ciders tested as part of our program. Of these, patulin was detected a total of 10 times (58.8%) ranging in concentration ranging from 0.002 – 0.010 µg/Kg (ppb), at an average concentration of 0.006 µg/Kg, well below the action level set by the FDA.

Preservative Analysis

In addition to the pesticide analysis performed at the CAES we routinely perform analysis for potassium sorbate and sodium benzoate on samples of juices and ciders to help enforce labeling laws; these results are included in Table 2. These chemicals are routinely used in foods to preserve freshness by inhibiting mold growth and preventing spoilage and are Generally Recognized as Safe (GRAS) by the FDA (GRAS, 2010). Because they are introduced into food, they must also be declared on the label of the container as an additive. The maximum amount of sodium benzoate that can be added to food is 0.1% (Pylypiw *et al.; 2000;* e-CFR Sodium Benzoate, 2006) whereas potassium sorbate is typically used at 0.1 – 0.2% (Pylypiw *et al., 2000*; e-CFR Potassium Sorbate, 2010). In 2012, a total of twenty two (22) samples were tested. Neither of these preservatives was found in any of the samples of carrot juice (2) tested. Potassium sorbate (0.048%) was found in one of the three samples of black currant juice tested. Of the seventeen (17) apple juices and ciders tested, 12 were found to contain potassium sorbate (0.004 – 0.054%) and none were found to contain sodium benzoate. In all cases where the potassium sorbate was found it had been appropriately declared as an additive on its label. The levels found were all below the legally allowed limits.

2013 Findings

In 2013 as part of the pesticide residue program, a total of five samples were tested. There were three samples of fresh (60.0%) and two (40%) processed samples tested. Pesticide residues were found on four (80%) of the five samples tested. There was a total of thirteen residues found comprised of eleven different active ingredients. There was one violative residue found on a sample of fresh strawberries from Florida. The sample was found to contain 0.101 ppm of the insecticide dichlorvos which is not allowed on

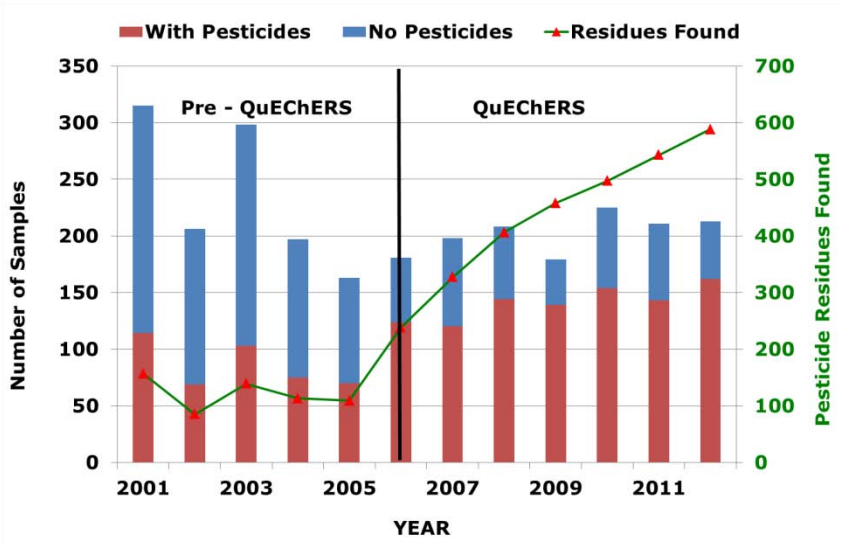
strawberries. The results of the 2013 findings are presented in tables 3 and 4 for fresh and processed samples respectively.

The number of samples tested in 2013 was by far the fewest ever reported since the inception of this survey. The reason for this remains unclear. As a requirement of our ISO 17025:2005 accreditation work, an agreement has been established between the DCP and the DAC at the CAES on the number of samples to be tested in future years of this program. Owing to the statistical variability associated with such a small sample size the 2013 data was not included in any calculations associated with Figure 1 or Figure 2.

Program Improvements

Summary results of the CAES pesticide residue program from 2001 to 2012 are presented in Figure 1. A discernible change in the data is obvious in 2006. Changes to our program in 2006 included 1) testing for a larger number of pesticide AI's 2) use of the QuEChERS extraction method, and 3) use of simultaneous GC/MS and LC/MS detection. The average number of samples containing pesticide residues increased from 36.6% (1179 samples; 431 with pesticides) pre QuEChERS (2001 – 2005) to 69.7% (1415 samples; 986 with pesticides) in the QuEChERS timeframe (2006 – 2012) (primary axis). The average number of pesticide residues found per year increased from 121 (603 total from 2001 – 2005) to 437 (3057 total from 2006 – 2012). The green line in Figure 1 (secondary axis) shows the change in the number of pesticide residues found each year. Since the program improvements in 2006, on average each year 58 additional residues from the previous year have been found. There were 26 (12.2%) samples in which violative residues were found in 2012. In the pre-QuEChERS timeframe 1.52% (18 samples of 1179 total) of the samples tested were found to be violative, and in the QuEChERS timeframe, 7.70% (109 samples of 1415 total) of the samples tested were found to be violative.

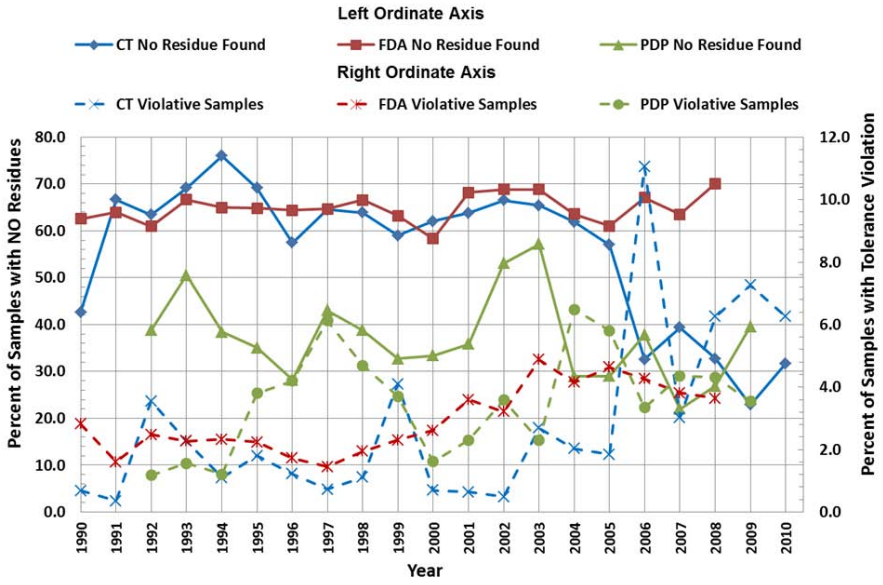
Figure 1: Pesticide Residues in Food Sold in Connecticut 2001-2012.



The number of different AI's found on samples containing pesticides has increased from 1.4 in the pre-QuEChERS timeframe to 3.0 in the QuEChERS timeframe. It should be observed that the results in all reports to date only include residues found above 0.001 ppm. This is an arbitrary lower limit set by the CAES for reporting. There are many instances in which pesticides are observed below this limit but are not reported. As part of our ongoing laboratory accreditation efforts, we will be performing validation studies to obtain limits of detection (LOD's) and limits of quantification (LOQ's) for each individual pesticide AI studied.

It is noteworthy that there is not a significant difference in the proportions of pesticide residue-free samples, 63.3% reported by CT (n=4871) and 64.2% reported by FDA (FDA, 1993-2008) (n=167215) (Figure 2), over the 16-year timeframe from 1990-2005 when the data are compared using a z-test (P=0.230; z=1.200) (Krol *et al.*, 2013). As can be seen in Figure 2, beginning in 2006, the FDA and CT surveys dramatically diverge, and the results of the CT survey more closely matches those of the targeted, commodity specific, USDA Pesticide Data Program (PDP) (USDA PDP, 1992-2009). On average, over the three years 2006–2008, the QuEChERS protocol in the CT survey found that 36.3% of the samples contained no residues, compared to 66.9% reported by the FDA. During this same timeframe the CT violation rate was 6.9% as compared to the 3.9% reported by the FDA.

