（1）MTT assay

| group | blank | Experimental group | Remove blank | Inhibiting rate |
|---|---|---|---|---|
| CK | 0.102 | 1.359 | 1.257 | 0 |
| | 0.102 | 1.169 | 1.067 | 0 |
| | 0.112 | 0.921 | 0.809 | 0 |
| 给药 50uM | 0.432 | 1.411 | 0.979 | 0.221 |
| | 0.401 | 1.223 | 0.822 | 0.23 |
| | 0.359 | 1.007 | 0.648 | 0.199 |

| SK-N-SH | blank | Experimental group | Remove blank | Inhibiting rate |
|---|---|---|---|---|
| CK | 0.102 | 1.359 | 1.257 | 0 |
| | 0.102 | 1.169 | 1.067 | 0 |
| | 0.112 | 0.921 | 0.809 | 0 |
| 给药 100uM | 0.386 | 1.281 | 0.895 | 0.288 |
| | 0.461 | 1.219 | 0.758 | 0.29 |
| | 0.444 | 0.444 | 0.599 | 0.26 |

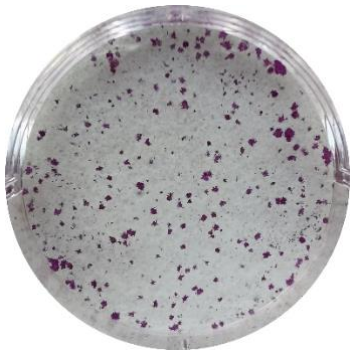
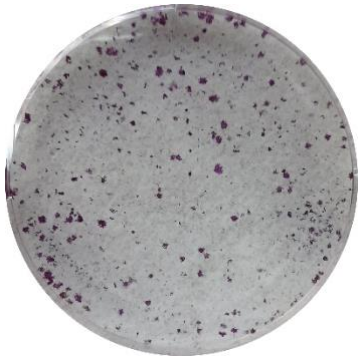
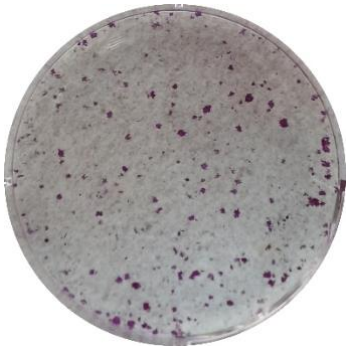
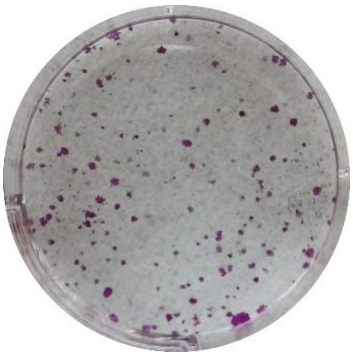
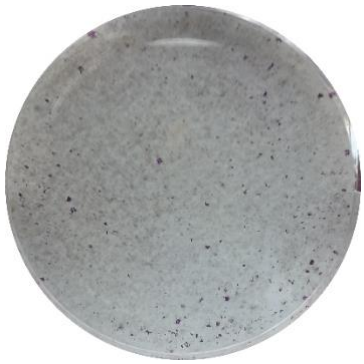
| SK-N-SH | blank | Experimental group | Remove blank | Inhibiting rate |
|---|---|---|---|---|
| CK | 0.102 | 1.359 | 1.257 | 0 |
| | 0.102 | 1.169 | 1.067 | 0 |
| | 0.112 | 0.921 | 0.809 | 0 |
| 给药 200uM | 0.411 | 1.115 | 0.704 | 0.44 |
| | 0.483 | 1.059 | 0.576 | 0.46 |
| | 0.356 | 0.816 | 0.460 | 0.431 |

| SK-N-SH | blank | Experimental group | Remove blank | Inhibiting rate |
|---|---|---|---|---|
| CK | 0.102 | 1.359 | 1.257 | 0 |
| | 0.102 | 1.169 | 1.067 | 0 |
| | 0.112 | 0.921 | 0.809 | 0 |
| 给药 400uM | 0.412 | 0.837 | 0.425 | 0.662 |
| | 0.496 | 0.776 | 0.280 | 0.738 |
| | 0.398 | 0.552 | 0.154 | 0.81 |

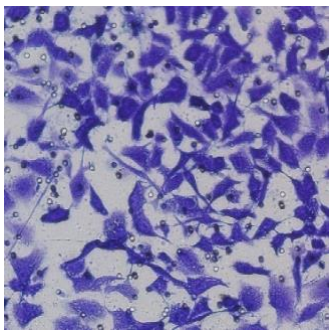
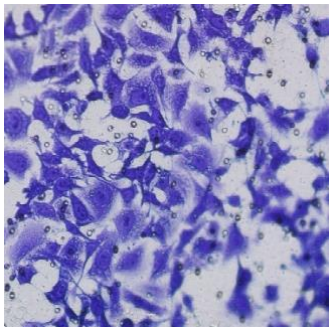
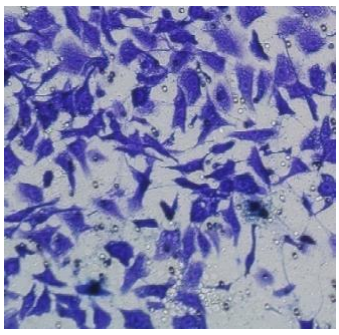
| Group | Colony formation ability |
|---|---|
| CK | 102±12 |

| | |
|---|---|
| si-NC | 88±12 |
| astaxanthin | 56±12 |
| Si-STAT3 | 64±8 |
| combined | 15±5 |

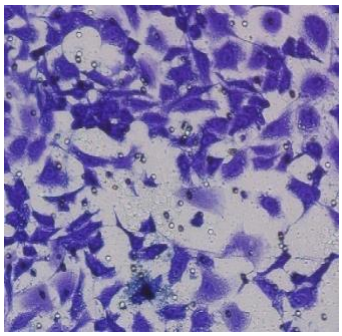
**Colony formation picture：**

| CK | Si-NC | astaxanthin |
|---|---|---|
|  |  |  |
| Si-stat3 | combined | |
|  |  | |

