**Supplementary　Table 1** Strains and plasmids used in this research.

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| --- | --- | --- |
| Strains and plasmids | Relevant properties | Source or reference |
| strains |  |  |
| E. coli Top 10 | F-, mcrAΔ(mrr-hsd RMS-mcrBC), φ80, lacZΔM15, ΔacX 74, recA1, araΔ139Δ(ara-leu)7697, galU, galK, rps, (Strr) endA1, nupG | Lab stock |
| E. coli BL21 (DE3) | F-,ompT hsdS(rB-mB-) gal dcm(DE3) | TransGen Biotech |
| plasmids |  |  |
| peasy | cloning vector, KanaR, AmpR | TransGen Biotech |
| pET28a | bacterial expression vector with T7 lac promoter, KanaR | Lab stock |
| pMal-c5x | bacterial expression vector with T7 lac promoter, AmpR | Lab stock |
| pAthemA1 | pMal-c5x inserted with *AthemA1* | Lab stock |
| ppgr7 | pET28a inserted with At*pgr7* | Lab stock |
| pgltX | pET28a inserted with *EcgltX* | Lab stock |
| phemL | pET28a inserted with *EchemL* | Lab stock |
| pzwf | pET28a inserted with *Eczwf* | This work |
| ppgl | pET28a inserted with *Ecpgl* | This work |
| pgnd | pET28a inserted with *Ecgnd* | This work |
| padk | pET28a inserted with *Ecadk* | This work |
| pppk | pET28a inserted with *Ecppk* | This work |
| pHK | pET28a inserted with *HK* from Yeast | This work |

**Supplementary　Table 2** Primers used in this research. The base underlined means the restriction enzyme sites.

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| Primers | Sequence |
| zwfBamHI-F | 5’-CGGGATCCATGGCGGTAACGCAAACA-3’ |
| zwfEcoR1-R | 5’-GGAATTCTTACTCAAACTCATTCCA-3’ |
| pglBamHI-F | 5’-CGGGATCCATGAAGCAAACAGTTTAT-3’ |
| pglEcoR1-R | 5’-GGAATTCTTAGTGTGCGTTAACCA-3’ |
| gndBamHI-F | 5’-CGGGATCCATGTCCAAGCAACAGATC-3’ |
| gndEcoR1-R | 5’-GGAATTCTTAATCCAGCCATTCGGT-3’ |
| HKBamHI-F | 5’-CGGGATCCATGTCCTTGCACGACGC-3’ |
| HKEcoR1-R | 5’- GGAATTCTTAATTCTTAAGATGCTC-3’ |
| ppkBamHI-F | 5’-CGGGATCCATGGGTCAGGAAAAGCTA-3’ |
| ppkHindIII-R | 5’-CCCAAGCTTTTATTCAGGTTGTTCGAG-3’ |
| adkBamHI-F | 5’-CGGGATCCATGCGTATCATTCTGCTTGG-3’ |
| adkHindIII-R | 5’-CCCAAGCTTTTAGCCGAGGATTTTTTC-3’ |