



AGRICULTURAL



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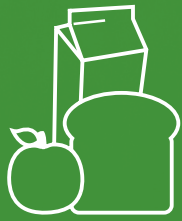
Agricultural & Food Safety Analysis



QuEChERS

Informational Booklet

QUICK, EASY, CHEAP, EFFECTIVE, RUGGED AND SAFE



QuEChERS, the Multiresidue Method of Choice

QuEChERS (pronounced “catchers”), an acronym for Quick, Easy, Cheap, Effective, Rugged and Safe, covers a variety of sample preparation and clean-up techniques for the analysis of multiple pesticide residues in agricultural matrices.

Originally designed for the analysis of fruits and vegetables, **QuEChERS** now includes a wide range of agricultural products. Since its development and publication by scientists at the USDA in 2003, **QuEChERS** has gained significant popularity as the method of choice. It combines several sample preparation steps and extends the range of analytes recovered over older, tedious extraction methods. A driving force in the growth of **QuEChERS** is the emerging need to determine trace amounts of analytes in a high throughput environment.

Matrices include:

- animal products--meat, fish, kidney, chicken, milk, honey
- cereals and grain products
- food products--wines, juices, fruit and vegetables

The expansion of the **QuEChERS** methodology indicates not only its power for sample extraction and clean-up but also addresses the concern about detecting a vast array of pesticides, herbicides, fungicides, antibiotics, and other compounds throughout the entire food supply.

QuEChERS in its basic form involves three steps:

1. liquid micro-extraction
2. solid-phase clean-up
3. LC/MS/MS or GC/MS analysis

QuEChERS continues to undergo modifications for improved sample preparation in a broad array of analytes in a vast array of matrices. Due to the large number of **QuEChERS** methods now published, **QuEChERS** is considered an “approach” rather than a “method.” **QuEChERS** has now become a generic technique with many modifications, each variation is designed to accomplish one thing—**quick sample extraction and clean-up.**

Modifications to the original **QuEChERS** method have been introduced to:

- increase sample throughput while reducing costs
- minimize degradation of susceptible compounds (e.g. base and acid labile pesticides)
- expand the range of matrices amenable by this approach





The Three Primary QuEChERS Methods

1) Original QuEChERS Method (by Anastassiades, Lehotay, et al)

- Sodium Chloride is used to reduce polar interferences
- Provides the cleanest extraction because it uses fewer reagents
- Does not use acetic acid which may be problematic in GC/MS analysis
- Uses dispersive clean-up procedures

2) AOAC 2007.01

- Employs 1% acetic acid in acetonitrile and sodium acetate buffer to protect base sensitive analytes from degradation
- A USDA study has demonstrated that this method provides superior recovery for pH sensitive compounds when compared to the other two QuEChERS methods
- The approach uses acetic acid in the extraction step. The acetic acid can overload the PSA sorbent used in the clean-up step making it ineffective and possibly causing GC resolution issues

3) EN 15662

- The European method includes sodium chloride to limit polar interferences and several buffering reagents to preserve base sensitive analytes
- Sodium hydroxide used in the citrus step should be avoided as it can add impurities to the extract as well as damage the sorbent used in the clean-up step

Sample Preparation and Extraction

- Freeze samples to -20°C
- Homogenize with dry ice until a free flowing powder is formed
- The sample is then:
 - 1) **extracted** into solvent
 - 2) **dispersive or cartridge SPE is used for clean-up**

Features and Impact

QuEChERS significantly improves laboratory efficiency and throughput. A batch of 20 extracts can be prepared in less than 60 minutes by a single analyst. This procedure requires only a few milliliters of solvent and is capable of generating recoveries of 90-110% with RSD's < 5% for a wide range of GC and LC amenable compounds.

Extraction and Clean-Up

- Solvent extraction techniques are designed to remove as much analyte from the base matrix as possible
- Solvent selection is important to minimize co-extracting compounds
- Sample clean-up is necessary to reduce interferences
- Interferences can damage analytical instrumentation and complicate analyte identification and quantification

Extraction Reagents and Their Function

Magnesium sulfate, anhydrous—facilitates solvent partitioning and improves recovery of polar analytes

Acetic acid—used to adjust pH

Acetonitrile—organic solvent providing the best characteristics for extracting the broadest range of pesticides with the least number of co-extractables. Amenable for both LC and GC analysis

Buffers—prevents degradation of pH sensitive analytes by maintaining optimal pH

Sodium Chloride—reduces the amount of polar interferences

Clean-up Reagents and Their Function

Aminopropyl—removes sugars and fatty acids. Serves the same function as PSA, but is less likely to catalyze degradation of base sensitive analytes. Aminopropyl has a lower capacity for clean-up than PSA

ChloroFiltr®— polymeric sorbent for selective removal of chlorophyll from acetonitrile extracts without loss of polar aromatic pesticides

C18—removes long chain fatty compounds, sterols and other non-polar interferences

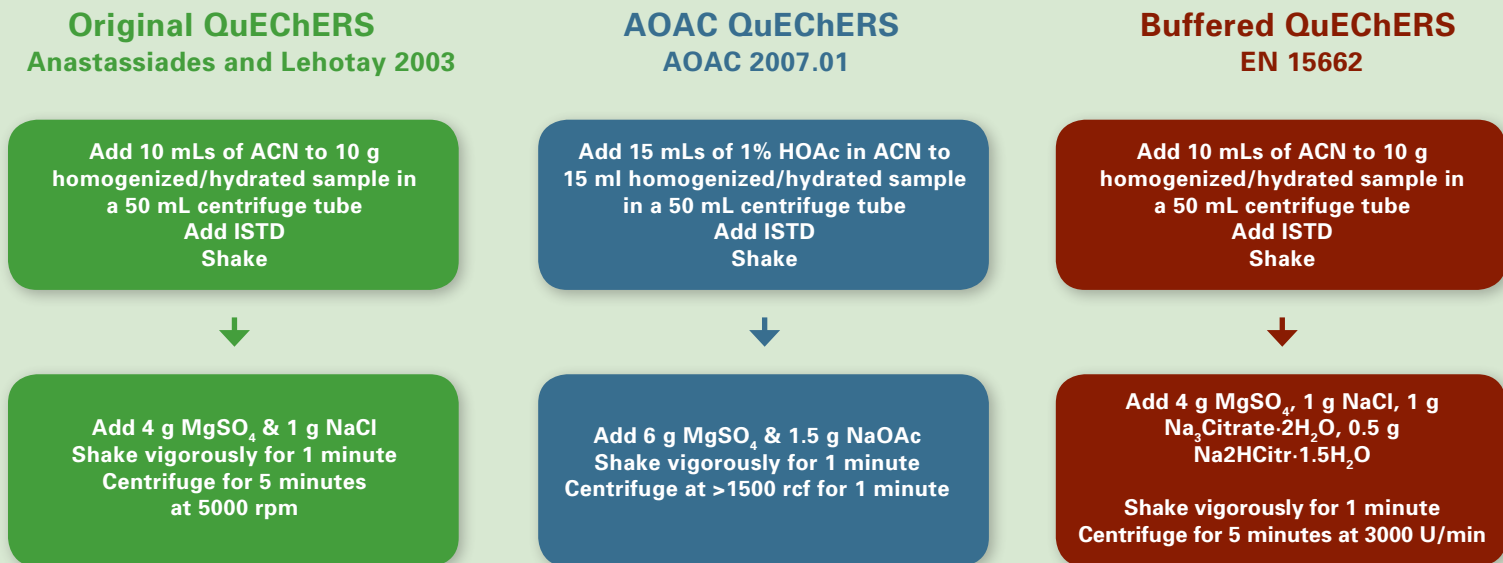
Graphitized carbon black (GCB)—strong sorbent for removing pigments, polyphenols, and other polar compounds: examples of planar (polar aromatic) pesticides which may be removed: chlorothalonil, coumaphos, hexachlorobenzene, thiabendazole, terbufos, and quintozone

