How to Use QuEChERS for Diverse Sample Types

By Jana Hepner, PhD

- Realize the advantages of QuEChERS for your most challenging analytes and sample types.
- Streamline method development with effective strategies for sample modification, extraction, and cleanup.
- Improve method performance by using appropriate salts and dSPE sorbents for different applications.

One of the biggest challenges faced by food safety labs is the need to analyze a broad range of pesticides in many different sample types. No single method will be best in all cases, which makes the QuEChERS approach advantageous because it can be easily adapted to different sample types and analyte lists. Compared to liquid-liquid or solid-phase extraction methods, QuEChERS sample preparation is fast, simple, and inexpensive. And, because QuEChERS is easy to modify, it can be very effective across a wide range of sample types and analyte chemistries.

QuEChERS was originally developed for analyzing pesticides in high-water content matrices, but it has since been successfully adapted for a wide range of samples. The first step in the optimization of QuEChERS methods is to characterize your sample matrix. Is it high or low in water, sugars, fats, pigments, pH, etc.? For general commodities, like celery, that are high in water and low in lipids, pigments, and other interferences, a simple 1:1 sample:acetonitrile extraction and standard dSPE cleanup sorbent (magnesium sulfate and primary secondary amine) may be adequate. However, when testing low-water, high-fat matrices, such as avocado, you will likely need to modify the extraction procedure by adding water. Similarly, for cleanup of avocado extracts, using a dSPE product containing C18 will be more effective at removing lipid interferences than one that does not.

Featured Products

- *Q-sep QuEChERS Extraction Salts*
- *Q-sep QuEChERS dSPE Tubes for Extract Cleanup*
- *QuEChERS Performance Standards Kit*
- *GC Multiresidue Pesticide Kit*
- *Rxi-5ms (cat.# 13423)*

Recommended Products

- *Q-sep Multispeed Centrifuge for QuEChERS*
- *Q-sep Bottle Top Solvent Dispenser*
- *Raptor ARC-18 (cat.# 9314A12)*
- *LC Multiresidue Pesticide Kit*
- *AOAC QuEChERS QC Spike Mix*
- *QuEChERS Internal Standard Mix for GC-MS Analysis*
- *QuEChERS Internal Standard Mix for GC-NPD and LC-MS/MS Analysis*

The key to achieving the maximum benefits of QuEChERS is to optimize methods effectively for different matrices instead of using a generic approach for all sample types. While a literature review is a good starting point, the best way to establish procedures that reliably ensure accurate results for your samples is to conduct preliminary experiments like those detailed here. In this article, we explore how to use QuEChERS most effectively for celery, spinach, orange, avocado, brown rice flour, and honey and demonstrate how to evaluate and modify QuEChERS methods to improve pesticide recoveries for these very diverse sample types.

Optimization of QuEChERS Extraction and dSPE Cleanup

There are three widely used standard QuEChERS methods: the original unbuffered method [1] and two buffered methods, an AOAC method [2] and a European EN method [3]. All three methods consist of two primary steps: sample extraction and dSPE cleanup of the sample extract. Both steps should be optimized for best results. However, prior to optimization of QuEChERS extraction and cleanup, we first need to assess whether low-water content samples need to be modified.

Modifications for Low-Moisture Samples

Water is critically important for QuEChERS extractions because its presence allows analytes in the sample to become accessible to the water-miscible extraction solvent (usually acetonitrile). High-water content samples are usually sufficiently moist for extraction. But drier samples must have water added to them or extraction will be incomplete, and recoveries may be poor. Generally, water needs to be present in a 1:1 ratio with the extraction solvent, so sample matrices will need to have their intrinsic water amounts supplemented up to a level that gives this ratio (generally 10-15 mL total water is required for extraction). Regardless of whether additional water is needed, all samples must be properly homogenized to ensure representative results.

In addition to adding water to dry samples, labs may also need to assess whether less sample mass should be used. In our optimization of QuEChERS, we are evaluating two low-water content samples: brown rice flour and avocado. For the brown rice flour, we tested two sample size modifications and (assuming a moisture level of nearly zero) added 10 mL of water to each. For avocado, we initially accounted for the sample being approximately 70% water and added an additional 3 mL of water to our 10 g sample. We also tried another approach for avocado in which we modified both the sample weight and the volume of additional water (Table I).

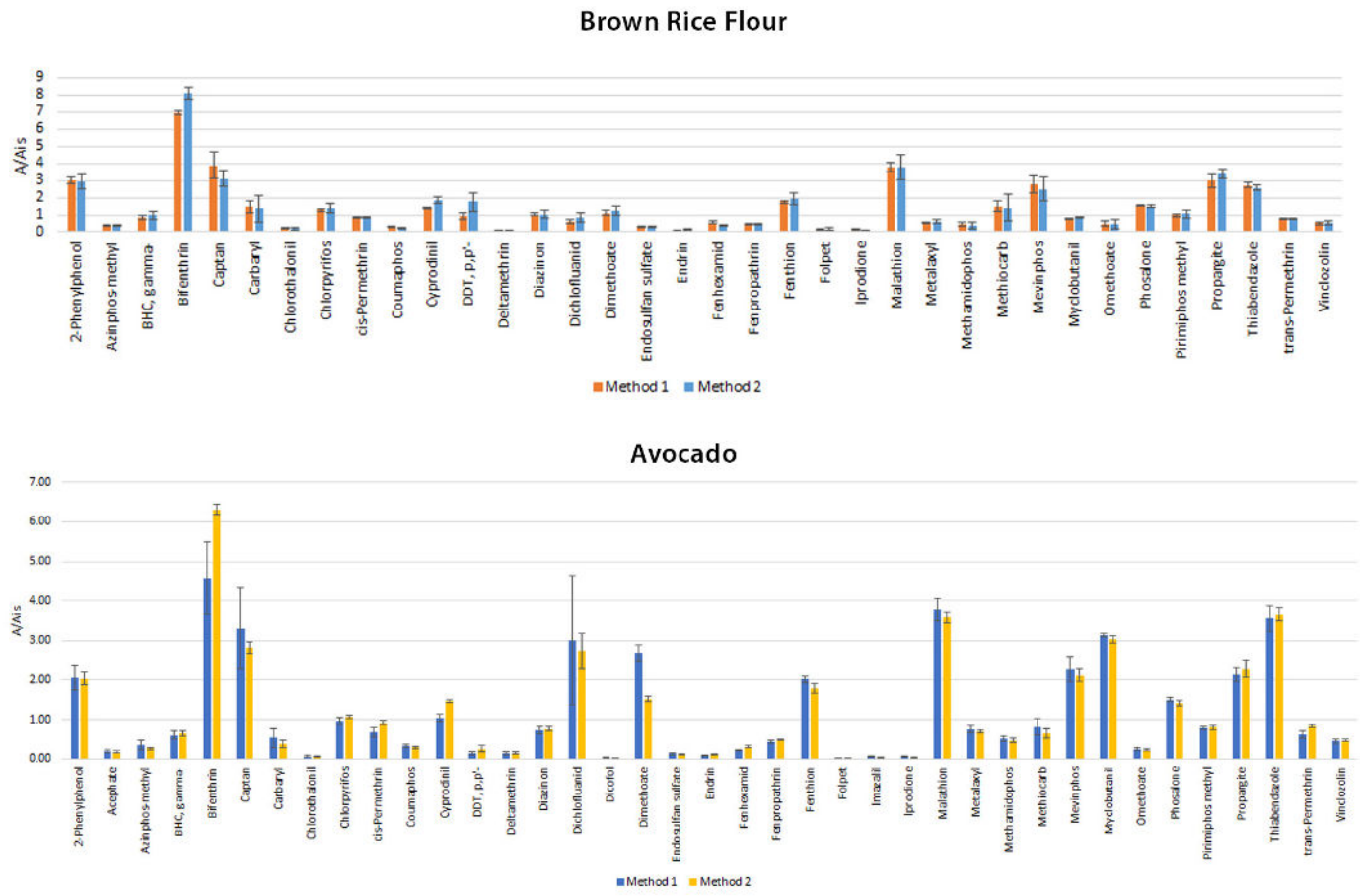
Table I: Sample and Water Modifications for QuEChERS Extraction of Low Water Content Commodities

Sample (Method)	Sample Weight (g)	Added Water (mL)	Acetonitrile (mL)
Brown rice flour (method 1)	10	10	10
Brown rice flour (method 2)	5	10	10
Avocado (method 1)	10	3	10
Avocado (method 2)	5	6	10

Method performance was tested using Restek's QuEChERS performance mix (cat.# 31152), and extraction was carried out using unbuffered salts (cat.# 25848) for flour samples and EN salts (cat.# 25850) for avocado. This performance mix was selected because it contains 40 organochlorine, organonitrogen, organophosphorus, and carbamate pesticides that vary in chemical characteristics (volatile, polar, active, base-sensitive, and nonvolatile), which allows method performance to be assessed for a wide range of compound chemistries using a manageable number of representative analytes.

As shown in Figure 1, a simple comparison of raw recoveries (analyte area:internal standard area) is a quick way to determine if one method performs better than the other. In the case of brown rice flour, method 2 (reduced sample mass) provided slightly better recoveries for bifenthrin, cyprodinil, and DDT, but performance was very similar for other analytes. An additional benefit of method 2 is that these samples were much easier to process consistently because with the smaller sample size it was easier to shake the samples thoroughly, and remove the supernatant cleanly. For avocado, method 1 (10 g avocado, 3 mL water) provided better results for dimethoate, and method 2 (5 g avocado, 6 mL water) provided better responses for bifenthrin, but otherwise method performance was essentially the same for most pesticides, meaning either of these sample mass and hydration modifications should work well for most compounds.

Figure 1: Evaluation of Sample Mass and Water Addition Modifications



Extraction Salt Selection

Once any necessary modifications to sample mass and supplemental water are made for dry samples, the next step in determining how to use QuEChERS optimally for different sample types is to select the extraction salt that will work best for each. The extraction salts enhance extraction efficiency and drive the analytes from the aqueous sample into the organic solvent. The choice between the original unbuffered method salts and buffered method salts should be based on the expected pH of the final extract and the pH sensitivity of the target analytes. Unbuffered salts work well for most analytes; however, if critical target analytes are unstable at some pHs, a buffered method that maintains the necessary pH will produce more accurate results for pH-sensitive pesticides. If using a buffered method, AOAC salts are somewhat acidic and buffer the final extract to a pH of around 4.75, whereas EN salts are a bit more neutral and buffer the extract to 5.0–5.5. Note that when using unbuffered salts, the pH of the final extract is largely determined by the sample pH.

For our optimization of QuEChERS extraction salts experiments, we again used the QuEChERS performance mix (cat.# 31152) because it contains a wide range of indicator compounds. It is a good choice for evaluating representative pesticides without having to analyze an excessive number of compounds. Then, we extracted each sample using unbuffered salts (cat.# 25848), AOAC salts (cat.# 25852), and EN salts (cat.# 25850). To take a high-level look at differences among the salts, we averaged the responses of all pesticides for each matrix and then normalized the results for each of the buffered methods to the original unbuffered method. The results are presented two ways: as a comparison for each sample (Figure 2) and as a comparison of the salts themselves (Figure 3). This allows us to see which salt is best for each sample type (optimization for sample type) as well as which salt gives the best results across all samples (which salt is most universal).