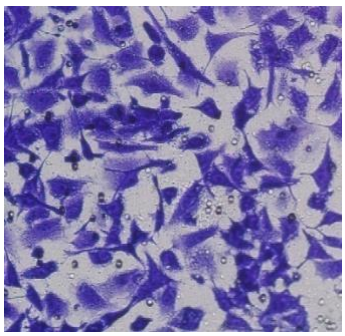
migration assay picture

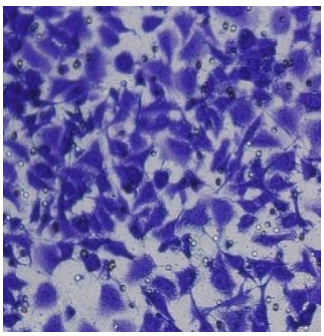
CK-1 CK-2 CK-3



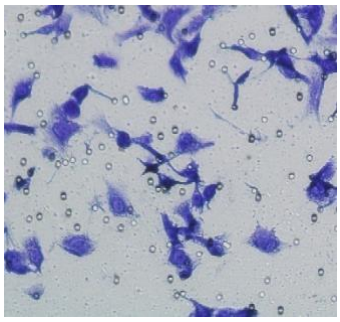
si-NC-1



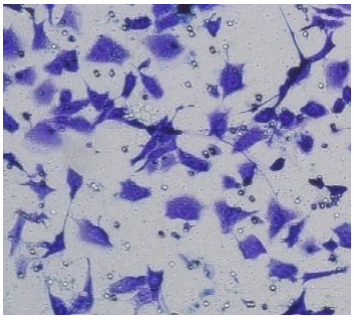
si-NC-2



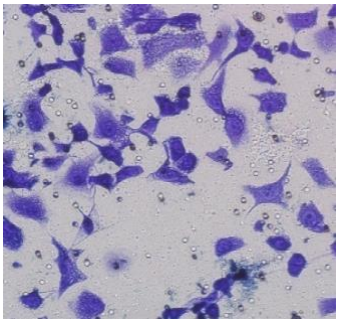
si-NC-3



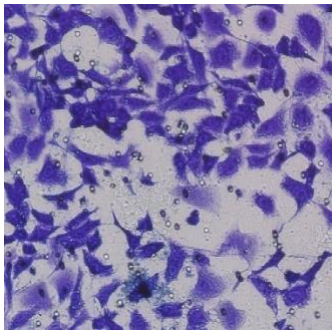
Astaxanthin-1



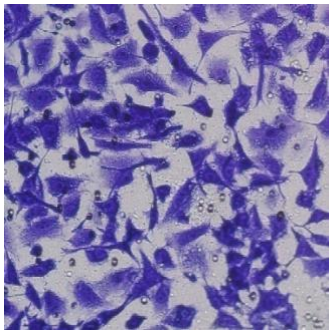
Astaxanthin-2



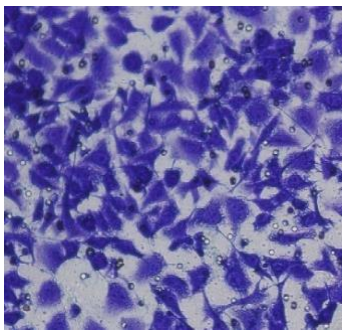
Astaxanthin-3



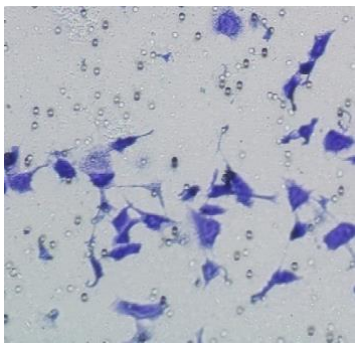
si-STAT3-1



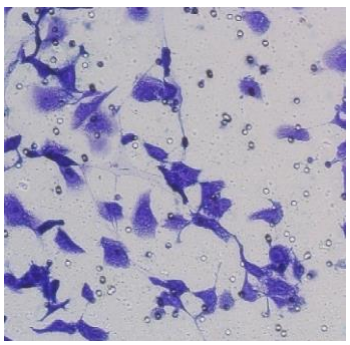
si-STAT3-2



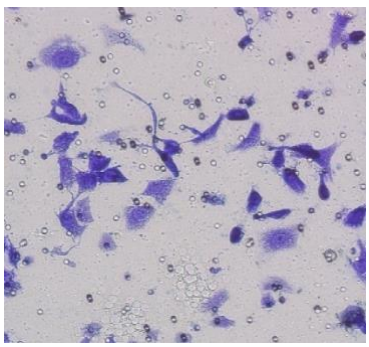
si-STAT3-3



Combined-1

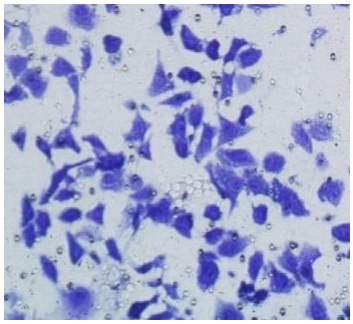


Combined-2

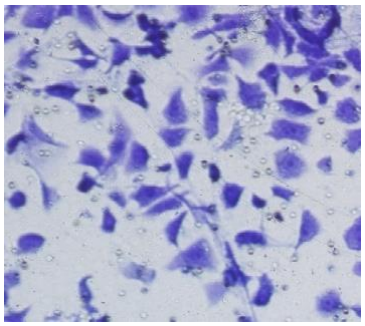


Combined-3

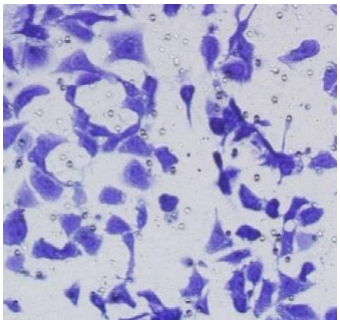
invasion assay picture



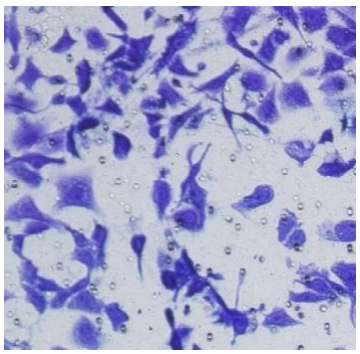
CK-1



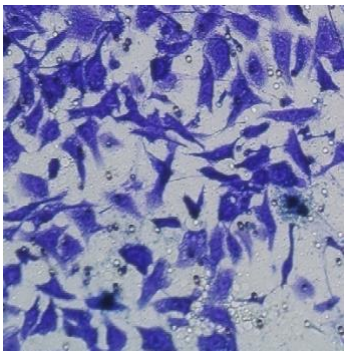
CK-2



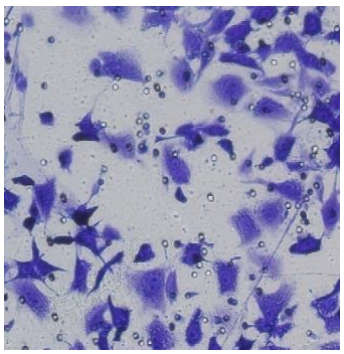
CK-3



