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# 应用GPC–GCMS和GC–MS快速测定蔬菜中的97种农药残留

No.GCMS-006

**摘要：** GPC–GCMS是GPC提纯系统与GC/MS在线连接而成的装置。应用GPC提纯系统可将油脂、色素成分与农药分离，通过切换阀排出油脂、色素等杂质，将要分析的农药导入GC–MS。实现了从试样的提纯到农药的分析完全自动化。采用快速的QuEChERS方法做样品的前处理，分别应用GPC–GCMS和GC–MS快速测定了三种蔬菜中的97种农药残留，并对结果做了比较。

**关键词：** GPC–GCMS 蔬菜 农药残留 快速测定

## GC–MS的分析条件

◆GC(GC-2010)

| | |
|---|---|
| Column | : Rtx-5ms [0.25 mm(ID) x 30 m(L),Thickness 0.25 um] |
| Injector | : Splitless |
| Injection volume | : 2 uL |
| Injection temperature | : 260 °C |
| Oven temperature program | : 80 °C (2 min) - (20 °C/min) - 180 °C/mim – (5 °C/min) - 280 °C (20 min) |
| Carrier gas | : He |
| Linear velocity | : 45.0 cm/sec |

◆MS(GCMS-QP2010)

| | |
|---|---|
| Ion Source temperature | : 230 °C |
| Interface temperature | : 260 °C |

SCAN

| | |
|---|---|
| Start time | : 4.0 min |
| End time | : 47 min |
| Mass range | : m/z 86 - 450 |
| Interval | : 0.5 sec |

## GPC–GCMS的分析条件

◆GPC

| | |
|---|---|
| Mobile phase | : Acetone / Cyclohexane (3 / 7 by volume) |
| Flow rate | : 0.1 mL/min |
| Column | : Shodex CLNpak EV-200AC (2 mm x 150 mm) |
| Oven temperature | : 40 °C |
| Injection Volume | : 10 uL |
| Fraction time | : 3.32 – 5.32 min |
| Fraction volume | : 200 uL |

◆GC(GC-2010)

| | |
|---|---|
| Column | : deactivated silica tubing [0.53 mm(ID) x 5 m(L)] + pre-column DB5-ms[0.25 mm(ID) x 5 m(L),] + DB5-ms [0.25 mm(ID) x 30 m(L),Thickness 0.25 um] |
| Injector | : PTV |
| Injector time program | : 120 °C(5 min) - (100 °C/min) - 250 °C (31.7 min) |
| Oven temperature program | : 82 °C (5 min) - (8 °C/min) - 300 °C (5.75 min) |
| Carrier gas | : He |
| Linear velocity | : 45.0 cm/sec |

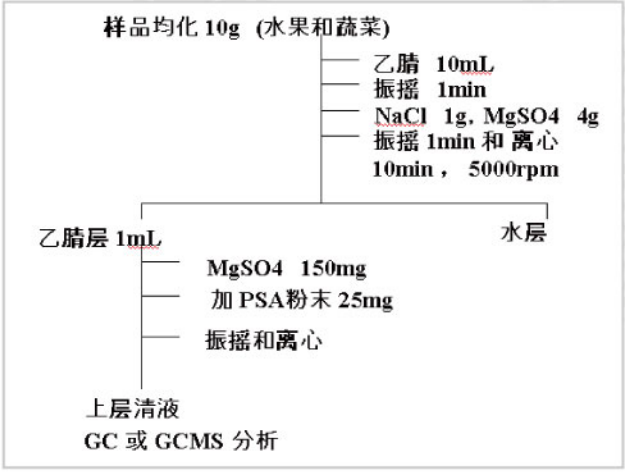
◆MS(GCMS-QP2010)

| | |
|---|---|
| Ion Source temperature | : 200 °C |
| Interface temperature | : 250 °C |