The approach taken in Figure 2 is helpful when evaluating what is best for a specific matrix. We can easily see that for celery, spinach, and avocado the AOAC salts produced a much higher response and would be preferred if you are developing a truly optimized method for a given matrix. The remaining results were similar and showed modest differences in most cases. However, using either of the buffered salts generally gave a higher response than the unbuffered salts.

Figure 3 is simply a different organization of the same results, and it is a useful view if you want to compare the salts directly to more easily see which had the highest performance overall across all matrices. This approach is helpful if you are developing a screening method and want to know which salt is best for the most sample types. In this view, it is easier to see that AOAC salts produced higher pesticide responses overall.

Figure 2: Overall assessment of which salt performs best for each type of sample. (Y axis = average recoveries of 40 pesticides normalized to the recoveries using unbuffered salts.)

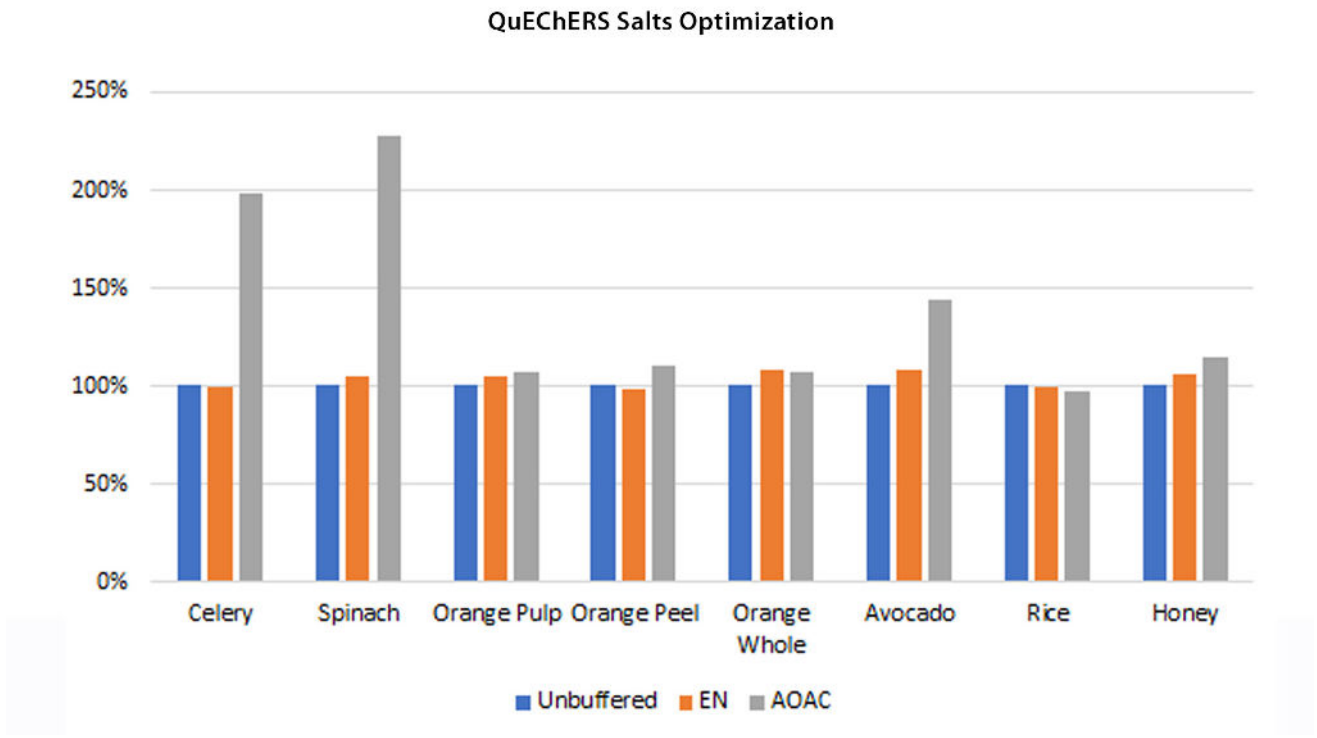
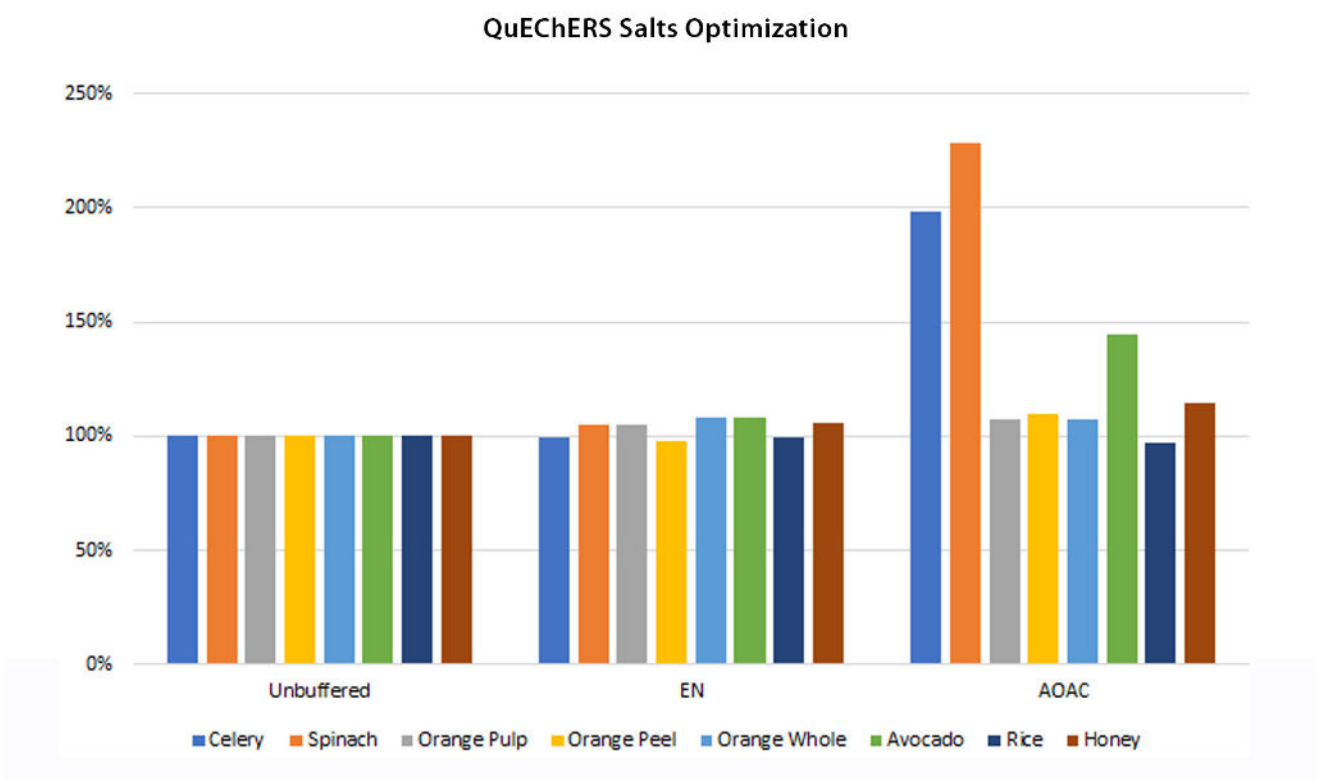
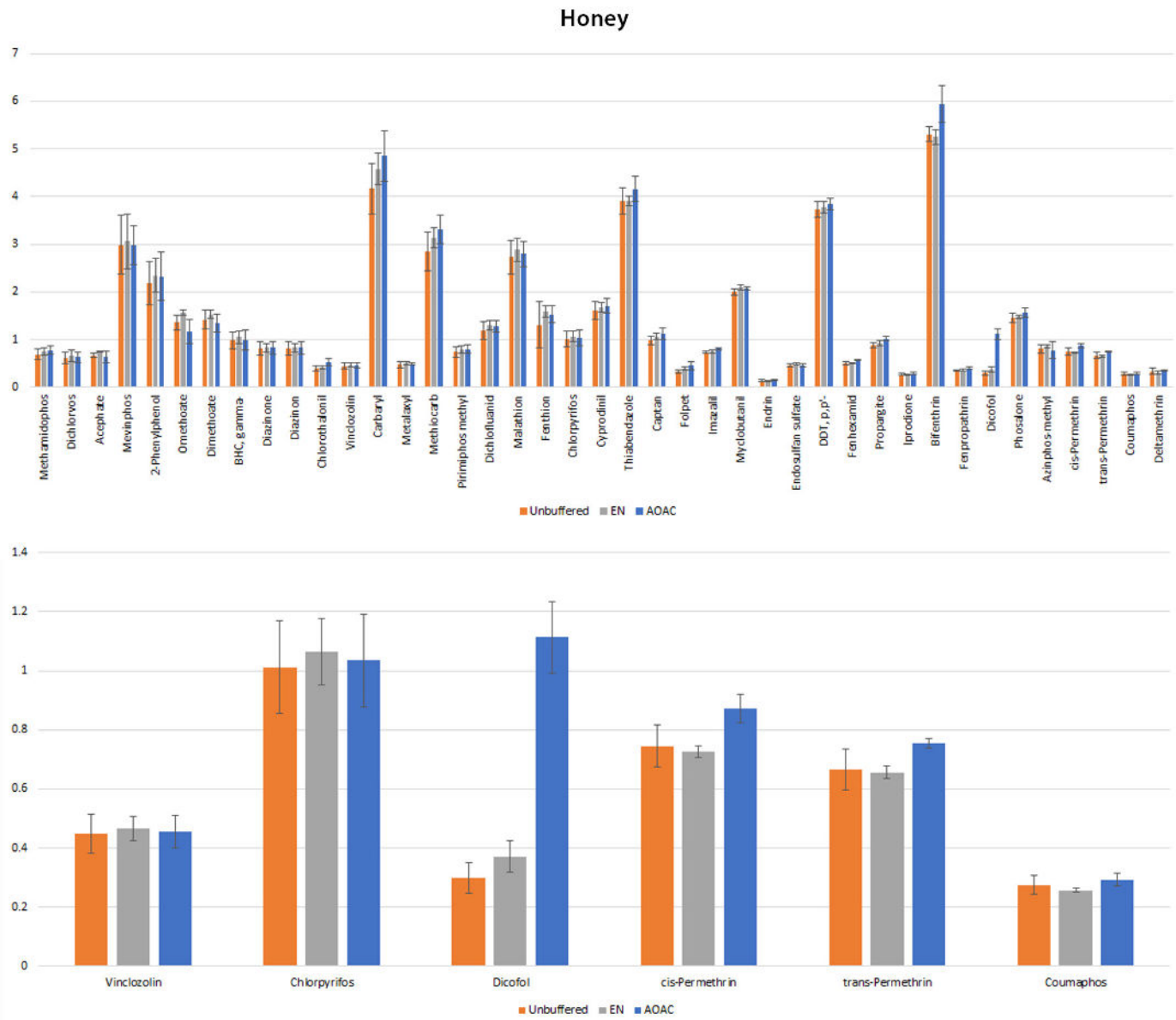


Figure 3: Overall assessment of which salt gives the highest response for the most sample types. (Y axis = average recoveries of 40 pesticides normalized to the recoveries using unbuffered salts.)