Figure 2: Comparison of the CT, FDA and PDP Programs.



A z-test comparison was made between the CT data obtained by the QuEChERS protocol (776 samples) and the targeted PDP data (40726 samples) between 2006 and 2009. The proportions of pesticide residue-free groups in the two studies were found to be statistically significant (P=0.783; z=0.275) (Krol *et al.*, 2013).

International Standard for Organization (ISO) 17025:2005 Accreditation

Laboratories use ISO 17025:2005 to implement a quality system which is aimed at improving their ability to produce valid results. Because the focus of the standard is about competence, accreditation may simply be viewed as a formal recognition of a demonstration of that competence.

Owing, in part to the unique role that the CAES plays in the Food Emergency Response Network (FERN), and for testing manufactured food on behalf of the CT DCP, the DAC at the CAES was awarded a grant under the FDA manufactured food program to pursue ISO 17205:2005 accreditation in 2010. A second, five year award was granted by the FDA in 2011.

To aid in the accreditation process, the DAC at the CAES has hired a Quality Assurance Manager, (QAM) and additional Research Technician. In 2013, a Thermo Scientific Ultra GC triple quadrapole instrument and obtained a Thermo Scientific Velos LC ion trap instrument were also acquired as part of the accreditation process.

Conclusions:

In 2012, once again, a greater number of AI's (80) and pesticide residues (589) were detected than in any other year in our survey. The vast majority of total residues found (556; 94.4%) were found to be within the tolerances set by the EPA. Of the 213 samples analyzed tested, 162 (76.1%) were found to contain pesticide residues. Residues were found in 112 (85.5%) of the fresh, 50 (61.0%) of the processed and 6 (14.0%) of the organic samples tested. In 2013 only five samples were tested, one of which was found to be violative.

The mycotoxin patulin was added to our survey in 2012 during the testing of ciders and juices. Patulin was found in 10 of the 17 (58.8%) of the apple ciders and juices tested. The levels found were far less than the FDA action level of 0.050 µg/Kg (ppm).

Testing for two of the most commonly added preservatives, potassium sorbate and sodium benzoate was also analyzed in all ciders and juices. Of the 22 samples tested, 13 (59.1%) were found to contain potassium sorbate. The levels of potassium sorbate found were all below the allowable limits of 0.1-0.2%.

In the past, owing to the sensitivity and specificity of the instruments used at the CAES for analysis, many of the residues we are now capable of observing have gone undetected in the past. The results obtained through our original program with previous methodology were found to be statistically similar to those of the larger FDA program. Through the implementation of newer QuEChERS extraction methodology and owing to the increased sensitivity of the instrumentation used at the CAES, significantly greater numbers of pesticides at significantly lower levels are being detected. The results of our current program are now statistically similar to those in the USDA PDP program, which employs similar extraction and analysis protocols. In the short span of a few years, the program at the CAES has become nationally and internationally recognized for its abilities to determine residues of pesticides in food.

Nearly all the food we eat, with the exception of organically grown produce, has been 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.

References:

Anastassiades, M., Lehotay, S.J., Stajnbaher, D. and Schenck, F.J. 2003. Fast and Easy Multiresidue Method Employing Acetonitrile Extraction/Partitioning and "Dispersive Solid-Phase Extraction" for the Determination of Pesticide Residues in Produce. J AOAC Int., 86:412-431. See also: http://www.QuEChERS.com/

AOAC 2007. Official Methods of Analysis; Method 2007.01. Pesticide Residues in Foods by Acetonitrile Extraction and Partitioning with Magnesium Sulfate. First Action, 2007.

BAM 1998. Bacterial Analytical Manual, U. S. Food and Drug Administration, Department of Health and Human Services. Available online at:
http://www.fda.gov/Food/ScienceResearch/LaboratoryMethods/BacteriologicalAnalyticalManualBAM/default.htm

Becci, P.J., Hess, F.G., Johnson, W.D., Gallo, M.A., Babish, J.G., Dailey, R.E., and Parent, R.A. 1981. Long-term carcinogenicity and toxicity studies of patulin in the rat. J. Appl. Toxicol 1(5): 256-261.

e-CFR [Electronic Code of Federal Regulations]. 2012. Title 40, 24, Part 180.
http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?&c=ecfr&tpl=/ecfrbrowse/Title40/40tab_02.tpl

e-CFR Potassium Sorbate [Electronic Code of Federal Regulations]. 2010. Title 27 §24.246 CFR 182.3089.

http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=854ae8dad832d0691586c6cf6ed8b20b&rgn=div8&view=text&node=27:1.0.1.1.19.12.295.7&idno=27

e-CFR Sodium Benzoate [Electronic Code of Federal Regulations]. 2006. Title 21 CFR 184.1733. http://edocket.access.gpo.gov/cfr_2006/aprqtr/pdf/21cfr184.1733.pdf

FDA, 2013 see discussion at: www.fda.gov/food/foodborneillnesscontaminants/naturaltoxins/ucm21520.htm

FDA, 1993-2008. Residue Monitoring Reports 1993-2008,

http://www.fda.gov/Food/FoodSafety/FoodContaminantsAdulteration/Pesticides/ResidueMonitoringReports/default.htm

GRAS [Generally Recognized as Safe]. 2010. Federal Register Volume 75 Title 21, Part 182 Chemicals Generally Recognized as Safe. http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&rgn=div5&view=text&node=21:3.0.1.1.13&idno=21#PartTop

Hopmans, E.C. 1997. Patulin: a Mycotoxin in Apples. Perishables Handling Quarterly (91): 5 - 6. August 1997.

Krol, W.J., Arsenault, T., Mattina, M. J. I. 2006. Pesticide Residues in Produce Sold in Connecticut 2005. Bulletin 1006. The Connecticut Agricultural Experiment Station, New Haven, CT. Available at: http://www.caes.state.ct.us/Bulletins/bulllist.htm

Krol, W.J., Eitzer, B.D., Arsenault, T., Mattina, M. J. I. 2007. Pesticide Residues in Produce Sold in Connecticut 2006 with a Comparison of Two Sample Preparation Methods. Bulletin 1012. The Connecticut Agricultural Experiment Station, New Haven, CT. Available at: http://www.caes.state.ct.us/Bulletins/bulllist.htm

Krol, W.J., Eitzer, B.D., Arsenault, T., White, J.C., Fontana, J., Kinney, A.S., Lin, L.A., Robinson, S., Sloan, E. A Targeted Study of Pesticide Residues in Herbs Sold in Connecticut 2011. In preparation.

Krol, W.J., Eitzer, B.D., Arsenault, T., Mattina, M.J.I., White, J.C. 2013. Significant Improvements in Pesticide Residue Analysis in Food Using the QuEChERS Method. *LC/GC North America* In press.

NOP [National Organic Program]. 2004. Federal Register Volume 69 Title 7, Part 205 § 205.671 *Exclusion from Organic sale*.

PAM [Pesticide Analytical Manual]. 1994. Volume I, 3rd Edition, Updated October, 1999, C.M. Makovi, ed., U. S. Food and Drug Administration, Office of Plant and Dairy Foods and Beverages. Available at: http://www.cfsan.fda.gov/~frf/pami1.html

McKinley, E.R., Carlton, W.W. 1991. Patulin. In Mycotoxins and Phytoalexins, Ed. Sharms, R.P., Salunkhe, D.K. CRC Press, Atlanta.

Pylypiw H., Grether, M.T. 2000. Rapid high-performance liquid chromatography method for the analysis of sodium benzoate and potassium sorbate in foods. J Chrom. A, 883:229-304.

USDA PDP, 1992-2009. United State Department of Agriculture Pesticide Data Program, Databases and Annual Summaries 1992 -2009. http://www.ams.usda.gov/AMSv1.0/ams.fetchTemplateData.do?template=TemplateG&topNav=&leftNav=ScienceandLaboratories&page=PDPDownloadData/Reports&description=Download+PDP+Data/Reports&acct=pestcddataprg

US EPA section 18 actions searchable database
http://cfpub.epa.gov/oppref/section18/search.cfm

Leistra, M., Smelt, J.H, Zandvoort, R. 1975. Persistance and mobility of bromacil in orchard soil. Weed Research, 15 (4), 243-247.