SCAN

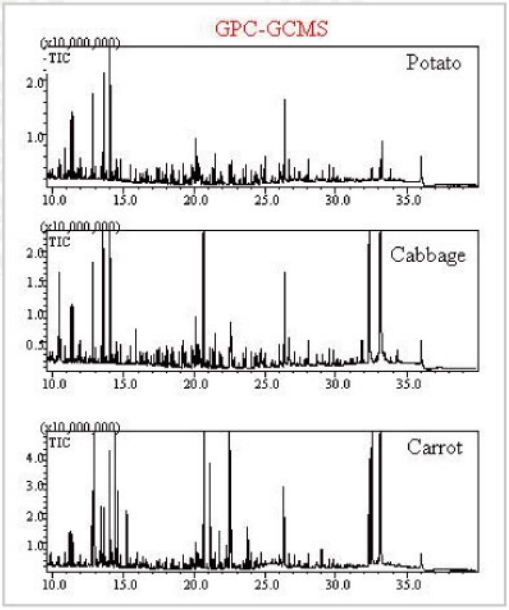
| | |
|---|---|
| Start time | : 10.2 min |
| End time | : 37 min |
| Mass range | : m/z 86 - 450 |
| Interval | : 0.5 sec |

## 样品前处理：QuEChERS 法

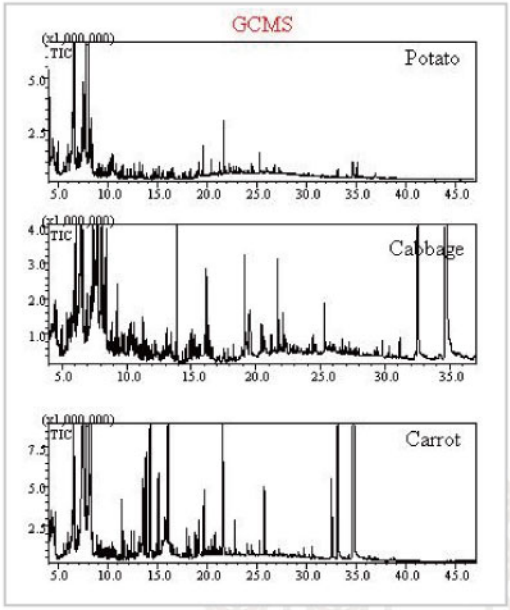


## 实验结果

土豆、白菜、胡萝卜的TIC图




土豆、白菜、胡萝卜的TIC图




GPC-GCMS与GC-MS中土豆、白菜、胡萝卜的回收率（%）及相似度检索结果

| Name | Potato | | Cabbage | | Carrot | | Name | Potato | | Cabbage | | Carrot | | Name | Potato | | Cabbage | | Carrot | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GPC-GCMS | GCMS | GPC-GCMS | GCMS | GPC-GCMS | GCMS | | GPC-GCMS | GCMS | GPC-GCMS | GCMS | GPC-GCMS | GCMS | | GPC-GCMS | GCMS | GPC-GCMS | GCMS | GPC-GCMS | GCMS |
| Methamidophos | 68.20 | 70.99 | 72.36 | 83.82 | 70.79 | 67.88 | Chlorpyrifos | 96.88 | 69.74 | 95.26 | 70.92 | 100.21 | 73.09 | Iprodione | 103.40 | 137.83 | 103.87 | 156.43 | 112.31 | 90.84 |
| DDVP | 87.88 | 71.60 | 87.54 | 77.98 | 91.06 | 73.34 | Parathion | 113.57 | 83.00 | 108.31 | 77.35 | 120.19 | 96.46 | Acetamiprid | 70.63 | 89.10 | 91.16 | 99.73 | 99.33 | 107.72 |
| EPTC | 98.56 | 68.53 | 96.56 | 68.98 | 101.35 | 70.13 | DCBP | 103.76 | 78.30 | 107.55 | 81.73 | 120.14 | 80.34 | EPN | 109.60 | 95.34 | 112.45 | 96.52 | 137.74 | 113.07 |
| Butylate | 109.67 | 68.00 | 110.90 | 69.46 | 109.71 | 69.12 | Isofenphos Oxon | 119.89 | 118.23 | 116.89 | 112.04 | 87.97 | 109.91 | Tebufenpyrad | 111.70 | 88.54 | 108.01 | 91.19 | 118.66 | 91.72 |
| Acephate | 72.50 | 234.31 | 73.97 | 255.41 | 70.36 | 489.84 | Fosthiazate | 107.65 | 127.06 | 105.25 | 126.76 | 118.50 | 129.15 | Phosalone | 111.25 | 87.39 | 115.74 | 95.34 | 119.95 | 103.02 |
| Isoprocarb | 94.98 | 80.16 | 95.75 | 86.65 | 96.28 | 68.88 | Fosthiazate | 107.63 | 114.55 | 105.24 | 133.73 | 114.19 | 125.49 | Pyriproxyfen | 99.45 | 87.44 | 102.62 | 89.26 | 105.51 | 93.15 |
| BPMC | 97.80 | 78.55 | 97.00 | 85.94 | 99.89 | 74.02 | α-CVP | 102.78 | 91.23 | 103.87 | 94.59 | 107.15 | 94.05 | Mefenacet | 103.96 | 92.75 | 107.88 | 95.03 | 116.04 | 107.11 |
