Pesticide Residues in Produce Sold in Connecticut in 2010 with Concurrent Surveillance for Microbial Contamination

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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 are used in accordance with their label and 2) to ensure that the public is protected from the deliberate or accidental misuse of pesticides. In 2010 this interagency collaboration was expanded to include the CT Department of Public Health (DPH) for the concurrent microbiological analysis for *Escherichia coli* (*E. coli*) O157:H7, Shiga Toxin-Producing *E.coli* (STEC), *Salmonella* species and *Listeria monocytogenes* in a limited number (52) of the total samples tested for pesticides. The 2010 data help to clarify and define the use of pesticides in the production of the food we consume, and the presence (or absence) of potentially harmful microbes. The findings of the 224 samples analyzed in the calendar year 2010 are summarized herein.

Enforcement of the Environmental Protection Agency, (EPA) mandated tolerances require both the Food and Drug Administration (FDA) and DCP to know the amount and the 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

[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.

this state, but also includes fresh produce from other states and foreign countries, as well as processed food. In the current year, samples were obtained from 80 Connecticut farms, producers, retailers, and wholesale outlets. The program determines if the amounts and types of pesticides found on fruits and vegetables adhere to the tolerances set by the EPA. These tolerances are continually updated and available in the electronic Code of Federal Regulations (e-CFR, 2011).

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 allowed (no tolerance). In all cases, the results of the laboratory findings at the CAES are forwarded to the DCP. For violations found on crops grown within Connecticut, the DCP notifies both the grower and the Connecticut Department of Environmental Protection (DEP) of the results. The DEP may perform an audit of the grower's records to ensure proper pesticide use. The DCP may, at its discretion, recall or destroy the violative commodity and/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 microbiological testing results presented in this survey were undertaken at the CT DPH lab in Hartford. In 2010, the DPH received a grant from the United States Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS) to test food in the marketplace for potentially harmful pathogens linked to human illness. Part of this grant included working with the Department of Analytical Chemistry at the CAES in its capacity as a chemistry Cooperative Agreement Program (c-CAP) laboratory in the Food Emergency Response Network (FERN). Utilizing the collection and regulatory arm of the CT DCP as the lead agency, a pilot study was undertaken in which samples of food collected in the marketplace would undergo concurrent pesticide residue *and* microbial analysis. The DCP provided the CAES and DPH with identical, split, samples of material for this purpose. Results from the latter two agencies were forwarded back to the DCP to enforce any violations which were found. This dual mode of testing food offered for sale in Connecticut helps to ensure that the consumer is protected not only from the use of illegal pesticides in the sample, but also ensures that the samples are devoid of any bacterial contamination that might be present.

Methods

Sample Collection:

Samples of produce grown in Connecticut, other states, and foreign countries were collected at 80 different Connecticut farms, producers, retailers, and wholesale outlets by inspectors from the DCP. The samples collected were brought to our laboratory in New Haven by inspectors for pesticide residue testing. In all cases, these market basket samples were collected without prior knowledge of any pesticide application.

Fifty two (52) of the 224 samples in the current study were split upon collection by the DCP inspector. In these cases the inspector delivered half of the sample to the DPH labs in Hartford for microbial testing, and the other half to the CAES labs in New Haven for pesticide residue analysis. As with the other samples in this survey, samples were collected without prior knowledge of pesticide application *or* potential microbial contamination.

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 robot coupe® 3 quart 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 <u>*Qu*</u>ick, <u>*E*</u>asy, <u>*Ch*</u>eap, <u>*E*</u>ffective, <u>*R*</u>ugged, <u>*S*</u>afe (*QuEChERS*; pronounced "catchers") multi-residue 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). For the GC analysis, an Agilent 6890 plus GC equipped with: dual 7683 series injectors and a 7683 autosampler (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 *A*utomated *M*ass spectral *D*econvolution and *I*dentification *S*ystem (AMDIS) with a user constructed library. 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; 6µL injection volume; flow rate 0.25 mL/min; gradient flow 87.5% A (H_2O/0.1*N* HCOOH) to B (100% MeOH/0.1*N* HCOOH) over 20 min; hold 100% B for 10 min. The column eluant 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.

iv. 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 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.

B) Microbiological Methods

The 52 produce samples collected by DCP were delivered to the DPH laboratory and were processed with an amended FDA procedure. Briefly, the samples were weighed out in 1:10 aliquots and soaked in a selective pre-enrichment media. Following this pre-enrichment incubation, a Polymerase Chain Reaction (PCR) screening method, using a DuPont Qualicon BAX® detection system, was performed targeting the presence of *Salmonella* spp., *E. coli* 0157:H7, and *Listeria monocytogenes* Deoxyribonucleic Acid (DNA). Simultaneously, conventional microbiology was performed on the enriched samples, which involved culture plating onto selective agars, Enzyme Linked Immunoassays (ELISA), biochemical and confirmation testing. All samples were streaked onto 1) Xylose lysine Deoxycholate (XLD) agar for isolation of *Salmonella* spp. colonies 2) MacConkey with Cefixime and Tellurite agar and MacConkey Sorbitol Agar for *E. coli* 0157:H7 and STEC colonies and 3) modified Oxford agar for suspect *Listeria* colonies. Any suspect colonies were further characterized using biochemical and confirmation testing. ELISA was performed for the confirmation of *Salmonella* spp. and STEC Following identification and confirmation, all isolates were sent for Pulsed-Field Gel Electrophoresis (PFGE) for DNA fingerprinting using the Centers for Disease Control (CDC) PulseNet protocol. The PFGE laboratory results were compared to the DNA fingerprints in both the local and national databases which contain images obtained from clinical, environmental and food isolates.

Results and Discussion

During the 2010 calendar year, a total of 224 samples, representing a variety of fresh and processed foods, were tested. Of those 224 samples, 138 (61.6%) were fresh produce, 86 (38.4%) were processed products. The findings of the combined pesticide residue and microbial surveillance survey are detailed in Table 1, for fresh, and Table 2 for processed foods. Those samples which underwent concurrent analysis for microbial contamination are specified in these tables as bacterial analysis and denoted using green text.

The majority of the total samples tested, 154 (68.8%), were found to contain residues of at least one pesticide, while the remaining samples, 70 (31.2%), were found to be free of any detectable residues. Pesticide residues were found in 104 samples of fresh produce (75.3%) and 50 (58.1%) samples of processed products. A total of 497 pesticide residues comprised of 64 different Active Ingredients (AI's) were found during the course of this work. Twelve of these are reported for the first time in this work. The number of residues and different AI's found in 2010 again surpass those found in any previous year of this study. Of those samples containing residues, 140 (62.5% of the total samples) contained permissible pesticide levels (non-violative residues) and fourteen samples (6.3% of the total samples) contained 21 residues which were not allowed (violative samples). Of the violative samples, ten (7.3% of the total fresh samples) were found on fresh and four (4.7% of the total processed food samples) on processed produce.

