AFFINIMIP® SPE

Estrogens
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Natural and synthetic estrogens are known to be growth promoters for livestock. So, Diethylstilbestrol (DES), a synthetic estrogens was used at a large scale before being prohibited on USA at the end of the 70’s.

17β-Estradiol, a natural estrogen is naturally present in cattle plasma at very low concentration. Calves’ plasma contains ca. 1-2 pg/mL and plasma of adult animals approximately 1-5 pg/mL. Only in plasma of pregnant cows, concentrations ranging from 100 to 1000 pg/mL are found.

In 1989, the European Community issued a ban on all meat from animals treated with steroid growth hormones (including Estradiol). Several directives were edicted and amended to obtain a permanent prohibition of 17β-Estradiol and ester-like derivatives as growth promoter use and to regulate their use for therapeutic or zootechnical purposes. (Directive 96/22/EC, Directive 2003/74/EC and Directive 2008/97/EC).

In order to protect public health, maximum residue limits (MRLs) of veterinary medical products in foodstuffs of animal origin (liver, milk, egg, kidney, muscle, fat, etc.) have been established according to European Union regulation (2377/90/CEE).

In the EU currently a MRL of 40 pg/mL of Estradiol is valid for biological fluids such as blood, urine and serum.
Estrogens are a group of compounds which play an important role in the estrous cycle. They are either natural (Estrone, Estriol, 17α- and 17β-Estradiol) or synthetic compounds (17α-EthinylEstradiol, Dienestrol, Diethylstilbestrol). Estrogens play a key role in developmental and reproductive functions. They also affect a diversity of biological processes involved in coronary artery disease, immunocompetence and cancer susceptibility. When they are present in wastewater, these endocrine disrupting chemicals (EDC) have adverse effects on endocrine systems of human beings and animals.

In addition, because of their anabolic effects, estrogens have been used in animal fattening. Steroid hormones are used in animal fattening because of their capacity to increase weight gain and to reduce the feed conversion ratio which is the average feed intake in relation to the weight gain. For several years now, the use of anabolic steroids in animal fattening is prohibited in the European Community because of their possible toxic effects on public health (96/22/EC). Nevertheless, they are still offered on the ‘black’ market for animal fattening purposes.

**AFFINIMIP® SPE Estrogens** are selective solid phase extraction cartridges that selectively clean and concentrate natural and synthetic Estrogens compounds from complex matrices such as Water, Plasma or Serum prior to analysis by HPLC.

To ensure the best quality of its products, the performance is checked by following several QC tests according to each product’s quality control procedure. After passing all these tests, results are gathered in a QC report available on demand for the customer for the purchased batch. Then, products receive a certificate of analysis which proved the compliance with the defined criteria.

**Catalog number:**
- PH100-02 for 25 cartridges, 3mL
- PH100-03 for 50 cartridges, 3mL
- PH100-1.96W for 1 96-well plate
Advantages of using AFFINIMIP® SPE Estrogens

- Extraction of a broad family of natural and synthetic estrogens by direct percolation of diluted plasma or water
- Fast and simple protocol

**Lower Cost**
- Lower solvent consumption
- Lower reagent consumption
- Less apparatus

**Faster Protocol**
- Fewer steps

**Greater Safety**
- Less exposure to toxic agents

**Greater Accuracy**
- No cross contamination

**No Emulsion Problems**
- Less sample handling
- Fewer steps

**No Transporting of Samples to Lab**
- Direct field sampling

**Reduced Harm to Labile Samples**
- Minimal evaporation

**Minimal Glass Breakage**
- Less glassware used, less to wash

**Easy to use with SPE automate**
Compatible with the SPE automate

**Manual SPE manifold**
10 to 12 SPE could be made in the same time and two series of SPE could be easily made during one day
>>> 20 to 24 samples analyses are easily obtained
AFFINISEP method

2mL Bovine plasma
Enzymatic hydrolysis

AFFINIMIP® SPE Estrogens 3cc

Usual method

Liquid - Liquid Extraction with Ether

Copolymeric SPE

Liquid - Liquid Extraction with Pentane

Silica SPE

Preparative dimethylaminopropyle

Derivatisation PFB/TMS

HPLC analysis : GC-MS/MS

Performance. Save your time.