Magnesium sulfate anhydrous—removes water from organic phase

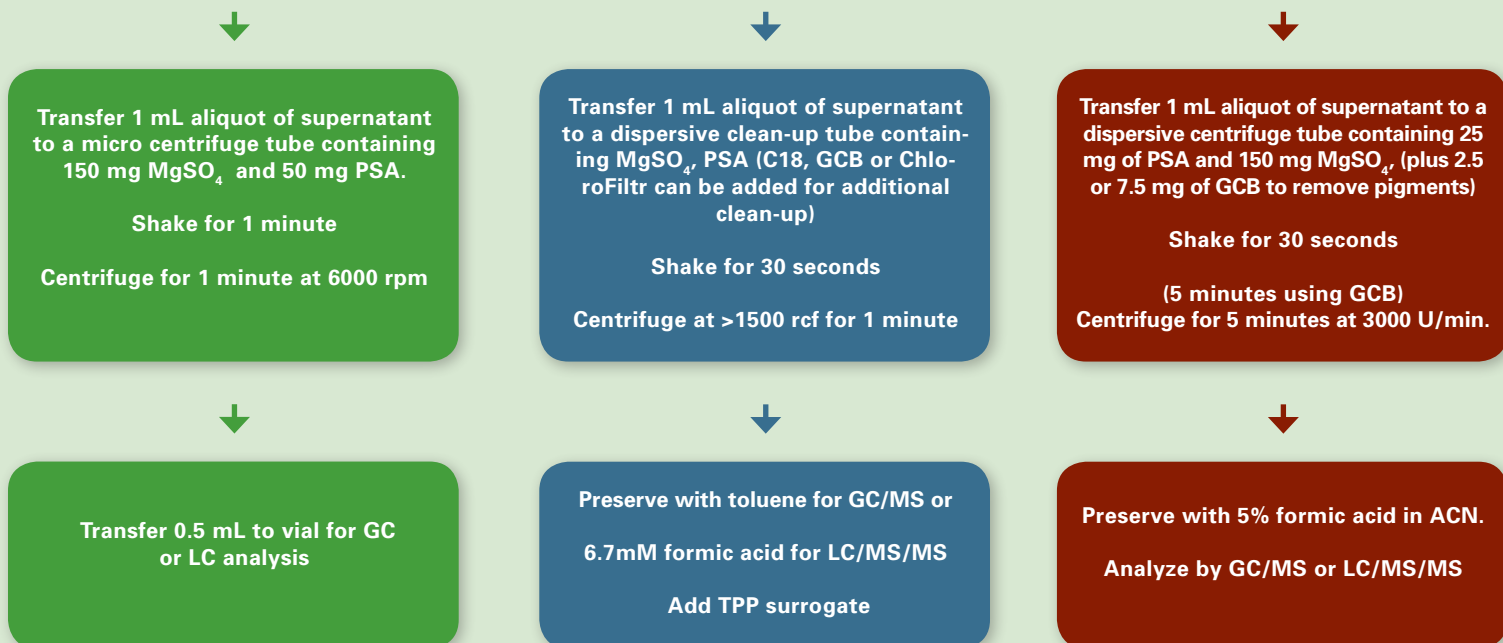
Primary Secondary Amine (PSA)—used in the removal of sugars and fatty acids, organic acids, lipids and some pigments. When used in combination with C18, additional lipids and sterols can be removed

QuEChERS Methods Schematic Flow Chart

Step 1 – Extraction Processes

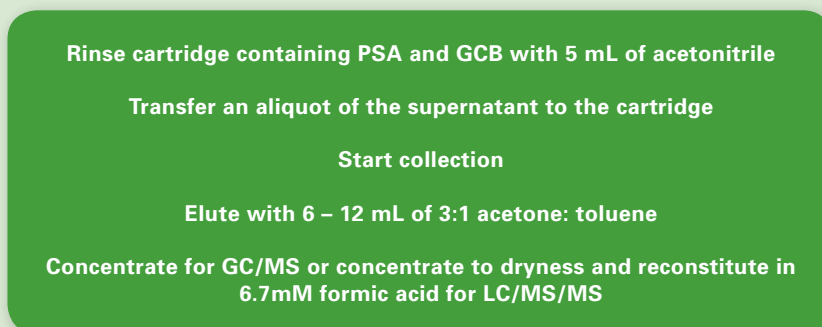


Step 2 – Dispersive SPE Clean-Up Processes



Step 2a – Alternative Cartridge SPE Clean-Up Processes

GCB graphitized carbon black
MgSO₄ magnesium sulfate anhydrous
ACN acetonitrile
HOAc acetic acid
NaCl sodium chloride
Na₃Citrate sodium citrate tribasic dihydrate
Na₂HCitr sodium citrate dibasic sesquihydrate
PSA primary secondary amine
TPP triphenyl phosphate



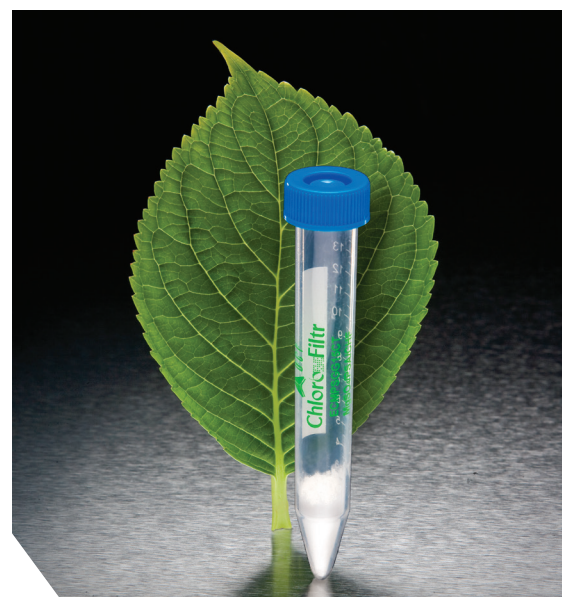
Cartridge or Dispersive SPE (dSPE)

- The original QuEChERS Method uses dSPE clean-up because it's quicker, easier, and less expensive than using traditional SPE cartridges
- With dSPE, the quantity and type of adsorbent can be readily adjusted for differing matrix interferences and various analytes
- dSPE tubes containing **ChloroFiltr®** can be used to remove chlorophyll without loss of planar analytes
- PSA and graphitized carbon sorbents are available in 6mL SPE cartridges with PTFE® frits
- Magnesium sulfate and PSA is available in the Quick QuEChERS cartridge format
- Cartridges provide a better clean-up than dispersive SPE

ChloroFiltr®

Polymeric Sorbent

- **ChloroFiltr®** is a polymeric sorbent available exclusively from UCT. It is designed to replace graphitized carbon black (GCB) for the efficient removal of chlorophyll without loss of planar analytes
- **ChloroFiltr®** has been tested against hundreds of pesticides and herbicides and has been shown to reduce chlorophyll concentration by greater than 82% without loss of planar analytes.



| Comparison of Pesticide Recoveries and RSDs Obtained by dSPE Cleanup of Spinach Sample using ChloroFiltr® and GCB (n=4) | | | | |
|---|--------------|------|-----------|------|
| Pesticide | ChloroFiltr® | | GCB | |
| | Recovery% | RSD% | Recovery% | RSD% |
| Carbendazim | 87.1 | 1.0 | 71.2 | 4.0 |
| Thiabendazole | 93.2 | 1.9 | 55.9 | 2.6 |
| Pyrimethanil | 97.3 | 1.2 | 85.0 | 1.2 |
| Cyprodinil | 91.2 | 0.5 | 79.3 | 3.1 |
| Diazinon | 104.5 | 2.3 | 100.0 | 0.6 |
| Pyrazophos | 92.0 | 0.9 | 92.7 | 1.6 |
| Chlorpyrifos | 95.6 | 2.5 | 96.3 | 2.1 |

The recoveries of carbendazim, thiabendazole, pyrimethanil, and cyprodinil were adversely affected by GCB, especially thiabendazole with a much lower recovery of 55.9% compared to 93.2% obtained by **ChloroFiltr®**. Diazinon, pyrazophos, and chlorpyrifos were less or not affected by GCB due to the non-planar side chains in their structures.