A total of eight residues of six different AI's were found on six (33.3%) of the eighteen organically grown food samples tested as part of this survey. This is once again the highest percentage of pesticide residues found on organic produce in the history of the residue testing program at CAES. Employing the QuEChERS method from 2006-2009, on average, 22.1% of organic food tested (85 samples; 29 residues) was found to contain pesticide residues. From 2000-2005, on average, 10.2% of the organic samples tested (107 samples; 14 residues) were found to contain pesticide residues. The increasing numbers of organic samples found to contain residues is likely due to the lower levels of pesticides being detected in our program (*vide infra).*

None of the residues found on organic produce in 2010 were tolerance violations. One sample of organically labeled pear baby food was found to be in violation of the National Organic Program (NOP) exclusion from sale provision related to pesticide residue testing. 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). In the current instance a sample of organically labeled pear baby food produced outside of CT was found to contain 0.027 ppm of the insecticide thiacloprid. The tolerance for thiacloprid on pears is 0.3 ppm. The level found was nine percent (9%) above the tolerance, and thus violates the NOP provision. The results from this analysis were forwarded to the DCP, who in turn forwarded them to the United States Department of Agriculture (USDA). The USDA maintains the responsibility for enforcing the NOP.

It should be noted that the results of all analysis performed at the CAES and DPH were forwarded to the DCP. The laboratories 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 performing laboratories. In those cases where the laboratories are 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.

The fourteen violative samples found were comprised of twelve different commodities as can be seen in Tables 1 & 2. There was one sample of apples that resulted in an over tolerance violation; a separate sample of apples that contained separate residues that were each individually over tolerance and no tolerance violations; and there were twelve samples which contained eighteen residues for which there was no tolerance. There were eight samples from the United States (US), with four grown in Connecticut; five foreign samples and a single sample whose origin was unknown. Violations were found on fresh samples of alfalfa sprouts (1 MA), apples (2 CT), apricots (1 CT), Kale (1 MN, 1 TX), nectarines (1 Chile), snow peas (1 Guatemala), plums (1 CT) and yams (1 Costa Rica). The remaining four violations

[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*.*

were found on processed samples of guava and blackberry pulp (1 each from Columbia), watermelon chunks (1 FL) and collard greens of unknown foreign origin.

The violative sample of alfalfa sprouts from Massachusetts was found to contain residues of the chlorotriazine herbicide atrazine (0.003 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 these laboratories and others, may persist from one growing season to another. The results of this analysis were communicated to the DCP, and were in turn forwarded to the FDA. A review of the FDA website indicates that no recall was issued based upon these findings.

Two separate samples of apples grown at the same farm in Connecticut accounted for both over tolerance violations. The insecticide chlorpyrifos was found at 0.027 and 0.044 ppm on these samples. The tolerance for chlorpyrifos on apples is 0.010 ppm. On one of these samples, the fungicide chlorothalonil (0.007 ppm) was also found resulting in a concurrent no tolerance violation. In addition to these violative residues, there were six other residues found on these samples. Another grower in Connecticut was responsible for two other no tolerance violations on samples of fresh apricots and plums. The insecticide thiacloprid was found on both of these samples at 0.007 ppm. There is no tolerance for thiacloprid on these commodities. It is interesting to note that peaches taken from the same grower on the same day contained thiacloprid at 0.001 ppm. The tolerance for thiacloprid on peaches is 0.3 ppm, and thus the residue is allowed. There were five other, different, residues found on all the samples from this same grower. It appears likely that an application was made to all three commodities from the same tank mix of pesticides, and while the thiacloprid was allowed on one of the commodities, it was not registered for use on the other two. These results were communicated to the DCP for enforcement. A letter, accompanied by the lab report, was sent to these growers informing them of the violative residues.

There were two samples of fresh kale greens, one from Texas and one from Minnesota which contained atrazine (0.002 ppm) and linuron (0.001 ppm) respectively. Neither of these pesticides is allowed on kale resulting in two no tolerance violations. As indicated above, the atrazine likely carried over in the soil between growing seasons. The Kale sample from Minnesota was also found to be contaminated with *Listeria monocytogenes*. These results were communicated to the DCP, and were in turn forwarded to the FDA. The FDA enforcement report dated October 6, 2010 which can be found at: http://www.fda.gov/Safety/Recalls/EnforcementReports/ucm228605.htm indicates that the Minnesota sample was subjected to a nationwide recall due to this *Listeria* finding.

The remaining three no tolerance violations on fresh produce were all on samples imported into the US. Nectarines from Chile were found to contain the insecticide azinphos methyl (0.002 ppm). Snow peas from Guatemala and yams from Costa Rica were found to contain residues of carbendazim (0.188 and 0.005 ppm respectively). Carbendazim is a fungicide in its own right, but has no tolerances in the US. It is also a metabolite (breakdown product) of the fungicides benomyl and thiophanate methyl, neither of which is allowed for use on these commodities. The results of these analyses were communicated to the DCP, and were in turn forwarded to the FDA. A review of the FDA website indicates that no recalls were issued based upon these findings.

It is interesting to note that snow peas from Guatemala have been on automatic detention since 1992 (http://www1.american.edu/TED/snowpea.htm). This condition was subsequently, and perhaps prematurely, lifted in May of 2011 (http://www.accessdata.fda.gov/cms_ia/importalert_261.html). When on the automatic detection list, growers are required to demonstrate that the crop is free from pesticides without US tolerances using an independent laboratory *prior* to entering the US. The lifting of the automatic detention condition no longer requires the growers to conduct this analysis. When the current finding was made, the condition was in effect, and the sample of snow peas was still permitted to enter the US. It seems likely that the independent laboratory that performed the analysis was unable to analyze for or to detect residues of carbendazim. We have reported several findings in the past of illegal residues found on snow peas from Guatemala (Krol et al. 2006 and 2008). The consumer should be aware that snow peas from Guatemala have a history of arriving to the US marketplace containing illegal pesticide residues.

The guava and blackberry pulps were both frozen puréed samples from Columbia. The guava was found to contain 0.002 ppm of carbendazim. As this is not allowed for use in the US (*vide supra*), and benomyl and thiophanate methyl are not allowed, and as such this residue is illegal. The blackberry pulp was found to contain ten different pesticide residues. Of these, seven of these residues were not allowed (no tolerance) on blackberries (See Table 2), and thus considered illegal. This sample contained the highest proportion of illegal residues to date in our survey. These results were forwarded to the DCP and in turn to the FDA.

