## Supplementary data

**Fig. S1.** Effects of methanol ratio, extraction time, and liquid-solid ratio on the extraction of tangshenoside I and lobetyolin (n=3)

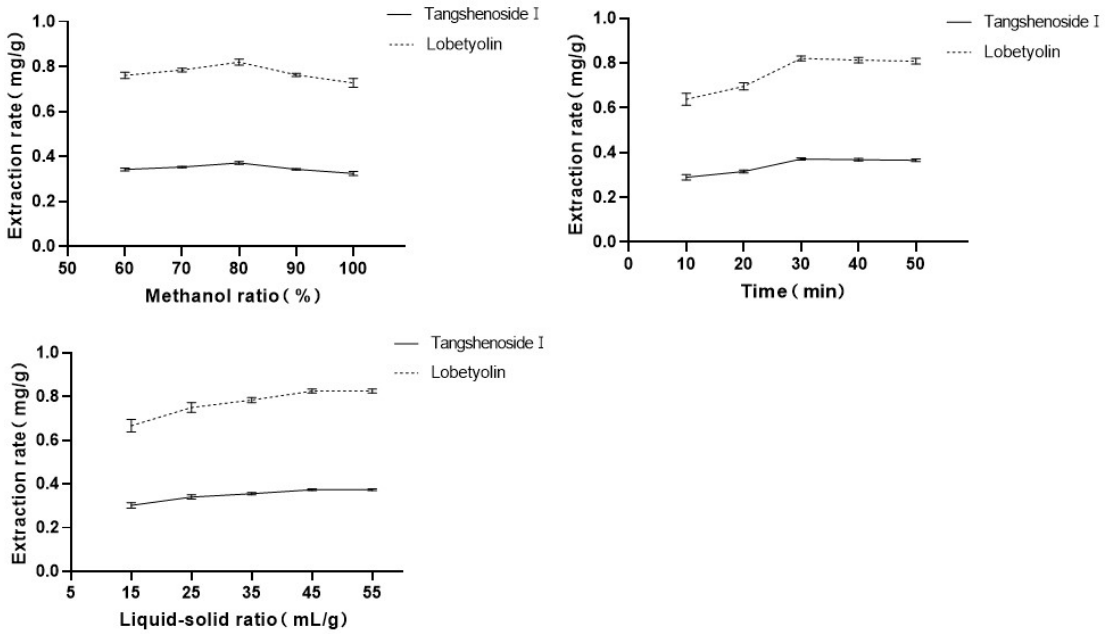


**Table S1.** Source information of Codonopsis Radix

| Batch no. | Production area/locality (in China) | Latitude | Longitude | Altitude (m) |
|---|---|---|---|---|
| S1 | Pingshun County, Changzhi City, Shanxi Province | 36.2002°N | 113.4292°E | 1212 |
| S2 | Pingshun County, Changzhi City, Shanxi Province | 36.2002°N | 113.4292°E | 1212 |
| S3 | Min County, Dingxi City, Gansu Province | 35.5166°N | 104.626°E | 2077 |
| S4 | Min County, Dingxi City, Gansu Province | 35.5166°N | 104.626°E | 2077 |
| S5 | Min County, Dingxi City, Gansu Province | 35.5166°N | 104.626°E | 2077 |
| S6 | Min County, Dingxi City, Gansu Province | 35.5166°N | 104.626°E | 2077 |
| S7 | Min County, Dingxi City, Gansu Province | 35.5166°N | 104.626°E | 2077 |
| S8 | Longxi County, Dingxi City, Gansu Province | 35.0079°N | 104.6390°E | 2077 |
| S9 | Weiyuan County, Dingxi City, Gansu Province | 35.1374°N | 104.2117°E | 2080 |
| S10 | Changbai Mountain, Jilin Province | 41.7452°N | 127.9656°E | 1673 |
| S11 | Aba of sichuan province | 33.5203°N | 102.8021°E | 3433 |
| S12 | Zhaotong City, Yunnan Province | 27.3167°N | 103.7167°E | 2132 |
| S13 | Wenxian County, Longnan City, Gansu Province | 32.9438°N | 104.6834°E | 2151 |
| S14 | Wenxian County, Longnan City, Gansu Province | 32.9438°N | 104.6834°E | 2151 |
| S15 | Banqiao Town, Enshi City, Hubei Province | 30.5927°N | 109.2755°E | 1472 |
| S16 | Banqiao Town, Enshi City, Hubei Province | 30.5927°N | 109.2755°E | 1472 |
| S17 | Wushan Town, Chongqing | 31.0774°N | 109.8754°E | 291 |
| S18 | Wushan Town, Chongqing | 31.0774°N | 109.8754°E | 291 |