UCT



Spinach Extract Before
and After ChloroFiltr

QuEChERS Spinach Extract (acetonitrile) Showing Effectiveness of ChloroFiltr®

Why Use UCT QuEChERS Products?

- Pre-packed products save valuable laboratory time for increased lab throughput
- Best selection of QuEChERS products available
- Cleaner extracts from cleaner products
- Excellent lot to lot reproducibility
- Magnesium sulfate is organic free
- Unique **ChloroFiltr**® sorbent removes chlorophyll from acetonitrile extracts without loss of planar analytes
- UCT offers sorbents in bulk, dispersive, Quick QuEChERS or traditional cartridge format
- Expert QuEChERS technical support
- Custom made products are available

Contamination Reduced by UCT Products

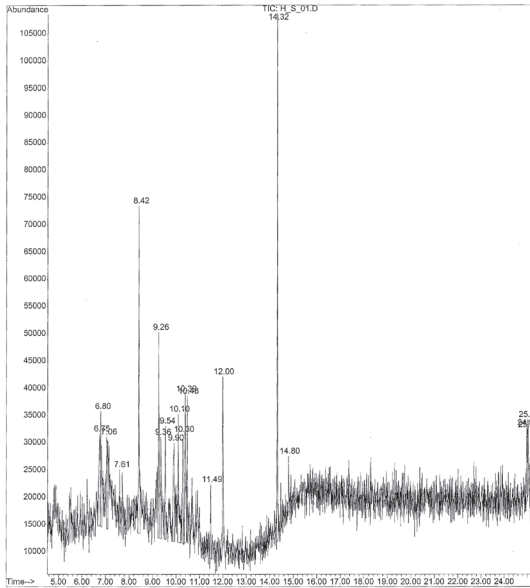
A few laboratories assemble their own extraction and clean-up products. QuEChERS sorbents usually become contaminated when exposed to air in the typical laboratory.

A study conducted at a USDA laboratory compared commercially assembled QuEChERS products to those assembled in a USDA lab. Bulk anhydrous magnesium sulfate, PSA, and endcapped C18 sorbents provided by UCT were assembled in a USDA laboratory. These lab preps were compared to UCT assembled products from the same lot of bulk sorbents. The ratio of magnesium sulfate, PSA and C18 was 3:1:1 for this test. Products were evaluated on extracts of milk, honey and soybean and the efficacy of the clean-up was determined by GC/MS analysis. Comparisons of the extracts were made by counting the number of peaks above threshold. Results proved that the UCT assembled products provided superior clean-up compared to the products assembled in the lab. The results were confirmed in three different matrices. The extra peaks observed in the lab prepared products were probably caused by contamination from the lab air. UCT assembled products are prepared under controlled manufacturing conditions so the potential for contamination is eliminated.

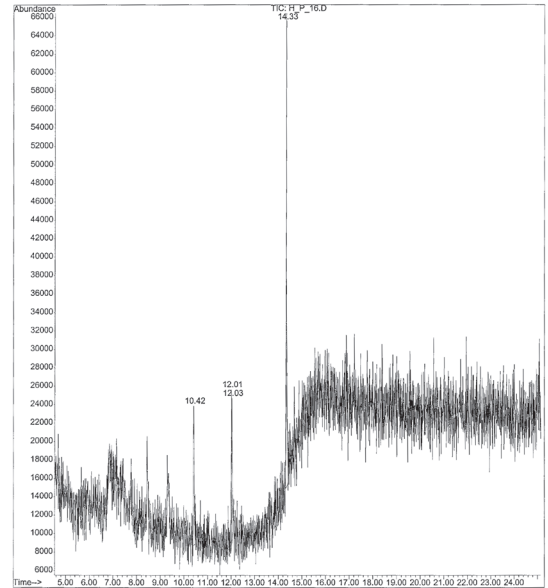
These results, along with time and labor savings, prove that QuEChERS products preassembled at UCT are cleaner and more cost effective than products assembled in the lab.

UCT prepared products show a significant reduction in background

Honey Extracted with "In-House" Product



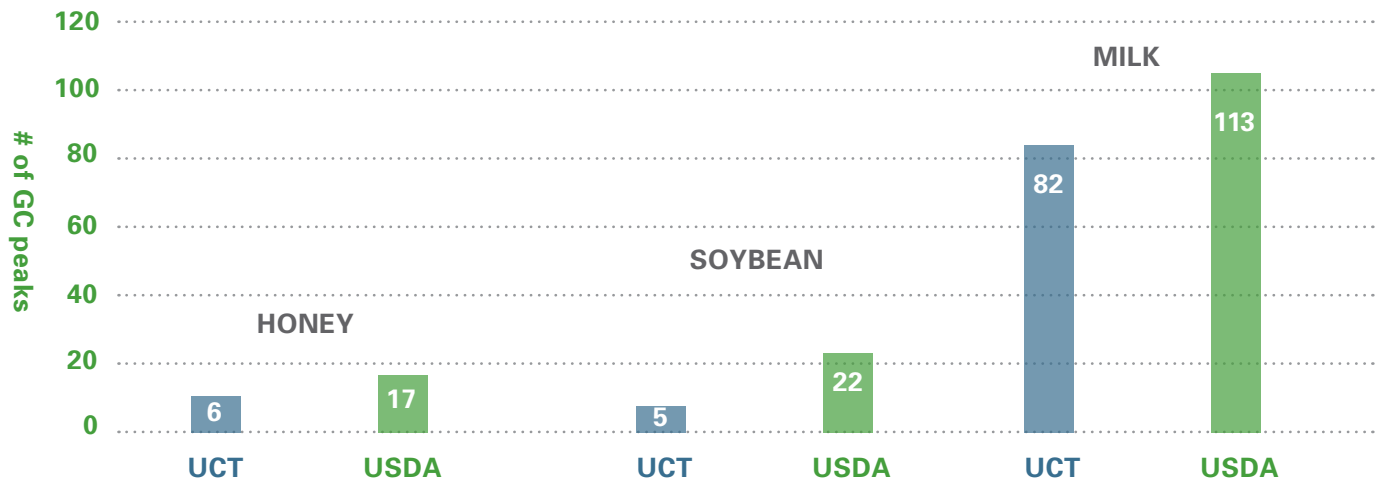
Honey Extract Cleaned with UCT Products



The peaks displayed in the chromatogram on the left show contamination from lab air. The chromatogram on the right shows results from the cleaner UCT prepackaged **QuEChERS** product.

Studies with soybean and milk products show similar improvement in clean-up when using UCT manufactured vs. laboratory prepared products.

Summary Graph Showing the Total Number of Peaks Seen in GC Chromatograms For Honey, Soybean and Milk



The use of UCT prepared products results in cleaner extracts

QuEChERS Troubleshooting Tips



I. Recovery Issues

- a) Use matrix matched calibration standards for greatest accuracy
- b) Use internal standards
- c) Samples must be at least 80% hydrated for effective extraction
- d) Adding extraction salts directly onto the sample will reduce recovery. Mix sample with solvent first
- e) Buffering is required for base sensitive compounds
- f) Graphitized Carbon Black (GCB) can reduce planar analyte recovery
 - i. Use **ChloroFiltr**[®] during extraction to remove chlorophyll
 - ii. Use less GCB
 - iii. Use dual phase (GCB/PSA) cartridge and elute with 3:1 acetone/toluene (product ECPSACB256 is recommended)
- g) For GC analysis, solvent exchanging the final extract into toluene prevents the loss of thermally labile and acetonitrile sensitive pesticides such as chlorothalonil
- h) Adding dilute formic acid to the extract after clean-up will prevent degradation of base sensitive compounds while waiting for LC analysis
- i) Do not use **ChloroFiltr**[®] when extracting mycotoxins. Use endcapped C18 for clean-up.