Table 1: Summary of Pesticides Found in Fresh Fruits and Vegetables Sold in Connecticut in 2012.

Commodity Origin Pesticide	Samples with Residues (Total)	Found by[1] GC, LC, EX BGCLC BLCEX, ALL	Number of Times Detected	Residue Range (ppm)	Average Residue (ppm)	EPA Tolerance (ppm)
Apples (15 Samples)						
Connecticut	15 (15)					
Acetamiprid		BLCEX	4	0.007-0.082	0.040	1
Boscalid		ALL	5	0.003-0.078	0.027	3
Carbaryl		BLCEX	1	0.087		12
Carbendazim (Metabolite)		BLCEX	8	0.003-0.058	0.015	none*
Chlorantraniliprole		BLCEX	2	0.013-0.014	0.014	1.2
lambda Cyhalothrin		GC	1	0.020		0.3
Cyprodinil		ALL	3	0.002-0.017	0.008	1.7
Fenbuconazole		BLCEX	3	0.002-0.021	0.009	0.4
Fenpropathrin		ALL	1	0.055		5
Fenpyroximate		BLCEX	2	0.002-0.004	0.003	0.4
Imidacloprid		BLCEX	2	0.001-0.002	0.002	0.5
Indoxacarb		BLCEX	3	0.002-0.039	0.020	1
Kresoxim-Methyl		EX	1	0.004		0.5
Phosmet		BLCEX	7	0.002-0.079	0.019	10
Pyraclostrobin		BLCEX	2	0.003-0.011	0.007	1.5
Pyridaben		BLCEX	1	0.003		0.5
Thiacloprid		BLCEX	1	0.002		0.3
Thiophanate Methyl		BLCEX	5	0.015-0.172	0.084	2
Trifloxystrobin		BLCEX	2	0.004-0.005	0.005	0.5
Asparagus (1 Sample; 1 Foreign)						
Foreign (Peru)	1 (1)					
Malathion		GC, EX	1	0.001		8
Avocado (1 Sample; 1 Foreign)						
Foreign (Chile)	0 (1)					
Basil (1 Sample; 1 Foreign; 1 *Organic*; **1 Violation**)						
Foreign; *Organic* (Columbia)	1 (1)					
Cadusafos		**EX**	**1**	**0.017**	**No Tolerance**	**0**
			>5% of Tolerance; also NOP Violation			
Beans (4 Samples; **1 Violation**)						
Connecticut	2 (4)					
Acephate		BLCEX	1	0.001		3
Boscalid		BLCEX	1	0.008		1.6
Chlorothalonil		BLCEX	1	0.003		0.1
Fipronil		**ALL**	**1**	**0.010**	**No Tolerance**	**0**
Iprodione		BLCEX	1	0.003		2
Thiophanate Methyl		BLCEX	1	0.044		0.2

Blueberries (8 Samples; 1 *Organic*; 1 Foreign)						
Connecticut	4 (4)					
Azoxystrobin		BLCEX	1	0.032		5
Boscalid		BLCEX	3	0.004-0.045	0.024	6
Cyprodinil		BLCEX	1	0.002		10
Fenbuconazole		BLCEX	1	0.003		0.3
Fenhexamid		ALL	1	0.604		20
Fenpropathrin		BLCEX	1	0.012		3
Fludioxonil		BLCEX	1	0.001		5
Iprodione		BLCEX	1	0.034		25
Malathion		ALL	1	0.121		8
Phosmet		BLCEX	2	0.008-0.026	0.016	10
Pyraclostrobin		BLCEX	2	0.001		4
New Jersey	1 (1)					
Acetamiprid		BLCEX	1	0.013		1.6
Azoxystrobin		ALL	1	0.011		5
Methomyl		BLCEX	1	0.062		6
Methoxyfenozide		BLCEX	1	0.020		3
Phosmet		BLCEX	1	0.073		10
North Carolina	1 (1)					
Fenbuconazole		ALL	1	0.002		0.3
Malathion		ALL	1	0.047		8
Organic (Florida)	1 (1)					
Spinosad		BLCEX	1	0.013	**< 5% of Tolerance**	0.7
Foreign (Chile)	1 (1)					
Iprodione		BLCEX	1	0.004		25
Phosmet		BLCEX	1	0.027		10
Bok Choi (1 Sample; **1 Violation**)						
Connecticut	1 (1)					
Atrazine		**BLCEX**	**1**	**0.002**	**No Tolerance**	**0**
Chlorothalonil		ALL	1	0.003		5
lambda Cyhalothrin		GC	1	0.014		0.4
Endosulfan		**GC**	**1**	**0.006**	**No Tolerance**	**0**
Broccoli (2 Samples; **1 Violation**)						
Connecticut	1 (2)					
Acephate		**BLCEX**	**1**	**0.009**	**No Tolerance**	**0**
Brussels Sprouts (2 Samples; 1 Unknown)						
California	1 (1)					
Permethrin		GC	1	0.022		1
Thiamethoxam & Metabolites		BLCEX	1	0.008		4.5
Unknown (US)	1 (1)					
Clopyralid		BLCEX	1	0.011		2
Chlorantraniliprole		BLCEX	1	0.009		4
Pyraclostrobin		BLCEX	1	0.004		5
Cherries (1 Sample)						
California	1 (1)					
Boscalid		ALL	1	0.033		3.5
lambda Cyhalothrin		GC	1	0.015		0.5

Fenpropathrin	ALL	1	0.011		5
Imidacloprid & Metabolites	BCLEX	1	0.003		3
Malathion	BLCEX	1	0.002		8
Pyraclostrobin	BLCEX	1	0.002		2.5
Tebuconazole	ALL	1	0.016		5
Corn, on Cobb (2 Samples)					
Connecticut 1 (2)					
Thiabendazole	BLCEX	1	0.001		0.01
Cucumbers (9 Samples; 3 Foreign; 1 *Organic*; **1 Violation**)					
Connecticut 3 (5)					
Chlorothalonil	BLCEX	1	0.002		5
***lambda* Cyhalothrin**	**GC**	**1**	**0.086**	**No Tolerance**	**0**
Dinotefuran	BLCEX	1	0.459		1.5
Metolachlor	BLCEX	1	0.005		0.13
Pymetrozine	BLCEX	1	0.052		0.1
Thiamethoxam	BLCEX	2	0.002-0.003	0.002	0.2
Foreign (Mexico) 2 (2)					
Azoxystrobin	BLCEX	1	0.002		0.3
Chlorpyrifos	LC	2	0.002-0.004	0.003	0.05
Dinotefuran	BLCEX	1	0.027		1.5
Flucopolide	BLCEX	1	0.007		0.5
Imidacloprid	BLCEX	1	0.004		0.5
Myclobutanil	BLCEX	1	0.009		0.2
Propamocarb	GC, EX	2	0.004-0.139	0.067	1.5
(Dominican Republic) 1 (1)					
Imidacloprid	BLCEX	1	0.043		0.5
Metalaxyl	ALL	1	0.011		1
Methomyl	BLCEX	1	0.042		0.2
Oxamyl	BLCEX	1	0.131		2
Propamocarb	EX	1	0.039		1.5
Thiamethoxam	BLCEX	1	0.005		0.2
Organic (California) 0 (1)					
Eggplant (5 Samples; **2 Violations**)					
Connecticut 5 (5)					
Acephate	**BLCEX**	**1**	**0.286**	**No Tolerance**	**0**
Boscalid	BLCEX	1	0.005		1.2
Carbaryl	BLCEX	1	0.098		5
Chlorothalonil	ALL	4	0.014-0.216	0.101	6
Imidacloprid	BLCEX	1	0.044		1
Iprodione	**BLCEX**	**1**	**0.007**	**No Tolerance**	**0**
Metalaxyl	BLCEX	1	0.001		1
Pyraclostrobin	BLCEX	1	0.003		1.4
Grapes (2 Samples; 2 Foreign)					
Foreign (Chile) 2 (2)					
Bifenthrin	GC	1	0.005		0.2
Boscalid	ALL	1	0.179		3.5
Imidacloprid	BLCEX	1	0.010		1
Iprodione	ALL	1	0.108		60