| Ethoprophos | 99.19 | 77.87 | 99.68 | 78.42 | 102.99 | 81.98 | Pendimethalin | 110.07 | 85.02 | 108.06 | 78.90 | 120.11 | 96.30 | Cyhalothrin1 | 111.95 | 85.59 | 121.13 | 111.91 | 118.31 | 109.72 |
| Chlorpropham | 112.01 | 71.91 | 113.36 | 76.88 | 115.20 | 75.95 | Pyrifenox-1 | 98.44 | 79.22 | 95.08 | 80.82 | 106.51 | 84.63 | Cyhalothrin2 | 118.06 | 81.80 | 130.48 | 112.44 | 94.65 | 85.05 |
| Bendiocarb | 85.79 | 71.40 | 86.85 | 94.41 | 91.71 | 75.25 | Isophenphos | 115.58 | 79.62 | 114.24 | 83.08 | 120.08 | 88.17 | Fenarimol | 99.78 | 84.66 | 99.31 | 85.24 | 111.24 | 95.34 |
| Cadusafos | 104.05 | 73.71 | 101.76 | 76.55 | 107.60 | 80.31 | β-CVP | 104.09 | 91.13 | 100.10 | 94.53 | 106.26 | 93.98 | Acrinathrin | 115.00 | 85.00 | 134.71 | 113.14 | 224.86 | 87.75 |
| α-BHC | 96.52 | 76.29 | 97.27 | 78.63 | 102.31 | 79.48 | Captan | 90.50 | 68.91 | 65.72 | 0.00 | 76.83 | 51.48 | Pyraclofos | 107.68 | 140.60 | 107.40 | 157.46 | 190.84 | 161.42 |
| Thiometon | 103.32 | 73.76 | 107.00 | 75.08 | 107.38 | 78.98 | Quinalphos | 97.53 | 79.96 | 98.14 | 83.63 | 103.81 | 88.87 | Bitertanol | 125.36 | 94.72 | 118.90 | 90.50 | 100.24 | 114.43 |
| Dimethipin | 77.24 | 84.40 | 78.80 | 88.83 | 79.16 | 73.47 | Triadimenol-11 | 101.63 | 78.70 | 97.15 | 82.48 | 109.20 | 90.60 | Permethrin1 | 112.83 | 92.12 | 110.87 | 95.15 | 114.86 | 97.90 |
| β-BHC | 106.71 | 80.36 | 106.40 | 82.97 | 112.33 | 82.69 | PAP | 98.38 | 78.46 | 94.93 | 80.01 | 105.69 | 89.05 | Pyridaben | 120.35 | 89.34 | 120.63 | 95.76 | 83.49 | 102.61 |
| γ-BHC | 98.53 | 75.96 | 100.97 | 76.68 | 105.60 | 76.04 | Triadimenol-22 | 105.07 | 78.63 | 102.99 | 82.42 | 112.49 | 90.57 | Permethrin2 | 104.62 | 92.15 | 109.92 | 95.59 | 116.08 | 97.91 |
| Terbufos | 120.30 | 75.09 | 122.45 | 78.40 | 119.99 | 80.53 | Chinomethionat | 55.85 | 48.61 | 54.65 | 49.49 | 54.73 | 48.35 | Cyfluthrin1 | 92.12 | 67.19 | 100.96 | 79.38 | 124.44 | 75.20 |