II. Chromatography Issues

- a) Acetic acid can hinder the clean-up effectiveness of PSA and cause fronting and tailing issues with GC chromatograms. Choose a QuEChERS method that does not use acetic acid
- b) Dispersive SPE may not produce “clean enough” extracts. Use cartridge clean-up to yield a cleaner extract.

Dispersive SPE Clean-Up Guide

Tube Size Recommendations

- 2 mL centrifuge tubes for 1 mL of extract
- 15 mL centrifuge tubes for 3+ mL of extract



| Matrix | Product Contents | Recommendations Part Number | Product Application & Reference Notes |
|--|---|--|---|
|  Pigmented Fruits & Vegetables High pigmentation, some planar analytes | Magnesium sulfate anhydrous Primary Secondary Amine (PSA) Graphitized Carbon Black (GCB) Endcapped C18 (C18) | ECPSAC1856 ECQUEU1115CT ECQUEU32CT ECQUEU515CT ECPSACB256 ECPSACB6 ECPURMPSMC CUMC18CT ECMSC1850CT ECMS12CPSCPSA415CT | F T I I W F Z J T U |
|  General Fruits & Vegetables Lightly pigmented | Magnesium sulfate anhydrous Primary Secondary Amine (PSA) Graphitized Carbon Black (GCB) Endcapped C18 (C18) | CUMPS2CT ECMS12CPSA415CT ECMSC1850CT CUMC182CT ECQUEU122CT CUMPSC1875CB2CT CUMPSC18CT ECQUEU1115CT ECPSACB256 | L U T J K, Y K N T W |
|  Pigmented Fruits & Vegetables with waxes/lipids | Primary Secondary Amine (PSA) Graphitized Carbon Black (GCB) Endcapped C18 (C18) | ECPSACB6 ECPSAC1856 | F F |
|  High Lipid Content (animal products, oils and nuts) | Magnesium sulfate anhydrous Primary Secondary Amine (PSA) Endcapped C18 (C18) Graphitized Carbon Black (GCB) | CUMPS15C18CT CUMPSC1875CB2CT ECMSC1850CT ECPSAC1856 CUMPSC18CT ECQUEU122CT ECPSACB6 EUSILMSSM26 ECMPSC1815CT EEC18156 | A, K B, B1, C, C1 F, X X, N, O, P K F G G1 S |
|  Wine and Berries | Magnesium sulfate anhydrous Primary Secondary Amine (PSA) Graphitized Carbon Black (GCB) | ECMPSCB15CT ECPURMPSMC | M M1, Z |
|  Vegetation with Chlorophyll | Magnesium sulfate anhydrous Primary Secondary Amine (PSA) ChloroFiltr® Endcapped C18 (C18) | CUMPSGG2CT CUMPSGGC182CT | R H |
|  Cereal & Grain Products | Magnesium sulfate anhydrous Primary Secondary Amine (PSA) C18 Endcapped (C18) | CUMPS15C18CT EEC18156 | D S |

UCT QuEChERS Applications Notes

| | | |
|-----------|--|--|
| A | Acrylamide by QuEChERS Extraction with LCMSMS Detection | ECMSSC50CT-MP CUMPS15C18CT |
| B | Flukicides / Anthelmintics by QuEChERS | ECMSSC50CT-MP ECMSC1850CT |
| B1 | Determination of Anthelmintic Drug Residues in Milk Using Ultra High Performance Liquid Chromatography-Tandem Mass Spectrometry | ECMSSC50CT-MP ECMSC1850CT |
| C | Antibiotics in Beef or Serum by QuEChERS | ECMSC1850CT |
| C1 | Streamlined Method for the Determination of More Than 100 Veterinary Drugs in Animal Tissue Using Dispersive-SPE Clean-up and LC- MS/MS Detection | ECMSC1850CT |
| D | Multiresidue Analysis in Cereal Grains Using Modified QuEChERS Method with UPLC-MS/MS and GC-TOFMS | ECMSSC50CT-MP CUMPS15C18CT |
| E | Trichothecene Type A & B Analysis in Wheat and Corn Using the QuEChERS Approach | ECMSSC50CT-MP CUMPS2CT |
| F | Modified QuEChERS Procedure for Analysis of Bisphenol A in Canned Food Products | ECQUEU750CT-MP ECPSAC1856 ECPSACB6 |
| G | Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Seafood Using GC/MS | ECQUUS2-MP ECPAHR50CT EUSILMSSM26 |
| G1 | Extraction of Polycyclic Aromatic Hydrocarbons from Fish Using the QuEChERS Approach | ECMSSC-MP ECPAHR50CT ECMPSC1815CT |
| H | ChloroFiltr[®] : A Novel Sorbent for Chlorophyll Removal using QuEChERS | ECQUUS2-MP CUMPSGGC182CT |
| I | Extraction of Pesticides from Tomato Using the QuEChERS Approach This method is applicable to all pigmented fruit and vegetables | ECQUEU32CT ECQUEU750CT-MP ECQUEU515CT |
| J | Determination of Chlorophenoxyacetic Acid and Other Acidic Herbicides Using a QuEChERS Sample Preparation Approach and LC-MS/MS Analysis | ECQUEU750CT-MP CUMC182CT |
| K | QuEChERS Sample Preparation For The Analysis Of Pesticide Residues In Olives | ECMSSC50CT-MP ECQUEU122CT CUMPS1875CB2CT |
| L | QuEChERS Extraction and Clean-Up of Pesticides from Olive Oil | CUMPS2CT |
| M | QuEChERS Multiresidue Pesticide Method for the Determination of Multiple Pesticides in Wines | ECQUVIN50CT ECMPSCB15CT |

UCT QuEChERS Applications Notes

| | | |
|-----------|--|--|
| M1 | Determination of Pesticides in Red Wine by QuEChERS Extraction, Quick QuEChERS Clean-up, and LC/MS/MS Detection | ECQUUS2-MP ECPURMPSCMC |
| N | Analysis of 136 pesticides in Avocado using a modified QuEChERS method with LC-MS/MS and GC-MS/MS | ECMSSA50CT-MP CUMPSC18CT |
| O | Pesticide Residue Analysis in Whole Milk by QuEChERS and LC-MS/MS | ECMSSA50CT-MP CUMPSC18CT |
| P | Extraction of Pyrethrin and Pyrethroid Pesticides from Fish Using the QuEChERS Approach | EC4MSSA50CT-MP CUMPSC18CT |
| Q | EURL-FV Multiresidue Method Using QuEChERS by GC-MS/MS & LC-MS/MS for Fruits & Vegetables | ECQUEU750CT-MP ECMPS15CT |
| R | Determination of Pesticide Residues in Marijuana and Tea by QuEChERS and LC/MS/MS | ECQUUS2-MP CUMPSGG2CT |
| S | Analysis of Cyromazine in Poultry Feed Using a QuEChERS Approach | ECMSSA50CT-MP EEC18156 |
| T | QuEChERS Pesticide Analysis for Fresh Produce using GCMSMS | ECMSSC50CTFS-MP ECQUEU1115CT ECMSC1850CT ECMAG00D |
| U | QuEChERS-Based LC/MS/MS Method for Multiresidue Pesticide Analysis in Fruits and Vegetables | EC4MSSA50CT-MP ECMS12CPSA415CT |
| V | QuEChERS Analysis of Miticides and Other Agrochemicals in Honey Bees, Wax or Pollen | ECMSSA50CT-MP CUMPSC18CT ECPSACB256 ECMAG00D |
| W | Multi-residue Pesticide Analysis of Botanical Dietary Supplements using SPE Cleanup and GC-MS/MS | ECMSSC50CT-MP ECPSACB256 |
| X | Pesticides in Fatty Matrices | ECPSAC1856 CUMPSC18CT |
| Y | Determination of Carbendazim in Orange Juice Using QuEChERS with LC/MS/MS Detection | ECQUEU750CT-MP CUMPSC18CT |
| Z | Determination of Pesticides in Strawberries by QuEChERS Extraction, Quick QuEChERS Clean-up , and GC/MS Detection | ECQUEU750CT-MP ECPURMPSCMC |