	Myclobutanil	BLCEX	2	0.002-0.004	0.003	1
	Pyraclostrobin	BLCEX	1	0.017		2
	Pyrimethanil	BLCEX	1	0.007		5
	Quinoxyfen	B LCEX	1	0.003		0.6
Greens, Collard (2 Samples)						
Connecticut	1 (1)					
	Bosclaid	BLCEX	1	0.011		3
	Chlorothalonil	BLCEX	1	0.008		5
	Difenoconazole	BLCEX	1	0.006		1.9
	Iprodione	BLCEX	1	0.005		15
	Mandipropamid	BLCEX	1	0.027		3
Georgia	1 (1)					
	Chlorpyrifos	BLCEX	1	0.005		0.05
	Imidacloprid	BLCEX	1	0.01		3.5
	Indoxacarb	BLCEX	1	0.062		12
	Mandipropamid	BLCEX	1	0.027		3
Kale (3 Samples)						
Connecticut	3 (3)					
	Bifenthrin	GC	1	0.011		0.6
	Boscalid	BLCEX	1	0.004		3
	Chlorpyrifos	LC	1	0.007		1
	Cyprodinil	GC	1	0.004		1
	Dinotefuran	BLCEX	1	0.048		1.4
	Thiamethoxam	BLCEX	1	0.013		4.5
Lettuce (2 Samples)						
Connecticut	1 (1)					
	Atrazine	BLCEX	1	0.001		0.25
Lime (1 Sample; 1 Foreign)						
Foreign (Mexico)	1 (1)					
	Malathion	BLCEX	1	0.002		8
Mango (1 Sample; 1 Foreign)						
Foreign (Mexico)	0 (1)					
Nectarines (3 Samples; 1 *Organic*; **2 Violations**)						
Connecticut	2 (2)					
	Acetamiprid	BLCEX	1	0.029		1.2
	Boscalid	ALL	2	0.068-0.223	0.151	3.5
	lambda Cyhalothrin	GC	1	0.015		0.5
	Fenbuconazole	ALL	1	0.137		1
	Imidacloprid	BLCEX	1	0.018		3
	Indoxacarb	BLCEX	1	0.002		0.9
	Myclobutanil	BLCEX	1	0.008		2
	Piperonyl Butoxide	**GC, EX**	**1**	**0.242**	**No Tolerance**	**0**
	Propiconazole	BLCEX	1	0.002		4
	Pyraclostrobin	BLCEX	2	0.014-0.060	0.037	2.5
	Quinoxyfen	BLCEX	1	0.001		0.7
	Thiophanate Methyl	**BLCEX**	**1**	**0.145**	**No Tolerance**	**0**
Organic (California)	1 (1)					
	Chlorantraniliprole	BLCEX	1	0.005	**<5% of Tolerance**	4

Fludioxonil	BLCEX	1	0.053	**<5% of Tolerance**	5
Propiconazole	BLCEX	1	0.001	**<5% of Tolerance**	2
Spinetoram	BLCEX	1	0.002	**<5% of Tolerance**	0.2
Trifloxystrobin	BLCEX	1	0.002	**<5% of Tolerance**	2
Oranges (2 Samples; 1 Foreign)					
California 1 (1)					
Chlorpyrifos	ALL	1	0.287		1
Imazalil	ALL	1	0.900		10
Imidacloprid	BLCEX	1	0.002		0.7
Thiabendazole	ALL	1	0.585		10
Foreign (Australia) 1 (1)					
Fludioxonil	BLCEX	1	0.001		10
Imazalil	ALL	1	6.275		10
Malathion	BLCEX	1	0.015		8
Thiabendazole	ALL	1	1.257		10
Peaches (6 Samples; **1 Violation**)					
Connecticut 8 (8)					
Acetamiprid	BLCEX	2	0.002-0.037	0.020	1.2
Boscalid	ALL	5	0.005-0.475	0.184	3.5
Carbendazim (Metabolite)	BLCEX	2	0.003-0.009	0.006	none*
Cyprodinil	ALL	1	0.007		2
Difenoconazole	BLCEX	1	0.002		2.5
Diphenylamine	**ALL**	**1**	**0.013**	**No Tolerance**	**0**
Dodine	EX	1	0.004		5
Etoxazole	BLCEX	1	0.002		1
Fenbuconazole	BLCEX	2	0.023-0.048	0.036	1
Imidacloprid	BLCEX	2	0.002-0.005	0.003	3
Indoxacarb	BLCEX	1	0.005		0.9
Phosmet	BLCEX	4	0.013-0.333	0.097	10
Piperonyl Butoxide	GC, EX	1	0.030		8
Pyraclostrobin	BLCEX	4	0.007-0.084	0.033	2.5
Spinetoram	BLCEX	1	0.016		0.2
Spirodiclofen	EX	1	0.070		1
Thiophanate Methyl	BLCEX	2	0.054-0.121	0.088	3
Pears (5 Samples; **2 Violations**)					
Connecticut 5 (5)					
Acetamiprid	BLCEX	2	0.002-0.038	0.020	1
Boscalid	ALL	3	0.003-0.113	0.047	3
Carbendazim (Metabolite)	BLCEX	2	0.002-0.071	0.037	none*
Difenoconazole	BLCEX	1	0.005		1
Dodine	EX	1	0.092		5
Fenbuconazole	**ALL**	**2**	**0.002-0.005**	**No Tolerance**	**0**
Fenpropathrin	ALL	1	0.014		5
Fenpyroximate	BLCEX	2	0.017-0.025	0.021	0.4
Imidacloprid	BLCEX	2	0.020-0.172	0.096	0.6
Indoxacarb	BLCEX	1	0.007		0.2
Malathion	All	1	0.019		8
Myclobutanil	**BLCEX**	**1**	**0.023**	**No Tolerance**	**0**

	Phosmet	BLCEX	2	0.008-0.060	0.034	10
	Pyraclostrobin	BLCEX	2	0.005-0.018	0.012	1.5
	Pyridaben	ALL	2	0.014-0.068	0.041	0.75
	Spinetoram	BLCEX	1	0.001		0.2
	Thiacloprid	BLCEX	2	0.001-0.041	0.021	0.3
	Trifloxystrobin	ALL	3	0.002-0.006	0.004	0.5
Peas (2 Samples; 1 Foreign; **1 Violation**)						
Connecticut	0 (1)					
Foreign (Guatemala)	1 (1)					
	Azoxystrobin	BLCEX	1	0.004		3
	Chlorothalonil	BLCEX	1	0.048		5
	Chlorpyrifos	BLCEX	1	0.002		0.05
	DImethoate	BLCEX	1	0.002		2
	Tebuconazole	**BLCEX**	**1**	**0.017**	**No Tolerance**	**0**
Peppers (8 Samples)						
Connecticut	4 (5)					
	Carbaryl	BLCEX	2	0.002-0.158	0.080	5
	Chlorothalonil	BLCEX	2	0.002-0.003	0.003	6
	Difenoconazole	BLCEX	2	0.002-0.006	0.004	0.6
	Imidacloprid	BLCEX	2	0.019-0.054	0.037	1
	Mandipropamid	BLCEX	2	0.003-0.004	0.004	1
	Metalaxyl	ALL	1	0.011		1
Florida	3 (3)					
	Bifenthrin	GC	2	0.023-0.153	0.088	0.5
	Chlorpyrifos	ALL	1	0.039		0.05
	Fenuron	EX	1	0.002	No Std. Available	0
	Imidacloprid	BLCEX	1	0.009		1
	Metalaxyl	BLCEX	1	0.007		1
	Methoxyfenozide	BLCEX	1	0.001		2
	Propamocarb	ALL	1	0.013		2
	Thiamethoxam	BLCEX	2	0.019-0.028	0.024	0.25
Plums (1 Sample)						
Connecticut	1 (1)					
	Boscalid	ALL	1	0.014		3.5
	lambda Cyhalothrin	GC	1	0.008		0.5
	Myclobutanil	BLCEX	1	0.002		2
	Propiconazole	BLCEX	1	0.001		0.6
	Pyraclostrobin	BLCEX	1	0.004		2.5
	Thiophanate Methyl	BLCEX	1	0.031		0.5
Potatoes (3 Samples)						
Connecticut	2 (3)					
	Carbaryl	BLCEX	1	0.003		2
	Chlorothalonil	LC	1	0.013		0.1
	Imidacloprid	BLCEX	1	0.025		0.4
Raspberries (1 Sample)						
Connecticut	0 (1)					