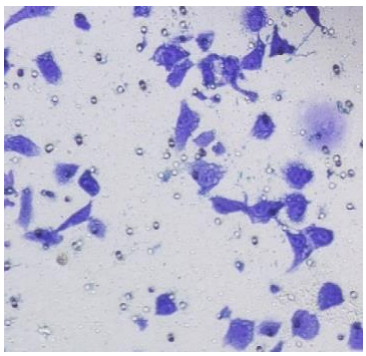
si-NC-1



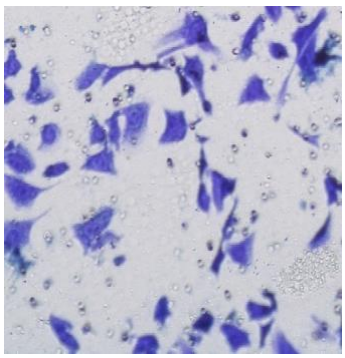
si-NC-2



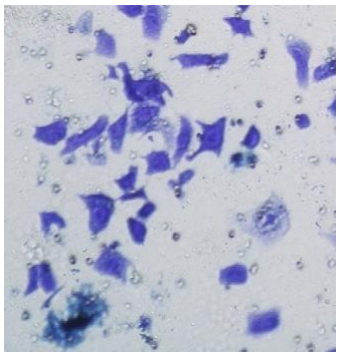
si-NC-3



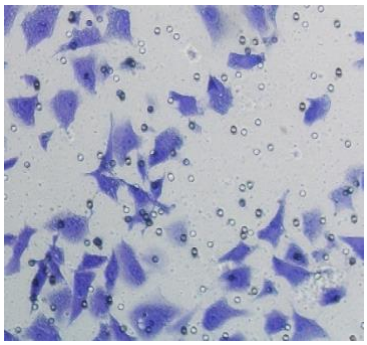
Astaxanthin-1



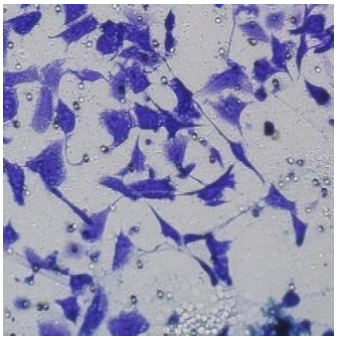
Astaxanthin-2



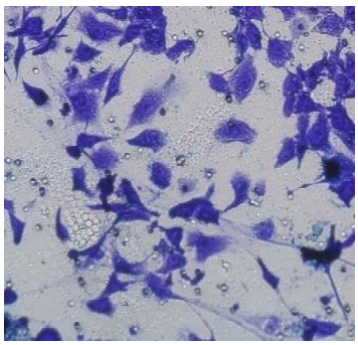
Astaxanthin-3



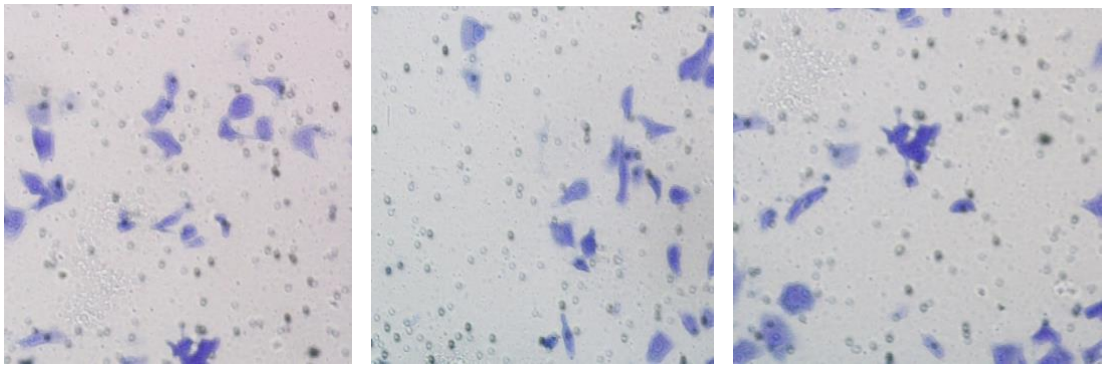
si-STAT3-1



si-STAT3-2



si-STAT3-3



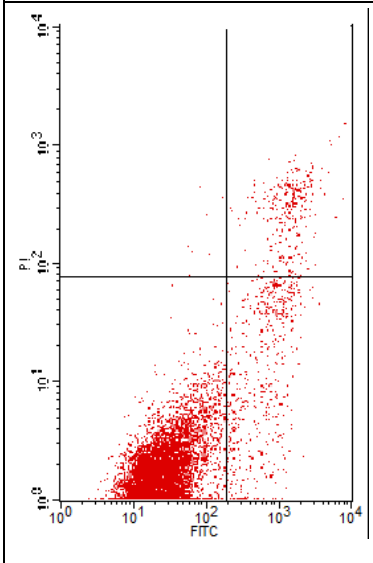
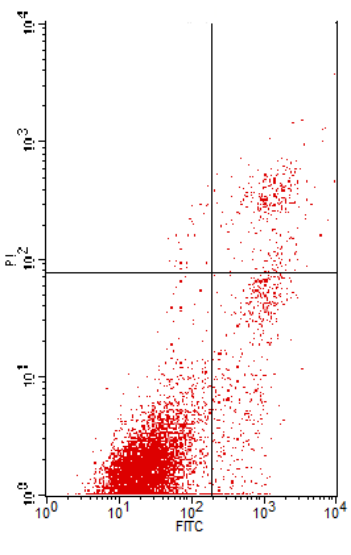
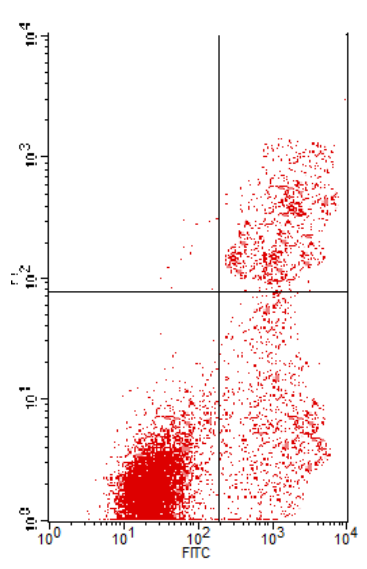
Combined-1 Combined-2 Combined-3

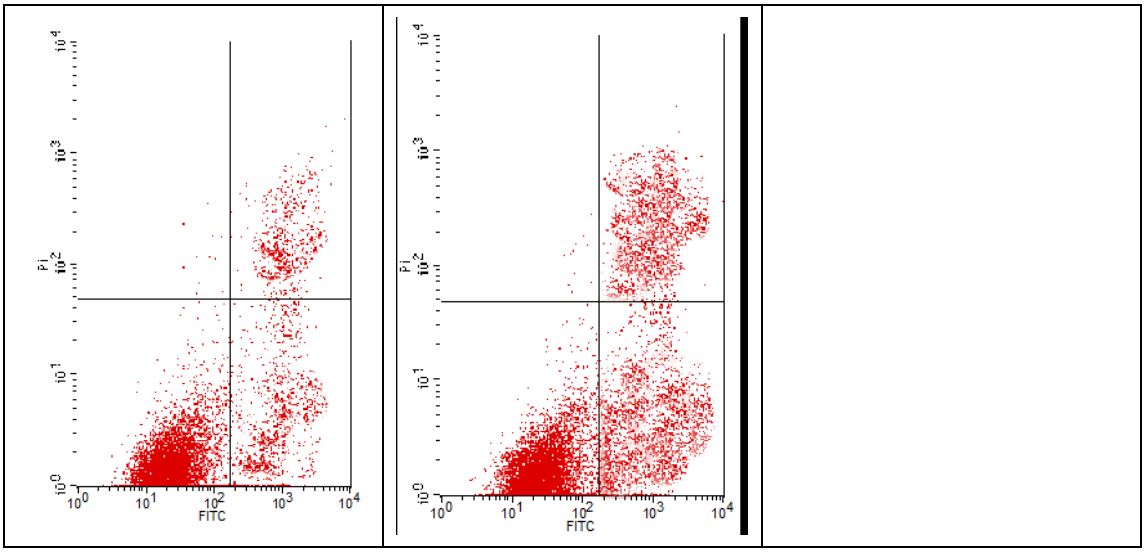
## Apoptosis assay

**Apoptosis assay：**

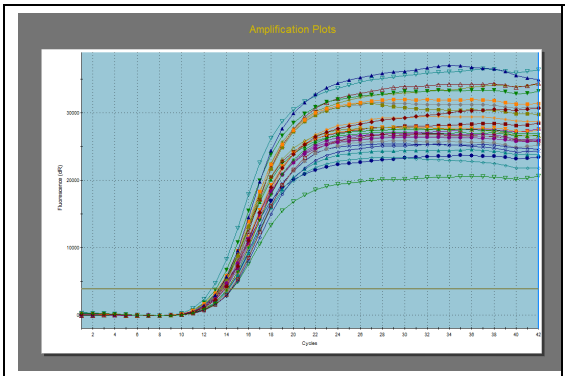
| 组别 | 凋亡率% |
|---|---|
| CK | 7.69±0.31 |
| si-NC | 7.63±0.25 |
| astaxanthin | 29.06±0.41 |
| si-stat3 | 27.58±0.37 |
| astaxanthin+si-stat3 | 37.97±0.62 |

**凋亡图：**

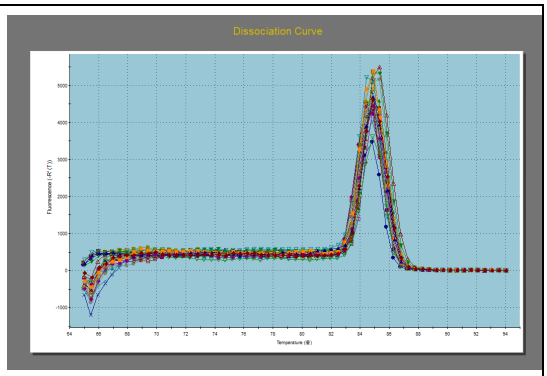
| CK | NC | 虾青素 |
|---|---|---|
|  |  |  |
| 干扰 | NC+EGF | |