The watermelon chucks of sliced, packaged watermelon from Florida were found to contain the insecticide acephate at 0.053 ppm. The collard greens were found to contain the herbicide linuron at 0.003 ppm. These pesticides are not allowed on the crops to which they were found, as such are considered illegal residues. The results of these analyses were forwarded to the DCP who in turn forwarded them to FDA for further action or follow-up.

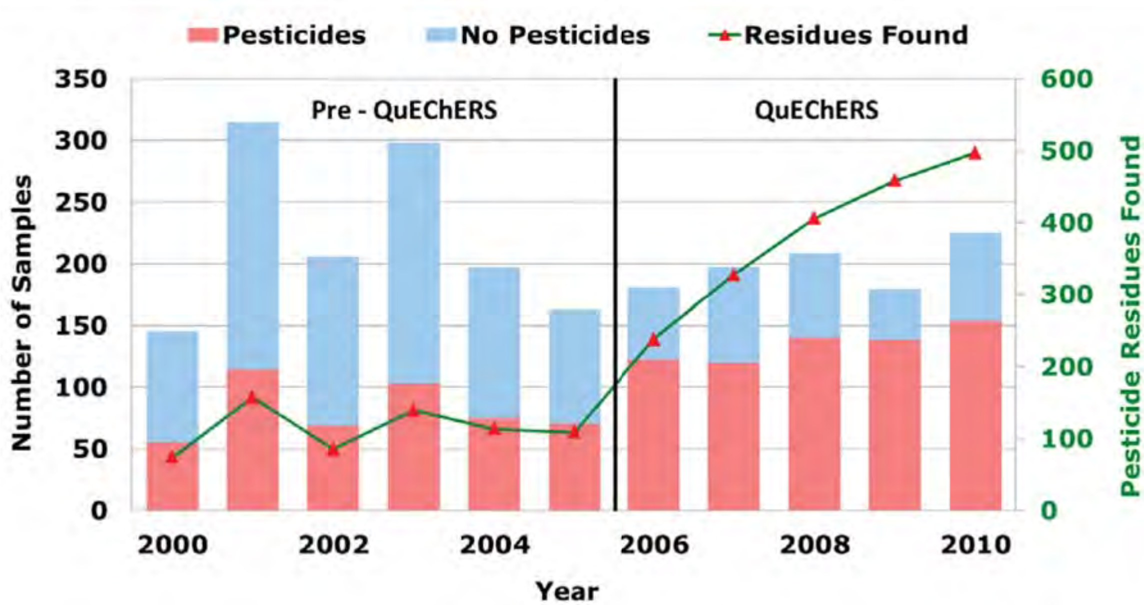
In addition to the pesticide analysis performed at the CAES we routinely perform analysis for potassium sorbate and sodium benzoate on samples of juices and ciders to help enforce labeling laws; these results are included in Table 2. These chemicals are routinely used in foods to preserve freshness by 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 2010, a total of ten (10) samples were tested. Neither of these preservatives was found in any of the samples except for a single sample from New York that was found to contain 0.036% of potassium sorbate which had been declared as an additive on its label.

Program Improvements

Summary results of the CAES pesticide residue program from 2000 to present are presented in Figure 1. It can be seen in Figure 1 that the number of samples which were found to contain pesticides has increased as has the number of residues found (green) since the introduction of QuEChERS (2006 – 2010). The discord observed between the pre-QuEChERS timeframe of 2000-2005 with that of the QuEChERS interval (2006-2010) is the result of several major (and ongoing) improvements made in our program which are described in previous work (Krol *et al.*; 2007, 2010). During the pre-QuEChERS timeframe, on average 63.3% of the samples tested contained no detectable pesticides residues. Following the introduction of the

QuEChERS method, 31.1% of the samples tested were found to be devoid of pesticide residues. During the pre-QuEChERS era, there were, on average, 1.3 residues found on those samples containing pesticides. Using QuEChERS, on average, there were 2.8. As a side note, the CAES results during the pre-QuEChERS era correlated well with those of the FDA pesticide residue monitoring program since 1990 and are described more comprehensively in previous work (Krol *et al.*, 2010).

Figure 1: Pesticide Residues in Food Sold in Connecticut 2000-2010.



Extension of the Program to Microbiological Testing

In 2010, the CT DPH joined the market basket survey and began concurrent testing of some of the produce collected by DCP for *E. coli* O157:H7, STEC, *Salmonella* spp. and *Listeria monocytogenes*. This active surveillance of produce was in response to a foodborne outbreak associated with alfalfa sprouts in 2010 and to an observed increase in outbreaks associated with other fresh produce. We now actively monitor recent clusters and recalls and select produce that has been most associated with outbreaks including bagged salad, sprouts and fresh herbs. In 2010 there were 52 separate food products collected for the pilot study; the samples were of domestic (38) and foreign (14) origin, and encompassed a range of fruits and vegetables, including four certified organic commodities.

The results of these analyses are included in Tables 1 and 2. Nine products from the joint survey were free of pesticide residues and of those containing pesticides, all but three contained permitted residues below EPA tolerances. The three violative samples contained residues for which no tolerance exists, and included samples of domestic watermelon, alfalfa, and kale which contained low levels of acephate, atrazine, and linuron, respectively (*vide supra*). The kale sample mentioned above also contained *L. monocytogenes*. There were no PFGE matches and no human cases associated with this *Listeria monocytogenes* isolate. A trace back was performed by FDA. As indicated above, this sample was the subject of a nationwide recall in October of 2010. In all other samples tested, *E. coli* O157:H7, *Salmonella* spp. and *Listeria monocytogenes* were not found.

This pilot study offered the opportunity to test both residual pesticides and foodborne pathogens in produce that was consumed in CT. In 2011, testing for the Shiga-toxin producing *E. coli* (STEC) was added to this Pilot study. The microbiological portion of this pilot study was funded by a grant from the United States Department of Agriculture (USDA) Food Safety and Inspection Service (FSIS). Additional funding to support ongoing simultaneous chemical and microbial surveillance is being sought.

Conclusions:

In the current work, a greater number of AI's (64) and pesticide residues (497) were detected than any other year in our survey. The vast majority of the residues (95.8%) were found to be within the tolerances set by the EPA. Of the 224 samples analyzed, 154 (68.8%) were found to contain pesticide residues. Residues were found in 75.4% of the fresh, 58.1% of the processed and 33.3% of the organic samples analyzed.

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 used in accordance with the approved use of the pesticidal product, the levels resulting on the food will be below the EPA tolerance. In the past, owing to the sensitivity and specificity of the instruments used at the CAES for detection, many of the residues have gone undetected. Owing to the increased sensitivity of our instrumentation and the QuEChERS methodology for the extraction of the residues from samples, we are detecting greater numbers of pesticides at lower levels. 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.