Spinach (2 Samples; 1 Foreign; 1 *Organic*)						
Connecticut	1 (1)					
Atrazine		BLCEX	1	0.002		0.25
Foreign, *Organic* (Mexico)	0 (1)					
Squash (4 Samples)						
Connecticut	3 (4)					
Boscalid		ALL	1	0.006		1.6
Imidacloprid		BLCEX	1	0.007		0.5
Malathion		BLCEX	1	0.005		8
Thiamethoxam		BLCEX	1	0.002		0.2
Strawberries (12 Samples)						
Connecticut	11 (12)					
Acetamiprid		BLCEX	2	0.003-0.084	0.044	1.6
Bifenthrin		GC	3	0.009-0.107	0.043	3
Boscalid		ALL	8	0.015-0.235	0.093	4.5
Carbendazim (Metabolite)		BLCEX	3	0.003-0.016	0.054	none*
Cyprodinil		ALL	9	0.003-0.669	0.087	5
Difenoconazole		ALL	2	0.004-0.021	0.011	2.5
Fenhexamid		ALL	3	0.008-0.032	0.023	3
Fenpropathrin		ALL	4	0.002-0.006	0.004	2
Fludioxonil		ALL	7	0.002-0.180	0.055	2
Imidacloprid		BLCEX	1	0.002		0.5
Metalaxyl		ALL	2	0.004-0.058	0.032	10
Pendimethalin		BLCEX	1	0.002		0.1
Pyraclostrobin		BLCEX	7	0.005-0.027	0.013	1.2
Trifloxystrobin		BLCEX	1	0.001		1.1
Sweet Potatoes (1 Sample)						
North Carolina	1 (1)					
Fludioxonil		BLCEX	1	0.019		3.5
Tomatoes (15 Samples; 1 *Organic*; **2 Violations**)						
Connecticut	11 (14)					
Acephate		**BLCEX**	**1**	**0.003**	**No Tolerance**	**0**
Azoxystrobin		BLCEX	2	0.004		0.2
Boscalid		ALL	3	0.001-0.023	0.01	1.2
Carbaryl		ALL	1	1.70		5
Chlorothalonil		BLCEX	7	0.001-0.067	0.021	5
Clothianadin		BLCEX	1	0.003		0.2
Cyprodinil		ALL	1	0.002		0.45
Diethyltoluamide (DET)		**ALL**	**1**	**0.040**	**No US Food Use**	**0**
Difenoconazole		BLCEX	3	0.001-0.004	0.003	0.6
Dimethomorph		BLCEX	1	0.002		1.5
Imidacloprid		BLCEX	2	0.005-0.006	0.006	1
Mandipropamid		BLCEX	2	0.002-0.023	0.013	1
Methiocarb		**BLCEX**	**1**	**0.027**	**No Tolerance**	**0**
Pendimethalin		LC	1	0.001		0.1
Pyraclostrobin		BLCEX	1	0.001		1.4
Pyrimethanil		BLCEX	1	0.006		0.5

Organic (N. Carolina) 1 (1)					
Imidacloprid	BLCEX	1	0.004	**<5% of Tolerance**	1
Spinosad	EX	1	0.001	**<5% of Tolerance**	0.4
Turnips (2 Samples; **1 Violation**)					
Connecticut 1 (1)					
Chlorpyrifos	ALL	1	0.002		1
Massachusetts 1 (1)					
Chlorpropham (CIPC)	**ALL**	**1**	**0.004**	**No Tolerance**	**0**
Fenuron	EX	1	0.002	No Std. Avail.	0
Yam, Yellow (1 Sample; 1 Foreign; **1 Violation**)					
Foreign (Jamaica) 1 (1)					
Dicloran	**GC**	**1**	**4.52**	**No Tolerance**	**0**
Thiophanate Methyl	**LC**	**1**	**0.324**	**No Tolerance**	**0**

1. **GC** indicates found by Gas Chromatography (GC) – Mass Spectrometry (MS); **LC** indicates found by Liquid Chromatography (LC) – Ion Trap MS; **EX** indicates found by LC using the Exactive; **BGCLC** indicates found by GC and LC-MS; **BLCEX** indicates found by LC-MS and LC-Exactive; **ALL** indicates found by all instruments.

none* -- There is no US tolerance for carbendazim. Carbendazim has been used as a standalone pesticide in the past; however it is also a metabolite of the insecticides Thiophanate methyl and benomyl both of which undergo rapid degradation in the field to carbendazim. When 'none' is used, it indicates that the commodity has a tolerance for either/both benomyl and/or Thiophanate methyl. Provided the level of carbendazim is below the tolerance level of these pesticides on the specific commodity of interest, it is not considered a violation. When '0' is used it indicates that the metabolite carbendazim is not allowed because there is no tolerance for benomyl or Thiophanate methyl on these commodities. For a more comprehensive discussion on this subject the reader is referred to Krol *et al*, 2007.

FRESH TOTALS:	SAMPLES	131	
	WITH RESIDUES	112	(85.5%)
	VIOLATIVE SAMPLES	17	(13.0%)
	ORGANIC SAMPLES	6	
	ORGANIC VIOLATIVE	1	(16.7%)
	NATIONAL ORGANIC PROGRAM VIOLATION	1	

TOTAL DIFFERENT ACTIVE INGREDIENTS FOUND:	69	
TOTAL NUMBER OF RESIDUES FOUND:	394	
TOTAL NUMBER OF ILLEGAL RESIDUES FOUND:	22	(6.7%) Of residues found

Table 2: Summary of Pesticides Found in Processed Fruits and Vegetables Sold in Connecticut in 2012.

Commodity / Origin / Pesticide	Samples with Residues (Total)	Found by[1] GC, LC, EX BGCLC BLCEX, ALL	Number of Times Detected	Residue Range (ppm)	Average Residue (ppm)	EPA Tolerance (ppm)
Baby Food (11 Samples; 3 Foreign; 11 *Organic*; 8 Unknown; **2 Violations**)						
Apple (1 Sample; 1 *Organic*; 1 Unknown)						
United States	0 (1)					
Apple/Banana (1 Sample; 1 Foreign; 1 *Organic*)						
Canada	1 (1)					
Thiabendazole		BLCEX	1	0.002	**<5% of Tolerance**	5
Apple/Carrot (1 Sample; 1 *Organic*; 1 Unknown)						
United States	0 (1)					
Apple/Sweet Potato (1 Sample; 1 Foreign; 1 *Organic*; **1 Violation**)						
Canada	1 (1)					
Amitraz		**BLCEX**	**1**	**0.005**	**No Tolerance**	**0**
			>5% of Tolerance; also NOP Violation			
Banana/Pumpkin (1 Sample; 1 *Organic*; 1 Unknown)						
United States	1 (1)					
Flutriafol		BLCEX	1	0.004	**<5% of Tolerance**	0.3
Beans /Potatoes (1 Sample; 1 *Organic*; 1 Unknown)						
United States	0 (1)					
Beans, Green/Peas, Sweet (1 Sample; 1 *Organic*; 1 Unknown)						
United States	0 (1)					
Peaches (1 Sample; 1 *Organic*; 1 Unknown; **1 Violation**)						
United States	1 (1)					
Thiabendazole		**BLCEX**	**1**	**0.003**	**No Tolerance**	**0**
			>5% of Tolerance; also NOP Violation			
Spinosad		EX	1	0.008	**<5% of Tolerance**	0.2
Pears (1 Sample; 1 *Organic*; 1 Unknown)						
United States	1 (1)					
Spinosad		EX	1	0.003	**<5% of Tolerance**	0.2
Pears/Squash, Butternut (1 Sample; 1 Foreign; 1 *Organic*)						
Canada	0 (1)					
Prunes (1 Sample; 1 *Organic*; 1 Unknown)						
United States	0 (1)					
Fruits & Vegetables, Boxed (2 Samples; 1 Unknown; **1 Violation**)						
Arugula (1 Sample; **1 Violation**)						
Florida	1 (1)					
Atrazine		BLCEX	1	0.001		0.25
Bromacil		**BLCEX**	**1**	**0.006**	**No Tolerance**	**0**
Imidacloprid		BLCEX	1	0.002		3.5
Methomyl		BLCEX	1	0.002		0.2