| Diazinon | 105.90 | 75.76 | 103.92 | 78.33 | 109.19 | 79.45 | Paclobutrazol | 105.54 | 83.56 | 101.54 | 82.85 | 111.64 | 92.41 | Cyfluthrin2 | 109.31 | 75.73 | 126.81 | 107.15 | 134.14 | 74.64 |
| Tefluthrin | 117.73 | 76.36 | 116.12 | 79.34 | 117.15 | 79.85 | Pyrifenox-2 | 96.94 | 80.70 | 93.56 | 79.81 | 102.07 | 83.97 | Cyfluthrin3 | 109.67 | 82.12 | 116.31 | 98.91 | 117.18 | 75.74 |
| δ-BHC | 104.60 | 65.79 | 106.33 | 82.29 | 108.39 | 75.08 | Flutolanil | 112.70 | 84.92 | 109.50 | 88.11 | 109.87 | 103.70 | Cyfluthrin4 | 82.81 | 69.91 | 103.46 | 140.52 | 114.93 | 79.03 |
| Etrimfos | 103.07 | 73.90 | 100.95 | 75.02 | 106.58 | 77.73 | Prothiofos | 103.20 | 79.65 | 100.76 | 83.42 | 85.77 | 84.87 | Cypermethrin1 | 105.90 | 55.10 | 103.94 | 85.49 | 103.03 | 54.17 |
| Pirimicarb | 92.40 | 76.07 | 89.03 | 78.00 | 96.66 | 80.26 | Tricyclazole | 94.42 | 94.03 | 100.11 | 100.32 | 103.82 | 110.94 | Halfenprox | 93.69 | 91.57 | 97.11 | 99.11 | 103.49 | 115.33 |
| Ethiofencarb | 93.55 | 105.36 | 91.88 | 121.24 | 91.13 | 97.54 | Pretilachlor | 113.77 | 88.26 | 113.38 | 82.54 | 118.38 | 100.93 | Cypermethrin2 | 87.84 | 90.91 | 99.82 | 120.27 | 104.92 | 92.45 |
| Benfuresate | 94.47 | 75.28 | 94.14 | 76.96 | 102.22 | 76.67 | p,p'-DDE | 100.45 | 81.81 | 96.81 | 82.12 | 94.57 | 80.58 | Cypermethrin3 | 94.43 | 80.56 | 131.37 | 96.25 | 93.40 | 79.00 |
| Methyl-Parathion | 103.97 | 85.38 | 119.78 | 82.06 | 115.21 | 92.39 | Myclobutanil | 91.46 | 83.94 | 91.85 | 84.37 | 98.42 | 93.20 | Cypermethrin4 | 81.74 | 69.61 | 109.84 | 112.83 | 102.34 | 92.21 |
| Tolclofos-methyl | 96.87 | 76.10 | 97.18 | 79.61 | 101.06 | 81.63 | Flusilazole | 92.76 | 80.42 | 92.26 | 85.26 | 97.36 | 87.21 | Flucythrinate1 | 105.36 | 94.07 | 106.86 | 110.59 | 117.49 | 101.58 |
| NAC | 99.17 | 78.32 | 105.79 | 124.35 | 108.64 | 78.38 | Cyprocpnazole | 106.20 | 83.16 | 104.99 | 83.74 | 117.38 | 90.86 | Flucythrinate2 | 113.89 | 93.30 | 119.75 | 118.98 | 119.62 | 110.04 |
| Methiocarb | 112.42 | 89.99 | 113.50 | 126.23 | 117.53 | 79.56 | Chlorobenzilate | 113.91 | 86.36 | 111.02 | 83.89 | 116.86 | 92.39 | Silafluofen | 88.41 | 90.49 | 119.23 | 91.73 | 118.31 | 91.90 |