Of the 52 samples tested jointly for pesticide and microbial contamination, three samples (5.7%) contained violative pesticide residues and one (1.9%) was also found to contain detectable microbial contamination. Whereas the focus of this program in the past has primarily focused on pesticide residues, we look forward to continuing to expand our joint testing efforts of food sold in CT for the inclusion of harmful microorganisms. Microorganisms present in food, like pesticides, pose a risk to the consumer if inadvertently consumed. Unlike pesticides that we might consume, the health effects of unwanted microorganisms can prove to be of a more immediate health concern over a much wider geographic population.

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Table 1: Summary of Pesticides Found in Fresh Fruits and Vegetables Sold in Connecticut in 2010.

Commodity Origin Pesticide	Samples with Residues (Total)	Found by LC, GC or Both	Number of Times Detected	Residue Range (ppm)	Average Residue (ppm)	EPA Tolerance (ppm)
Avocado (2 Samples; 2 Foreign)						
Foreign						
Dominican Republic	1 (1)					
Fenpropathrin		Both	1	0.374		
Thiabendazole		Both	1	0.232		1
Mexico	1 (1)					
Carbendazim		LC	1	0.147		none*
Fepropathrin		LC	1	0.590		1
Apples (18 Samples; 1 Unknown; **2 Violations**; 2 Bacterial Analysis)						
Connecticut	15 (15)					
Acetamiprid		LC	5	0.014-0.161	0.047	1
Boscalid		Both	6	0.001-0.260	0.125	3
Carbaryl		LC	5	0.001-0.004	0.002	12
Carbendazim (Metabolite)		LC	6	0.034-0.347	0.158	none*
Chlorothalonil		**LC**	**1**	**0.007**	**No Tolerance**	**0**
Chlorpyrifos* (2 Viol., 1 OK)		**Both**	**3**	**0.004-0.270**	**Over Tolerance**	**0.01**
Cyhalothrin, *lambda*		GC	1	0.003		0.3
Cyprodinil		Both	3	0.001-0.019	0.009	0.1
Difenoconazole		Both	5	0.001-0.010	0.003	1
Endosulfan		GC	2	0.014-0.035	0.025	1
Fenbuconazole		Both	2	0.003-0.078	0.030	0.4
Fenpyroximate		GC	1	0.012		0.4
Imidacloprid		LC	4	0.009-0.030	0.022	0.5
Indoxacarb		Both	2	0.011-0.112	0.059	1
Myclobutanil		Both	2	0.015-0.226	0.077	0.5
Pendimethalin		Both	2	0.007-0.018	0.011	0.1
Phosmet		Both	15	0.002-0.266	0.075	10
Pyraclostrobin		LC	3	0.036-0.060	0.049	8
Thiacloprid		LC	2	0.008-0.042	0.025	0.3
Thiamethoxam		LC	2	0.006-0.007	0.007	0.2
Thiophanate Methyl		LC	5	0.102-0.205	0.141	2
Trifloxystrobin		Both	3	0.002-0.015	0.008	0.5
New York	1 (1)					
Acetamiprid		LC	1	0.099		1
Boscalid		Both	1	0.051-0.068	0.060	3
Diphenylamine		Both	1	0.082-0.097	0.090	10
Imidacloprid		LC	1	0.006		0.5
Indoxacarb		LC	1	0.047		1
Phosmet		LC	1	0.008		10
Thiacloprid		LC	1	0.001		0.3
Thiophanate Methyl		LC	1	0.331		2

Washington 1 (1)					
Boscalid	LC	1	0.002		3
Carbaryl	LC	1	0.002		12
Chlorantraniliprole	LC	1	0.022		1.2
Imidacloprid	LC	1	0.001		0.5
Thiabendazole	Both	1	0.680		5
Thiacloprid	LC	1	0.002		0.3
Unknown 1 (1)					
Acetamiprid	LC	1	0.021		1
Carbendazim (Metabolite)	LC	1	0.016		none*
Chlorantraniliprole	LC	1	0.002		1.2
Thiacloprid	LC	1	0.005		0.3
Trifloxystrobin	Both	1	0.003		0.5
Apricots (1 Sample; **1 Violation**)					
Connecticut 1 (1)					
Fenbuconazole	LC	1	0.008		1
Indoxacarb	Both	1	0.021		0.9
Imidacloprid	LC	1	0.052		3
Myclobutanil	GC	1	0.066		2
Thiacloprid	**LC**	**1**	**0.007**	**No Tolerance**	**0**
Thiophanate Methyl	LC	1	0.220		1
Arugula (1 Sample; 1 Bacterial Analysis)					
Massachusetts 0 (1)					
Beans, Snap (4 Samples; 1 Unknown; 1 Foreign; 2 Bacterial Analysis)					
Connecticut 2 (2)					
Acephate	LC	1	0.009		3
Boscalid	Both	1	0.044		1.6
Carbendazim (Metabolite)	LC	1	0.050		none*
Chlorothalonil	LC	1	0.003		5
Imidacloprid	LC	1	0.009		4
Foreign (Guatamala) 0 (1)					
Unknown (US) 1 (1)					
Acephate	Both	1	0.167		3
Endosulfan	GC	1	0.012		2
Blackberries (1 Sample; 1 Foreign; 1 Bacterial Analysis)					
Foreign (Mexico) 1 (1)					
Diuron	LC	1	0.002		0.1
Blueberries (3 Samples; 2 Foreign; 2 Bacterial Analysis)					
Michigan 1 (1)					
Fenbucoazole	Both	1	0.002		
Phosmet	LC	1	0.033		
Foreign (Canada) 1 (1)					
Boscalid	Both	1	0.45		6
Cyprodinil	GC	1	0.002		10
Fenhexamid	Both	1	0.016		20
Imidacloprid	LC	1	0.002		3.5
Phosmet	LC	1	0.010		10