Products List and Use Description

QuEChERS Multi-Packs

Micro Extraction Products—Reagent Pouches
50 mL centrifuge tubes included (50/pk)

| Part Number | Contents |
|--|--|
| EC4MSSA50CT-MP | 4000 mg MgSO ₄ 1000 mg Sodium Acetate |
| ECMSNA50CT-MP | 8000 mg MgSO ₄ 3500 mg Sodium Chloride |
| EUMIV50CT-MP | 6000 mg MgSO ₄ 1500 mg Sodium Chloride 750 mg Disodium Citrate sesquihydrate 1500 mg Sodium Citrate tribasic dihydrate |
| ECMSSA50CT-MP | 6000 mg MgSO ₄ 1500 mg Sodium Acetate |
| ECMSSC50CT-MP | 4000 mg MgSO ₄ 1000 mg Sodium Chloride |
| ECMSSC50CTFS-MP | 6000 mg MgSO ₄ 1500 mg Sodium Chloride |
| ECQUVIN50CT-MP | 8000 mg MgSO ₄ 2000 mg Sodium Chloride |
| ECQUEU750CT-MP European QuEChERS Method EN 15662 | 4000 mg MgSO ₄ 1000 mg Sodium Chloride 500 mg Sodium Citrate dibasic sesquihydrate 1000 mg Sodium Citrate tribasic dihydrate |
| ECMS4MSC550CT-MP | 4000 mg MgSO ₄ 500 mg Sodium Chloride |
| ECPAHR50CT | Centrifuge tubes for PAH Extraction |

QuEChERS Multi-Packs

Micro-Extraction Products-Reagent Pouches (without tubes)

| Part Number | Contents |
|-------------|--|
| ECMSSA-MP | 6000 mg MgSO ₄ 1500 mg Sodium Acetate |
| ECMSSC-MP | 4000 mg MgSO ₄ 1000 mg Sodium Chloride |
| ECQUEU7-MP | 4000 mg MgSO ₄ 1000 mg Sodium Chloride 500 mg Sodium Citrate dibasic sesquihydrate 1000 mg Sodium Citrate tribasic dihydrate |
| EUMIV-MP | 6000 mg MgSO ₄ 1500 mg Sodium Chloride 750 mg Disodium Citrate sesquihydrate 1500 mg Sodium Citrate tribasic dihydrate |
| ECQUUS2-MP | 4000 mg MgSO ₄ 2000 mg Sodium Chloride |

Extraction Kits

| Part Number | | Contents |
|--|-------|--|
| ECQUEU215CT 50/pk | 15 mL | 6000 mg MgSO ₄ 1500 mg Sodium Acetate |
| ECQUEU750CT 50/pk European QuEChERS Method EN 15662 | 50 mL | 4000 mg MgSO ₄ 1000 mg Sodium Chloride 500 mg Sodium Citrate dibasic sesquihydrate 1000 mg Sodium Citrate tribasic dihydrate |
| ECMSSC50CT 250/pk | 50 mL | 4000 mg MgSO ₄ 1000 mg Sodium Chloride |
| ECMSSA50CT 250/pk | 50 mL | 6000 mg MgSO ₄ 1500 mg Sodium Acetate |
| EUMIV50CT 250/pk | 50 mL | 6000 mg MgSO ₄ 1500 mg Sodium Chloride 750 mg Disodium Citrate sesquihydrate 1500 mg Sodium Citrate tribasic dihydrate |
| ECMS4MSC550CT 50/pk Designed for Acrylamide Extraction | 50 mL | 4000 mg MgSO ₄ 500 mg Sodium Chloride |
| ECMS4MSC550CT | 50 mL | 4000 mg MgSO ₄ 500 mg Sodium Chloride |
| ECQUEU415CT | 15 mL | 4000 mg MgSO ₄ 1000 mg Sodium Chloride 500 mg Sodium Citrate dibasic sesquihydrate 1000 mg Sodium Citrate tribasic dihydrate |



ChloroFiltr® Dispersive Products

| Part Number | Size | Contents |
|---|------|--------------------------|
| CUMPSGG2CT 100/pk A dispersive SPE product for removing polar organic acids, some sugars, lipids and chlorophyll. Designed for 1 mL aliquot of supernatant | 2mL | 150 mg MgSO ₄ |
| | | 50 mg PSA |
| | | 50 mg ChloroFiltr® |
| | | |
| CUMPSGGC182CT 100/pk A dispersive SPE product For removing polar organic acids, some sugars, high lipids and chlorophyll. Designed for 1 mL aliquot of supernatant | 2mL | 150 mg MgSO ₄ |
| | | 50 mg PSA |
| | | 50 mg endcapped C18 |
| | | 50 mg ChloroFiltr® |
| ECMPSGG15CT 50/pk Same as CUMPSGG2CT above except for larger samples. Designed for 3 mL of supernatant | 15mL | 900 mg MgSO ₄ |
| | | 300 mg PSA |
| | | 150 mg ChloroFiltr® |
| | | |
| ECMSGG15CT 50/pk Designed for 3 mL of supernatant | 15mL | 900 mg MgSO ₄ |
| | | 150 mg ChloroFiltr® |
| | | |

Dispersive Products

| Part Number | Size | Contents |
|-----------------------------|------|--------------------------|
| ECQUEU12CT 100/pk | 2 mL | 150 mg MgSO ₄ |
| | | 25 mg PSA |
| | | |
| ECQUEU32CT 100/pk | 2 mL | 150 mg MgSO ₄ |
| | | 25 mg PSA |
| | | 2.5 mg GCB |
| | | |
| ECQUEU42CT 100/pk | 2 mL | 150 mg MgSO ₄ |
| | | 25 mg PSA |
| | | 7.5 mg GCB |
| | | |
| ECQUEU22CT 100/pk | 2 mL | 150 mg MgSO ₄ |
| | | 25 mg PSA |
| | | 25 mg endcapped C18 |
| | | |

Dispersive Products

| Part Number | Size | Contents |
|----------------------------------|-------|--|
| CUMPS2CT 100/pk | 2 mL | 150 mg MgSO ₄ 50 mg PSA |
| CUMPSCB2CT 100/pk | 2 mL | 150 mg MgSO ₄ 50 mg PSA 50 mg GCB |
| CUMPSC1875CB2CT 100/pk | 2 mL | 150 mg MgSO ₄ 50 mg PSA 7.5 mg GCB 50 mg endcapped C18 |
| CUMPSC18CT 100/pk | 2 mL | 150 mg MgSO ₄ 50 mg PSA 50 mg endcapped C18 |
| CUMPS15C18CT 100/pk | 2 mL | 150 mg MgSO ₄ 150 mg PSA 50 mg endcapped C18 |
| ECQUEU122CT 100/pk | 2 mL | 150 mg MgSO ₄ 50 mg PSA 50 mg endcapped C18 50 mg GCB |
| CUMC182CT 100/pk | 2 mL | 150 mg MgSO ₄ 50 mg endcapped C18 |
| ECMPS15CT 50/pk | 15 mL | 900 mg MgSO ₄ 150 mg PSA |
| ECQUEU315CT 50/pk | 15 mL | 900 mg MgSO ₄ 150 mg PSA 150 mg endcapped C18 |
| ECQUEU615CT 50/pk | 15 mL | 900 mg MgSO ₄ 150 mg PSA 45 mg GCB |
| ECQUEU515CT 50/pk | 15 mL | 900 mg MgSO ₄ 150 mg PSA 15 mg GCB |
| ECMPSA50CT 250/pk | 50 mL | 1200 mg MgSO ₄ 200 mg PSA |
| ECMPSCB15CT 50/pk | 15 mL | 900 mg MgSO ₄ 300mg PSA 150 mg GCB |
| ECMPSC1815CT 50/pk | 15 mL | 900 mg MgSO ₄ 300mg PSA 150 mg endcapped C18 |
| ECMS12CPSA415CT 50/pk | 15 mL | 1200 mg MgSO ₄ 400 mg PSA |
| CUMPSC1815CT2 50/pk | 15 mL | 1200 mg MgSO ₄ 400 mg PSA 400 mg endcapped C18 |