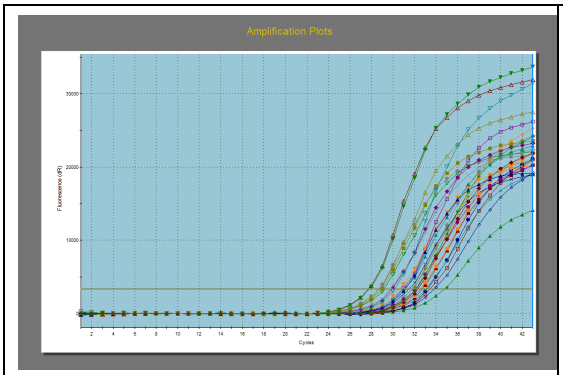

## RT-PCR data



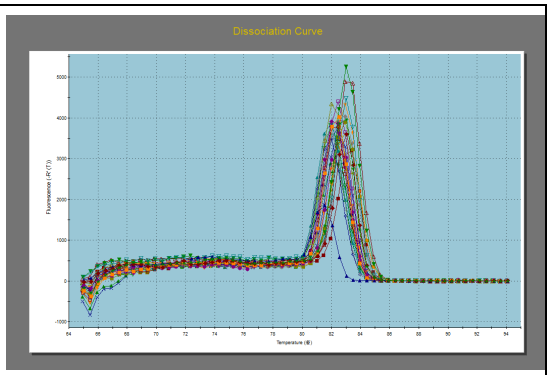

Actin 扩增曲线




Actin 溶解曲线




Bcl2 扩增曲线

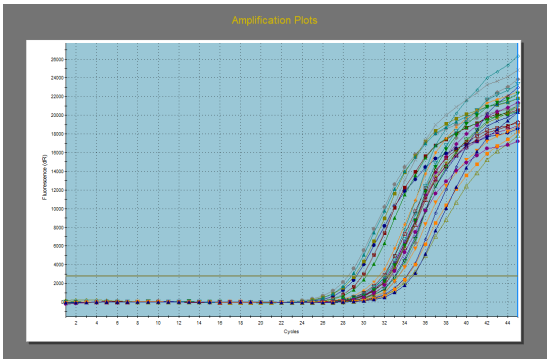



Bcl2 溶解曲线

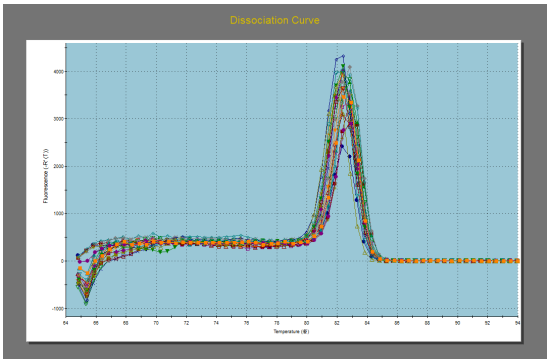
## 扩增结果

| BCL2 | Ct (dR) | actin | Ct (dR) | △CT | △△CT | 相对表达量 |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| | 30.95 | | 13.74 | 17.21 | 0.02 | 0.98 |
| ck | 30.69 | ck | 13.45 | 17.24 | 0.05 | 0.96 |
| | 30.51 | | 13.40 | 17.11 | -0.08 | 1.05 |
| | 29.98 | | 13.61 | 16.37 | -0.82 | 1.76 |
| si-NC | 29.91 | N | 13.57 | 16.34 | -0.85 | 1.80 |
| | 30.07 | | 13.18 | 16.89 | -0.30 | 1.23 |
| | 31.87 | | 13.09 | 18.78 | 1.59 | 0.33 |
| astaxanthin | 31.85 | E+G | 13.64 | 18.21 | 1.02 | 0.49 |
| | 31.07 | | 13.33 | 17.74 | 0.55 | 0.68 |
| | 33.22 | | 13.72 | 19.50 | 2.31 | 0.20 |
| si-stat3 | 32.76 | I | 14.55 | 18.21 | 1.02 | 0.49 |
| | 32.83 | | 14.37 | 18.46 | 1.27 | 0.41 |
| | 32.16 | | 12.73 | 19.43 | 2.24 | 0.21 |
| combined | 32.14 | M+E | 13.68 | 18.46 | 1.27 | 0.41 |
| | 32.61 | | 13.32 | 19.29 | 2.10 | 0.23 |



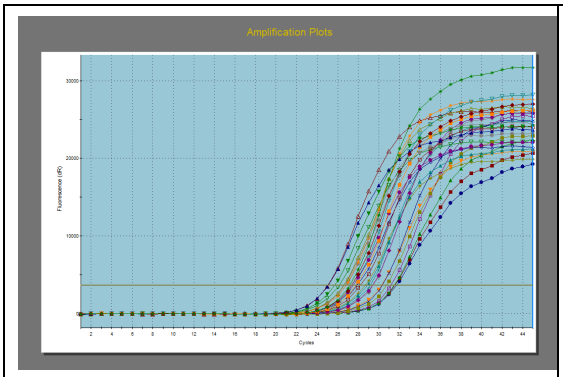

Bax 扩增曲线



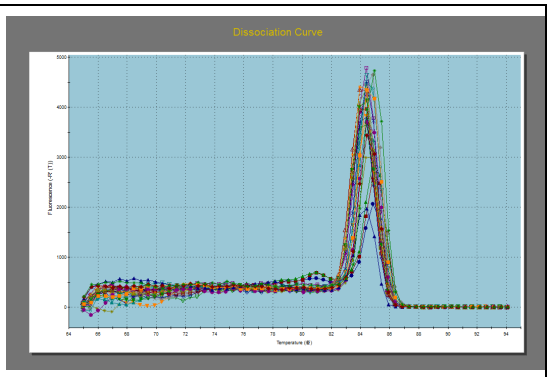

Bax 溶解曲线

| BAX | Ct (dR) | actin | Ct (dR) | △CT | △△CT | 相对表达量 |
|---|---|---|---|---|---|---|
| | 29.50 | | 13.74 | 15.76 | 0.17 | 0.89 |
| ck | 28.69 | ck | 13.45 | 15.24 | -0.35 | 1.27 |
| | 29.16 | | 13.40 | 15.76 | 0.17 | 0.89 |
| | 30.79 | | 13.61 | 17.18 | 1.59 | 0.33 |
| si-NC | 28.90 | N | 13.57 | 15.33 | -0.26 | 1.19 |
| | 29.43 | | 13.18 | 16.25 | 0.66 | 0.63 |
| | 26.81 | | 13.09 | 13.72 | -1.87 | 3.65 |
| astaxanthin | 27.90 | E+G | 13.64 | 14.26 | -1.33 | 2.51 |
| | 28.23 | | 13.33 | 14.90 | -0.69 | 1.61 |
| si-stat3 | 27.56 | M+E | 12.73 | 14.83 | -0.76 | 1.69 |
| | 27.54 | | 13.68 | 13.86 | -1.73 | 3.31 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 27.80 | | 13.32 | 14.48 | -1.11 | 2.15 |
| | 27.09 | | 13.41 | 13.68 | -1.91 | 3.75 |
| combined | 27.38 | I+G | 13.85 | 13.53 | -2.06 | 4.16 |
| | 27.21 | | 14.09 | 13.12 | -2.47 | 5.53 |

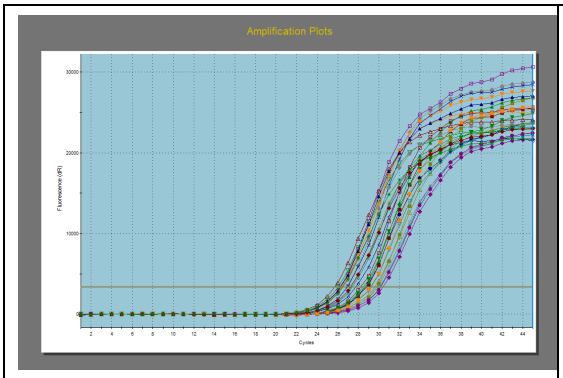



NF-KB 扩增曲线

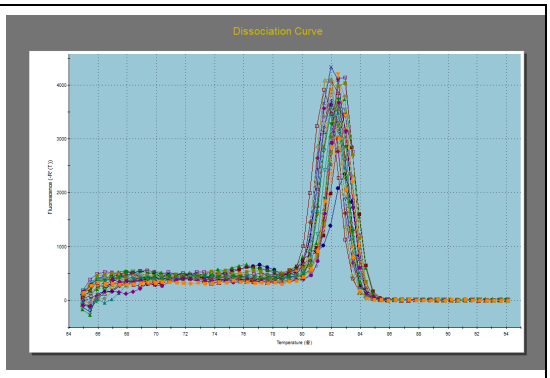



NF-KB 溶解曲线

| NF-KB | Ct (dR) | actin | Ct (dR) | △CT | △△CT | 相对表达量 |
|---|---|---|---|---|---|---|
| | 30.84 | | 13.74 | 17.10 | -0.60 | 1.52 |
| ck | 31.32 | ck | 13.45 | 17.87 | 0.17 | 0.89 |
| | 31.53 | | 13.40 | 18.13 | 0.43 | 0.74 |
| | 31.21 | | 13.61 | 17.60 | -0.10 | 1.07 |
| si-NC | 31.91 | N | 13.57 | 18.34 | 0.64 | 0.64 |
| | 31.42 | | 13.18 | 18.24 | 0.54 | 0.69 |
| | 33.01 | | 14.11 | 18.90 | 1.20 | 0.44 |
| astaxanthin | 32.50 | N+G | 14.53 | 17.97 | 0.27 | 0.83 |
| | 33.12 | | 14.47 | 18.65 | 0.95 | 0.52 |
| | 31.86 | | 12.73 | 19.13 | 1.43 | 0.37 |
| si-stat3 | 32.68 | M+E | 13.68 | 19.00 | 1.30 | 0.41 |
| | 32.14 | | 13.32 | 18.82 | 1.12 | 0.46 |
| | 34.72 | | 13.72 | 21.00 | 3.30 | 0.10 |
| combined | 34.31 | I | 14.55 | 19.76 | 2.06 | 0.24 |
| | 34.82 | | 14.37 | 20.45 | 2.75 | 0.15 |