(Chile)	1 (1)				
Iprodione		LC	1	0.004	15
Phosmet		LC	1	0.033	10
Broccoli (2 Samples; 1 Foreign; 1 Bacterial Analysis)					
California	1 (1)				
Boscalid		Both	1	0.289	3
Chlorpyrifos		LC	1	0.002	1
Imidacloprid		LC	1	0.002	3.5
Indoxacarb		Both	1	0.028	12
Foreign (Mexico)	0 (1)				
Cabbage (1 Sample; 1 Unknown)					
Unknown (US)	1 (1)				
Imidacloprid		LC	1	0.009	3.5
Carrots (2 Samples; 1 *Organic*; 1 Unknown; 2 Bacterial Analysis)					
Organic (California)	1 (1)				
DDE		GC	1	0.003	3
Unknown (US)	1 (1)				
Boscalid		Both	1	0.015	1
Cyprodinil		LC	1	0.012	0.75
Linuron		LC	1	0.005	1
Metalaxyl		LC	1	0.002	0.5
Cauliflower (2 Samples)					
California	1 (2)				
Imidacloprid		LC	1	0.001	3.5
Cherries (2 Samples; 1 Foreign; 1 Bacterial Analysis)					
Connecticut	1 (1)				
Boscalid		Both	1	0.145	1.7
Captan		GC	1	0.038	50
Cyprodinil		GC	1	0.005	2
Fenbuconazole		Both	1	0.149	1
Fenvalerate		GC	1	0.162	10
Phosmet		Both	1	0.463	10
Thiophanate Methyl		LC	1	0.222	20
Foreign (Chile)	0 (1)				
Clementines (1 Sample)					
California	1 (1)				
Carbendazim (Metabolite)		LC	1	0.002	none*
Imazalil		Both	1	3.2	10
Thiabendazole		Both	1	0.963	10
Pendimethalin		LC	1	0.001	0.1
Collards (1 Sample; 1 Unknown)					
Unknown	1 (1)				
Imidacloprid		LC	1	0.002	3.5
Corn (3 Samples)					
Connecticut	0 (3)				
Cucumbers (3 Samples; 1 Foreign; 1 Bacterial Analysis)					
Connecticut	1 (2)				
Chlorothalonil		LC	1	0.008	5

Endosulfan		GC	1	0.061		1
Methomyl		LC	1	0.003		0.2
Foreign (Mexico)	1 (1)					
Bifenthrin		GC	1	0.003		0.4
Boscalid		Both	1	0.012		0.5
Carbendazim (Metabolite)		LC	1	0.002		none*
Endosulfan		GC	1	0.027		1
Metalaxyl		LC	1	0.004		1
Garlic (2 Samples; 1 Foreign; 1 Unknown)						
Foreign (China)	0 (1)					
Unknown (US)	1 (1)					
Boscalid		LC	1	0.001		3
Ginger, Root (1 Sample; 1 Unknown)						
Unknown (US)	0 (1)					
Grapefruit (1 Sample)						
Florida	1 (1)					
Imazalil		Both	1	0.417		10
Thiabendazole		Both	1	0.695		10
Trifloxystrobin		LC	1	0.002		0.6
Grapes (2 Samples; 2 Foreign; 1 Bacterial Analysis)						
Foreign (Chile)	1 (1)					
Boscalid		Both	1	0.008		3.5
Iprodione		LC	1	0.039		60
Foreign (Chile)	1 (1)					
Azoxystrobin		LC	1	0.001		1
Boscalid		Both	1	0.010-0.983	0.497	3.5
Cyprodinil		Both	1	0.082		2
Difenozocazole		LC	1	0.001		0.1
Fludioxonil		GC	1	0.353		1
Imidacloprid		LC	1	0.099		1
Trifloxystrobin		LC	1	0.001		2
Greens, Mixed (2 Samples; 2 Bacterial Analysis)						
California	1 (2)					
Boscalid		LC	1	0.004		1
Imidacloprid		LC	1	0.002		3.5
Kale (2 Samples; **2 Violations**; 2 Bacterial Analysis; **1 Positive for *Listeria monocytogenes***)						
Minnesota	1 (1)	***L. monocytogenes*** **Positive**				
Chlorothalonil		LC	1	0.024		5
Linuron		**LC**	**1**	**0.001**	**No Tolerance**	**0**
Texas	1 (1)					
Azoxystrobin		LC	1	0.002		3
Atrazine		**LC**	**1**	**0.002**	**No Tolerance**	**0**
Imidacloprid		LC	1	0.063		3.5
Mandipropamid		LC	1	0.176		3
Metalaxyl		Both	1	0.018		0.1
Lettuce (4 Samples; 1 Foreign; 1 Unknown; 3 Bacterial Analysis)						
California	1 (1)					
Acephate		LC	1	0.003		10

Acetamiprid		LC	1	0.049		3
Cypermethrin		GC	1	0.476		4
DDE		GC	1	0.002		0.5
Dimethomorph		Both	1	0.557		10
Imidacloprid		LC	1	0.033		3.5
Methomyl		LC	1	0.068		5
Connecticut	1 (1)					
Boscalid		LC	1	0.004		1
Chlordane		GC	1	0.004		0.1
Fenhexamid		LC	1	0.003		30
Imidacloprid		LC	1	0.004		3.5
Unknown (US)	1 (1)					
Boscalid		LC	1	0.002		1
Dimethomorph		LC	1	0.005		10
Linuron		LC	1	0.011		1
Foreign (Canada)	1 (1)					
Endosulfan		GC	1	0.124		11
Nectarines (2 Samples; 2 Foreign; **1 Violation**)						
Foreign (Chile)	2 (2)					
Acetamiprid		LC	1	0.019		1.2
Azinphos Methyl		**LC**	**1**	**0.002**	**No Tolerance**	**0**
Boscalid		LC	1	0.001		1.7
Carbendazim (Metabolite)		LC	1	0.002		none*
Chlorothalonil		LC	1	0.017		0.5
Chlorpyrifos		LC	1	0.003		0.05
Imidacloprid		LC	1	0.001		3
Iprodione		Both	2	0.846-0.956	0.899	20
Tebuconazole		LC	1	0.023		1
Oranges (1 Sample)						
California	1 (1)					
Diuron		LC	1	0.034		0.05
Imazalil		Both	1	2.500		10
Pyriproxyfen		LC	1	0.001		0.3
Simazine		LC	1	0.002		0.25
Thiabendazole		Both	1	1.400		10
Parsnips (1 Sample)						
Massachusetts	1 (1)					
Carbaryl		LC	1	0.002		2
Diazinon		LC	1	0.002		0.5
Peaches (3 Samples)						
Connecticut	3 (3)					
Boscalid		Both	1	0.089		3.5
Carbendazim (Metabolite)		LC	1	0.010		none*
Cyhalothrin, *lambda*		GC	2	0.011-0.123	0.117	0.5
Endosulfan		GC	1	0.044		2
Fenbuconazole		Both	1	0.060		1
Imidacloprid		LC	1	0.092		3
Indoxacarb		LC	1	0.002		0.9