Dispersive Products

| Part Number | Size | Contents |
|--|-------|----------------------------------|
| ECQUUS215CT 50/pk | 15 mL | 1200 mg MgSO ₄ |
| | | 400 mg PSA |
| | | 400 mg GCB |
| | | 400 mg endcapped C18 |
| ECQUEU1115CT 50/pk | 15 mL | 1200 mg MgSO ₄ |
| | | 400 mg PSA |
| | | 400 mg GCB |
| ECMPSA615CT 50/pk | 15 mL | 1800 mg MgSO ₄ |
| | | 600 mg PSA |
| ECMNAX15CT 50/pk Florida-Modified QuEChERS for State Program Fruits and Vegetables | 15 mL | 900 mg MgSO ₄ |
| | | 150 mg Aminopropyl bonded silica |
| | | |
| ECMSC1850CT 50/pk | 50 mL | 1500 mg MgSO ₄ |
| | | 500 mg endcapped C18 |

Cartridge Products

Cartridges are available as an alternative to traditional QuEChERS dSPE clean-up

30/pk

| Part Number | Size | Contents |
|--------------------|---------------------|---|
| ECPSACB6 | 6 mL | 200 mg Graphitized Carbon Black GCB (top layer) |
| | | PTFE frit |
| | | 400 mg PSA (bottom layer) |
| ECPSACB256 | 6 mL | (recommended) |
| | | 250 mg Graphitized Carbon Black GCB (top layer) |
| | | PTFE frit |
| | | 500 mg PSA (bottom layer) |
| ECPSACB506 | 6 mL | 500 mg Graphitized Carbon Black GCB (top layer) |
| | | PTFE frit |
| | | 500 mg PSA (bottom layer) |
| ECMSPSACB6 | 6 mL | 750 mg MgSO ₄ (top layer) |
| | | 500 mg PSA |
| | | 250 mg GCB (bottom layer) |
| ECNAXCB506 | 6 mL | 500 mg Graphitized Carbon Black GCB (top layer) |
| | | PTFE frit |
| | | 500 mg Aminopropyl bonded silica (bottom layer) |
| ECPSAC1856 | 6 mL | 500 mg endcapped C18 (top layer) |
| | | PTFE frit |
| | | 500 mg PSA (Bottom layer) |
| ECPURMPSMC | Medium Cartridge | 110 mg MgSO ₄ (top layer) |
| | | Teflon Frit |
| | | 180 mg PSA (bottom layer) |
| EEC18156 | 6 mL | 500 mg endcapped C18 |
| EUSILMSSM26 | 6 mL | 200 mg sodium sulfate anhydrous (top layer) |
| | | 1000 mg silica gel (bottom layer) |

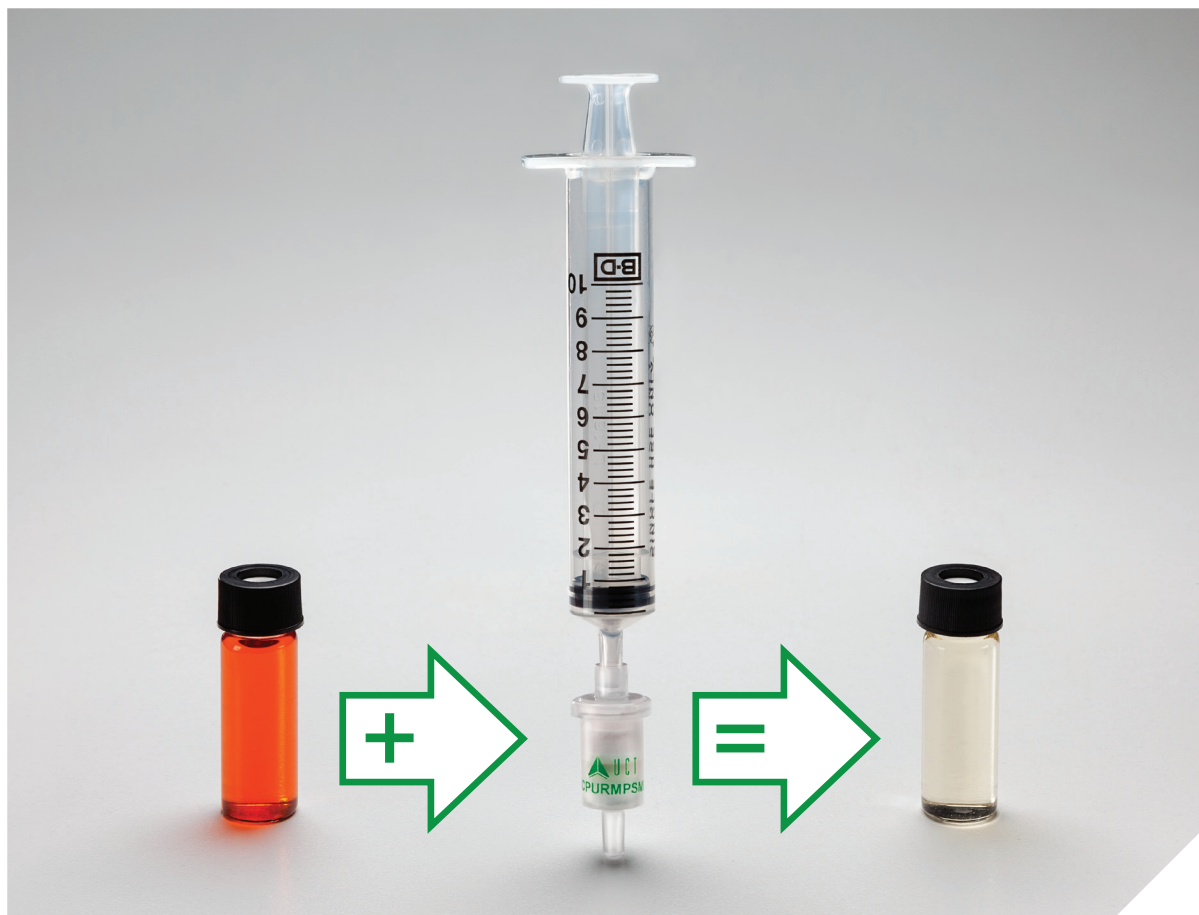
QuICK QuEChERS

Simple, Fast, Efficient
Cartridges for Clean-Up of QuEChERS Extracts

UCT's **QuICK QuEChERS** push-thru cartridge eliminates the need for shaking and centrifugation of extracts during clean-up, significantly reducing sample processing time