Data extracted from Quantification of estrogens at ppt levels in bovine plasma by Molecularly Imprinted Solid Phase Extraction and GC-MS/MS analysis, Emmanuelle Bichon et al. (LABERCA) Poster session, HTSP-2 and HTC 2012
Application notes

Determination of Estrogens in plasma 8
Determination of synthetic and natural Estrogens in river water 9
Determination of Estrogens in sea urchin body fluid sample 10
Determination of Estrogens in water by GC-MS/MS 11
Determination of Estrogens in water by GC-HRMS 12
13 estrogenics EDCs from biological fluids by UHPLC-MS/MS with AFFINIMIP®SPE PHENOLICS 13
DETERMINATION OF ESTROGENS IN PLASMA

RESULT

<table>
<thead>
<tr>
<th>17β-Estradiol-d₃</th>
<th>419&gt;285</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 α/β-Estradiol</td>
<td>416&gt;129</td>
</tr>
<tr>
<td>17 α/β-Estradiol</td>
<td>416&gt;285</td>
</tr>
</tbody>
</table>

MRM chromatograms from GC-MS/MS analysis of fortified calves' plasma samples at 0, 10, 40 and 100 pg.mL⁻¹ with 17α-estradiol, 17β-estradiol and estrone. Chromatograms obtained after a clean-up with AFFINIMIP® SPE Estrogens (Courtesy of Emmanuelle Bichon - LABERCA)

PROTOCOL OF PURIFICATION

Sample preparation
2mL serum samples spiked with 40pg 17β-Estradiol-d3. Then 2mL of Acetate buffer (0.8M, pH 6.8) and 100μL β-glucuronidase were added. Hydrolysis performed overnight at 37°C and samples centrifuged at 4000 rpm for 10min. Upper layer was used as loading solution.

Purification with a 3mL/100mg AFFINIMIP® SPE Estrogens cartridge

Equilibration
- 4mL Methanol
- 4mL Acetonitrile
- 4mL Water

Loading solution from sample preparation

Washing of interferents
- 5mL Water
- 5mL Water/Acetonitrile (60/40)

Elution (E)
3mL Methanol

The elution fraction was then evaporated and estrogens were derivatised 40min at 60°C with BSTFA before GC-MS/MS analysis.

GC-MS/MS Analysis

Column: RTX-1614 Resteck 15m x 0.25mm x 0.10μm
Gradient temperature: 80 to 320°C (15°C/min)

Data extracted from Quantification of estrogens at ppt levels in bovine plasma by Molecularly Imprinted Solid Phase Extraction and GC-MS/MS analysis, Emmanuelle Bichon et al. (LABERCA) Poster session, HTSP-2 and HTC 2012
DETERMINATION OF SYNTHETIC AND NATURAL ESTROGENS IN RIVER WATER

PROTOCOL OF PURIFICATION

Sample preparation
100mL of river water were filtered through 0.45µm cellulose filter to obtain the loading solution.

Purification with a 3mL/100mg AFFINIMIP® SPE Estrogens cartridge

Equilibration
- 5mL Acetonitrile
- 5mL Water

Loading solution from sample preparation

Washing of interferents
- 4mL Water/Acetonitrile (80/20)
- 2mL Water

Drying under vacuum during 5min

Washing of interferents
- 2mL Acetonitrile
- 2mL Methanol/Acetonitrile (5/95)

Elution (E)
3mL Methanol
The elution fraction was then evaporated and reconstituted in 500µL of UHPLC.