Myclobutanil	GC	1	0.021		2
Phosmet	Both	2	0.002-0.196	0.097	10
Propiconazole	Both	1	0.011		1
Pyridaben	GC	1	0.128		2.5
Thiacloprid	LC	1	0.001		0.3
Thiophanate Methyl	LC	1	0.016		3
Pears (2 Samples)					
Connecticut 1 (1)					
Boscalid	LC	1	0.002		3
Cyhalothrin, *lambda*	GC	1	0.055		0.3
Difenoconazole	LC	1	0.001		1
Fenbuconazole	LC	1	0.005		0.4
Fenpyroximate	LC	1	0.038		0.4
Permethrin	GC	1	0.002		0.05
Thiophanate Methyl	LC	1	0.119		2
Washington 1 (1)					
Azinphos Methyl	LC	1	0.038		1.5
Carbaryl	LC	1	0.044		12
Fenpyroximate	LC	1	0.005		0.4
Fludioxonil	GC	1	0.439		5
Pyrimethanil	Both	1	0.123		14
Thiabendazole	Both	1	0.454		5
Peas (3 Samples; 1 Foreign; **1 Violation**)					
Connecticut 0 (2)					
Foreign (Guatemala) 1 (1)					
Carbendazim (Metabolite)	**LC**	**1**	**0.188**	**No Tolerance**	**0**
Chlorothalonil	LC	1	0.023		5
Dimethoate	LC	1	0.023		2
Peppers (6 Samples; 2 Foreign; 1 *Organic*; 1 Bacterial Analysis)					
Connecticut 1 (3)					
Chlorothalonil	LC	1	0.005		6
Difenoconazole	LC	1	0.004		0.6
Imidacloprid	LC	1	0.005		1
Foreign (Mexico) 1 (1)					
Captan	GC	1	0.011		0.05
Chlorothalonil	LC	1	0.071		6
Chlorpyrifos	LC	1	0.002		1
Endosulfan	GC	1	0.165		2
Imidacloprid	LC	1	0.087		1
Thiophanate Methyl	LC	1	0.013		0.5
Foreign (Mexico) 1 (1)					
Acetamiprid	LC	1	0.002		0.2
Endosulfan	LC	1	0.016		2
Imidacloprid	LC	1	0.002		1
Metalaxyl	Both	1	0.002		1
Methomyl	LC	1	0.002		2
Organic (Florida) 0 (1)					
Plums (2 Samples; **1 Violation**)					

Connecticut	2 (2)					
Fenbuconazole		Both	2	0.009-0.028	0.019	1
Imidacloprid		LC	1	0.022		3
Indoxacarb		GC	1	0.005		0.9
Myclobutanil		GC	1	0.051		2
Phosmet		Both	1	0.013		5
Thiacloprid		**LC**	**1**	**0.007**	**No Tolerance**	**0**
Thiophanate Methyl		LC	1	0.089		0.5
Potatoes (2 Samples; 1 Foreign; 1 *Organic*)						
Idaho	1 (1)					
Chlorpropham (CIPC)		Both	1	3.104		30
Imidacloprid		LC	1	0.062		0.4
Foreign; *Organic* (Canada)	1 (1)					
Chlorpropham		Both	1	0.033		30
Rutabaga, Root (1 Sample; 1 Foreign)						
Foreign (Canada)	0 (1)					
Spinach (5 Samples; 1 Foreign; 1 *Organic*; 2 Unknown; 5 Bacterial Analysis)						
California	1 (1)					
DDE		GC	1	0.004		0.5
Mandipropamid		LC	1	0.002		20
Permethrin		GC	1	3.080		20
Foreign (Canada)	0 (1)					
Organic (Massachusetts)	1 (1)					
Boscalid		LC	1	0.001		
Unknown (US)	2 (2)					
Azoxystrobin		Both	2	0.027-0.085	0.053	30
Endosulfan		GC	1	0.04		11
Imidacloprid		LC	1	0.011		3.5
Pyraclostrobin		LC	2	0.094-0.194	0.144	29
Sprouts, Mixed (4 Samples; 1 *Organic*; **1 Violation**; 4 Bacterial Analysis)						
Alfalfa						
Massachusetts	1 (1)					
Atrazine		**LC**	**1**	**0.003**	**No Tolerance**	**0**
Pennsylvania	0 (1)					
Soybean						
Massachusetts	0 (1)					
Mung Bean						
Organic Massachusetts	0 (1)					
Squash (11 Samples; 3 Foreign; 1 *Organic*; 1 Unknown; 1 Bacterial Analysis)						
Connecticut	2 (6)					
Boscalid		Both	1	0.008		1.6
Carbendazim (Metabolite)		LC	1	0.005		none*
Chlordane		GC	1	0.003		0.1
Thiamethoxam		LC	1	0.001		0.2
Massachusetts	1 (1)					

Thiamethoxam		LC	1	0.006		0.2
Foreign (Mexico)	2 (2)					
Captan		GC	1	0.002		0.05
Carbendazim (Metabolite)		LC	1	0.002		none*
Chlorothalonil		LC	1	0.007		5
Dinotefuran		LC	1	0.006		0.5
Endosulfan		GC	1	0.062		1
Imidacloprid		LC	2	0.015-0.019	0.017	0.5
Thiamethoxam		LC	1	0.061		0.2
Foreign, *Organic*						
Mexico	1 (1)					
Imidacloprid		LC	1	0.002		0.5
Unknown (US)	0 (1)					
Strawberries (14 Samples; 1 Bacterial Analysis)						
California	1 (1)					
Boscalid		Both	1	0.070		4.5
Carbendazim (Metabolite)		LC	1	0.004		none*
Cyprodinil		Both	1	0.279		5
Propiconazole		LC	1	0.001		1.3
Pyrimethanil		Both	1	0.061		3
California	1 (1)					
Bifenzate		GC	1	0.066		1.5
Malathion		Both	1	0.046		8
Connecticut	11 (11)					
Bifenthrin		GC	1	0.066		3
Boscalid		Both	9	0.005-0.121	0.077	4.5
Captan		GC	3	0.045-0.457	0.289	20
Carbendazim (Metabolite)		LC	1	0.003		none*
Cyprodinil		Both	10	0.002-0.154	0.032	5
Endosulfan		GC	2	0.045-0.073	0.059	2
Fenhexamid		Both	2	0.032-0.153	0.115	3
Fenpropathrin		Both	4	0.009-0.211	0.089	2
Fludioxonil		GC	4	0.010-0.031	0.022	2
Imidacloprid		LC	1	0.001		0.5
Myclobutanil		GC	1	0.140		0.5
Pendimethalin		Both	1	0.001		0.1
Florida	1 (1)					
Bifenthrin		GC	1	0.022		3
Captan		GC	1	0.061		20
Carbendazim (Metabolite)		LC	1	0.042		none*
Cyprodinil		Both	1	0.015		5
Pyrimethanil		GC	1	0.085		3
Sweet Potatoes (1 Sample; 1 Unknown)						
Unknown (US)	1 (1)					
Chlorpyrifos		LC	1	0.003		0.05
Dichloran		GC	1	0.563		10
Tangerines (1 Sample)						
Florida	1 (1)					