| MEP | 100.26 | 80.74 | 101.72 | 73.77 | 111.66 | 94.35 | Fensulfothion | 98.56 | 88.93 | 102.08 | 97.02 | 119.16 | 122.23 | Pyrimidufen | 82.03 | 93.50 | 84.51 | 101.10 | 86.11 | 106.55 |
| Pirimiphos-methyl | 102.80 | 75.55 | 101.86 | 81.74 | 107.89 | 83.95 | p,p'-DDD | 104.72 | 82.19 | 103.52 | 86.88 | 106.79 | 88.53 | Fenvalerate 1 | 100.61 | 73.75 | 101.50 | 104.85 | 103.60 | 88.61 |
| Esprocarb | 99.30 | 77.32 | 98.12 | 78.96 | 102.94 | 82.34 | Mepronil | 108.99 | 85.29 | 109.73 | 85.14 | 118.66 | 93.12 | Fenvalerate 2 | 104.94 | 81.36 | 106.73 | 110.72 | 111.77 | 84.62 |
| Dichlofluanid | 71.65 | 62.79 | 62.22 | 57.91 | 50.04 | 61.48 | EDDP | 107.49 | 131.51 | 107.09 | 142.62 | 117.90 | 128.06 | Fluvalinate1 | 135.00 | 91.10 | 154.83 | 132.96 | 161.08 | 79.40 |
| Thiobencarb | 96.25 | 76.55 | 96.53 | 78.33 | 100.73 | 80.60 | Propiconazole1 | 101.81 | 84.52 | 100.24 | 86.37 | 110.44 | 92.14 | Fluvalinate2 | 141.81 | 81.87 | 155.01 | 136.95 | 152.11 | 75.08 |
| Malathion | 97.33 | 82.57 | 95.35 | 90.76 | 103.67 | 90.23 | Lenacil | 108.62 | 90.74 | 106.57 | 91.54 | 118.97 | 104.00 | Difenoconazole1 | 143.31 | 89.80 | 117.42 | 86.90 | 186.62 | 120.87 |
| Diethofencarb | 116.68 | 86.47 | 106.31 | 84.19 | 114.50 | 89.03 | Propiconazole2 | 96.88 | 84.52 | 98.07 | 86.37 | 104.77 | 92.14 | Difenoconazole2 | 123.32 | 95.26 | 115.22 | 86.89 | 136.73 | 117.12 |
| Metolachlor | 101.85 | 80.18 | 99.37 | 79.61 | 106.58 | 85.71 | Tebuconazole | 108.98 | 82.08 | 102.33 | 83.96 | 117.25 | 92.81 | Deltamethrin | 108.75 | 78.32 | 94.89 | 81.47 | 110.71 | 107.65 |
| MPP | 62.67 | 76.22 | 57.34 | 80.67 | 56.28 | 83.26 | Thenylchlor | 99.55 | 88.00 | 100.73 | 85.04 | 109.03 | 97.78 | Imibenconazole | 157.38 | 88.31 | 155.53 | 98.96 | 180.13 | 113.40 |
| (Z)-Dimethylvinphos | 96.72 | 94.14 | 94.37 | 99.44 | 102.41 | 96.69 | Difolatan | 89.84 | 0.00 | 58.20 | 0.00 | 112.40 | 0.00 | | | | | | | |