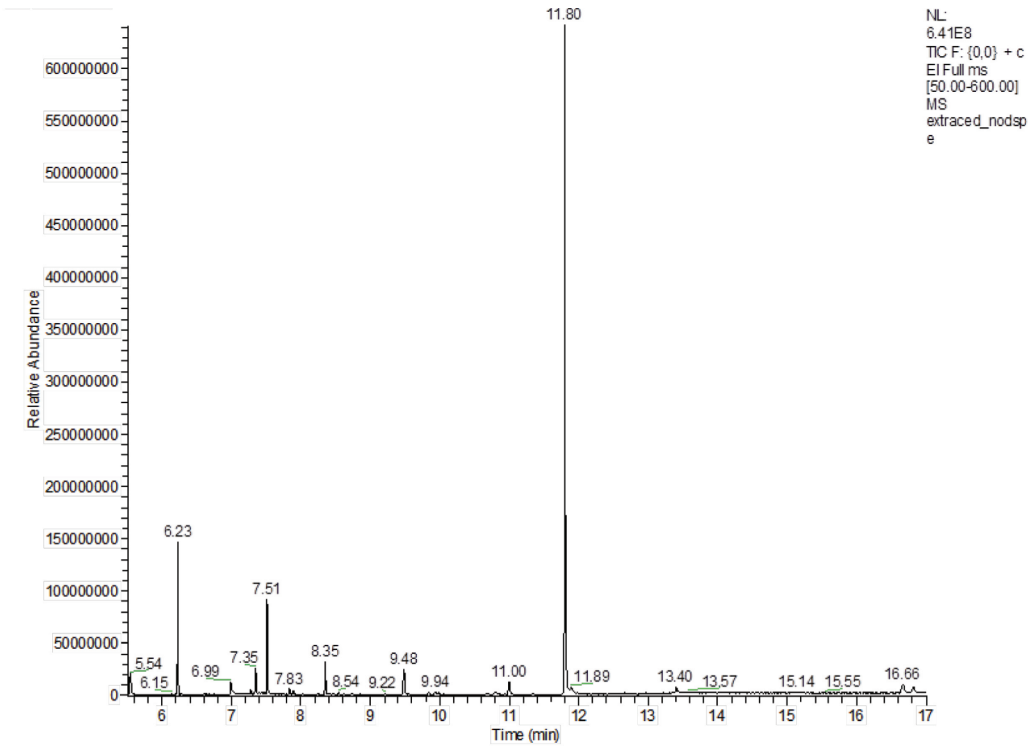
After QuEChERS sample extraction:

1. Draw the extract into a disposable syringe
2. Push the extract through the cartridge into a sample vial
3. Sample is ready for analysis by LC or GC

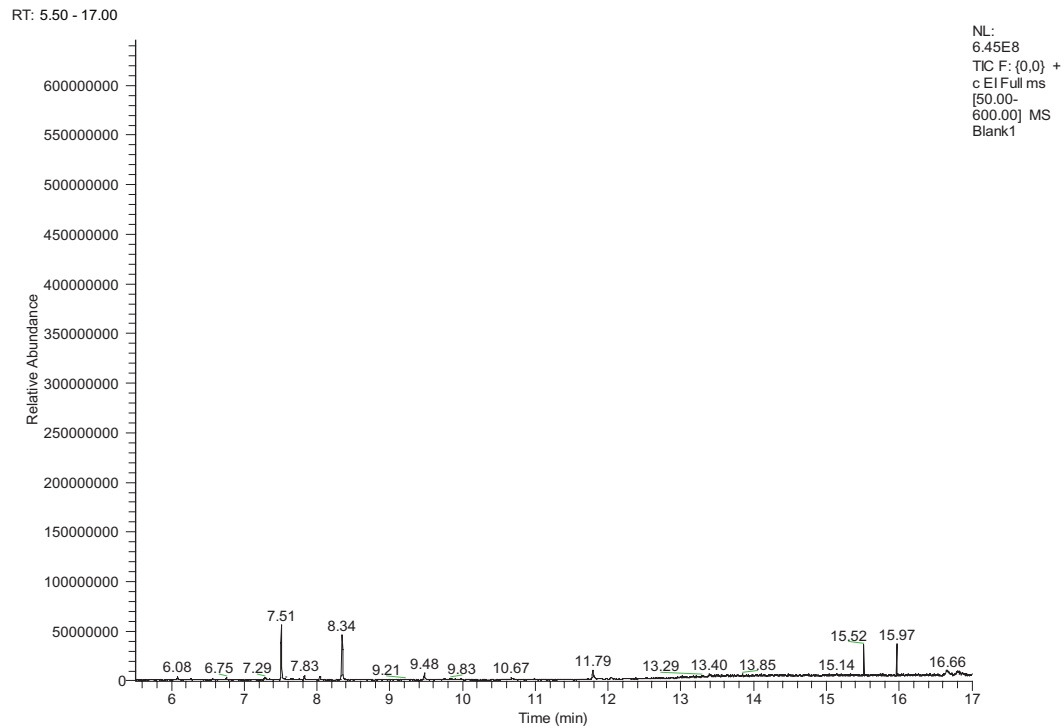


The UCT QuICK QuEChERS cartridge ECPURMPSMC contains 110 mg anhydrous MgSO_4 and 180 mg of PSA, providing results comparable to traditional QuEChERS but without the need for centrifugation.

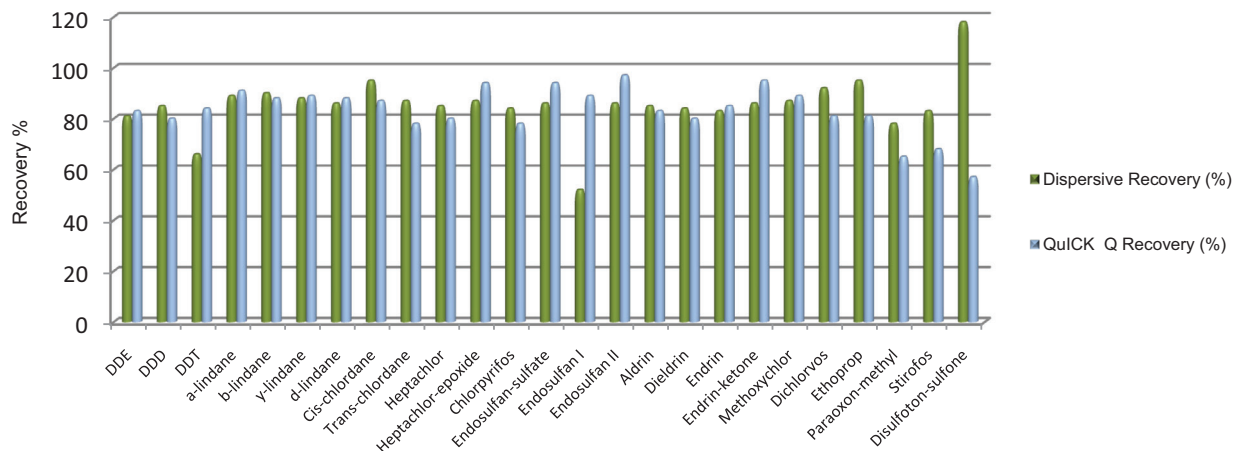
Strawberry Supernatant before Clean-up



After QuIcK Clean-Up



dSPE Recovery Data Comparison vs. QuICK QuEChERS



| Part Number | Cartridge Size | Contents |
|-------------|----------------|--|
| ECPURMPSMC | Medium | 110 mg MgSO4 (top layer) PTFE Frit 180 mg PSA (bottom layer) |

Centrifuge Tubes for PAH Extraction

UCT's ENVIRO-CLEAN® PAH certified centrifuge tubes ECPAHR50CT (C of A available) are specially designed for performing PAH analysis using either QuEChERS, AOAC or other methods that require the use of 50 mL centrifuge tubes. UCT's special polypropylene tubes with plug-seal caps are ideal for performing low level PAH extractions.