Both Figures 2 and 3 take a high-level view because the responses for all compounds are averaged together. If you have particular pesticides that you need a method for, it is essential to assess their results individually. It can be helpful to know which pesticides are commonly used on each crop commodity so you can look specifically at the performance of those compounds during your optimization of QuEChERS experiments. Figure 4 is a more detailed assessment of pesticides in honey. In this case, we are evaluating raw response ratios (not normalized) for each of the pesticides in our test mix. We can see in the top chart that for most compounds the choice of salt does not make a clear difference. But, in the bottom chart, where we focus on selected pesticides, we can see that for dicofol the choice of extraction salt had a big effect, and the response was much higher when using the AOAC salts. If dicofol is a critical analyte, it is clear that the AOAC salts should be used.

Figure 4: Detailed comparison of extraction salt performance for specific pesticides in a given matrix.

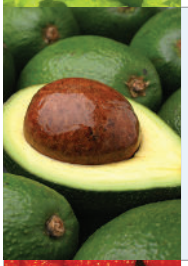
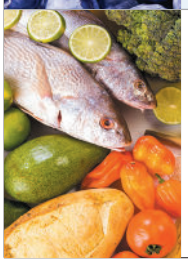


Choosing a dSPE Cleanup

Once an extraction salt has been chosen, the next step in determining how to use QuEChERS effectively is to select the dSPE sorbent for extract cleanup. There are a wide range of dSPE products available, and they contain different sorbent combinations (both type and amount) that will remove excess water and specific interferences from the extracts. The key to optimizing a QuEChERS cleanup is to select sorbents that will effectively remove the particular types of interferences that are found in different samples. The goal is to provide effective—but not excessive—cleanup so that interferences are removed, but target analytes remain in the extract.

Table II provides recommended sorbent combinations for different sample types. Magnesium sulfate and primary secondary amine exchange material (PSA) are used universally to remove water (MgSO4) as well as sugars, fatty acids, and organic acids (PSA) that can be analytical interferences. Beyond that, C18 is recommended for high-fat samples to remove lipids, and graphitized carbon black (GCB) is used to remove pigments. Sorbent choice should be targeted to the types of contaminants in each sample to minimize the concomitant removal of target analytes. For example, while GCB effectively removes pigments, it can also remove planar pesticides, such as chlorothalonil and thiabendazole. Considering the type and relative amount of matrix components that need to be removed from extracts prior to analysis will guide your choice in selecting appropriate dSPE products.

Table II: A wide range of dSPE sorbent combinations are available to most effectively remove the different analytical interferences found in diverse sample types.

Sample Type		Example	Method	Sorbent Mass (mg)				Product Information	
				$MgSO_4$	PSA*	C18-EC	GCB**	Vial Volume (mL)	Cat.#
				Removes					
				Excess water	Sugars, fatty acids, organic acids, anthocyanine pigments	Lipids, nonpolar interferences	Pigments, sterols, nonpolar interferences		
	General fruits and vegetables	Celery, head lettuce, cucumber, melon	AOAC 2007.01	150	50	-	-	2	26124
			Original unbuffered, EN 15662, mini-multiresidue	150	25	-	-	2	26215
			AOAC 2007.01	1200	400	-	-	15	26220
			Original unbuffered, EN 15662	900	150	-	-	15	26223
	Foodstuffs with fats and waxes	Cereals, avocado, nuts, seeds, and dairy	Mini-multiresidue	150	25	25	-	2	26216
			-	150	-	50	-	2	26242
			AOAC 2007.01	150	50	50	-	2	26125
			AOAC 2007.01	1200	400	400	-	15	26221
			-	1200	-	400	-	15	26244
			-	900	150	150	-	15	26226
	Pigmented fruits and vegetables	Strawberries, sweet potatoes, tomatoes	Mini-multiresidue, EN 15662	150	25	-	2.5	2	26217
			AOAC 2007.01	150	50	-	50	2	26123
			AOAC 2007.01	1200	400	400	400	15	26222
			EN 15662	900	150	-	15	15	26224
	Highly pigmented fruits and vegetables	Red peppers, spinach, blueberries	Mini-multiresidue, EN 15662	150	25	-	7.5	2	26218
			AOAC 2007.01	150	50	50	50	2	26219
			EN 15662	900	150	-	45	15	26225
			-	900	300	-	150	15	26126
	General Purpose	Wide range of commodities, including fatty and pigmented fruits and vegetables	-	150	50	50	7.5	2	26243
			-	900	300	300	45	15	26245

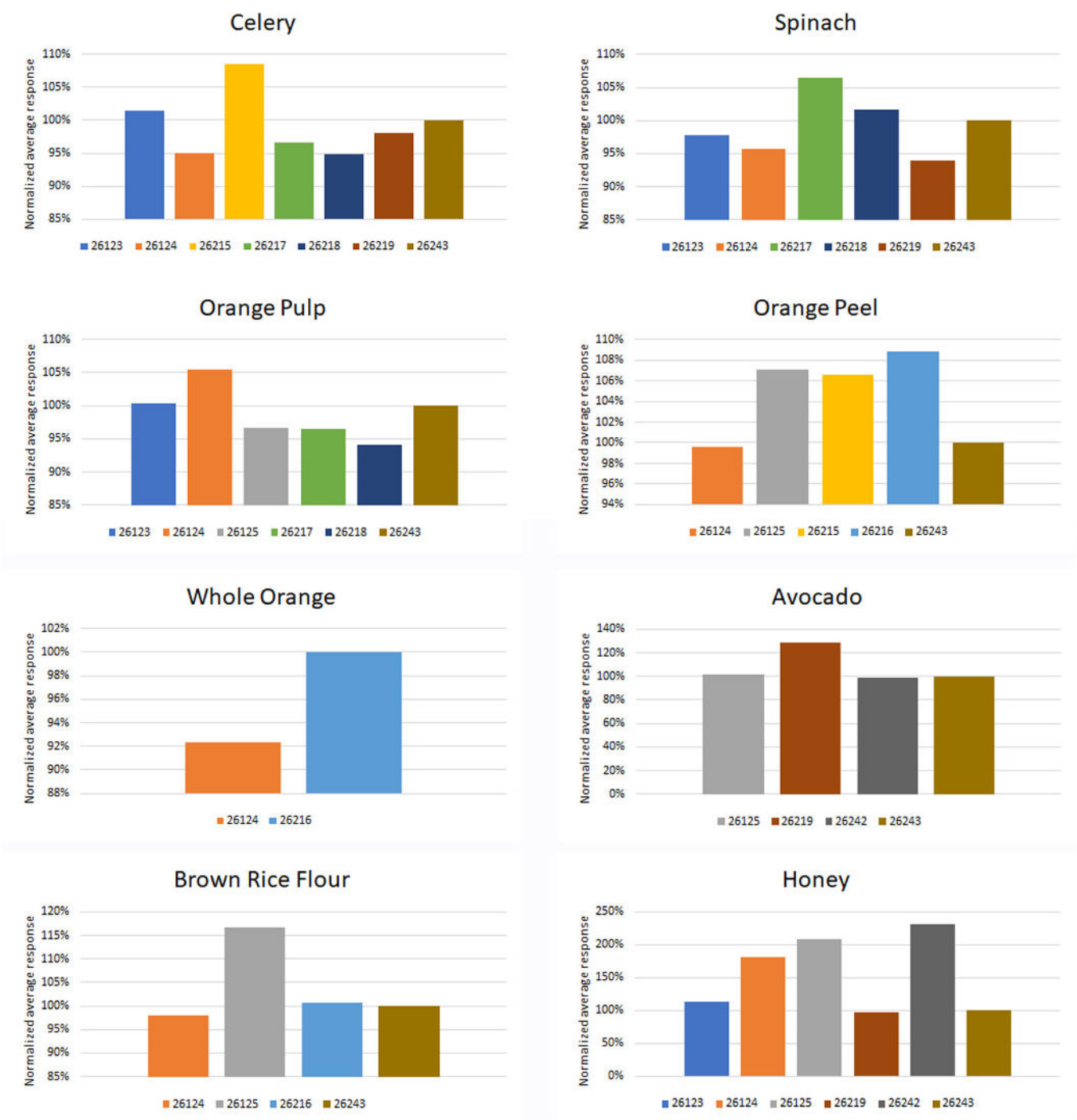
Note: No entry in the Method column refers to dSPE formulations not specifically included in one of the cited references. These products can be used to accommodate the various needs of specific matrices not directly met by the cited references.

*PSA = primary secondary amine exchange material

**GCB = graphitized carbon black

Returning to our optimization of QuEChERS experiments, we cleaned our extracts using a range of dSPE products from Table I and plotted combined pesticide responses for each product normalized to a general-purpose product (cat.# 26243) that contained low-to-moderate levels of MgSO4, PSA, C18, and GCB. As shown in Figure 5, as expected, no single dSPE product provided optimal results for all samples. Compared to the general formulation, pesticide responses were higher in celery when using dSPE cat.# 26215 for cleanup, which contains half the PSA and no C18 or GCB. For spinach, optimized responses were seen with dSPE cat.# 26217, which contained no C18 and less PSA and GCB. Avocado samples had highest analyte responses when dSPE cat.# 26219 was used, which contained more GCB than the general dSPE product. Results proved optimal for brown rice flour samples when using dSPE cat.# 26125, which did not contain any GCB. All four cases are examples of where an effective cleanup using an optimal sorbent blend provided better results than an excessive cleanup using a general dSPE approach. Finally, the dSPE that was optimal for orange depended on the subsample tested, and for honey three dSPE products (cat.# 26124, 26125, and 26242) provided significantly higher responses (over 175% higher) compared to the general-purpose dSPE.