Pymetrozine	BLCEX	1	0.002		0.6
Kale Greens (1 Sample; 1 Unknown)					
United States 1 (1)					
Dimethomorph	BLCEX	1	0.001		20
Flubendiamide	BLCEX	1	0.143		25
Imidacloprid	BLCEX	1	0.014		3.5

Fruits & Vegetables, Canned or Jarred (7 Samples; 1 Foreign; 6 Unknown)

Asparagus (1 Sample; 1 Foreign)
Foreign (Peru) 0 (1)

Beans, Green (1 Sample; 1 Unknown)
Unknown 1 (1)

Carbendazim (Metabolite)	BLCEX	1	0.016		none*

Beets (1 Sample1; 1 Unknown)
Unknown 0 (1)

Carrots (1 Sample; 1 Unknown)
Unknown 1 (1)

Azoxystrobin	BLCEX	1	0.002		0.5

Corn (1 Sample; 1 Unknown)
Unknown 0 (1)

Potatoes (1 Sample; 1 Unknown)
Unknown 1 (1)

Imidacloprid	BLCEX	1	0.008		0.4

Tomatoes (1 Sample; 1 Unknown)
Unknown 1 (1)

Imidacloprid	BLCEX	1	0.006		1

Fruits & Vegetables, Chopped or Shredded (7 Samples; 3 Foreign; 1 *Organic*; 4 Unknown)

Apples, Sliced (2 Samples; 2 Unknown)
Unknown 2 (2)

Boscalid	BLCEX	2	0.001-0.110	0.055	3
Carbendazim (Metabolite)	BLCEX	1	0.005		none*
Cyprodinil	BLCEX	1	0.001		1.7
Diphenylamine	ALL	2	0.003-0.161	0.090	10
Imidacloprid	BLCEX	1	0.003		0.6
Phosmet	BLCEX	1	0.011		10
Pyraclostrobin	BLCEX	1	0.024		1.5
Pyrimethanil	BLCEX	1	0.016		14
Thiabendazole	ALL	1	0.078		5

Broccoli, Florets (1 Sample; 1 *Organic*; 1 Unknown)
Organic, Unknown (US) 1 (1)

Pendimethalin	BLCEX	1	0.001	**<5% of Tolerance**	0.1

Cantaloupe, Chunks (1 Sample; 1 Foreign)
Foreign (Guatemala/ Costa Rica) 1 (1)

Dimethoate	BLCEX	1	0.003		1

Methomyl		BLCEX	1	0.001		0.2

Lettuce, Shredded, Iceberg (1 Sample; 1 Unknown)

Unknown (US) 1 (1)

Imidacloprid		BLCEX	1	0.002		3.5

Peas, Baby Green (1 Sample; 1 Foreign)

Foreign (Guatemala) 0 (1)

Pineapple, Spears (1 Sample; 1 Foreign)

Foreign (Costa Rica) 0 (1)

Fruits & Vegetables, Frozen (27 Samples; 15 Foreign; 21 *Organic*; 12 Unknown; **3 Violations**)

Beans, Green and Lima (2 Samples; 2 *Organic*; 2 Unknown)

Organic, Unknown

(US) 0 (2)

Beans, Green, Carrots, Corn, Peas (1 Sample; 1 *Organic*; 1 Unknown)

Organic, Unknown

(US) 0 (1)

Beans, Green, Carrots, Onion, Pepper, Red, Squash (1 Sample; 1 *Organic*; 1 Unknown)

Organic, Unknown

(US) 0 (1)

Blackberries (1 Sample; 1 Foreign; 1 *Organic*)

Foreign, *Organic*

(Chile) 0 (1)

Blueberries (3 Samples; 1 Foreign; 1 *Organic*; 2 Unknown)

Foreign, *Organic*

(Canada) 0 (1)

Unknown (US) 2 (2)

Azoxystrobin	BLCEX	1	0.003		5
Boscalid	BLCEX	1	0.026		6
Carbaryl	BLCEX	1	0.001		12
Cyprodinil	ALL	1	0.012		10
Fenbuconazole	BLCEX	2	0.001-0.002	0.002	0.3
Fenpropathrin	ALL	1	0.026		3
Methoxyfenozide	BLCEX	1	0.007		3
Phosmet	BLCEX	2	0.003-0.054	0.029	10
Pyraclostrobin	BLCEX	2	0.002-0.003	0.003	4

Broccoli (1 Sample; 1 Foreign; 1 *Organic*)

Foreign, *Organic*

(Mexico) 1 (1)

Imidacloprid		BLCEX	1	0.002	**<5% of Tolerance**	3.5

Cherries (3 Sample; 1 Foreign; 2 *Organic*; 2 Unknown)

Foreign, *Organic*

(Chile) 0 (1)

Organic, Unknown

(US) 0 (1)

Unknown (US) 1 (1)

Azinphos Methyl		BLCEX	1	0.003		2

Boscalid	ALL	1	0.060		3.5
Carbaryl	BLCEX	1	0.783		10
Carbendazim (Metabolite)	BLCEX	1	0.003		none*
Fenbuconazole	ALL	1	0.085		1
Imidacloprid	BLCEX	1	0.013		3
Iprodione	BLCEX	1	0.002		20
Propiconazole	BLCEX	1	0.005		1
Pyraclostrobin	BLCEX	1	0.010		2.5
Tebuconazole	ALL	1	0.120		5
Trifloxystrobin	BLCEX	1	0.002		2

Mangoes, Chunks (1 Sample; 1 Foreign; 1 *Organic*)

Foreign, *Organic*

(Mexico) 0 (1)

Mushrooms, Mixed (2 Sample; 2 Foreign; 2 *Organic*; **1 Violation**)

Foreign, *Organic*

(China) 1 (2)

Carbendazim (Metabolite)	**BLCEX**	**1**	**0.004**	**No Tolerance**	**none***
		>5% of Tolerance; also NOP Violation			
Thiabendazole	BLCEX	1	0.002	**<5% of Tolerance**	40

Peaches, Sliced (1 Sample; 1 *Organic*; 1 Unknown)

Organic, Unknown

(US) 0 (1)

Peas, Green (1 Sample; 1 *Organic*; 1 Unknown)

Organic, Unknown

(US) 0 (1)

Peppers, Green, Peppers, Red, Onions (1 Sample; 1 *Organic*; 1 Unknown)

Organic, Unknown

(US) 0 (1)

Peppers, Tricolor (1 Sample; 1 Foreign; 1 *Organic*; **1 Violation**)

Organic, Foreign

(China) 1 (1)

Acephate	BLCEX	1	0.015	**<5% of Tolerance**	4
Acetamiprid	BLCEX	1	0.003	**<5% of Tolerance**	0.2
Carbofuran	**BLCEX**	**1**	**0.001**	**No Tolerance**	**0**
		>5% of Tolerance; also NOP Violation			
Carbosulfan	**EX**	**1**	**0.089**	**No US Food Use**	**0**
		>5% of Tolerance; also NOP Violation			
Chlorpyrifos	BLCEX	1	0.003	**<5% of Tolerance**	1
Difenoconazole	BLCEX	1	0.002	**<5% of Tolerance**	0.6
Imidacloprid	BLCEX	1	0.006	**<5% of Tolerance**	1
Metolacarb	**BLCEX**	**1**	**0.002**	**No Tolerance**	**0**
		>5% of Tolerance; also NOP Violation			

Raspberries (3 Samples; 3 Foreign; 1 *Organic*)