Azoxystrobin	Both	1	0.028		10
Chlorpyrifos	LC	1	0.004		1
Imazalil	Both	1	0.902		10
Imidacloprid	LC	1	0.013		0.7
Malathion	LC	1	0.020		8
Metalaxyl	LC	1	0.002		1
Phosmet	LC	1	0.118		5
Thiabendazole	Both	1	0.786		10
Tomatoes (15 Samples; 2 Foreign; 2 Bacterial Analysis)					
Arizona 1 (1)					
Dinotefuran	LC	1	0.418		0.7
Connecticut 7 (11)					
Carbaryl	LC	1	0.045		5
Carbendazim (Metabolite)	LC	2	0.001		none*
Chlorantraniliprole	LC	1	0.001		0.7
Chlorothalonil	Both	4	0.010-0.168	0.054	5
Difenoconazole	Both	2	0.001-0.153	0.463	0.6
Endosulfan	GC	1	0.145		1
Imidacloprid	LC	1	0.005		1
Maine 0 (1)					
Foreign (Mexico) 1 (1)					
Boscalid	Both	1	0.010		1.2
Imidacloprid	LC	1	0.015		1
Foreign (Mexico) 1 (1)					
Acetamiprid	LC	1	0.021		0.2
Imidacloprid	LC	1	0.002		1
Thiamethoxam	LC	1	0.003		0.25
Turnips, Tuber (1 Sample; 1 Unknown)					
Unknown (US) 0 (1)					
Yams (1 Sample; 1 Foreign; **1 Violation**)					
Foreign (Costa Rica) 1 (1)					
Carbendazim (Metabolite)	**LC**	**1**	**0.005**	**No Tolerance**	**0**
Yucca (1 Sample; 1 Foreign)					
Foreign (Costa Rica) 0 (1)					

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.

Table 2: Summary of Pesticides Found in Processed Fruits and Vegetables Sold in Connecticut in 2010.

Commodity / Origin / Pesticide	Samples with Residues (Total)	Found by LC, GC or Both	Number of Times Detected	Residue Range (ppm)	Average Residue (ppm)	EPA Tolerance (ppm)
Juices/Ciders						
Apple Cider/Juice (10 Samples; 2 Foreign; 2 Unknown)						
Connecticut	4 (4)					
Acetamiprid		LC	2	0.015-0.027	0.021	1
Boscalid		Both	2	0.004-0.007	0.006	10
Carbendazim (Metabolite)		LC	3	0.002-0.099	0.040	none*
Myclobutanil		Both	1	0.008		0.5
Phosmet		Both	2	0.005-0.025	0.015	10
Thiacloprid		LC	2	0.001		0.3
Thiamethoxam		LC	1	0.005		0.2
Preservatives	*0 (4)*	*No potassium sorbate or sodium benzoate found*				
Michigan	0 (1)					
Preservatives	*0 (1)*	*No potassium sorbate or sodium benzoate found*				
New York	1 (1)					
Acetamiprid		LC	1	0.044		1
Carbendazim (Metabolite)		LC	1	0.080		none*
Thiacloprid		LC	1	0.003		0.3
Preservatives	*1 (1)*	*0.036% potassium sorbate found; no sodium benzoate found*				
Foreign	1 (2)					
China/Argentina						
Carbendazim (Metabolite)		LC	1	0.002		none*
Preservatives	*0 (2)*	*No potassium sorbate or sodium benzoate found*				
Unknown (US)	2 (2)					
Acetamiprid		LC	2	0.003-0.008	0.006	1
Carbendazim (Metabolite)		LC	2	0.067-0.213	0.140	none*
Chlorantraniliprole		LC	1	0.004		1.2
Thiacloprid		LC	2	0.001		0.3
Preservatives	*0 (2)*	*No potassium sorbate or sodium benzoate found*				
Carrot Juice (1 Sample; 1 Foreign)						
Foreign (Poland)	0 (1)					
Cranberry Juice (1 Sample; 1 Foreign)						
Foreign (Poland)	0 (1)					
Fruits & Vegetables, Frozen						
Beans, Green (2 Samples; 1 Foreign; 1 Unknown)						
Foreign (Belgium)	1 (1)					
Boscalid		Both	1	0.031		2.5
Carbendazim (Metabolite)		LC	1	0.034		none*
Unknown (US)	1 (1)					
Carbendazim (Metabolite)		LC	1	0.030		none*

Blackberries (1 Sample; 1 Foreign; **1 Violation**)					
Foreign (Columbia)	1 (1)				
Atrazine		**LC**	**1**	**0.001**	**0**
Azoxystrobin		LC	1	0.003	5
Carbendazim (Metabolite)		LC	1	0.341	none*
Chlorpyrifos		**LC**	**1**	**0.004**	**0**
Difenoconazole		**LC**	**1**	**0.004**	**0**
Dimethoate		**LC**	**1**	**0.006**	**0**
Metalaxyl		**Both**	**1**	**0.010**	**0**
Profenofos		**LC**	**1**	**0.005**	**0**
Propiconazole		LC	1	0.021	1
Thiacloprid		**LC**	**1**	**0.002**	**0**
Broccoli (2 Samples; 1 Foreign; 1 Unknown)					
Foreign (Mexico)	0 (1)				
Unknown (US)	1 (1)				
Azoxystrobin		LC	1	0.001	3
Coconut (1 Sample; 1 Foreign)					
Foreign (Dominican Republic)	0 (1)				
Collard Greens (1 Sample; 1 Unknown; **1 Violation**)					
Unknown	1 (1)				
Linuron		**LC**	**1**	**0.003**	**0**
Metalaxyl		Both	1	0.001	0.1
Guava (1 Sample; 1 Foreign; **1 Violation**)					
Foreign (Columbia)	1 (1)				
Carbendazim (Metabolite)		**LC**	**1**	**0.002**	**none***
Mango (1 Sample; 1 Foreign)					
Foreign (Columbia)	0 (1)				
Peas (1 Sample; 1 Unknown)					
Unknown (US)	0 (1)				
Spinach (1 Sample; 1 Unknown)					
Unknown	1 (1)				
Azoxystrobin		Both	1	0.011	30
Fruits & Vegetables, Canned or Jarred					
Beans (6 Samples; 3 *Organic*; 3 Unknown)					
Organic (US/F)	1 (3)				
Carbendazim (Metabolite)		LC	1	0.004	none*
Unknown	1 (3)				
Bifenthrin		GC	1	0.010	0.6
Carbendazim (Metabolite)		LC	1	0.004	none*
Carrots (1 Sample; 1 Foreign)					
Foreign (Canada)	0 (1)				
Grapefruit (1 Sample; 1 Unknown)					
Unknown (US)	1 (1)				
Imazalil		LC	1	0.002	10
Oranges (1 Sample; 1 Foreign)					
Foreign (China)	1 (1)				