LC-MS Analysis
Column: Ascentis Express Phenyl-Hexyl 150mmx2.1mm, 2.7µm
Column Temperature: 35°C
Mobile phase: Water/Acetonitrile/Methanol (51/44/5) at 450µL/min

RESULTS

SRM Chromatograms of Estrogens extracted from 100 mL river water spiked at 100 ng L⁻¹ (Courtesy of P. Lucci, University of Barcelona, SPAIN)

Recovery yield in river water

<table>
<thead>
<tr>
<th>Matrix</th>
<th>Recoveries %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estrone (E1)</td>
<td>89</td>
</tr>
<tr>
<td>17α-Estradiol (α-E2)</td>
<td>101</td>
</tr>
<tr>
<td>17β-Estradiol (β-E2)</td>
<td>93</td>
</tr>
<tr>
<td>Estriol (E3)</td>
<td>82</td>
</tr>
<tr>
<td>17α- Ethynilestradiol (EE2)</td>
<td>100</td>
</tr>
</tbody>
</table>

Publications
Data extracted from Solid-phase extraction using molecularly imprinted polymer for selective extraction of natural and synthetic estrogens from aqueous samples, Paolo Lucci, Oscar Núñez, M.T. Galceran, Journal of Chromatography A, 1218(30), 4828-4833, 2011
Molecules analyzed: Estradiol, estrone, estriol, 17α-Estradiol (α-E2)

PROTOCOLD OF PURIFICATION
Sample preparation
40 mL of coelomic fluid were spiked with the internal standard estradiol-d2 to the final concentration of 10 ng ml⁻¹ and centrifuged to obtain the loading solution.

Purification with a 3mL/100mg AFFINIMIP® SPE Estrogens cartridge

Equilibration
- 3mL Acetonitrile
- 3mL Water

Loading solution from sample preparation

Washing of interferents
- 3mL water
- 3mL Water/Acetonitrile (60/40)

Elution (E)
3mL Methanol
The elution fraction was evaporated until dryness under nitrogen before derivatization with 100 μl of dansyl chloride (1mg ml⁻¹ in acetone) and 100 μl of 0.1 M sodium bicarbonate in water, heated at 60°C for 3 minutes. The derivatized extract was reconstituted in 1mL of methanol:water (70:30 v/v).

LC-MS/MS Analysis
Column: Synergi Hydro RP (150mmx2.0 mm, 4μm)
Column Temperature: 30°C
Injection volume: 10μL
Flow rate: 0.3mL/min
Detection: LC-MS/MS ESI+
Mobile phase: gradient

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>% Methanol</th>
<th>% Water-0.1% acid formic</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>1</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>10</td>
<td>95</td>
<td>5</td>
</tr>
<tr>
<td>12</td>
<td>5</td>
<td>95</td>
</tr>
<tr>
<td>14</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>20</td>
<td>70</td>
<td>30</td>
</tr>
</tbody>
</table>

Publications
Data extracted from
DETERMINATION OF ESTROGENS IN WATER  
BY GC-MS/MS

PROTOCOL OF PURIFICATION

Sample preparation
100 mL of tap water spiked with 17β-E2-d₃ to a final concentration of 75 ng/L was the loading solution.

Purification with a 3 mL/100 mg AFFINIMIP® SPE Estrogens cartridge

Equilibration
• 3 mL Acetonitrile
• 3 mL Water

Loading solution from sample preparation

Washing of interferents
• 3 mL water
• 3 mL Water/Acetonitrile (60/40)

Elution (E)
3 mL Methanol

The elution fraction was then evaporated to dryness under a stream of nitrogen. Residues were treated with 10 µL of a mixture containing BSTFA +1 % TMCS and 8 µL of pyridine (dried with solid KOH). After a vortex stirring, derivatisation was performed for 30 min at 55 °C. The derivatives were cooled to room temperature, 2-µL aliquots of the recovery standard (pyrene-d₁₀) were added to each vial and the samples were subjected to GC-MS analysis.