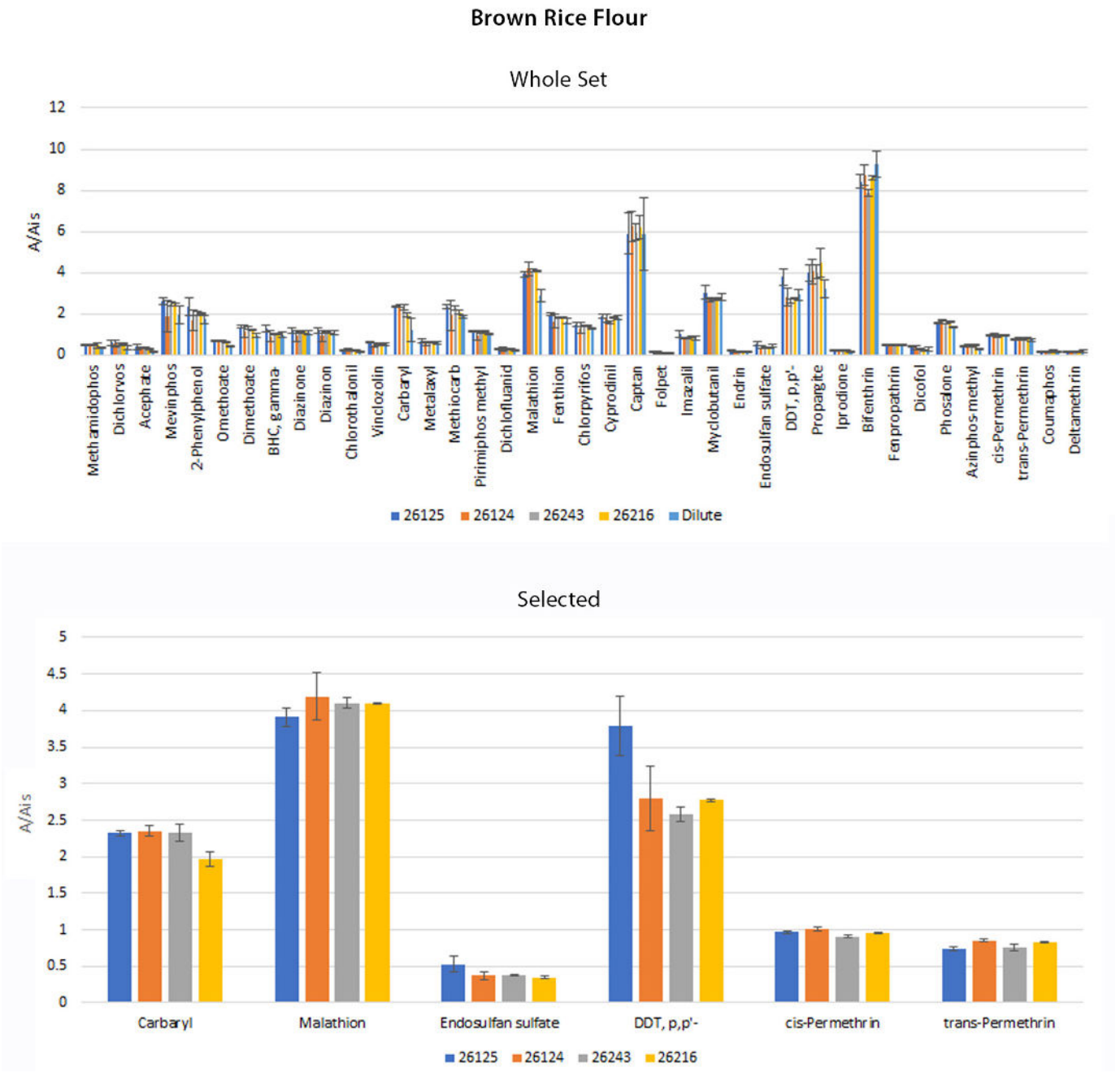
Figure 5: Overall assessment of which dSPE performs best for each type of sample.



The above results again are based on a high-level decision-making approach where all pesticide responses are combined. This is appropriate for general screening when a QuEChERS method that will work well for a wide range of pesticides is needed. But, if good results for particular analytes are essential, then it is necessary to evaluate methods for those individual analytes. These are both valid approaches with different purposes, and analysts should be aware that they may yield different dSPE product choices. Therefore, the products selected here should not be interpreted as definitive recommendations, rather labs should use this approach as a guide for conducting their own experiments on how to use QuEChERS effectively for the pesticides and matrices that will ultimately be used in the method they are developing.

Taking a closer look at the results for individual pesticides, Figure 6 shows that in brown rice flour samples most pesticides have similar responses, but DDT has a greater response using dSPE cat.# 26125 (the recommended dSPE based on our overall assessment in Figure 5), whereas malathion has a lower response. The malathion response is relatively high compared to other pesticides, so its response will likely be adequate when using dSPE cat.# 26125, but if it is a required pesticide, further assessment should be done during method development to ensure the final method performs as desired.

Figure 6: Detailed comparison of dSPE performance for specific pesticides in a given matrix.



Analyze Samples Accurately and Efficiently

Our optimization of QuEChERS experiments identified sample modifications (for dry samples), extraction salts, and dSPE products that yielded relatively high responses for the 40 pesticides in our test mix. Next, we wanted to evaluate a much larger list of pesticides that would be encountered during routine analysis. To test this, we fortified samples with the 203 pesticides contained in Restek's GC multiresidue pesticide kit (cat.# 32562). Because the list of target analytes was significantly expanded, we reviewed the list of products recommended in the optimization experiments and made some adjustment based on our prior experience with these matrices and the expanded analyte list. For example, with spinach we chose to use dSPE cat.# 26219 instead of cat.# 26217 because 26219 contained more GCB and PSA, which effectively remove pigments, producing clearer extracts that will result in less instrument contamination and, thus, less downtime for maintenance. Samples were extracted and cleaned using the final adjusted list of products in Table III and then analyzed by GC-MS/MS. Recoveries were used to assess method performance and incurred residues were measured in blank samples.

Table III: Final selection of extraction salts and dSPE sorbents used to prepare samples for GC-MS/MS analysis of 203 pesticides.

Matrix	Salts (Method and Catalog#)	dSPE	$MgSO_4$ (mg)	PSA (mg)	C18-EC (mg)	GCB (mg)
Celery	AOAC (cat.# 25852)	cat.# 26215	150	25	-	-
Spinach	AOAC (cat.# 25852)	cat.# 26219	150	50	50	50
Orange pulp	AOAC (cat.# 25852)	cat.# 26124	150	50	-	-
Orange peel	EN (cat.# 25850)	cat.# 26216	150	25	25	-
Whole Orange	EN (cat.# 25850)	cat.# 26216	150	25	25	-
Avocado	AOAC (cat.# 25852)	cat.# 26125	150	50	50	-
Brown rice flour	Unbuffered (cat.# 25848)	cat.# 26125	150	50	50	-
Honey	AOAC (cat.# 25852)	cat.# 26124	150	50	-	-

For recovery, most matrices were fortified at 10 and 100 ppb, but the high spike was 50 ppb for whole orange and avocado, and the low spike was 20 ppb for whole orange and honey. Across both low- and high-level spikes for all matrices, 82-99.5% of the pesticides were in the target recovery range of 70-120% (Figures 7 and 8). Precision was also assessed for the low-level spikes and more than 90% were in the target area of <20% RSD (Figure 9). The more difficult matrices (highly pigmented spinach, high-fat avocado, and low-moisture rice flour and honey) have more %RSDs in the higher categories (10-20%, and >20%) than the easier commodities, such as celery. In addition to the method performance evaluation, incurred residues were shown to be detectable, in most cases, at low ppb levels in four of the six commodities. (Table IV).

Figure 7: High Spike Recoveries (Whole Oranges and Avocados: 50 ppb; Other Commodities: 100 ppb)

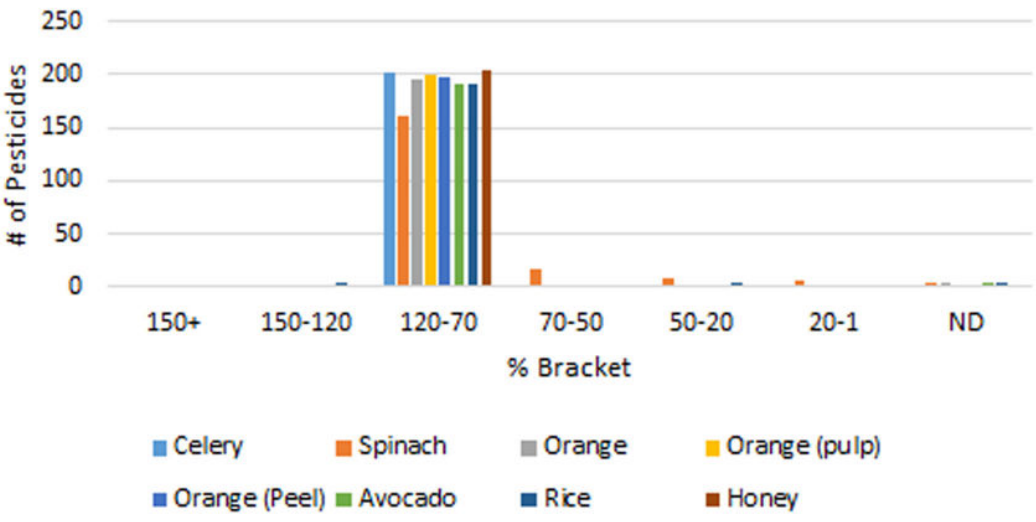


Figure 8: Low Spike Recoveries (Whole Oranges and Honey: 20 ppb; Other Commodities: 10 ppb)

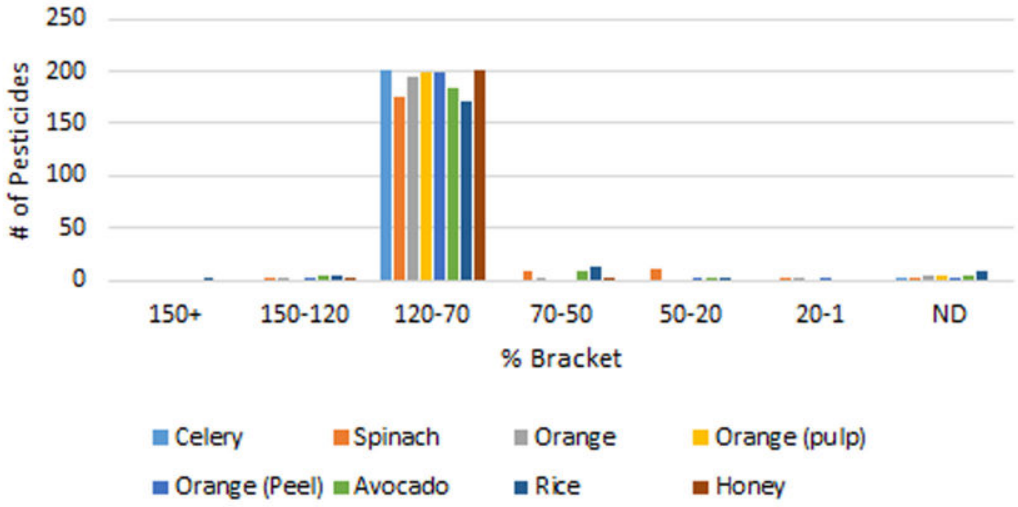


Figure 9: Low spike precision (comparison of %RSD for low-level spikes, 10 or 20 ppb).

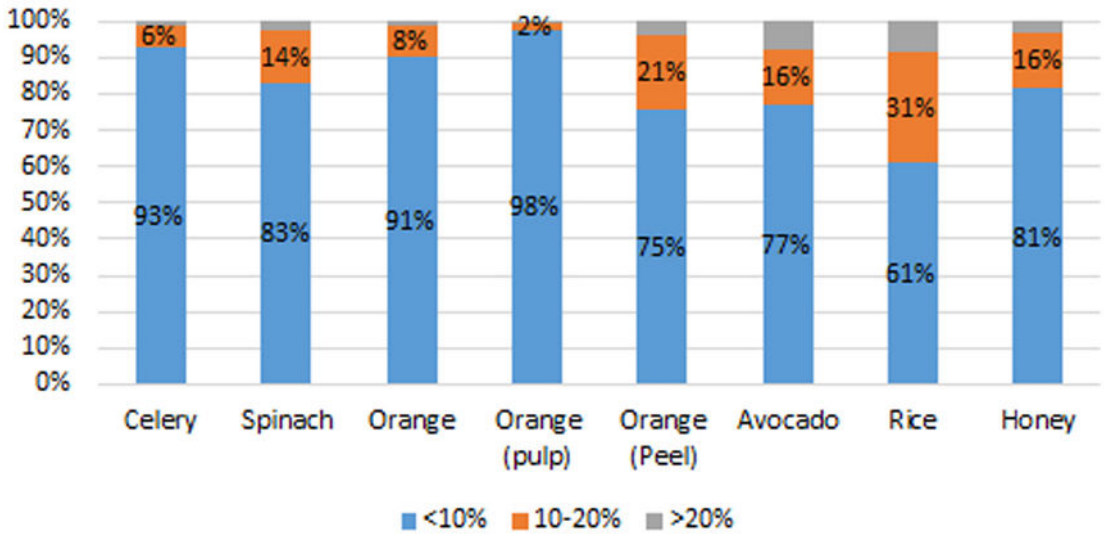


Table IV: Incurred pesticides.