**ECPAHR50CT
50/PK**

| | Specification Values | Analysis |
|--|----------------------|-----------|
| Acenaphthene | 0.5 ppb | ND |
| Acenaphthylene | 1 ppb | < 0.5 ppb |
| Anthracene | 0.5 ppb | ND |
| Benz(a)anthracene | 0.5 ppb | ND |
| Benzo(a)pyrene | 0.5 ppb | ND |
| Benzo(b) fluoranthene | 0.5 ppb | ND |
| Benzo(g,h,i) perylene | 0.5 ppb | ND |
| Benzo(k) fluoranthene | 0.5 ppb | ND |
| Chrysene | 0.5 ppb | ND |
| Dibenzo(a,h) anthracene | 0.5 ppb | ND |
| Fluoranthene | 0.5 ppb | ND |
| Fluorene | 0.5 ppb | ND |
| Indeno(1,2,3-cd) pyrene | 0.5 ppb | ND |
| Naphthalene | 1 ppb | < 0.3 ppb |
| Phenanthrene | 0.5 ppb | ND |
| Pyrene | 0.5 ppb | ND |
| *Note : Values based on 10g sample size | | |

List of possible pesticide analytes that have been shown to yield >90% (or >70 %*) recoveries using the QuEChERS method. GC-amenable pesticides are capitalized; those preferentially analyzed by LC/MS-MS are not capitalized; those that can be analyzed by either technique are underlined**

Pesticide Analytes

| | | | | |
|------------------------|------------------------------------|---|-----------------------------|------------------------|
| <u>acephate*</u> | acetamiprid | Acrinathrin | aldicarb | aldicarb sulfone |
| aldicarb sulfoxide | Aldrin | azaconazole | azamethipos | <u>azinphos-methyl</u> |
| <u>azoxystrobin</u> | Bifenthrin | <u>bitertanol</u> | Bromopropylate | <u>bromuconazole</u> |
| Bupirimate | <u>buprofezin</u> | butocarboxim | butocarboxim sulfone | butocarboxim sulfoxide |
| Cadusafos | <u>carbaryl</u> | carbendazim | <u>carbofuran</u> | 3-hydroxy-carbofuran |
| chlorbromuron | (α -, γ -)Chlordane | (α -, β -)Chlorfenvinphos | Chlorpropham | Chlorpyrifos |
| Chlorpyrifos-methyl | Chlorthaldimethyl | Chlorothalonil* | Chlozolinate | clofentezine |
| Coumaphos | cycloxydim* | (λ -)Cyhalothrin | cymoxanil | Cypermethrin |
| <u>cyproconazole</u> | <u>cyprodinil</u> | (2,4'-4,4'-)DDE | (2,4'-4,4'-)DDT | Deltamethrin |
| demeton | demeton-O-sulfoxide | demeton-S-methyl | demeton-S-methyl sulfone | desmedipham |
| Diazinon | <u>dichlofluanid*</u> | Dichlorobenzophenone | <u>dichlorvos</u> | diclobutrazole |
| Dicloran | dicrotophos | Dieldrin | <u>Diethofencarb</u> | <u>difenoconazole</u> |
| Diflufenican | <u>dimethoate</u> | dimethomorph | <u>diniconazole</u> | Diphenyl |
| Diphenylamine | <u>disulfoton</u> | <u>disulfoton sulfone</u> | diuron | <u>dmsa</u> |
| dmst | dodemorph | α - Endosulfan | -Endosulfan | Endosulfan sulfate |
| EPN | <u>epoxiconazole</u> | Esfenvalerate | etaconazole | ethiofencarb sulfone |
| ethiofencarb sulfoxide | Ethion | ethirimol | <u>Ethoprophos</u> | <u>etofenprox</u> |
| Etridiazole | Famoxadone | fenamiphos | <u>fenamiphos sulfone</u> | <u>Fenarimol</u> |
| Fenazaquin | fenbuconazole | <u>fenhexamid*</u> | Fenithrothion | <u>fenoxycarb</u> |
| Fenpiclonil | Fenpropathrin | Fenpropidine | <u>fenpropimorph</u> | <u>fenpyroximate</u> |
| Fenthion | <u>fenthion sulfoxide</u> | Fenvalerate | florasulam* | Flucythrinate I & II |
| Fludioxonil | flufenacet | Flufenconazole | <u>flusilazole</u> | Flutolanil |
| Fluvalinate | Fonophos | fosthiazate | Furalaxyl | furathiocarb |
| <u>furmecyclox</u> | Heptachlor | Heptachlor epoxide | Heptenophos | Hexachlorobenzene |
| <u>hexaconazole</u> | hexythiazox | imazalil | imidacloprid | Iprodione |
| iprovalicarb | isoprothiolane | isoxathion | <u>kresoxim-methyl</u> | Lindane |
| linuron | <u>Malathion</u> | <u>malathion oxon</u> | Mecarbam | <u>mephosfolan</u> |
| Mepronil | Metalaxyl | metconazole | <u>methamidophos*</u> | Methidathion |
| <u>methiocarb</u> | methiocarb sulfone* | methiocarb sulfoxide | methomyl | methomyl-oxime |
| metobromuron | metoxuron | Mepanipyrim | Mevinphos | <u>monocrotophos</u> |
| monolinuron | <u>myclobutanil</u> | nuarimol | Ofurace | <u>omethoate</u> |
| <u>oxadixyl</u> | oxamyl | oxamyl-oxime | oxydemeton-methyl | paclobutrazole |
| Parathion | Parathion-methyl | <u>penconazole</u> | <u>pencycuron</u> | cis- Permethrin |
| trans-Permethrin | phenmedipham | o-Phenylphenol | <u>Phorate</u> | <u>phorate sulfone</u> |
| Phosalone | Phosmet | Phosmet-oxon | phosphamidon | Phthalimide |
| <u>picoxystrobin</u> | Piperonyl butoxide | <u>pirimicarb</u> | <u>pirimicarb-desmethyl</u> | Pirimiphos-methyl |
| prochloraz | Procymidone | <u>profenofos</u> | Prometryn | Propargite |
| Propham | <u>propiconazole</u> | <u>propoxur</u> | Propyzamide | Prothiofos |
| pymetrozine* | Pyrazophos | pyridaben | <u>pyridaphenthion</u> | <u>pyrifenoxy</u> |
| <u>pyrimethanil</u> | Pyriproxyfen | Quinalphos | Quinoxifen | Quintozene |
| sethoxydim* | spinosad | <u>spiroxamine</u> | <u>tebuconazole</u> | tebufenozide |
| <u>Tebufenpyrad</u> | <u>tetraconazole</u> | Tetradifon | Tetrahydrophthalimide | Terbufos |
| Terbufos sulfone | thiabendazole | thiacloprid | thiamethoxam | thiodicarb |
| thiofanox | thiofanox sulfone | thiofanox sulfoxide | thiometon | thiometon sulfone |
| thiometon sulfoxide | thiophanate-methyl | Tolclofos-methyl | <u>tolylfluanid*</u> | <u>triadimefon</u> |
| <u>triadimenol</u> | Triazophos | trichlorfon | tricyclazole | tridemorph |
| <u>trifloxystrobin</u> | trifluminazole | Trifluralin | <u>Triphenylphosphate</u> | vamidothion |
| vamidothion sulfone | vamidothion sulfoxide | Vinclozolin | | |

**from "Quick, Easy, Cheap, Effective, Rugged and Safe (QuEChERS) Approach for Determining Pesticide Residues", Lehotay, Steven J., U.S. Department of Agriculture, Agricultural Research Service, Eastern Regional Research Center, 600 East Mermaid Lane, Wyndmoor, Pennsylvania 19038; USA

Further Information

Additional information useful to the analyst planning QuEChERS analysis may be found in the following websites:

UCT, LLC

www.unitedchem.com/

A commercial database of application methods and product information related to QuEChERS and other aspects of solid-phase extraction

www.quechers.com

The original website dedicated to the QuEChERS Technique

Nutrient Data Laboratory Website

www.nal.usda.gov/fnic/foodcomp/search/

A nutritional database supported by the USDA Agricultural Research Service

European Websites

http://ec.europa.eu/food/plant/protection/pesticides/index_en.htm

An extensive website maintained by the Health and Consumer Protection Directorate General in Brussels

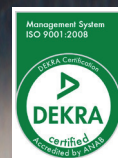
<http://www.crl-pesticides.eu/docs/public/home.asp?LabID=100&Lang=EN>

The Community Reference Laboratories and the National Reference Laboratories of the National Food Institute in Denmark





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