		Carbendazim (Metabolite)	LC	1	0.028		none*
Peaches (2 Samples; 2 Unknown)							
Unknown	1 (2)						
		Chlorothalonil	LC	1	0.001		0.5
Pears (2 Samples; 2 Unknown; 1 Bacterial Analysis)							
Unknown	0 (1)						
(US)	1 (1)						
		Carbaryl	LC	1	0.002		12
Peas (2 Samples; 2 Foreign; 2 Unknown)							
Foreign							
(Italy)	0 (1)						
(Mexico)	0 (1)						
Unknown	0 (2)						
Pineapple (3 Samples; 3 Foreign)							
Foreign (Thailand)	0 (3)						
Spinach (1 Sample; 1 Unknown)							
Unknown	0 (1)						
		Cypermethrin, *zeta*	GC	1	0.126		10
		Imidacloprid	LC	1	0.003		3.5
Watermelon (1 Sample; 1 Unknown; 1 Bacterial Analysis)							
Unknown (US)	1 (1)						
		Imidacloprid	LC	1	0.003		0.5
Baby Food							
Apples (3 Samples; 1 Foreign; 1 *Organic*; 2 Unknown)							
Foreign (Canada)	1 (1)						
		Carbendazim	LC	1	0.145		none*
		Thiacloprid	LC	1	0.013		0.3
Organic (Unknown)	0 (1)						
Unknown	1 (1)						
		Acetamiprid	LC	1	0.013		1
Beans, Green (1 Sample; 1 *Organic*; 1 Unknown)							
Organic (Unknown)	0 (1)						
Carrots (3 Samples; 2 *Organic*; 3 Unknown)							
Organic (Unknown)	0 (2)						
Unknown	0 (1)						
Mango (1 Sample; 1 Unknown)							
Unknown	0 (1)						
Pears (1 Sample; 1 *Organic*; 1 Unknown; **1 National Organic Program {NOP} Violation**)							
Organic (Unknown)	1 (1)						
		Thiacloprid	**LC**	**1**	**0.027**		**0.3**
	**** Residue Present at Greater than 5% of Tolerance ****						
Peas (3 Samples; 1 *Organic*; 3 Unknown)							
Organic (Unknown)	0 (1)						
Unknown	2 (2)						
		Bentazon	LC	2	0.003-0.004	0.004	3
Squash (3 Samples; 1 *Organic*; 3 Unknown)							
Organic (Unknown)	0 (1)						

Unknown	1 (2)					
Boscalid		LC	1	0.002		1.6
Imidacloprid		LC	1	0.004		0.5
Sweet Potato (3 Samples; 1 *Organic*; 3 Unknown)						
Organic (Unknown)	0 (1)					
Unknown	0 (2)					
Freeze Dried Baby Foods						
Apples (2 Samples; 2 Unknown)						
Unknown	2 (2)					
Acetamiprid		LC	1	0.024		1
Azinphos Methyl		LC	2	0.002-0.006	0.004	1.5
Carbendazim (Metabolite)		LC	1	0.197		none*
Imidacloprid		LC	1	0.003		0.5
Phosmet		LC	2	0.002-0.003	0.003	10
Thiacloprid		LC	2	0.002-0.011	0.007	0.3
Strawberry/Banana (3 Samples; 3 Foreign)						
Foreign	2 (3)					
(Argentina, Chili, Egypt, Mexico, Peru, USA)						
Boscalid		LC	1	0.003		4.5
Malathion		LC	1	0.005		8
Thiabendazole		LC	1	0.042		5
Thiophanate Methyl		LC	1	0.063		7
(Peru, Argentina, Chile, Egypt, Mexico, USA)						
Malathion		LC	1	0.007		8
Thiophanate Methyl		LC	1	0.029		7
(Ecuador, Argentina)						
Chopped/Shredded Foods						
Apples, Sliced (1 Sample; 1 Unknown; 1 Bacterial Analysis)						
Unknown (US)	1 (1)					
Chlorantraniliprole		LC	1	0.021		1.2
Diphenylamine		Both	1	0.266		10
Pyrimethanil		Both	1	0.023		14
Thiabenazole		Both	1	0.021		5
Carrots, Baby and Shredded (4 Samples; 1 Foreign; 1 *Organic*; 1 Unknown; 3 Bacterial Analysis)						
California	1 (1)					
Boscalid		LC	1	0.020		1
Carbendazim (Metabolite)		LC	1	0.002		none*
DDE		GC	1	0.007		3
Foreign (Canada)	1 (1)					
Boscalid		LC	1	0.001		1
Diazinon		LC	1	0.003		0.75
Linuron		LC	1	0.003		1
Organic (California)	0 (1)					
Unknown (US)	1 (1)					
Linuron		LC	1	0.009		1

Coleslaw (1 Sample; 1 Unknown; 1 Bacterial Analysis)					
Unknown (US) 1 (1)					
Linuron	LC	1	0.003		1
Lettuce (10 Samples; 2 Foreign; 5 Unknown; 10 Bacterial Analysis)					
California 3 (3)					
Acetamiprid	LC	1	0.004		3
Boscalid	LC	1	0.002		6.5
Cyprodinil	GC	1	0.003		30
Dimethoate	LC	1	0.027		2
Imidacloprid	LC	2	0.003-0.027	0.015	3.5
Mandipropamid	LC	2	0.005-0.008	0.007	20
Permethrin	GC	1	0.030		20
Thiamethoxam	LC	1	0.030		0.25
Foreign (Canada) 1 (1)					
Mandipropamid	LC	1	0.442		20
(USA, Canada, Peru) 1 (1)					
Dimethomorph	LC	1	0.009		10
Imidacloprid	LC	1	0.001		3.5
Iprodione	LC	1	0.007		25
Mandiproamid	LC	1	0.003		20
Unknown 1 (1)					
Endosulfan	GC	1	0.052		11
Pyraclostrobin	LC	1	0.003		29
Unknown (US) 4 (4)					
Boscalid	LC	1	0.002		6.5
Cyhalothrin, *lambda*	GC	1	0.040		2
Imidacloprid	LC	4	0.001-0.017	0.008	3.5
Mandipropamid	LC	2	0.007-0.020	0.014	20
Permethrin	GC	1	0.085		20
Thiamethoxam	LC	2	0.004		0.25
Watermelon, Chunks (1 Sample; **1 Violation**; 1 Bacterial Analysis)					
Florida 1 (1)					
Acephate	**LC**	**1**	**0.053**	**No Tolerance**	**0**
Carbendazim (Metabolite)	LC	1	0.011		none*
Oxamyl	LC	1	0.099		2
Other Samples					
Apples, Grape Flavored (Grapples) (1 Sample; 1 Unknown)					
Unknown (US) 1 (1)					
Acetamiprid	LC	1	0.045		1
Boscalid	Both	1	0.061		3
Captan	GC	1	0.153		25
Diazinon	LC	1	0.007		0.5
Diphenylamine	Both	1	0.084		10
Thiabendazole	Both	1	0.370		5
Thiophanate Methyl	LC	1	0.156		2

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.