Commodity/Pesticide	Mean (ppb)	SD
Celery		
Cypermethrin	2.6	0.3
Flutriafol	3.1	0.7
Malathion	6.8	0.4
Spinach		
Metalaxyl	3.4	0.9
trans-Permethrin	2.0	0.1
Whole orange		
Fludioxonil	322	2
Cypermethrin	5.1	0.4
Diphenylamine	1.5	0.1
Orange pulp		
Fludioxonil	6.8	0.2
Orange peel		
Fludioxonil	600	27
Cypermethrin	8.8	0.7
Diphenylamine	2.3	0.3
Honey		
3,4-Dichloroaniline	2.5	1.0
2,4-DPF	8.9	0.3
Piperonyl butoxide	0.40	0.09

Conclusion

Determining how to use QuEChERS for challenging matrices is simple to do through preliminary experimentation, and it pays dividends by ensuring better method performance compared to a one-size-fits-all method approach. Starting with an understanding of sample and analyte characteristics, informed choices can be made and sample modifications (e.g., mass and hydration), extraction salts, and dSPE sorbents can be evaluated during method development. By investing some upfront work in your QuEChERS methodology, you can easily use more robust extraction methods for your challenging assays.

References

Restek is not able to provide copies of these documents.

1. M. Anastassiades, S.J. Lehotay, D. Stajnbaher, F.J. Schenck, 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 (2003) 412-431. http://pubag.nal.usda.gov/pubag/downloadPDF.xhtml?id=555&content=PDF
2. AOAC Official Method 2007.01, Pesticide Residues in Foods by Acetonitrile Extraction and Partitioning with Magnesium Sulfate, 2007.
3. EN 15662:2018, Foods of plant origin - Multimethod for the determination of pesticide residues using GC- and LC-based analysis following acetonitrile extraction/partitioning and clean-up by dispersive SPE - Modular QuEChERS-method, revised 01, July 2018.

ordering notes

Certificates of analysis for this product are provided electronically. To view and download your certificate, simply visit www.restek.com/documentation

Q-sep QuEChERS Extraction Salts

- Free-flowing salts transfer easily and completely.
- Easy-open packets eliminate the need for a second empty tube for salt transfer.
- Convenient slim packets fit perfectly into tubes to prevent spills.
- Ready-to-use tubes, no glassware required.
- Pre-weighed, ultra-pure extraction salts.
- Ideal for original unbuffered, AOAC (2007.01), and European (EN 15662) QuEChERS methods.

QuEChERS methods are fast, easy, and cost-effective, and Restek Q-sep products make QuEChERS procedures even easier. No specialized glassware is required when you're using Q-sep extraction packets and tubes. Free-flowing extraction salts and salt packets that fit easily into the extraction tubes make transferring the salts to your sample mess-free and easy.

Description	Material	Method	qty.	cat.#
Q-sep QuEChERS Extraction Kit	4 g $MgSO_4$, 1 g NaCl with 50 mL Centrifuge Tube	Original unbuffered	50 packets & 50 tubes	25848
Q-sep QuEChERS Extraction Salt Packets Only	4 g $MgSO_4$, 1 g NaCl	Original unbuffered	50 packets	25847
Q-sep QuEChERS Extraction Kit	4 g $MgSO_4$, 1 g NaCl, 1 g TSCD, 0.5 g DHS with 50 mL Centrifuge Tube	European EN 15662	50 packets & 50 tubes	25850
Q-sep QuEChERS Extraction Salt Packets Only	4 g $MgSO_4$, 1 g NaCl, 1 g TSCD, 0.5 g DHS	European EN 15662	50 packets	25849
Q-sep QuEChERS Extraction Kit	6 g $MgSO_4$, 1.5 g NaOAc with 50 mL Centrifuge Tube	AOAC 2007.01	50 packets & 50 tubes	25852
Q-sep QuEChERS Extraction Salt Packets Only	6 g $MgSO_4$, 1.5 g NaOAc	AOAC 2007.01	50 packets	25851

DHS – disodium hydrogen citrate sesquihydrate; $MgSO_4$ – magnesium sulfate; NaCl – sodium chloride; NaOAc – sodium acetate; TSCD – trisodium citrate dihydrate

Q-sep QuEChERS dSPE Tubes for Extract Cleanup

Fast, Simple Sample Prep for Multiresidue Pesticide Analysis

- Packaged in foil subpacks of 10 for enhanced protection and storage stability.
- Ready-to-use tubes, no glassware required.
- Pre-weighed, ultra-pure sorbents.
- Support original unbuffered, AOAC (2007.01), European (EN 15662), and mini-multiresidue QuEChERS methods.

QuEChERS methods are fast, easy, and cost-effective, and Restek Q-sep products make QuEChERS procedures even simpler. All extraction salts, sorbents, and sample tubes are included—no specialized equipment or glassware is required. Prepare samples more efficiently with a complete line of QuEChERS supplies from Restek.

Multiple sorbents are used to extract different types of interferences.
$MgSO_4$—removes excess water.
PSA (primary and secondary amine)—removes sugars, fatty acids, organic acids, and anthocyanine pigments.
C18-EC (end-capped)—removes nonpolar interferences.
GCB (graphitized carbon black)—removes pigments, sterols, and nonpolar interferences.

Description	Material	Method	Type	Volume	qty.	Similar to Part #	cat.#
Foodstuffs with fats and waxes (e.g., cereals, avocado, nuts, seeds, and dairy)							
Q-sep QuEChERS dSPE Tubes	150 mg $MgSO_4$, 25 mg PSA, 25 mg C18-EC	Mini-multiresidue	2 mL Micro-Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (1 mL Extract)	2 mL	100 tubes	Agilent 5982-5121	26216
	150 mg $MgSO_4$, 50 mg C18-EC	—	2 mL Micro-Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (1 mL Extract)	2 mL	100 tubes		26242
	150 mg $MgSO_4$, 50 mg PSA, 50 mg C18-EC	AOAC 2007.01	2 mL Micro-Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (1 mL Extract)	2 mL	100 tubes		26125
	1200 mg $MgSO_4$, 400 mg PSA, 400 mg C18-EC	AOAC 2007.01	15 mL Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (6 mL and 8 mL Extract)	15 mL	50 tubes	Agilent 5982-5158	26221
	1200 mg $MgSO_4$, 400 mg C18-EC	—	15 mL Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (6 mL and 8 mL Extract)	15 mL	50 tubes		26244
	900 mg $MgSO_4$, 150 mg PSA, 150 mg C18-EC	—	15 mL Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (6 mL and 8 mL Extract)	15 mL	50 tubes		26226
General fruits and vegetables (e.g., celery, head lettuce, cucumber, melon)							
Q-sep QuEChERS dSPE Tubes	150 mg $MgSO_4$, 50 mg PSA	AOAC 2007.01	2 mL Micro-Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (1 mL Extract)	2 mL	100 tubes		26124
	150 mg $MgSO_4$, 25 mg PSA	Original unbuffered, EN 15662, mini-multiresidue	2 mL Micro-Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (1 mL Extract)	2 mL	100 tubes	Agilent 5982-5021	26215
	1200 mg $MgSO_4$, 400 mg PSA	AOAC 2007.01	15 mL Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (6 mL and 8 mL Extract)	15 mL	50 tubes		26220
	900 mg $MgSO_4$, 150 mg PSA	Original unbuffered, EN 15662	15 mL Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (6 mL and 8 mL Extract)	15 mL	50 tubes	Agilent 5982-5056	26223
General purpose (wide variety of sample types, including fatty and pigmented fruits and vegetables)							
Q-sep QuEChERS dSPE Tubes	150 mg $MgSO_4$, 50 mg PSA, 50 mg C18-EC, 7.5 mg GCB	—	2 mL Micro-Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (1 mL Extract)	2 mL	100 tubes		26243
	900 mg $MgSO_4$, 300 mg PSA, 300 mg C18-EC, 45 mg GCB	—	15 mL Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (6 mL and 8 mL Extract)	15 mL	50 tubes		26245
Highly pigmented fruits and vegetables (e.g., red peppers, spinach, blueberries)							
Q-sep QuEChERS dSPE Tubes	150 mg $MgSO_4$, 25 mg PSA, 7.5 mg GCB	Mini-multiresidue, EN 15662	2 mL Micro-Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (1 mL Extract)	2 mL	100 tubes		26218
	150 mg $MgSO_4$, 50 mg PSA, 50 mg C18-EC, 50 mg GCB	AOAC 2007.01	2 mL Micro-Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (1 mL Extract)	2 mL	100 tubes		26219
	900 mg $MgSO_4$, 150 mg PSA, 45 mg GCB	EN 15662	15 mL Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (6 mL and 8 mL Extract)	15 mL	50 tubes		26225
	900 mg $MgSO_4$, 300 mg PSA, 150 mg GCB	—	15 mL Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (6 mL and 8 mL Extract)	15 mL	50 tubes		26126
Pigmented fruits and vegetables (e.g., strawberries, sweet potatoes, and tomatoes)							
Q-sep QuEChERS dSPE Tubes	150 mg $MgSO_4$, 25 mg PSA, 2.5 mg GCB	Mini-multiresidue, EN 15662	2 mL Micro-Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (1 mL Extract)	2 mL	100 tubes		26217
	150 mg $MgSO_4$, 50 mg PSA, 50 mg GCB	AOAC 2007.01	2 mL Micro-Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (1 mL Extract)	2 mL	100 tubes		26123
	1200 mg $MgSO_4$, 400 mg PSA, 400 mg C18-EC, 400 mg GCB	AOAC 2007.01	15 mL Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (6 mL and 8 mL Extract)	15 mL	50 tubes		26222
	900 mg $MgSO_4$, 150 mg PSA, 15 mg GCB	EN 15662	15 mL Centrifuge Tubes Prefilled with dSPE Materials for Cleanup (6 mL and 8 mL Extract)	15 mL	50 tubes		26224

Note: No entry in the Method column refers to dSPE formulations not specifically included in one of the cited references. These products can be used to accommodate the various needs of specific matrices not directly met by the cited references.

QuEChERS Performance Standards Kit

- Designed for use in all QuEChERS methods for pesticides in fruits and vegetables, including the original unbuffered method, AOAC 2007.01, and EN 15662.
- Kit contains organochlorine, organonitrogen, organophosphorus, and carbamate pesticides commonly used on fruits and vegetables.
- Volatile, polar, active, base-sensitive, and nonvolatile compounds are included to allow comprehensive evaluation of QuEChERS extraction and cleanup efficiencies, and optimization of GC and LC instrumental conditions.
- Ideal for initial method evaluations and ongoing method performance validations.
- Analytes are divided into three ampuls based on compatibility for maximum stability and shelf life.*
- Precise formulations improve data quality and operational efficiency; spend more time running samples and less time sourcing and preparing standards.
- Quantitatively analyzed to confirm the composition and stability of each mixture.