Foreign, *Organic*

(Chile) 0 (1)

Foreign (Chile) 1 (2)

Azinphos Methyl	BLCEX	1	0.001		2

Soybeans, Edamame (1 Samples; 1 Foreign, 1 *Organic*; **1 Violation**)

Foreign, *Organic*						
(China)	1 (1)					
	Chlorantraniliprole	**BLCEX**	**1**	**0.002**	**No Tolerance**	**0**
			>5% of Tolerance; also NOP Violation			
	Metalaxyl	BLCEX	1	0.001	**<5% of Tolerance**	1

Spinach (1 Sample; 1 *Organic*; 1 Unknown)

Organic, Unknown						
(US)	0 (1)					

Strawberries (3 Samples; 3 Foreign; 2 *Organic*)

Foreign (Chile)	1 (1)					
	Acetamiprid	BLCEX	1	0.005		1.6
	Azoxystrobin	BLCEX	1	0.021		10
	Boscalid	BLCEX	1	0.003		4.5
	Carbendazim (Metabolite)	BLCEX	1	0.003		none*
	Fenhexamid	BLCEX	1	0.023		3
	Imidacloprid	BLCEX	1	0.007		0.5
	Iprodione	BLCEX	1	0.016		15
	Myclobutanil	BLCEX	1	0.011		0.5
	Thiamethoxam	BLCEX	1	0.004		0.35
Foreign, *Organic*						
	Argentina/Chile 0 (1)					
Foreign, *Organic*						
	(Mexico) 0 (1)					

Freeze Dried Fruits (6 Samples; 4 Foreign; 2 *Organic*; 2 Unknown)

Apples (2 Samples; 1 Foreign; 1 Unknown)

Foreign (China)	1 (1)					
	Acetamiprid	BLCEX	1	0.008		1
	Carbendazim (Metabolite)	BLCEX	1	0.080		none*
	Imidacloprid	BLCEX	1	0.012		0.5
Unknown	0 (1)					

Apple, Blueberry (1 Sample; 1 *Organic*; 1 Unknown)

Organic, Unknown						
(US)	1 (1)					
	Boscalid	BLCEX	1	0.005	**<5% of Tolerance**	3

Mango, Strawberry (1 Sample, 1 Foreign, 1 *Organic*)

Foreign, *Organic*						
(Argentina/Mexico)	0 (1)					

Peaches (1 Sample; 1 Foreign)

Foreign (China)	1 (1)					
	Carbendazim (Metabolite)	BLCEX	1	0.024		none*
	Chlorpyrifos	BLCEX	1	0.003		0.05
	Imidacloprid	BLCEX	1	0.017		3

Pears (1 Sample; 1 Foreign)

Foreign (China)	1 (1)					
	Acetamiprid	BLCEX	1	0.006		1

Carbendazim (Metabolite)	BLCEX	1	0.017		none*
Chlorpyrifos	BLCEX	1	0.002		0.05
Imidacloprid	BLCEX	1	0.030		0.6
Indoxacarb	BLCEX	1	0.005		0.2
Methomyl	BLCEX	1	0.002		4

Juices/Ciders (22 Samples; 2 Foreign; 2 *Organic*; 7 Unknown; **3 Violations**)

Apple Cider/Juice (17 Samples; 1 *Organic*; 5 Unknown; **1 Violations**)

Connecticut 6 (6)

Acetamiprid	BLCEX	3	0.005-0.016	0.011	1
Boscalid	BLCEX	2	0.001-0.001	0.001	3
Carbaryl	BLCEX	2	0.002-0.006	0.004	1.5
Carbendazim (Metabolite)	BLCEX	6	0.004-0.056	0.027	none*
Diphenylamine	BLCEX	1	0.004		10
Fenbuconazole	BLCEX	1	0.002		0.4
Imidacloprid	BLCEX	3	0.003-0.007	0.008	0.5
Patulin	BLCEX	4	0.001-0.010	0.008	0.05
Phosmet	BLCEX	4	0.003-0.012	0.012	10
Pyrimethanil	BLCEX	1	0.013		14
Thiabendazole	BLCEX	1	0.004		5
Thiacloprid	BLCEX	2	0.002-0.003	0.003	0.3
Preservatives 4 (6)	*(1) 0.022% potassium sorbate; No sodium benzoate*				
	(2) 0.050% potassium sorbate; No sodium benzoate				
	(3) 0.002% potassium sorbate; No sodium benzoate				
	(4) 0.002% potassium sorbate; No sodium benzoate				

North Carolina 1 (1)

Acetamiprid	BLCEX	1	0.003		1
Boscalid	BLCEX	1	0.002		3
Carbendazim (Metabolite)	BLCEX	1	0.006		none*
lambda Cyhalothrin	GC	1	0.046		0.3
Dinotefuran	BLCEX	1	0.007		1
Methomyl	BLCEX	1	0.002		1
Phosmet	BLCEX	1	0.003		10
Thiamethoxam	BLCEX	1	0.005		0.2
Preservatives 1 (1)	*0.046% potassium sorbate; no sodium benzoate found*				

New York 4 (4)

Acetamiprid	BLCEX	4	0.004-0.031	0.015	1
Boscalid	BLCEX	2	0.002-0.004	0.003	3
Carbaryl	BLCEX	1	0.005		1.5
Carbendazim (Metabolite)	BLCEX	3	0.004-0.063	0.033	none*
Cyprodinil	GC	1	0.003		0.1
Diphenylamine	ALL	2	0.002-0.044	0.024	30
Flubendiamide	BCLEX	1	0.002		0.7
Imidacloprid	BLCEX	1	0.002		0.5
Patulin	BLCEX	3	0.006-0.011	0.013	0.05
Phosmet	BLCEX	2	0.005-0.008	0.007	10
Pyrimethanil	BLCEX	2	0.045-0.120	0.093	14

Thiacloprid		BLCEX	3	0.001-0.068	0.025	0.3
Thiophanate Methyl		BLCEX	1	0.068		2
Preservatives	*4 (4)*	*(1) 0.023% potassium sorbate; no sodium benzoate found*				
		(2) 0.038% potassium sorbate; no sodium benzoate found				
		(3) 0.003% potassium sorbate; no sodium benzoate found				
		(4) 0.003% potassium sorbate; no sodium benzoate found				
Pennsylvania	1 (1)					
Acetamiprid		BLCEX	1	0.006		1
Boscalid		BLCEX	1	0.004		3
Carbendazim (Metabolite)		BLCEX	1	0.048		none*
Chlorantraniliprole		BLCEX	1	0.007		1.2
Cyprodinil		GC	1	0.003		1.7
Flubendiamide		BLCEX	1	0.007		0.7
Imidacloprid		BLCEX	1	0.001		0.5
Phosmet		BLCEX	1	0.004		10
Thiamethoxam		BLCEX	1	0.001		0.2
Preservatives	*1 (1)*	*0.044% potassium sorbate; no sodium benzoate found*				
Organic, Unknown	1 (1)					
Thiabendazole		BLCEX	1	0.004	**<5% of Tolerance**	5
Preservatives	*0 (1)*	*No potassium sorbate found; no sodium benzoate found*				
Unknown	1 (1)					
Acetamiprid		BLCEX	1	0.003		1
Boscalid		BLCEX	1	0.023		3
Carbendazim (Metabolite)		BLCEX	1	0.045		none*
Diphenylamine		ALL	1	0.024		10
Imidacloprid		BLCEX	1	0.002		0.5
Patulin		BLCEX	1	0.009		0.05
Phosmet		BLCEX	1	0.004		10
Pyraclostrobin		BLCEX	1	0.002		1.5
Thiabendazole		BLCEX	1	0.106		5
Preservatives	*0 (1)*	*No potassium sorbate found; no sodium benzoate found*				
Unknown (US)	3 (3)					
Acetamiprid		BLCEX	3	0.005-0.032	0.018	1
Boscalid		BLCEX	2	0.002-0.002	0.002	3
Carbendazim (Metabolite)		BLCEX	3	0.011-0.021	0.017	none*
Dimethoate		**BLCEX**	**1**	**0.002**	**No Tolerance**	**0**
Dinotefuran		BLCEX	1	0.006		1
Diphenylamine		ALL	1	0.028		10
Fludioxonil		BLCEX	1	0.004		5
Imidacloprid		BLCEX	1	0.001		0.5
Methomyl		BLCEX	1	0.001		1
Patulin		BLCEX	2	0.003-0.006		0.05
Phosmet		BLCEX	1	0.003		10
Pyrimethanil		All	1	0.120		14
Thiabendazole		BLCEX	1	0.019		5
Thiacloprid		BLCEX	2	0.001-0.003	0.002	0.3
Thiamethoxam		BLCEX	2	0.001-0.002	0.002	0.2

