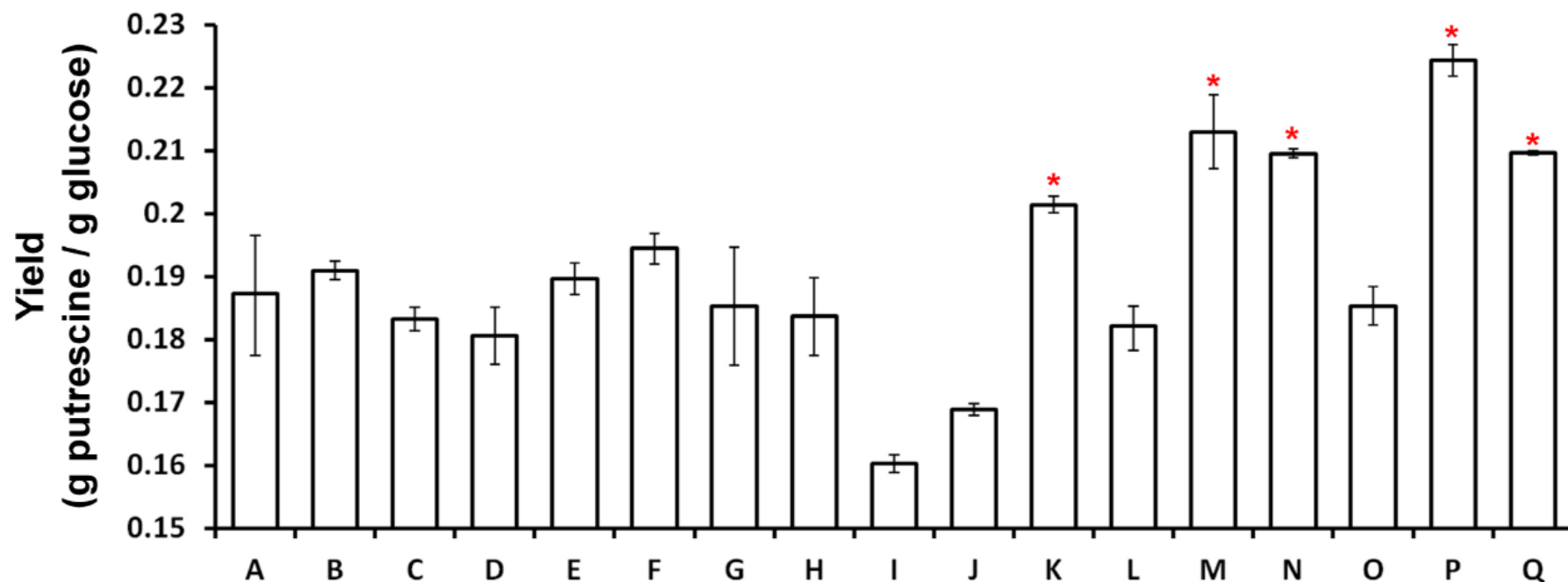




**Additional file 5. Putrescine production yield (g putrescine/g glucose) for the single gene-overexpressing strains based on *E. coli* XQ52 (p15SpeC) strain by flask cultivation on R/2 medium supplemented with 10 g/L glucose at 37°C.** (A) XQ52 (p15SpeC) (control), (B) XQ52 (p15SpeC-Eno), (C) XQ52 (p15SpeC-Pgm), (D) XQ52 (p15SpeC-GapA), (E) XQ52 (p15SpeC-FbaA), (F) XQ52 (p15SpeC-FbaB), (G) XQ52 (p15SpeC-TpiA), (H) XQ52 (p15SpeC-Pgk), (I) XQ52 (p15SpeC-PykA), (J) XQ52 (p15SpeC-PykF), (K) XQ52 (p15SpeC-Glk), (L) XQ52 (p15SpeC-Icd), (M) XQ52 (p15SpeC-AcnA), (N) XQ52 (p15SpeC-AcnB), (O) XQ52 (p15SpeC-GltA), (P) XQ52 (p15SpeC-AckA), and (Q) XQ52 (p15SpeC-Ppc) strains. The ‘\*’ indicates the selected strains for further validation by batch cultivation, which show improved results in comparison with the control strain by considering error bar. All the experiments were performed in duplicate.