**When combining compounds with different functionalities, chemical stability can be an issue. The analytes in this kit are separated into three mixes to ensure maximum long-term storage stability. For analysis, a fresh working standard should be prepared by combining the three kit mixes in a 1:1:1 ratio to prepare a 100 µg/mL working standard solution. Once blended, Restek does not recommend storing working standards or subsequent dilutions for future use.*

Contains 1 mL each of these mixtures. 31153: QuEChERS Performance Standard A 31154: QuEChERS Performance Standard B 31155: QuEChERS Performance Standard C 300 µg/mL each in acetonitrile/acetic acid (99.9:0.1), 1 mL/ampul. Blend equal volumes of all three ampuls for a 100 µg/mL final solution.

Contains 1 mL each of these mixtures. 300 µg/mL each in acetonitrile/acetic acid (99.9:0.1), 1 mL/ampul. Blend equal volumes of all three ampuls for a 100 µg/mL final solution.

Cat.# 31153: QuEChERS Performance Standard A (16 components)
Acephate (30560-19-1)
Azinphos methyl (86-50-0)
Chlorpyrifos (2921-88-2)
Coumaphos (56-72-4)
Diazinon (333-41-5)
Dichlofluanid (1085-98-9)
Dichlorvos (DDVP) (62-73-7)
Dimethoate (60-51-5)
Fenthion (55-38-9)
Malathion (121-75-5)
Methamidophos (10265-92-6)
Mevinphos (7786-34-7)
Omethoate (1113-02-6)
Phosalone (2310-17-0)
Pirimiphos methyl (29232-93-7)
Propargite (2312-35-8)

Cat.# 31154: QuEChERS Performance Standard B (7 components)
γ-BHC (Lindane) (58-89-9)
Chlorothalonil (1897-45-6)
4,4'-DDT (50-29-3)
Dicofol (Kelthane) (115-32-2)
Endosulfan sulfate (1031-07-8)
Endrin (72-20-8)
2-Phenylphenol (90-43-7)

Cat.# 31155: QuEChERS Performance Standard C (17 components)
Bifenthrin (82657-04-3)
Captan (133-06-2)
Carbaryl (Sevin) (63-25-2)
Cyprodinil (121552-61-2)
Deltamethrin (52918-63-5)
Fenhexamid (126833-17-8)
Fenpropathrin (39515-41-8)
Folpet (133-07-3)
Imazalil (35554-44-0)
Iprodione (36734-19-7)
Metalaxyl (57837-19-1)
Methiocarb (2032-65-7)
Myclobutanil (88671-89-0)
cis-Permethrin (61949-76-6)
trans-Permethrin (61949-77-7)
Thiabendazole (148-79-8)
Vinclozolin (50471-44-8)

Description	CRM?	Min Shelf Life on Ship Date	Shipping Conditions	Storage Temp.	qty.	cat.#
QuEChERS Performance Standards Kit	Yes	3 months	Ambient	10 °C or colder	kit	31152

GC Multiresidue Pesticide Kit

- Accurately identify and quantify pesticide residues by GC-MS/MS in fruits, vegetables, botanicals, and herbals such as tea, ginseng, ginger, echinacea, and dietary supplements.
- Comprehensive 203-compound kit covers food safety lists by the FDA, USDA, and other global governmental agencies; individual ampuls also sold separately.
- Formulated and grouped for maximum long-term stability.*
- Quantitatively tested to confirm composition; detailed support documentation provided.
- Optimized multiresidue pesticide method is offered free of charge; downloadable XLS file includes conditions and transition tables.

32562

** Note: When combining a large number of compounds with different chemical functionalities, mix stability can be an issue. In formulating these standards, we extensively studied the 203 compounds involved, then grouped them into as few mixes as possible while still ensuring maximum long-term stability and reliability. For quantitative analysis, we recommend analyzing each mix separately to ensure accurate results for every compound.*

Cat.# 32563: GC Multiresidue Pesticide Standard #1 (16 components)
Organophosphorus Compounds
100 µg/mL each in toluene, 1 mL/ampul
Azinphos ethyl (2642-71-9)
Azinphos methyl (86-50-0)
Chlorpyrifos (2921-88-2)
Chlorpyrifos methyl (5598-13-0)
Diazinon (333-41-5)
EPN (2104-64-5)
Fenitrothion (122-14-5)
Isazophos (42509-80-8)
Phosalone (2310-17-0)
Phosmet (732-11-6)
Pirimiphos ethyl (23505-41-1)
Pirimiphos methyl (29232-93-7)
Pyraclofos (89784-60-1)
Pyrazophos (13457-18-6)
Pyridaphenthion (119-12-0)
Quinalphos (13593-03-8)

Cat.# 32564: GC Multiresidue Pesticide Standard #2 (40 components)
Organochlorine Compounds
100 µg/mL each in toluene, 1 mL/ampul
Aldrin (309-00-2)
α-BHC (319-84-6)
β-BHC (319-85-7)
δ-BHC (319-86-8)
γ-BHC (Lindane) (58-89-9)
Chlorbenside (103-17-3)
cis-Chlordane (5103-71-9)
trans-Chlordane (5103-74-2)
Chlorfenson (Ovex) (80-33-1)
Chloroneb (2675-77-6)
2,4'-DDD (53-19-0)
4,4'-DDD (72-54-8)
2,4'-DDE (3424-82-6)
4,4'-DDE (72-55-9)
2,4'-DDT (789-02-6)
4,4'-DDT (50-29-3)
4,4'-Dichlorobenzophenone (90-98-2)
Dieldrin (60-57-1)
Endosulfan I (959-98-8)
Endosulfan II (33213-65-9)
Endosulfan ether (3369-52-6)
Endosulfan sulfate (1031-07-8)
Endrin (72-20-8)
Endrin aldehyde (7421-93-4)
Endrin ketone (53494-70-5)
Ethylan (Perthane) (72-56-0)
Fenson (80-38-6)
Heptachlor (76-44-8)
Heptachlor epoxide (isomer B) (1024-57-3)
Hexachlorobenzene (118-74-1)
Isodrin (465-73-6)
2,4'-Methoxychlor (30667-99-3)
4,4'-Methoxychlor olefin (2132-70-9)
Mirex (2385-85-5)
cis-Nonachlor (5103-73-1)
trans-Nonachlor (39765-80-5)
Pentachloroanisole (1825-21-4)
Pentachlorobenzene (608-93-5)
Pentachlorothioanisole (1825-19-0)
Tetradifon (116-29-0)

Cat.# 32565: GC Multiresidue Pesticide Standard #3 (25 components)
Organonitrogen Compounds
100 µg/mL each in toluene:acetonitrile (99:1), 1 mL/ampul
Benfluralin (1861-40-1)
Biphenyl (92-52-4)
Chlorothalonil (1897-45-6)
Dichlofluanid (1085-98-9)
Dichloran (99-30-9)
3,4-Dichloroaniline (95-76-1)
2,6-Dichlorobenzonitrile (Dichlobenil) (1194-65-6)
Diphenylamine (122-39-4)
Ethalfluralin (55283-68-6)
Fluchloralin (33245-39-5)
Isopropalin (33820-53-0)
Nitralin (4726-14-1)
Nitrofen (1836-75-5)
Oxyfluorfen (42874-03-3)
Pendimethalin (40487-42-1)
Pentachloroaniline (527-20-8)
Pentachlorobenzonitrile (20925-85-3)
Pentachloronitrobenzene (Quintozene) (82-68-8)
Prodiamine (29091-21-2)
Profluralin (26399-36-0)
2,3,5,6-Tetrachloroaniline (3481-20-7)
Tetrachloronitrobenzene (Tecnazene) (117-18-0)
THPI (Tetrahydrophthalimide) (1469-48-3)
Tolylfluanid (731-27-1)
Trifluralin (1582-09-8)

Cat.# 32566: GC Multiresidue Pesticide Standard #4 (28 components)
Organonitrogen Compounds
100 µg/mL each in toluene, 1 mL/ampul
Acetochlor (34256-82-1)
Alachlor (15972-60-8)
Allidochlor (93-71-0)
Clomazone (Command) (81777-89-1)
Cycloate (1134-23-2)
Diallate (*cis* & *trans*) (2303-16-4)
Dimethachlor (50563-36-5)
Diphenamid (957-51-7)
Fenpropathrin (39515-41-8)
Fluquinconazole (136426-54-5)
Flutolanil (66332-96-5)
Linuron (330-55-2)
Metazachlor (67129-08-2)
Methoxychlor (72-43-5)
Metolachlor (51218-45-2)
N-(2,4-Dimethylphenyl)formamide (60397-77-5)
Norflurazon (27314-13-2)
Oxadiazon (19666-30-9)
Pebulate (1114-71-2)
Pretilachlor (51218-49-6)
Prochloraz (67747-09-5)
Propachlor (1918-16-7)
Propanil (709-98-8)
Propisochlor (86763-47-5)
Propyzamide (23950-58-5)
Pyridaben (96489-71-3)
Tebufenpyrad (119168-77-3)
Triallate (2303-17-5)

Cat.# 32567: GC Multiresidue Pesticide Standard #5 (34 components)
Organonitrogen Compounds
100 µg/mL each in toluene, 1 mL/ampul
Atrazine (1912-24-9)
Bupirimate (41483-43-6)
Captafol (2425-06-1)
Captan (133-06-2)
Chlorfenapyr (122453-73-0)
Cyprodinil (121552-61-2)
Etofenprox (80844-07-1)
Etridiazole (2593-15-9)
Fenarimol (60168-88-9)
Fipronil (120068-37-3)
Fludioxonil (131341-86-1)
Fluridone (Sonar) (59756-60-4)
Flusilazole (85509-19-9)
Flutriafol (76674-21-0)
Folpet (133-07-3)
Hexazinone (Velpar) (51235-04-2)
Iprodione (36734-19-7)
Lenacil (2164-08-1)
MGK-264 (113-48-4)
Myclobutanil (88671-89-0)
Paclobutrazol (76738-62-0)
Penconazole (66246-88-6)
Procymidone (32809-16-8)
Propargite (2312-35-8)
Pyrimethanil (53112-28-0)
Pyriproxyfen (95737-68-1)
Tebuconazole (107534-96-3)
Terbacil (5902-51-2)
Terbuthylazine (5915-41-3)
Triadimefon (43121-43-3)
Triadimenol (55219-65-3)
Tricyclazole (Beam) (41814-78-2)
Triflumizole (68694-11-1)
Vinclozolin (50471-44-8)

Cat.# 32568: GC Multiresidue Pesticide Standard #6 (18 components)
Synthetic Pyrethroid Compounds
100 µg/mL each in toluene, 1 mL/ampul
Acrinathrin (101007-06-1)
Anthraquinone (84-65-1)
Bifenthrin (82657-04-3)
Bioallethrin (584-79-2)
Cyfluthrin (68359-37-5)
lambda-Cyhalothrin (91465-08-6)
Cypermethrin (52315-07-8)
Deltamethrin (52918-63-5)
Fenvalerate (51630-58-1)
Flucythrinate (70124-77-5)
tau-Fluvalinate (102851-06-9)
cis-Permethrin (61949-76-6)
trans-Permethrin (61949-77-7)
Phenothrin (*cis* & *trans*) (26002-80-2)
Resmethrin (10453-86-8)
Tefluthrin (79538-32-2)
Tetramethrin (7696-12-0)
Transfluthrin (118712-89-3)