Preservatives	*2 (3)*	*(1) 0.054% potassium sorbate; no sodium benzoate found*				
		(2) 0.030% potassium sorbate; no sodium benzoate found				
Carrot Juice (2 Samples; 1 *Organic*; 2 Unknown)						
Organic, Unknown	0 (1)					
Preservatives	*0 (1)*	*No potassium sorbate found; no sodium benzoate found*				
Unknown	1 (1)					
EPTC		BLCEX	1	0.003		0.1
Linuron		BLCEX	1	0.007		1
Preservatives	*0 (1)*	*No potassium sorbate found; no sodium benzoate found*				
Currant, Black (3 Samples; 2 Foreign; **2 Violations**)						
Connecticut	1 (1)					
Thiophanate Methyl		**BLCEX**	**1**	**0.022**	**No Tolerance**	**0**
Preservatives	*0 (1)*	*No potassium sorbate found; no sodium benzoate found*				
Foreign (England)	1 (1)					
Boscalid		ALL	1	0.006		
Cyprodinil		BLCEX	1	0.002		
Preservatives	*1 (1)*	*0.048% potassium sorbate; no sodium benzoate found*				
Foreign (Poland)	1 (1)					
Carbendazim (Metabolite)		**BLCEX**	**1**	**0.004**	**No Tolerance**	**none***
Preservatives	*0 (1)*	*No potassium sorbate found; no sodium benzoate found*				

1. **GC** indicates found by Gas Chromatography (GC) – Mass Spectrometry (MS); **LC** indicates found by Liquid Chromatography (LC) – Ion Trap MS; **EX** indicates found by LC using the Exactive; **BGCLC** indicates found by GC and LC-MS; **BLCEX** indicates found by LC-MS and LC-Exactive; **ALL** indicates found by all instruments.

none* -- There is no US tolerance for carbendazim. Carbendazim has been used as a standalone pesticide in the past; however it is also a metabolite of the insecticides Thiophanate methyl and benomyl both of which undergo rapid degradation in the field to carbendazim. When 'none' is used, it indicates that the commodity has a tolerance for either/both benomyl and/or Thiophanate methyl. Provided the level of carbendazim is below the tolerance level of these pesticides on the specific commodity of interest, it is not considered a violation. When '0' is used it indicates that the metabolite carbendazim is not allowed because there is no tolerance for benomyl or Thiophanate methyl on these commodities. For a more comprehensive discussion on this subject the reader is referred to Krol *et al*, 2007.

PROCESSED TOTALS:	SAMPLES	82	
	WITH RESIDUES	50	(61.0%)
	VIOLATIVE SAMPLES	9	(11.0%)
	ORGANIC SAMPLES	37	
	ORGANIC VIOLATIVE	5	(13.5%)
NATIONAL ORGANIC PROGRAM VIOLATION		7	

TOTAL DIFFERENT ACTIVE INGREDIENTS FOUND:	50		
TOTAL NUMBER OF RESIDUES FOUND:		195	
TOTAL NUMBER OF ILLEGAL RESIDUES FOUND:		11	(5.6%) Of residues found
TOTAL NUMBER OF TIMES PATULIN WAS FOUND	10	(58.8%) Of Juice/Cider Tested	
TOTAL TIMES PRESERVATIVES WERE FOUND		13	(59.0%) Of Juice/Cider Tested

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FRESH TOTALS:	SAMPLES		131
	WITH RESIDUES	112	(85.5%)
	VIOLATIVE SAMPLES	17	(13.0%)
	ORGANIC SAMPLES	6	
	ORGANIC VIOLATIVE	1	(16.7%)
NATIONAL ORGANIC PROGRAM VIOLATION		1	

TOTAL DIFFERENT ACTIVE INGREDIENTS FOUND:	69		
TOTAL NUMBER OF RESIDUES FOUND:		394	
TOTAL NUMBER OF ILLEGAL RESIDUES FOUND:		22	(5.6%) Of residues found

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FRESH AND PROCESSED			
SUM TOTALS:	SAMPLES	213	
	WITH RESIDUES	162	(76.1%)
	VIOLATIVE SAMPLES	26	(12.2%)
	ORGANIC SAMPLES	43	
	ORGANIC VIOLATIVE	6	(14.0%)
NATIONAL ORGANIC PROGRAM VIOLATION		8	

TOTAL DIFFERENT ACTIVE INGREDIENTS FOUND:	77		
TOTAL NUMBER OF RESIDUES FOUND:		589	
TOTAL NUMBER OF ILLEGAL RESIDUES FOUND:		33	(5.6%) Of residues found
TOTAL NUMBER OF TIMES PATULIN WAS FOUND	10	(58.8%) Of Juice/Cider Tested	
TOTAL TIMES PRESERVATIVES WERE FOUND		13	(59.0%) Of Juice/Cider Tested

Table 3: Summary of Pesticides Found in Fresh Fruits and Vegetables Sold in Connecticut in 2013.

Commodity Origin Pesticide	Samples with Residues (Total)	Found by[1] GC, LC, EX BGCLC BLCEX, ALL	Number of Times Detected	Residue Range (ppm)	Average Residue (ppm)	EPA Tolerance (ppm)
Avocado (1 Sample; 1 Foreign)						
Foreign (Mexico)	0 (1)					
Blueberries (1 Sample)						
California	1 (1)					
Boscalid		BLCEX	1	0.285		13
Phosmet		BLCEX	1	0.119		10
Pyraclostrobin		BLCEX	1	0.015		4
Strawberries (1 Sample; **1 Violation**)						
Florida	1 (1)					
Chlorantraniliprole		BLCEX	1	0.002		1.8
Cyprodinil		BLCEX	1	0.347		10
Dichlorvos		**BLCEX**	**1**	**0.101**	**No Tolerance**	**0**
Fludioxonil		BLCEX	1	0.251		5

1. **GC** indicates found by Gas Chromatography (GC) – Mass Spectrometry (MS); **LC** indicates found by Liquid Chromatography (LC) – Ion Trap MS; **EX** indicates found by LC using the Exactive; **BGCLC** indicates found by GC and LC-MS; **BLCEX** indicates found by LC-MS and LC-Exactive; **ALL** indicates found by all instruments.

Table 4: Summary of Pesticides Found in Processed Fruits and Vegetables Sold in Connecticut in 2013.

Commodity / Origin / Pesticide	Samples with Residues (Total)	Found by[1] GC, LC, EX BGCLC BLCEX, ALL	Number of Times Detected	Residue Range (ppm)	Average Residue (ppm)	EPA Tolerance (ppm)
Fruits & Vegetables, Chopped or Shredded (1 Sample)						
Carrots (1 Sample)						
California	1 (1)					
Boscalid		BLCEX	1	0.005		1
Cyazofamid		BLCEX	1	0.002		0.09
Linuron		BLCEX	1	0.059		1
Metalaxyl		BLCEX	1	0.015		0.5
Fruits & Vegetables, Frozen (1 Sample; 1 Unknown)						
Spinach (1 Sample; 1 Unknown)						
United States	1 (1)					
Clothianadin		BLCEX	1	0.064		3
Pyraclostrobin		BLCEX	1	0.072		29

1. **GC** indicates found by Gas Chromatography (GC) – Mass Spectrometry (MS); **LC** indicates found by Liquid Chromatography (LC) – Ion Trap MS; **EX** indicates found by LC using the Exactive; **BGCLC** indicates found by GC and LC-MS; **BLCEX** indicates found by LC-MS and LC-Exactive; **ALL** indicates found by all instruments.