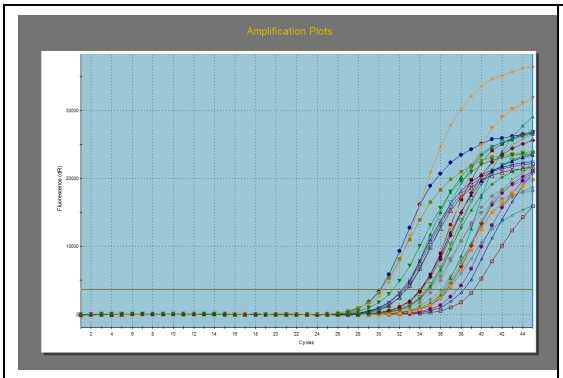



Casp3 扩增曲线

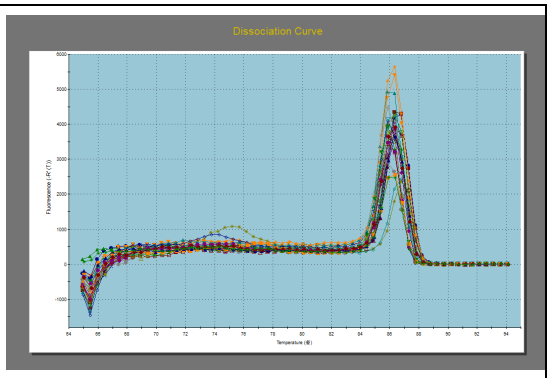



Casp3 溶解曲线

| casp3 | Ct (dR) | actin | Ct (dR) | △CT | △△CT | 相对表达量 |
|---|---|---|---|---|---|---|
| | 28.52 | | 13.74 | 14.78 | -0.39 | 1.31 |
| ck | 28.93 | ck | 13.45 | 15.48 | 0.31 | 0.80 |
| | 28.64 | | 13.40 | 15.24 | 0.07 | 0.95 |
| | 28.76 | | 13.61 | 15.15 | -0.02 | 1.01 |
| si-NC | 28.82 | N | 13.57 | 15.25 | 0.08 | 0.94 |
| | 28.66 | | 13.18 | 15.48 | 0.31 | 0.80 |
| | 26.92 | | 13.09 | 13.83 | -1.34 | 2.53 |
| astaxanthin | 27.36 | E+G | 13.64 | 13.72 | -1.45 | 2.73 |
| | 27.47 | | 13.33 | 14.14 | -1.03 | 2.04 |
| | 26.46 | | 12.73 | 13.73 | -1.44 | 2.71 |
| si-stat3 | 27.78 | M+E | 13.68 | 14.10 | -1.07 | 2.09 |
| | 28.26 | | 13.32 | 14.94 | -0.23 | 1.17 |
| | 26.31 | | 13.41 | 12.90 | -2.27 | 4.81 |
| combined | 27.26 | I+G | 13.85 | 13.41 | -1.76 | 3.38 |
| | 26.49 | | 14.09 | 12.40 | -2.77 | 6.81 |

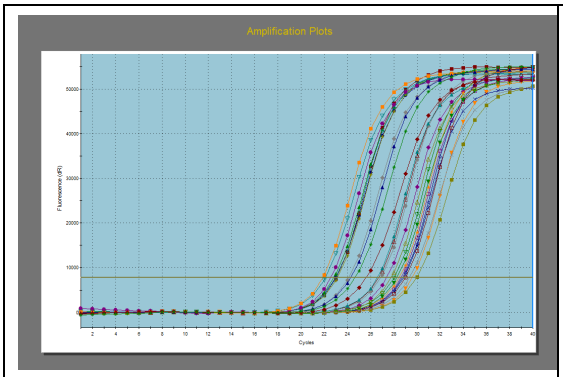



Casp9 扩增曲线

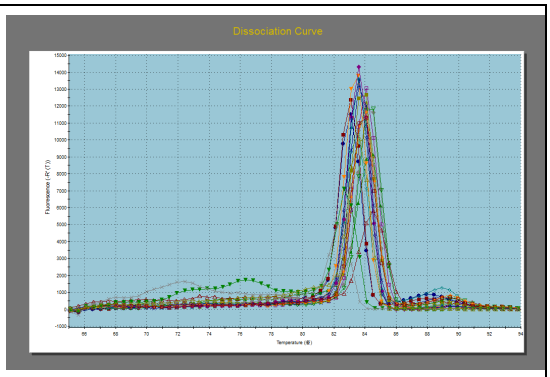



Casp9 溶解曲线

| casp9 | Ct (dR) | actin | Ct (dR) | △CT | △△CT | 相对表达量 |
|---|---|---|---|---|---|---|
| | 34.76 | | 13.74 | 21.02 | -0.31 | 1.24 |
| ck | 35.08 | ck | 13.45 | 21.63 | 0.30 | 0.81 |
| | 34.74 | | 13.40 | 21.34 | 0.01 | 0.99 |
| | 34.26 | | 13.61 | 20.65 | -0.68 | 1.60 |
| si-NC | 34.37 | N | 13.57 | 20.80 | -0.53 | 1.44 |
| | 34.67 | | 13.18 | 21.49 | 0.16 | 0.90 |
| | 33.42 | | 13.09 | 20.33 | -1.00 | 2.00 |
| astaxanthin | 33.90 | E+G | 13.64 | 20.26 | -1.07 | 2.10 |
| | 33.49 | | 13.33 | 20.16 | -1.17 | 2.25 |
| | 34.04 | | 13.41 | 20.63 | -0.70 | 1.62 |
| si-stat3 | 34.18 | I+G | 13.85 | 20.33 | -1.00 | 2.00 |
| | 34.78 | | 14.09 | 20.69 | -0.64 | 1.56 |
| | 32.14 | | 14.11 | 18.03 | -3.30 | 9.85 |
| combined | 32.11 | N+G | 14.53 | 17.58 | -3.75 | 13.45 |
| | 32.57 | | 14.47 | 18.10 | -3.23 | 9.38 |




jak2 扩增曲线




jak2 溶解曲线

| jak2 | Ct (dR) | actin | Ct (dR) | △CT | △△CT | 相对表达量 |
|---|---|---|---|---|---|---|
| | 24.33 | | 13.74 | 10.59 | -0.44 | 1.35 |
| ck | 24.65 | ck | 13.45 | 11.20 | 0.17 | 0.89 |
| | 24.69 | | 13.40 | 11.29 | 0.26 | 0.83 |
| | 24.14 | | 13.61 | 10.53 | -0.50 | 1.41 |
| si-NC | 23.15 | N | 13.57 | 9.58 | -1.45 | 2.73 |
| | 23.03 | | 13.18 | 9.85 | -1.18 | 2.26 |
| | 28.30 | | 14.11 | 14.19 | 3.16 | 0.11 |
| astaxanthin | 28.37 | N+G | 14.53 | 13.84 | 2.81 | 0.14 |
| | 28.78 | | 14.47 | 14.31 | 3.28 | 0.10 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | 28.30 | | 14.11 | 14.19 | 3.16 | 0.11 |
| si-stat3 | 28.37 | N+G | 14.53 | 13.84 | 2.81 | 0.14 |
| | 28.78 | | 14.47 | 14.31 | 3.28 | 0.10 |
| | 29.66 | | 13.72 | 15.94 | 4.91 | 0.03 |
| combined | 29.62 | I | 14.55 | 15.07 | 4.04 | 0.06 |
| | 28.86 | | 14.37 | 14.49 | 3.46 | 0.09 |

# Animal expeiment

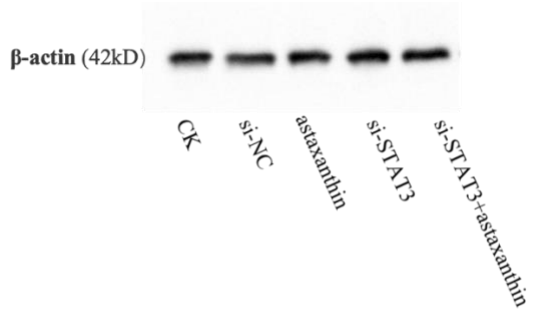
| 编号 | 质量 g | 体积（长*宽*高）（mm） |
|---|---|---|
| CK1 | 1.98 | 16*12*12 |
| CK2 | 1.96 | 18*13*11 |
| CK3 | 1.93 | 14*12*10 |
| CK4 | 1.48 | 13*10*10 |
| CK5 | 2.29 | 16*13*12 |
| CK6 | 1.60 | 14*14*10 |
| | | |
| si-NC1 | 1.78 | 18*10*10 |
| si-NC2 | 2.20 | 16*11*10 |
| si-NC3 | 2.01 | 14*13*12 |
| si-NC4 | 2.27 | 16*14*14 |