Cat.# 32569: GC Multiresidue Pesticide Standard #7 (10 components)
Herbicide Methyl Esters
100 µg/mL each in toluene, 1 mL/ampul
Acequinocyl (57960-19-7)
Bromopropylate (18181-80-1)
Carfentrazone ethyl (128639-02-1)
Chlorobenzilate (510-15-6)
Chlorpropham (101-21-3)
Chlozolinate (84332-86-5)
DCPA methyl ester (Chlorthal-dimethyl) (1861-32-1)
Fluazifop-*p*-butyl (79241-46-6)
Metalaxyl (57837-19-1)
2-Phenylphenol (90-43-7)

Cat.# 32570: GC Multiresidue Pesticide Standard #8 (24 components)
Organophosphorus Compounds
100 µg/mL each in toluene, 1 mL/ampul
Bromfenvinfos-methyl (13104-21-7)
Bromfenvinphos (33399-00-7)
Bromophos ethyl (4824-78-6)
Bromophos methyl (2104-96-3)
Carbophenothion (786-19-6)
Chlorfenvinphos (470-90-6)
Chlorthiophos (60238-56-4)
Coumaphos (56-72-4)
Edifenphos (17109-49-8)
Ethion (563-12-2)
Fenamiphos (22224-92-6)
Fenchlorphos (Ronnel) (299-84-3)
Fenthion (55-38-9)
Iodofenphos (18181-70-9)
Leptophos (21609-90-5)
Malathion (121-75-5)
Methacrifos (62610-77-9)
Profenofos (41198-08-7)
Prothiofos (34643-46-4)
Sulfotepp (3689-24-5)
Sulprofos (35400-43-2)
Terbufos (13071-79-9)
Tetrachlorvinphos (22248-79-9)
Tolclofos-methyl (57018-04-9)

Cat.# 32571: GC Multiresidue Pesticide Standard #9 (8 components)
Organophosphorus Compounds
100 µg/mL each in toluene, 1 mL/ampul
Disulfoton (298-04-4)
Fonofos (944-22-9)
Methyl parathion (298-00-0)
Mevinphos (7786-34-7)
Parathion (ethyl parathion) (56-38-2)
Phorate (298-02-2)
Piperonyl butoxide (51-03-6)
Triazophos (24017-47-8)

Description	CRM?	Min Shelf Life on Ship Date	Shipping Conditions	Storage Temp.	qty.	cat.#
GC Multiresidue Pesticide Kit	Yes	6 months	Ambient	10 °C or colder	kit	32562

Rxi-5ms Columns (fused silica)
low-polarity phase; Crossbond diphenyl dimethyl polysiloxane

- Ideal for pesticides in food.
- General-purpose columns that can be used for phenols, residual solvents, drugs of abuse, pesticides, semivolatiles, PCB congeners (e.g., Aroclor mixes), and solvent impurities.
- Tested and guaranteed for ultra-low bleed; improved signal-to-noise ratio for better sensitivity and mass spectral integrity.
- Temperature range: -60 °C to 330/350 °C.
- Equivalent to USP G27 and G36 phases.

ID	df	Length	Temp. Limits	qty.	Similar to Part #	cat.#
0.25mm	0.25 µm	30 m	-60 to 330/350 °C	ea.	Agilent 19091S-433UI; Phenomenex 7HG-G032-11	13423

Q-sep Multispeed Centrifuge for QuEChERS

- Program 10 custom cycles for time; braking; and speed or g-force (up to 4500 rpm or 3450 xg).
- QuEChERS-specific presets for AOAC and EN methods make consistent operation quick and simple.
- Convenient lid lighting indicates at a glance if unit is ready, running, or done.
- Control panel can be temporarily locked on one cycle for error-free reproducibility.
- Cool-Flow design prevents samples from overheating by maintaining unit at room temperature.
- Tube holders are carbon fiber for high strength, durability, and years of trouble-free use.
- Clear lid permits safe observation of samples and optical calibration of speed.

The Q-sep centrifuge is a continuous-duty, electronically controlled, horizontal laboratory centrifuge with a lid safety interlock system. The unit is controlled by an electronic push-button timer that is variable from one to 30 minutes for precise spin times and ease of use. Samples can be safely viewed through the transparent lid. The imbalance detection system safely terminates a run cycle in the event that a load is severely imbalanced. Entry into the machine is restricted during operation by the safety interlock system. The Q-sep centrifuge features a lighted control panel that displays the status of the machine, easily viewable from a distance. The unit comes with presets for AOAC and EN methods or up to 10 custom cycles can be programmed with full control of time; braking; and speed or g-force (up to 4500 rpm or 3450 xg).

Includes	Certification/Compliance	qty.	cat.#
15 mL four-place tube holder (6); 50 mL single-place tube holder (6); 50 mL conical tube insert (6); 2 mL tube adaptors (24); U.S. power cord (1); global/universal power cord (1)	UL61010-1/CSA C22.2 No. 61010-1 and IEC61010-2-020; FDA listed; MET U.S. E112532; CE; RoHS	ea.	28295

Q-sep Bottle Top Solvent Dispenser


23990

- Adjustment knob offers 56 output volume settings from 2.5 mL to 30 mL per stroke (0.5 mL increments)—ideal for QuEChERS methods!
- Base features 30 mm threads and includes five adaptors (28 mm, 32 mm, 36 mm, 40 mm, and 45 mm).
- Individually calibrated in accordance with ISO 8655 standards (certificate included) and can also be recalibrated by the user.
- PTFE, glass, and polypropylene construction for excellent chemical compatibility and 100% autoclavability.
- Integral safety discharge reduces risk of accidental dispensing, and nozzle cap prevents dripping.
- Easy to disassemble for cleaning and servicing.

Accurately and precisely dispense liquids for QuEChERS extractions with this versatile pump. A quick, simple adjustment lets you set the output volume anywhere from 2.5 mL to 30 mL per stroke, and the included adaptors will accommodate most reagent bottles.

Description	qty.	cat.#
Q-sep Bottle Top Solvent Dispenser, 2.5 mL–30 mL	ea.	23990

Raptor ARC-18 LC Columns (USP L1)

- Ideal for high-throughput LC-MS/MS applications with minimal sample preparation.
- Well-balanced retention profile for better detection and integration of large, multiclass analyte lists.
- Sterically protected to endure low-pH mobile phases without sacrificing retention or peak quality.
- Part of Restek's Raptor LC column line featuring 1.8, 2.7, and 5 µm SPP core-shell silica.

Designed and intended specifically for use on LC-MS/MS systems, the Raptor ARC-18 column offers a well-balanced retention profile without the drawbacks of using an ordinary C18 in the harsh, acidic mobile phases needed for mass spectrometry (MS). Even after extended use in these low-pH (≤ 2.0) conditions, the sterically protected ARC-18 offers consistent retention, peak shape, and response for charged bases, neutral acids, small polar compounds, and more. For the rapid analysis of large, multiclass assays by LC-MS/MS, the acid-resistant Raptor ARC-18 column truly is ahead of the curve.

ID	Length	qty.	cat.#
2.7 µm Particles Raptor ARC-18			
2.1 mm	100 mm	ea.	9314A12

LC Multiresidue Pesticide Kit

31971

- Accurately detect and quantify pesticides of global food safety concern in a wide range of fruits, vegetables, and other commodities by LC-MS/MS.
- Full kit contains 204 compounds of interest, covering many LC-determined pesticides listed by government agencies; individual ampuls also sold separately.
- Formulated and grouped for maximum long-term stability.
- Quantitatively tested to confirm composition; detailed support documentation provided.
- Optimized multiresidue pesticide method is offered free of charge; downloadable XLS file includes conditions and transition tables.
- Restek is your complete supplier for world-class LC-MS/MS multiresidue pesticide analysis: reference and internal standards, Ultra and Pinnacle DB LC columns, Q-sep QuEChERS sample prep products, accessories, and more!

** Note: When combining a large number of compounds with different chemical functionalities, mix stability can be an issue. In formulating these standards, we extensively studied the 204 compounds involved, and then grouped them into as few mixes as possible while still ensuring maximum long-term stability and reliability. For quantitative analysis, we recommend analyzing each mix separately to ensure accurate results for every compound.*

Cat.# 31972: LC Multiresidue Pesticide Standard #1 (13 components)
Organophosphorus Compounds
100 µg/mL each in acetonitrile, 1 mL/ampul
Acephate (30560-19-1)
Carbaryl (Sevin) (63-25-2)
Dicrotophos (141-66-2)
Dimethoate (60-51-5)
Dimethomorph (110488-70-5)
Isocarbophos (24353-61-5)
Methamidophos (10265-92-6)
Mevinphos (7786-34-7)
Monocrotophos (6923-22-4)
Omethoate (1113-02-6)
Temephos (Abate) (3383-96-8)
Trichlorfon (Dylox) (52-68-6)
Vamidothion (Vamidoate) (2275-23-2)

Cat.# 31973: LC Multiresidue Pesticide Standard #2 (16 components)
Carbamate/Uron Compounds
100 µg/mL each in acetonitrile, 1 mL/ampul
Alanycarb (83130-01-2)
Aldicarb (116-06-3)
Aldicarb sulfone (1646-88-4)
Aldicarb sulfoxide (1646-87-3)
Benfuracarb (82560-54-1)
Butocarboxim (34681-10-2)
Butoxycarboxim (34681-23-7)
Ethiofencarb (29973-13-5)
Furathiocarb (65907-30-4)
Methabenzthiazuron (18691-97-9)
Methiocarb (2032-65-7)
Methomyl (16752-77-5)
Oxamyl (23135-22-0)
Tebuthiuron (34014-18-1)
Thidiazuron (51707-55-2)
Thiophanate-methyl (23564-05-8)

Cat.# 31974: LC Multiresidue Pesticide Standard #3 (38 components)
Carbamate/Uron Compounds
100 µg/mL each in acetonitrile, 1 mL/ampul
Bendiocarb (22781-23-3)
Bifenazate (149877-41-8)
Carbofuran (1563-66-2)
Chlorfluazuron (71422-67-8)
Chloroxuron (1982-47-4)
Chlortoluron (15545-48-9)
Cycluron (2163-69-1)
Diethofencarb (87130-20-9)
Diflubenzuron (35367-38-5)
Dioxacarb (6988-21-2)
Diuron (330-54-1)
Fenobucarb (BPMC) (3766-81-2)
Fenoxycarb (72490-01-8)
Fenuron (101-42-8)
Flufenoxuron (101463-69-8)
Fluometuron (2164-17-2)
Forchlorfenuron (68157-60-8)
Hexaflumuron (86479-06-3)
3-Hydroxycarbofuran (16655-82-6)
Indoxacarb (173584-44-6)
Iprovalicarb (140923-17-7)
Isoprocarb (2631-40-5)
Isoproturon (34123-59-6)
Linuron (330-55-2)
Lufenuron (103055-07-8)
Metobromuron (3060-89-7)
Monolinuron (1746-81-2)
Neburon (555-37-3)
Novaluron (116714-46-6)
Pirimicarb (23103-98-2)
Promecarb (2631-37-0)
Propham (122-42-9)
Propoxur (Baygon) (114-26-1)
Pyraclostrobin (175013-18-0)
Siduron (1982-49-6)
Teflubenzuron (83121-18-0)
Thiobencarb (28249-77-6)
Triflumuron (64628-44-0)