| Name | Potato | | Cabbage | | Carrot | | Name | Potato | | Cabbage | | Carrot | | Name | Potato | | Cabbage | | Carrot | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GPC-GCMS | GCMS | GPC-GCMS | GCMS | GPC-GCMS | GCMS | | GPC-GCMS | GCMS | GPC-GCMS | GCMS | GPC-GCMS | GCMS | | GPC-GCMS | GCMS | GPC-GCMS | GCMS | GPC-GCMS | GCMS |
| Methamidophos | 88 | 74 | 64 | 72 | 93 | 73 | Chlorpyrifos | 85 | 83 | 83 | 82 | 77 | 77 | Iprodione | 74 | 38 | 78 | 43 | 77 | 31 |
| DDVP | 95 | 69 | 95 | 66 | 96 | 60 | Parathion | 87 | 68 | 87 | 62 | 68 | 57 | Acetamiprid | 53 | 91 | 87 | 90 | 87 | 89 |
| EPTC | 83 | 85 | 81 | 86 | 82 | 81 | DCBP | 87 | 87 | 78 | 31 | 51 | 88 | EPN | 92 | 66 | 92 | 49 | 88 | 63 |
| Butylate | 87 | 69 | 87 | 63 | 80 | 64 | Isofenphos Oxon | 73 | 57 | 53 | 57 | 25 | 42 | Tebufenpyrad | 91 | 73 | 91 | 79 | 91 | 82 |
| Acephate | 88 | 19 | 86 | 19 | 83 | 14 | Fosthiazate | 88 | 44 | 88 | 46 | 74 | 22 | Phosalone | 89 | 80 | 92 | 80 | 90 | 79 |
| Isoprocarb | 95 | 43 | 95 | 49 | 95 | 41 | Fosthiazate | 88 | 40 | 88 | 45 | 73 | 22 | Pyriproxyfen | 92 | 89 | 89 | 89 | 89 | 89 |
| BPMC | 97 | 88 | 97 | 87 | 97 | 88 | α-CVP | 86 | 61 | 88 | 62 | 88 | 60 | Mefenacet | 81 | 71 | 80 | 72 | 78 | 74 |
| Ethoprophos | 92 | 60 | 74 | 58 | 92 | 56 | Pendimethalin | 83 | 65 | 61 | 44 | 75 | 36 | Cyhalothrin1 | 87 | 56 | 87 | 62 | 88 | 57 |
| Chlorpropham | 91 | 53 | 90 | 61 | 90 | 59 | Pyrifenox-1 | 83 | 65 | 81 | 64 | 84 | 63 | Cyhalothrin2 | 80 | 43 | 84 | 48 | 83 | 42 |
| Bendiocarb | 95 | 54 | 94 | 57 | 77 | 49 | Isophenphos | 67 | 79 | 66 | 81 | 75 | 80 | Fenarimol | 88 | 84 | 88 | 82 | 77 | 85 |
| Cadusafos | 94 | 66 | 93 | 73 | 86 | 72 | β-CVP | 35 | 61 | 37 | 62 | 39 | 60 | Acrinathrin | 76 | 58 | 81 | 70 | 81 | 60 |
| α-BHC | 92 | 80 | 91 | 72 | 91 | 63 | Captan | 47 | 38 | 23 | | 23 | 47 | Pyraclofos | 86 | 60 | 90 | 55 | 89 | 49 |
| Thiometon | 49 | 70 | 49 | 69 | 45 | 71 | Quinalphos | 85 | 86 | 85 | 84 | 86 | 84 | Bitertanol | 93 | 75 | 92 | 74 | 96 | 70 |
| Dimethipin | 56 | 37 | 50 | 38 | 62 | 36 | Triadimenol-11 | 90 | 54 | 89 | 62 | 80 | 60 | Permethrin1 | 93 | 80 | 94 | 66 | 93 | 76 |
| β-BHC | 83 | 58 | 86 | 57 | 85 | 60 | PAP | 74 | 81 | 72 | 79 | 75 | 81 | Pyridaben | 87 | 75 | 87 | 75 | 89 | 75 |
| γ-BHC | 89 | 77 | 86 | 78 | 90 | 76 | Triadimenol-22 | 80 | 54 | 91 | 62 | 32 | 60 | Permethrin2 | 55 | 80 | 56 | 66 | 56 | 76 |
| Terbufos | 92 | 85 | 93 | 82 | 92 | 80 | Chinomethionat | 58 | 28 | 24 | 28 | 20 | 23 | Cyfluthrin1 | 79 | 36 | 80 | 46 | 79 | 32 |
| Diazinon | 86 | 76 | 88 | 77 | 88 | 77 | Paclobutrazol | 93 | 82 | 89 | 82 | 90 | 80 | Cyfluthrin2 | 78 | 45 | 79 | 49 | 79 | 42 |
| Tefluthrin | 55 | 65 | 58 | 55 | 67 | 60 | Pyrifenox-2 | 87 | 79 | 87 | 79 | 88 | 62 | Cyfluthrin3 | 68 | 36 | 72 | 41 | 69 | 38 |
| δ-BHC | 91 | 71 | 92 | 75 | 91 | 51 | Flutolanil | 61 | 86 | 68 | 74 | 69 | 24 | Cyfluthrin4 | 68 | 41 | 77 | 47 | 73 | 38 |