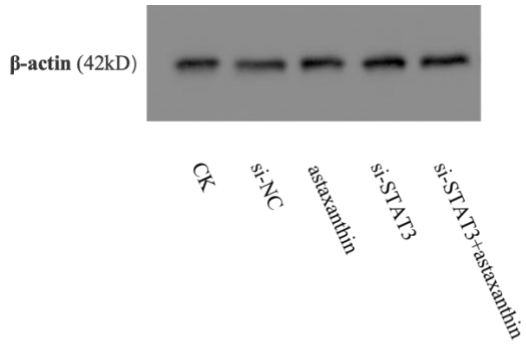
| | | |
|---|---|---|
| si-NC5 | 1.80 | 15*13*12 |
| si-NC6 | 2.58 | 18*14*12 |
| | | |
| si-Stat3-1 | 1.20 | 12*11*8 |
| si-Stat3-2 | 1.28 | 10*9*9 |
| si-Stat3-3 | 1.12 | 10*9*8 |
| si-Stat3-4 | 1.78 | 12*11*10 |
| si-Stat3-5 | 1.23 | 13*9*8 |
| si-Stat3-6 | 1.21 | 13*8*8 |
| | | |
| astaxanthin-1 | 0.92 | 9*8*7 |
| astaxanthin-2 | 1.02 | 9*7*7 |
| astaxanthin-3 | 1.10 | 10*8*8 |
| astaxanthin-4 | 0.81 | 9*8*6 |
| astaxanthin-5 | 0.88 | 10*8*7 |
| astaxanthin-6 | 1.19 | 12*10*8 |
| | | |
| Astaxanthin+si-STAT3-1 | 0.33 | 5*4*3 |
| Astaxanthin+si-STAT3-2 | 0.66 | 8*6*5 |
| Astaxanthin+si-STAT3-3 | 0.43 | 5*5*4 |
| Astaxanthin+si-STAT3-4 | 0.45 | 6*4*4 |
| Astaxanthin+si-STAT3-5 | 0.91 | 9*8*6 |
| Astaxanthin+si-STAT3-6 | 0.38 | 4*4*3 |

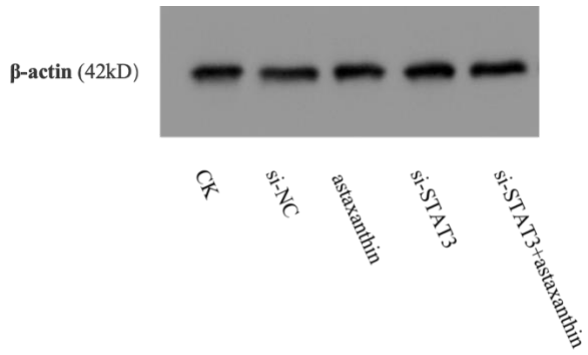
**Western blotting experiments**

The original unmodified blots of the Western blot experiments. In the Western blot images presented in this study, it is important to note that some of the blots were cut based on the size of the protein of interest and the positions indicated by the protein size markers as a cost-saving measure to optimize the use of antibodies and focus on specific bands of interest to minimize antibody use. Additionally, it is important to note that in certain cases, the edges of PVDF membranes may not be clearly visible due to pixel limitations, resulting in edges blending with the background color.

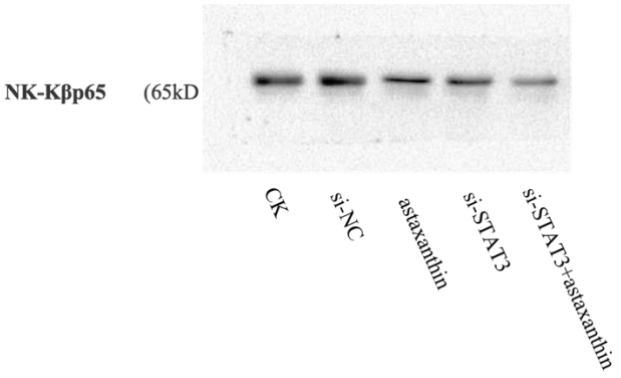
1. **β-actin** (Below are three images with different exposure levels).

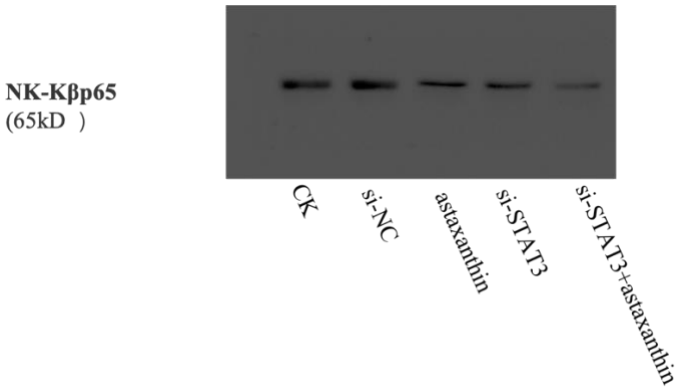


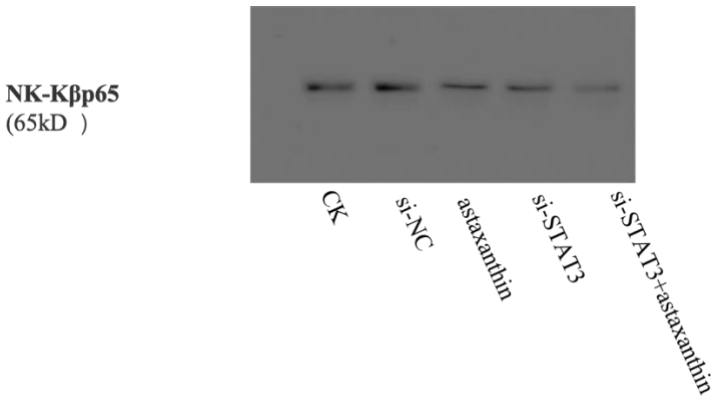



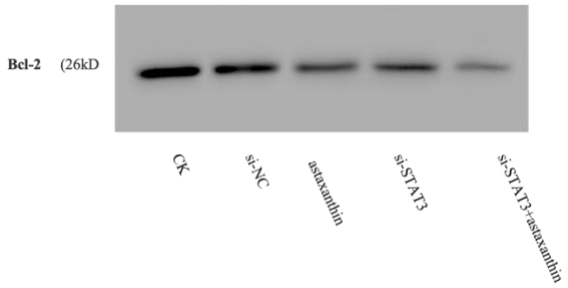
2. **NK-K β p65** (Below are three images with different exposure levels).

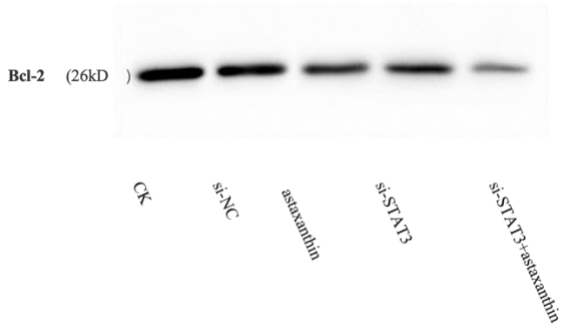


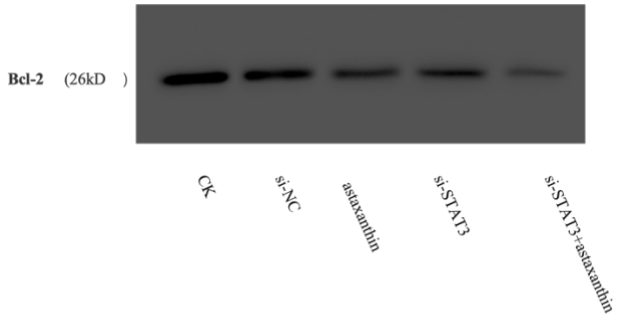



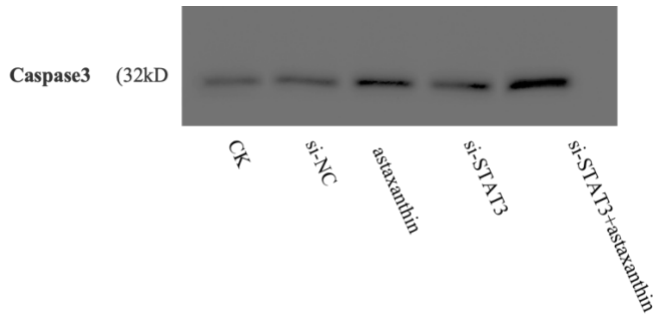

3. **Bcl-2** (Below are three images with different exposure levels).