**Table S2.** Design-response surface experiment results of extraction comprehensive score (n=3)

| No. | A：methanol ratio（%，v/v） | B：extraction time（min） | C：liquid-solid ratio（mL/g） | Y：comprehensive score |
|---|---|---|---|---|
| 1 | 70 | 30 | 35 | 0.552 |
| 2 | 80 | 40 | 55 | 0.579 |
| 3 | 70 | 40 | 45 | 0.580 |
| 4 | 80 | 30 | 45 | 0.585 |
| 5 | 80 | 30 | 45 | 0.593 |
| 6 | 90 | 30 | 55 | 0.571 |
| 7 | 70 | 30 | 55 | 0.557 |
| 8 | 80 | 40 | 35 | 0.568 |
| 9 | 80 | 30 | 45 | 0.587 |
| 10 | 80 | 30 | 45 | 0.595 |
| 11 | 80 | 30 | 45 | 0.594 |
| 12 | 70 | 20 | 45 | 0.535 |
| 13 | 90 | 20 | 45 | 0.548 |
| 14 | 90 | 30 | 35 | 0.552 |
| 15 | 90 | 40 | 45 | 0.572 |
| 16 | 80 | 20 | 35 | 0.536 |
| 17 | 80 | 20 | 55 | 0.548 |

**Table S3.** Eigenvalues and cumulative variance contribution rate

| Principal compo-nent | Initial eigenvalue | | | Extract eigenvalue | | |
|---|---|---|---|---|---|---|
| | Eigen-value | Variance contribution rate/% | Cumulative variance contribution rate/% | Eigen-value | Variance contribution rate/% | Cumulative variance contribution rate/% |
| 1.000 | 5.343 | 41.099 | 41.099 | 5.343 | 41.099 | 41.099 |
| 2.000 | 3.392 | 26.094 | 67.192 | 3.392 | 26.094 | 67.192 |
| 3.000 | 1.773 | 13.637 | 80.829 | 1.773 | 13.637 | 80.829 |

**Table S4.** The comprehensive scores of the principal components

| Serial number | y1 | y2 | y3 | Principal component comprehensive score Y | Ranking |
|---|---|---|---|---|---|
| S1 | 0.474 | -0.393 | 1.564 | 0.449 | 3 |
| S2 | 0.705 | -0.263 | 1.301 | 0.522 | 2 |
| S3 | -0.853 | 0.942 | -0.632 | -0.184 | 7 |
| S4 | -1.185 | 0.828 | -0.015 | -0.204 | 8 |
| S5 | -1.131 | -0.888 | -0.219 | -0.821 | 11 |
| S6 | 0.400 | 1.560 | -1.630 | 0.292 | 6 |
| S7 | 1.866 | -0.558 | -0.796 | 0.373 | 5 |
| S8 | 1.437 | -0.205 | -0.557 | 0.378 | 4 |
| S9 | -0.503 | -0.215 | 0.174 | -0.236 | 9 |
| S10 | 0.038 | 1.553 | 1.576 | 0.940 | 1 |
| S11 | -0.371 | -0.743 | -0.340 | -0.491 | 10 |
| S12 | -0.877 | -1.618 | -0.427 | -1.019 | 12 |