RESULTS

Method validation for 17β-E2 and 17α-EE2 by GC-MS/MS

<table>
<thead>
<tr>
<th></th>
<th>17β-E2</th>
<th>17α-EE2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linearity range, ng/L</td>
<td>0.08-80.0</td>
<td>0.08-80.0</td>
</tr>
<tr>
<td>Linearity (R²)</td>
<td>0.995</td>
<td>0.9998</td>
</tr>
<tr>
<td>m-LOQ, ng/L</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>Spiking level ng/L (n=5)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Recovery %</td>
<td>111</td>
<td>104</td>
</tr>
<tr>
<td>Precision (n=5)</td>
<td>6.2</td>
<td>6.8</td>
</tr>
<tr>
<td>Spiking level ng/L (n=5)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Recovery %</td>
<td>108</td>
<td>110</td>
</tr>
<tr>
<td>Precision (n=5)</td>
<td>9.7</td>
<td>15.3</td>
</tr>
</tbody>
</table>

GC-MS/MS Analysis

Column: Rtx-5 fused silica capillary columns (30 m, 0.25-mm ID, 0.25-µm film thickness)

Gas carrier: Helium at a flow 1.2 mL/min

Injection temperature: 50 to 300 °C at 100 °C/min, held at 300 °C for 10 min

GC-MS transfer line temperature: 280°C

Temperature program: 100°C during 2 min; 10°C/min to 265°C; 265°C during 2 min; 10°C/min to 300°C; 300°C during 3 min; 20°C/min to 310°C; 310°C during 3 min

Injection volume: 5 µL

Detector: GC-MS/MS EI⁺ mode

Detection mode: Selected reaction monitoring (SRM)

Publications

Data extracted from Determination of steroidal oestrogens in tap water samples using solid-phase extraction on a molecularly imprinted polymer sorbent and quantification with gas chromatography-mass spectrometry (GC-MS), D. Zacs, I. Perkons, V. Bartkevics, Environ Monit Assess 188, 433, 2016.
DETERMINATION OF ESTROGENS IN WATER
BY GC-HRMS

PROTOCOL OF PURIFICATION
Sample preparation
100mL of tap water spiked with 17β-E2-d₃ to a
final concentration of 75ng/L was the loading
solution.
Purification with a 3mL/100mg AFFINIMIP®
SPE Estrogens cartridge

Equilibration
- 3mL Acetonitrile
- 3mL Water

Loading solution from sample preparation

Washing of interferents
- 3mL water
- 3mL Water/Acetonitrile (60/40)

Elution (E)
3mL Methanol
The elution fraction was then evaporated to
dryness under a stream of nitrogen. Residues
was treated with 10 μL of a mixture containing
BSTFA +1 % TMCS and 8 μL of
pyridine (dried with solid KOH). After a vortex
stirring, derivatisation was performed for 30
min at 55 °C. The derivatives were cooled to
room temperature, 2-μL aliquots
of the recovery standard (pyrene-d₁⁰) were
added to each vial and the samples were
subjected to GC-MS analysis.

GC-HRMS Analysis
Column: Rtx-5 fused silica capillary columns
(30 m, 0.25-mm ID, 0.25-μm film thickness)
Gas carrier: Helium at a flow 1.2mL/min
Injection temperature: 260°C
GC-MS transfer line temperature: 280°C
Temperature program: 100°C during 2min;
10°C/min to 265°C; 265°C during 2min ;
10°C/min to 300°C; 300°C during 3 min ;
20°C/min to 310°C; 310°C during 3min
Injection volume: 1μL
Detector : GC-MS/MS EI+ mode
Detection mode: Selected Ion Recording (SIR)

RESULTS
Method validation for 17β-E2 and 17α-EE2 by
GC-MS/MS

<table>
<thead>
<tr>
<th></th>
<th>17β-E2</th>
<th>17α-EE2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linearity range, ng/L</td>
<td>0.08–</td>
<td>0.08–</td>
</tr>
<tr>
<td></td>
<td>80.0</td>
<td>80.0</td>
</tr>
<tr>
<td>Linearity (R²)</td>
<td>0.9990</td>
<td>0.9990</td>
</tr>
<tr>
<td>m-LOQ, ng/L</td>
<td>0.08</td>
<td>0.08</td>
</tr>
<tr>
<td>Spiking level ng/L (n=5)</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Recovery %</td>
<td>113</td>
<td>111</td>
</tr>
<tr>
<td>Precision (n=5)</td>
<td>4.6</td>
<td>5.4</td>
</tr>
<tr>
<td>Spiking level ng/L (n=5)</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Recovery %</td>
<td>99</td>
<td>106</td>
</tr>
<tr>
<td>Precision (n=5)</td>
<td>4.3</td>
<td>14.3</td>
</tr>
</tbody>
</table>