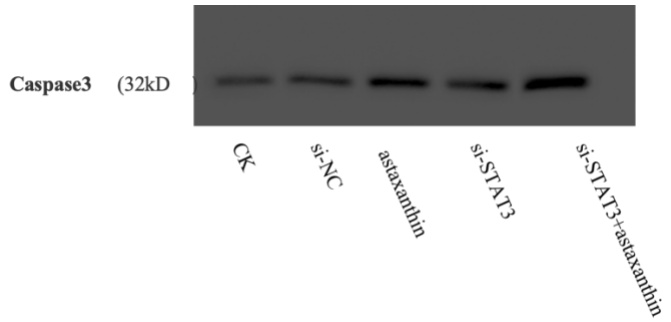


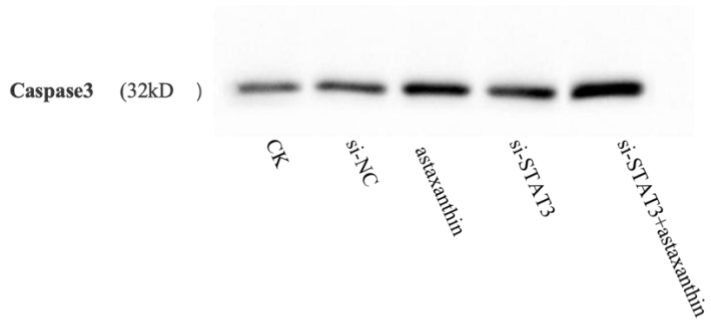



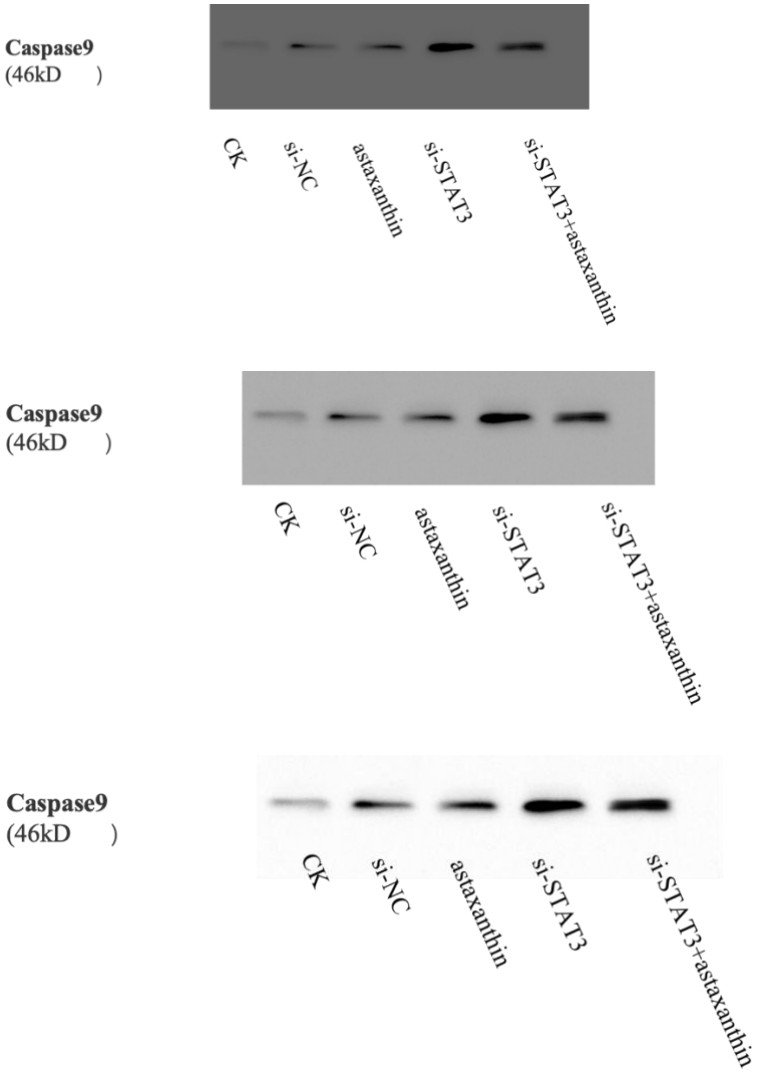

4. **Caspase3** (Below are three images with different exposure levels).



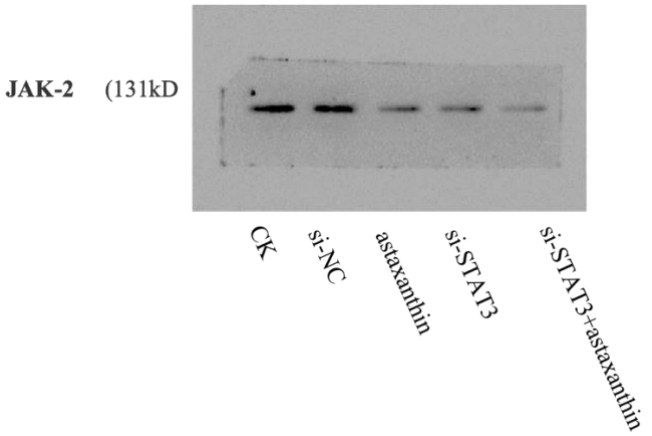



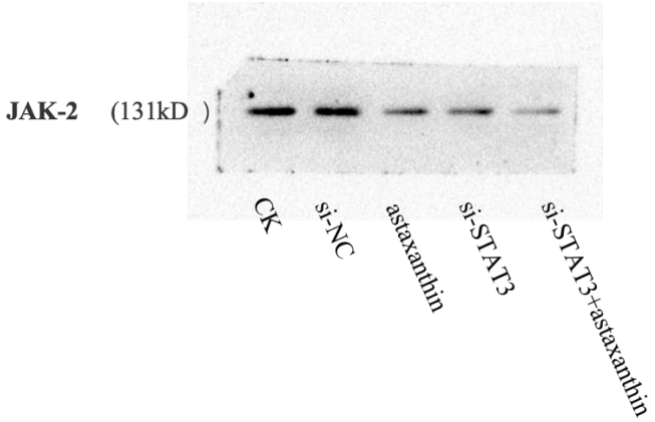



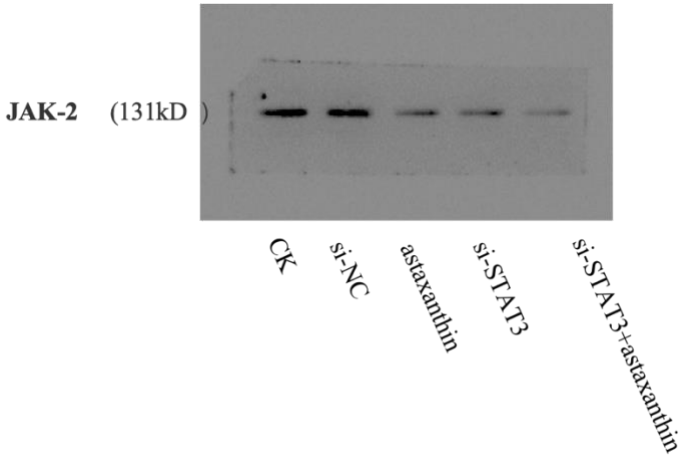

5. **Caspase9** (Below are three images with different exposure levels).



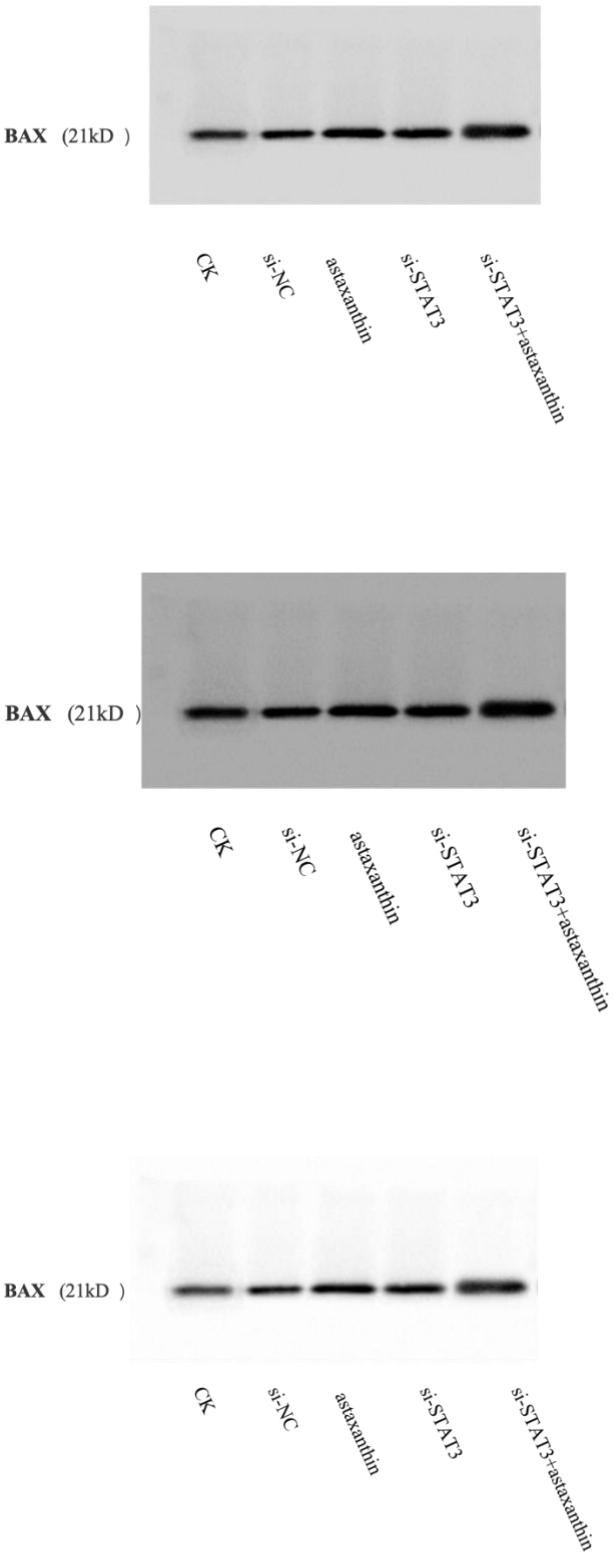

6. **JAK-2** (Below are three images with different exposure levels).