| Etrimfos | 84 | 76 | 84 | 82 | 87 | 78 | Prothiofos | 82 | 60 | 83 | 30 | 66 | 18 | Cypermethrin1 | 69 | 35 | 76 | 44 | 26 | 30 |
| Pirimicarb | 95 | 76 | 95 | 80 | 92 | 83 | Tricyclazole | 37 | 57 | 36 | 42 | 37 | 44 | Halfenprox | 90 | 80 | 92 | 78 | 91 | 80 |
| Ethiofencarb | 93 | 78 | 91 | 53 | 70 | 37 | Pretilachlor | 87 | 79 | 87 | 72 | 25 | 70 | Cypermethrin2 | 85 | 38 | 86 | 47 | 88 | 35 |
| Benfuresate | 87 | 77 | 88 | 77 | 87 | 72 | p,p'-DDE | 94 | 91 | 92 | 90 | 87 | 87 | Cypermethrin3 | 61 | 34 | 76 | 45 | 67 | 32 |
| Methyl-Parathion | 66 | 63 | 69 | 55 | 67 | 61 | Myclobutanil | 90 | 74 | 90 | 71 | 91 | 76 | Cypermethrin4 | 59 | 48 | 78 | 54 | 74 | 43 |
| Tolclofos-methyl | 89 | 87 | 87 | 87 | 89 | 85 | Flusilazole | 91 | 77 | 91 | 78 | 92 | 78 | Flucythrinate1 | 77 | 63 | 79 | 65 | 79 | 62 |
| NAC | 91 | 52 | 91 | 59 | 90 | 19 | Cyprocpnazole | 92 | 81 | 88 | 78 | 91 | 79 | Flucythrinate2 | 73 | 56 | 74 | 59 | 78 | 56 |
| Methiocarb | 93 | 59 | 93 | 65 | 89 | 44 | Chlorobenzilate | 96 | 93 | 96 | 83 | 96 | 90 | Silafluofen | 93 | 92 | 94 | 89 | 94 | 88 |
| MEP | 66 | 69 | 73 | 56 | 68 | 58 | Fensulfothion | 76 | 73 | 79 | 72 | 80 | 74 | Pyrimidufen | 96 | 90 | 95 | 90 | 96 | 89 |
| Pirimiphos-methyl | 88 | 73 | 88 | 65 | 86 | 68 | p,p'-DDD | 93 | 89 | 94 | 89 | 93 | 89 | Fenvalerate 1 | 84 | 65 | 85 | 62 | 84 | 60 |
| Esprocarb | 65 | 58 | 65 | 55 | 67 | 54 | Mepronil | 92 | 91 | 92 | 90 | 89 | 91 | Fenvalerate 2 | 80 | 54 | 76 | 60 | 82 | 55 |
| Dichlofluanid | 90 | 35 | 25 | 25 | 64 | 31 | EDDP | 94 | 78 | 93 | 79 | 94 | 32 | Fluvalinate1 | 74 | 36 | 69 | 40 | 75 | 24 |
| Thiobencarb | 90 | 77 | 90 | 66 | 88 | 71 | Propiconazole1 | 74 | 70 | 73 | 70 | 73 | 61 | Fluvalinate2 | 59 | 30 | 57 | 41 | 58 | 33 |
| Malathion | 75 | 49 | 85 | 49 | 81 | 47 | Lenacil | 91 | 76 | 92 | 77 | 89 | 75 | Difenoconazole1 | 79 | 59 | 77 | 54 | 82 | 63 |
| Diethofencarb | 81 | 64 | 82 | 63 | 79 | 60 | Propiconazole2 | 89 | 70 | 88 | 70 | 90 | 61 | Difenoconazole2 | 84 | 65 | 83 | 61 | 84 | 63 |
| Metolachlor | 77 | 84 | 91 | 84 | 82 | 80 | Tebuconazole | 90 | 63 | 90 | 59 | 90 | 62 | Deltamethrin | 87 | 40 | 88 | 35 | 86 | 37 |
| MPP | 56 | 84 | 61 | 81 | 51 | 72 | Thenylchlor | 86 | 87 | 90 | 84 | 79 | 86 | Imibenconazole | 78 | 66 | 84 | 67 | 84 | 69 |
| (Z)-Dimethylvinph | 87 | 39 | 87 | 36 | 82 | 34 | Difolatan | 27 | - | 18 | - | 24 | - | | | | | | | |

## 5. 结论

GPC-GCMS系统的进样量为10μL，比GCMS高5倍，因此具有更高的灵敏度。

在100ppb　97种农残的添加回收实验中，由于GPC的净化作用，应用GPC-GCMS系统可得到优于GCMS的结果。土豆、白菜、胡萝卜中农药回收率超出70-120%范围的分别有7，12，10种；而在GCMS中，分别有15，16，13种。

由于GPC能去除干扰物质，减少基质影响，应用GPC-GC/MS系统可得到优于GCMS的质谱图和定性结果，其中，土豆、白菜、胡萝卜中农药的检索相似度SI值低于70的分别有19，19，24种；而在GCMS中，分别有47，50，53种。

应用GPC-GCMS系统，可在50分钟内完成从GPC提纯到GCMS分析的过程。添加的97种农药中，有80多种回收率在70%到120%的范围内，结果良好。

采用快速样品前处理-QuEChERS法，只需30分钟即可完成样品的前处理。溶剂消耗量只有10mL，是常规样品前处理的几十分之一。

采用QuEChERS法+GPC-GCMS，可快速分析蔬菜中的农药残留，从样品前处理到GCMS分析，仅用1.5小时左右便可完成。适用于蔬菜中农药残留的筛查分析。