Publications
Data extracted from Determination of steroidal
oestrogens in tap water samples using solid-phase
extraction on a molecularly imprinted polymer
sorbent and quantification with gas
chromatography-mass spectrometry (GC-MS),
D. Zacs, I. Perkons, V. Bartkevics, Environ Monit Assess
188, 433, 2016.
The analysis of 13 analytes: estrone (E1), 17α-estradiol (α-E2), 17β-estradiol (β-E2), estriol (E3), 17α-ethynylestradiol (EE2), diethylstilbestrol (DES), bisphenol A (BPA), bisphenol S (BPS), 4-n-octylphenol (OP), 4-n-nonylphenol (NP), coumestrol (COU), genistein (GEN), and enterolactone (ENT) was performed by using AFFINIMIP® SPE PHENOLICS prior UHPLC–MS/MS analysis.

PROTOCOL OF PURIFICATION
Sample preparation
100mL of tap water spiked with 178-E2-d₃ to a final concentration of 75ng/L was the loading solution.

Purification with a 3mL/100mg AFFINIMIP® SPE Phenolics cartridge

Equilibration
• 3mL Methanol – Formic acid (98/2)
• 3mL Acetonitrile
• 3mL Water

Loading solution from sample preparation
Washing of interferents
• 4mL water
• 5mL Water/Acetonitrile (80/20)

Elution (E)
10mL Methanol
10mL Methanol – Acetic acid (98/2)

Elution solution was evaporated to dryness, reconstituted in 50 μL of dansyl chloride solution and held at 30 °C for 30 min. After further evaporation, a liquid/liquid extraction with 1.5 mL hexane and 1.5 mL H2O was performed. The organic solvent containing dansyl derivatives was collected and evaporated to dryness; the final residue was reconstituted in 50 μL ACN/ H2O (50:50, v/v).

Analysis by UPLC-MS/MS Analysis
Column: Accucore phenyl-hexyl (100mmx2.1 mm, 2.6μm)
Column Temperature: 50°C
Injection volume: 5μL
Flow rate: 0.5mL/min
Detection : LC-MS/MS ESI+ mode
Detection mode: Selected reaction monitoring (SRM)
Mobile phase: gradient

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>% Water-0.1% acid acetic</th>
<th>% Acetonitrile-0.1% acid acetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>1</td>
<td>70</td>
<td>30</td>
</tr>
<tr>
<td>4</td>
<td>40</td>
<td>60</td>
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<td>5</td>
<td>40</td>
<td>60</td>
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<td>7</td>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>100</td>
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</tbody>
</table>

RESULTS

Validation parameters in ultra-pure water: recoveries, reproducibility, reproducibility and quantification limits

<table>
<thead>
<tr>
<th>Analyte</th>
<th>Recovery (%)(n=2)</th>
<th>RSD (n=10)</th>
<th>LOQ (ng/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>107.6</td>
<td>10.8</td>
<td>0.07</td>
</tr>
<tr>
<td>α-E2</td>
<td>124.2</td>
<td>7.9</td>
<td>0.30</td>
</tr>
<tr>
<td>E3</td>
<td>121.6</td>
<td>60.2</td>
<td>2.7</td>
</tr>
<tr>
<td>β-E2</td>
<td>107.4</td>
<td>7.3</td>
<td>0.20</td>
</tr>
<tr>
<td>EE2</td>
<td>106.7</td>
<td>6.6</td>
<td>0.10</td>
</tr>
<tr>
<td>OP</td>
<td>51.8</td>
<td>Nd</td>
<td>0.07</td>
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<tr>
<td>NP</td>
<td>45.1</td>
<td>Nd</td>
<td>0.15</td>
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<td>BPA</td>
<td>104.6</td>
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<tr>
<td>BPS</td>
<td>129.6</td>
<td>36.2</td>
<td>0.07</td>
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<tr>
<td>COU</td>
<td>235.7</td>
<td>15.9</td>
<td>0.10</td>
</tr>
<tr>
<td>ENT</td>
<td>253.1</td>
<td>73.1</td>
<td>0.10</td>
</tr>
<tr>
<td>GEN</td>
<td>208.4</td>
<td>47.7</td>
<td>0.25</td>
</tr>
<tr>
<td>DES</td>
<td>109.5</td>
<td>38.7</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Publications