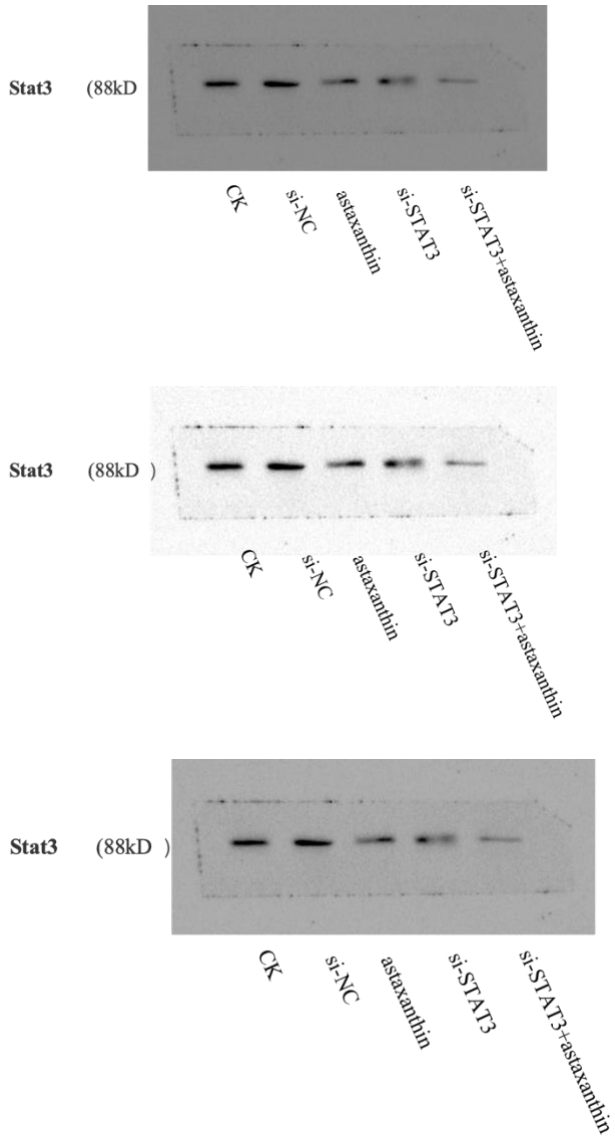



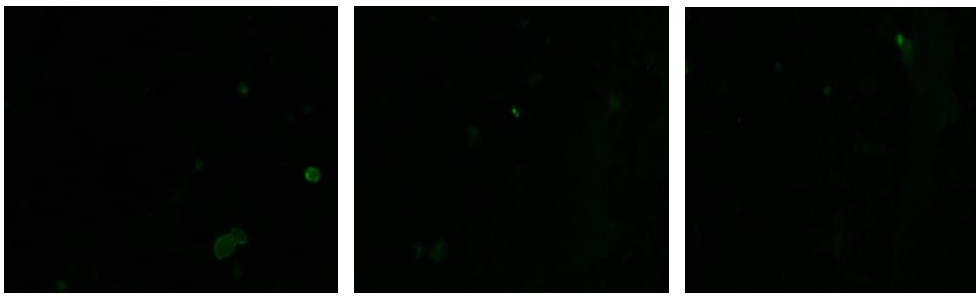

7. **BAX** (Below are three images with different exposure levels).



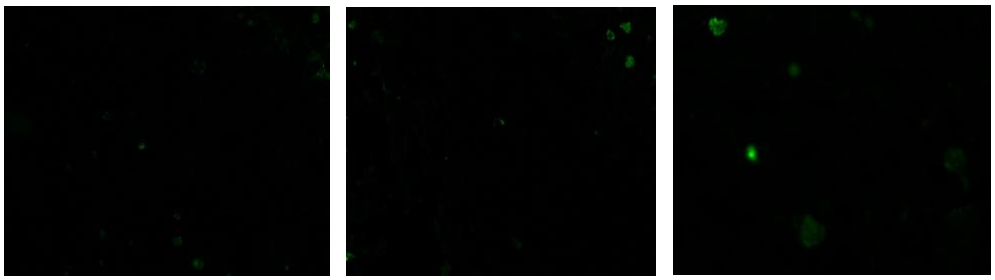

8. **Stat3** (Below are three images with different exposure levels).



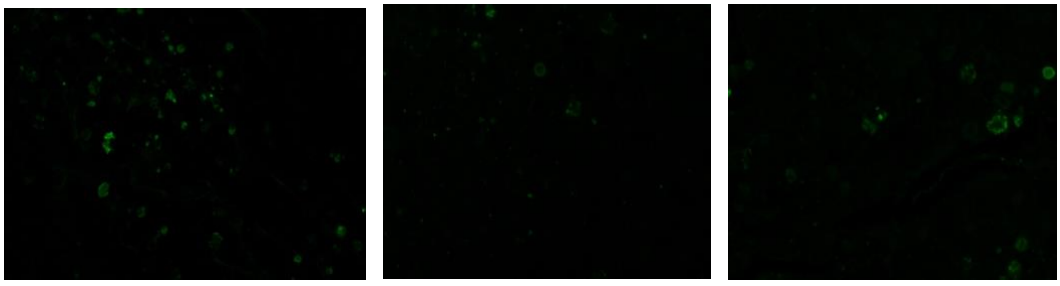

Tunel experiment



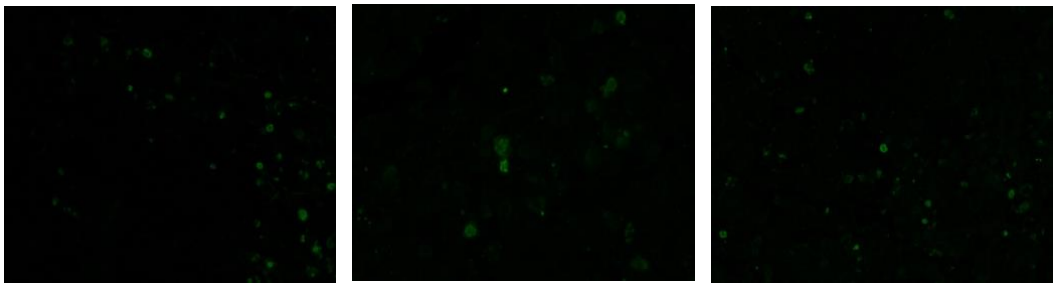
CK-1 CK-2 CK-3



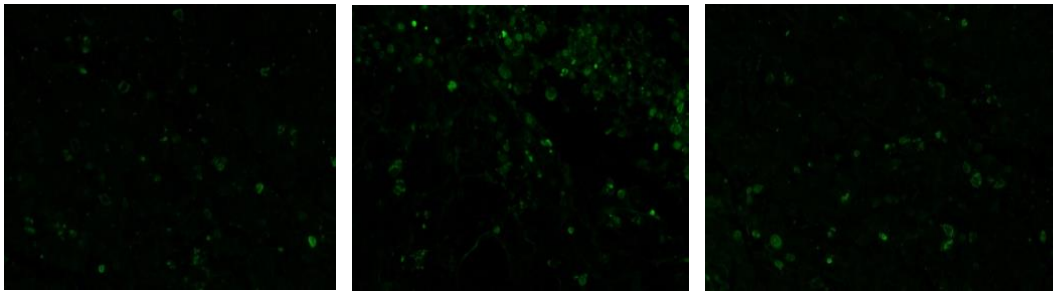
si-NC-1 si-NC-2 si-NC-3



Stat3-1 Stat3-2 Stat3-3



si-stat3-1 si-stat3-2 si-stat3-3



Combined-1 Combined-2 Combined-3