Cat.# 31975: LC Multiresidue Pesticide Standard #4 (63 components)
Organonitrogen Compounds
100 µg/mL each in acetonitrile, 1 mL/ampul
Abamectin (71751-41-2)
Acetamiprid (135410-20-7)
Ametryn (834-12-8)
Amitraz (33089-61-1)
Azoxystrobin (131860-33-8)
Benalaxyl (71626-11-4)
Benzoximate (29104-30-1)
Boscalid (188425-85-6)
Butafenacil (134605-64-4)
Carbetamide (16118-49-3)
Carfentrazone ethyl (128639-02-1)
Chlorantraniliprole (500008-45-7)
Clofentezine (74115-24-5)
Cymoxanil (57966-95-7)
Cyprodinil (121552-61-2)
Cyromazine (66215-27-8)
Dimoxystrobin (149961-52-4)
Dinotefuran (165252-70-0)
Doramectin (117704-25-3)
Eprinomectin (123997-26-2)
Famoxadon (131807-57-3)
Fenazaquin (120928-09-8)
Fenhexamid (126833-17-8)
(E)-Fenpyroximate (134098-61-6)
Flonicamid (158062-67-0)
Fluazinam** (79622-59-6)
Fludioxonil (131341-86-1)
Fluoxastrobin (361377-29-9)
Flutolanil (66332-96-5)
Furalaxyl (57646-30-7)
Halofenozide (112226-61-6)
Imazalil (35554-44-0)
Imidacloprid (138261-41-3)
Ivermectin (70288-86-7)
Kresoxim methyl (143390-89-0)
Mandipropamid (374726-62-2)
Mepanipyrim (110235-47-7)
Mepronil (55814-41-0)
Metaflumizone (139968-49-3)
Metalaxyl (57837-19-1)
Methoxyfenozide (161050-58-4)
Moxidectin (113507-06-5)
Myclobutanil (88671-89-0)
Nitenpyram (120738-89-8)
Oxadixyl (77732-09-3)
Picoxystrobin (117428-22-5)
Piperonyl butoxide (51-03-6)
Prochloraz (67747-09-5)
Prometon (1610-18-0)
Pymetrozine (123312-89-0)
Pyracarbolid (24691-76-7)
Pyrimethanil (53112-28-0)
Pyriproxyfen (95737-68-1)
Quinoxyfen (124495-18-7)
Rotenone (83-79-4)
Secbumeton (26259-45-0)
Spiroxamine (118134-30-8)
Tebufenozide (112410-23-8)
Tebufenpyrad (119168-77-3)
Terbumeton (33693-04-8)
Triadimefon (43121-43-3)
Trifloxystrobin (141517-21-7)
Zoxamide (156052-68-5)

Cat.# 31976: LC Multiresidue Pesticide Standard #5 (30 components)
Organonitrogen Compounds
100 µg/mL each in acetonitrile, 1 mL/ampul
Acibenzolar-S-methyl (135158-54-2)
Bupirimate (41483-43-6)
Buprofezin (69327-76-0)
Carboxin (5234-68-4)
Clethodim (99129-21-2)
Clothianidin (210880-92-5)
Cyazofamid (120116-88-3)
Ethiprole (181587-01-9)
Ethofumesate (26225-79-6)
Fenamidone (161326-34-7)
Fipronil (120068-37-3)
Flubendiamide (272451-65-7)
Flufenacet (Fluthiamide) (142459-58-3)
Hexythiazox (78587-05-0)
Mefenacet (73250-68-7)
Mesotrione (104206-82-8)
Methoprotryne (841-06-5)
Metribuzin (21087-64-9)
Prometryne (7287-19-6)
Propargite (2312-35-8)
Prothioconazole (178928-70-6)
Pyridaben (96489-71-3)
Simetryn (1014-70-6)
Sulfentrazone (122836-35-5)
Terbutryn (886-50-0)
Thiabendazole (148-79-8)
Thiacloprid (111988-49-9)
Thiamethoxam (153719-23-4)
Thiofanox (39196-18-4)
Tricyclazole (Beam) (41814-78-2)

Cat.# 31977: LC Multiresidue Pesticide Standard #6 (28 components)
Organonitrogen Compounds
100 µg/mL each in acetonitrile, 1 mL/ampul
Baycor (Bitertanol) (55179-31-2)
Bromuconazole (116255-48-2)
Cyproconazole (94361-06-5)
Diclobutrazol (75736-33-3)
Difenoconazole (119446-68-3)
Diniconazole (83657-24-3)
Epoxiconazole (133855-98-8)
Etaconazole (60207-93-4)
Ethirimol (23947-60-6)
Etoxazole (153233-91-1)
Fenarimol (60168-88-9)
Fenbuconazole (114369-43-6)
Fluquinconazole (136426-54-5)
Flusilazole (85509-19-9)
Flutriafol (76674-21-0)
Fuberidazole (3878-19-1)
Hexaconazole (79983-71-4)
Ipconazole (125225-28-7)
Metconazole (125116-23-6)
Nuarimol (63284-71-9)
Paclobutrazol (76738-62-0)
Penconazole (66246-88-6)
Propiconazole (Tilt) (60207-90-1)
Tebuconazole (107534-96-3)
Tetraconazole (112281-77-3)
Triadimenol (55219-65-3)
Triflumizole (68694-11-1)
Triticonazole (131983-72-7)

Cat.# 31978: LC Multiresidue Pesticide Standard #7 (7 components)
Organonitrogen Compounds
100 µg/mL each in acetonitrile, 1 mL/ampul
Emamectin-benzoate (155569-91-8)
Fenpropimorph (67564-91-4)
Spinetoram (J&L) (935545-74-7)**
Spinosad (A&D) (168316-95-8)†
Spirodiclofen (148477-71-8)
Spiromesifen (283594-90-1)
Spirotetramat (203313-25-1)

Cat.# 31979: LC Multiresidue Pesticide Standard #8
Organonitrogen Compounds
100 µg/mL in acetonitrile, 1 mL/ampul
Hydramethylnon (67485-29-4)

Cat.# 31980: LC Multiresidue Pesticide Standard #9 (7 components)
Carbamate/Uron Compounds
100 µg/mL each in acetonitrile, 1 mL/ampul
Aminocarb (2032-59-9)
Desmedipham (13684-56-5)
Formetanate HCL (23422-53-9)
Mexacarbate (Zectran) (315-18-4)
Monceren (Pencycuron) (66063-05-6)
Phenmedipham (13684-63-4)
Propamocarb free base (24579-73-5)

Cat.# 31981: LC Multiresidue Pesticide Standard #10
Carbamate/Uron Compounds
100 µg/mL in methanol, 1 mL/ampul
Carbendazim (10605-21-7)

Description	CRM?	Min Shelf Life on Ship Date	Shipping Conditions	Storage Temp.	qty.	cat.#
LC Multiresidue Pesticide Kit	Yes	6 months	On Ice	–20 °C or colder	kit	31971

*In this standard, fluazinam should only be used for qualitative analysis. A single-component standard (cat.# 31982) is available for quantitative analysis.

**This reference material contains both the Spinetoram J and L isomers (187166-40-1 and 187166-15-0); however, CAS# 935545-74-7 is displayed on the certificate as this is the neat material dissolved in the solution. CAS# 935545-74-7 is a blend of Spinetoram J and L and the ratio of each material isomer are displayed on your certificate of analysis.

†This reference material contains Spinosad A and D isomers (131929-60-7 and 131929-63-0); however, CAS# 168316-95-8 is displayed on the certificate as this is the neat material dissolved in the solution. CAS# 168316-95-8 is a blend of Spinosad A and D and the ratio of each material isomer are displayed on your certificate of analysis.

QuEChERS Reference Standards

Ready to use for QuEChERS extractions—no dilutions necessary.

AOAC QuEChERS QC Spike Mix

- Ready to use for generating test mixes, calibration standards, and spiking experiments.
- Reliable standards produced according to specifications defined in AOAC Official Method 2007.01.
- Cost-effective QuEChERS standards can be used without dilutions for greater lab efficiency.

(27 components)

Atrazine (1912-24-9)
Azoxystrobin (131860-33-8)
Bifenthrin (82657-04-3)
Carbaryl (Sevin) (63-25-2)
Chlorothalonil (1897-45-6)
Chlorpyrifos (2921-88-2)
Chlorpyrifos methyl (5598-13-0)
lambda-Cyhalothrin (91465-08-6)
Cyprodinil (121552-61-2)
2,4'-DDD (53-19-0)
Dichlorvos (DDVP) (62-73-7)
Endosulfan sulfate (1031-07-8)
Ethion (563-12-2)
Imazalil (35554-44-0)
Imidacloprid (138261-41-3)
Kresoxim methyl (143390-89-0)
Linuron (330-55-2)
Methamidophos (10265-92-6)
Methomyl (16752-77-5)
cis-Permethrin (61949-76-6)
trans-Permethrin (61949-77-7)
Procymidone (32809-16-8)
Pymetrozine (123312-89-0)
Tebuconazole (107534-96-3)
Thiabendazole (148-79-8)
Tolylfluanid (731-27-1)
Trifluralin (1582-09-8)

Conc. in Solvent	CRM?	Min Shelf Life on Ship Date	Max Shelf Life on Ship Date	Shipping Conditions	Storage Temp.	qty.	cat.#
40 µg/mL each in acetonitrile:acetic acid (99.9:0.1), 5 mL/ampul	Yes	3 months	12 months	Ambient	10 °C or colder	ea.	31999

QuEChERS Internal Standard Mix for GC-MS Analysis

(6 components)

PCB 18 (37680-65-2), 50 µg/mL
PCB 28 (7012-37-5), 50 µg/mL
PCB 52 (35693-99-3), 50 µg/mL
Triphenylmethane (519-73-3), 10 µg/mL
Triphenylphosphate (115-86-6), 20 µg/mL
Tris(1,3-dichloroisopropyl)phosphate (13674-87-8), 50 µg/mL

Conc. in Solvent	CRM?	Min Shelf Life on Ship Date	Max Shelf Life on Ship Date	Shipping Conditions	Storage Temp.	qty.	cat.#
In acetonitrile, 5 mL/ampul	Yes	6 months	75 months	Ambient	10 °C or colder	ea.	33267

QuEChERS Internal Standard Mix for GC-NPD and LC-MS/MS Analysis

(2 components)

Triphenylphosphate (115-86-6), 20 µg/mL
Tris(1,3-dichloroisopropyl)phosphate (13674-87-8), 50 µg/mL

Conc. in Solvent	CRM?	Min Shelf Life on Ship Date	Max Shelf Life on Ship Date	Shipping Conditions	Storage Temp.	qty.	cat.#
In acetonitrile, 5 mL/ampul	Yes	6 months	75 months	Ambient	10 °C or colder	ea.	33266

RESTEK
Pure Chromatography

Questions? Contact us or your local Restek representative (www.restek.com/contact-us).

www.restek.com

Lit. Cat.# FSAR3917A-UNV