- How to improve analytical strategies to monitor growth promoting agents misuse in cattle, E. Bichon, S. Rochereau, L. Sérée, S. Prevost, F. Monteau, B. Le Bizec. This conference was presented at 5th international Symposium on Recent Advances in Food Analysis (RAFA), Prague, Czech Republic, 1-4 November 2011 by the French reference laboratory on residues and contaminants in food (LABERCA - ONIRIS).

### AFFINIMIP SPE and Reactive – Product list

<table>
<thead>
<tr>
<th>Products</th>
<th>Designation</th>
<th>Definition</th>
<th>Reference</th>
<th>Nber of cartridges</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estrogens</td>
<td>AFFINIMIP® SPE Estrogens</td>
<td>Selective SPE cartridges for Estrogens, 3mL</td>
<td>FS104-02</td>
<td>25</td>
</tr>
<tr>
<td>Estrogens</td>
<td>AFFINIMIP® SPE Estrogens</td>
<td>Selective SPE cartridges for Estrogens, 1mL</td>
<td>FS104-03</td>
<td>50</td>
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<tr>
<td>Estrogens</td>
<td>AFFINIMIP® SPE Estrogens</td>
<td>Selective SPE cartridges for Estrogens, 1mL</td>
<td>FS104-02A</td>
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<tr>
<td>Estrogens</td>
<td>AFFINIMIP® SPE Estrogens</td>
<td>Selective SPE cartridges for Estrogens, 1mL</td>
<td>FS104-03A</td>
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### SPE ACCESSORIES – Product list

<table>
<thead>
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<th>SPE Accessories</th>
<th>Designation</th>
<th>Definition</th>
<th>Reference</th>
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</thead>
<tbody>
<tr>
<td>Manifold</td>
<td>SPE Vaccum Manifold</td>
<td>12-port model</td>
<td>ACC-MAN1</td>
</tr>
<tr>
<td>SPE Adapter &amp; Reservoir kit</td>
<td>SPE Adapter &amp; Reservoir kit</td>
<td>Kit of 12 reservoirs 60ml and adapters for use with 1,3 &amp; 6 mL cartridges</td>
<td>ACC-AR1</td>
</tr>
<tr>
<td>Mini-Vap</td>
<td>Mini Evaporator/Concentrator</td>
<td>6 port Mini-Vap Evaporator/Concentrator for use with 1 to 250mL containers</td>
<td>ACC-VAP1</td>
</tr>
<tr>
<td>Mini PUMP</td>
<td>Mini vacuum pump</td>
<td>Laboport diaphragm vacuum mini pump, 5.5L/min</td>
<td>ACC-PUMP</td>
</tr>
<tr>
<td>Vacuum pump trap</td>
<td>SPE Vacuum pump trap kit</td>
<td>1L trap kit</td>
<td>ACC-TRAP</td>
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</tbody>
</table>
About AFFINISEP

AFFINISEP is a worldwide expert in purification and sample preparation applications as well as for the design and the development of intelligent polymers with Molecularly Imprinted Polymers (MIP). AFFINISEP is dedicated to the development of analytical applications in various fields such as water, biological fluids, food and feed analysis with a complete set of products and services for sample preparation.

Our mission is to develop and market innovative products of high value to customers by a practical contribution to their work. By offering you a most comprehensive range of solid phase extraction products:

- AFFINIMIP® SPE products based on molecularly imprinted polymers,
- AttractSPE™ a range of polymeric phases
- SilactSPE™ Silica based products, associated reagents,
- QuEChERS
- small equipment,

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