AGILENT BL21-CODONPLUS COMPETENT CELLS

Data Sheet

Key Features

Improves protein expression by overcoming codon bias

Increases transformation efficiency with Hte phenotype

Suitable for expressing proteins from all species, including mammals

Introduction

Agilent BL21-CodonPlus competent cells dramatically improve protein expression in *E. coli* by overcoming codon bias. These cells have the high transformation efficiency (Hte) allele, which helps increase transformation efficiency to > 1 x 10^7 cfu/µg for large and ligated DNA. Additionally, the gene encoding endonuclease I (*endA*), which rapidly degrades plasmid DNA isolated by most miniprep procedures, is inactivated. BL21 and its derivatives are less susceptible to protein degradation due to their natural lack of OmpT and Lon proteases.

Overcoming Codon Bias

Codon bias occurs when forced high-level expression of a gene containing codons rarely expressed in *E. coli* depletes internal tRNA pools. This often results in poor protein synthesis, early termination of the polypeptide chain, or misincorporation of amino acids into the expressed protein. When expressing eukaryotic genes, all of the following codons have been shown to be depleted: AGA, AGG, AUA, CUA, and CCC (Table 1). BL21-CodonPlus competent cells are derivatives of BL21-Gold cells that have been engineered to include extra copies of genes that encode tRNAs for these rare *E. coli* codons. The additional availability of these tRNAs facilitates high level expression of many heterologous recombinant genes in BL21-CodonPlus competent cells (Figure 1). Overcoming codon bias saves time and labor by eliminating the need for site-directed mutagenesis or for expressing the protein in a eukaryotic expression system.

Organism	ACG arginine	AGA arginine	CUA leucine	AUA isoleucine	CCC proline
Escherichia coli	1.2	2.1	3.9	4.4	5.5
Homo sapiens	11.4	11.5	6.5	6.9	**20.0**
Drosophila melanogaster	6.4	5.1	8.2	9.2	**18.0**
Caenorhabditis elegans	4.0	**15.4**	8.0	9.7	4.5
Saccharomyces cerevisiae	9.3	**21.3**	13.4	**17.8**	6.8
Plasmodium falciparium	4.1	**20.2**	**15.2**	**33.2**	8.5
Clostridium pasteurianum	2.4	**29.4**	6.2	**50.0**	0.9
Pyrococcus horikoshii	**30.1**	**20.1**	**18.2**	**44.5**	10.2
Thermus aquaticus	14.3	1.3	3.6	1.4	**38.8**
Arabidopsis thaliana	10.9	**18.8**	10.0	12.7	5.3

Table 1. Codon Usage in Various Organisms
Codon frequencies are expressed as codons used per 1000 codons encountered. The arginine codons AGG and AGA are recognized by the same tRNA and should therefore be combined. Codon frequencies of more than 15 codons/1000 codons are shown in bold to help identify a codon bias that may cause problems for high-level expression in *E. coli*. These frequencies are updated regularly. A complete compilation of codon usage of the sequences in the GenBank database can be found at **www.kazusa.or.jp/codon/**.

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Strains of BL21-CodonPlus

BL21-CodonPlus-RP, BL21-CodonPlus (DE3)-RP, and **BL21-CodonPlus (DE3)-RP-X** have been optimized for expression of sequences from G-C rich genomes.

BL21-CodonPlus-RIL, BL21-CodonPlus (DE3)-RIL, and **BL21-CodonPlus (DE3)-RIL-X** have been optimized for expression of sequences from A-T rich genomes.

BL21-CodonPlus (DE3)-RIPL contains extra copies of all four rare tRNAs, and are therefore optimized for expression of sequences from both A-T and G-C rich genomes.

BL21-CodonPlus (DE3) contains a DE3 lysogen, which has the T7 RNA polymerase under the control of the lacUV5 promoter. Provides an all-purpose strain for high-level protein expression and easy induction with IPTG.

BL21-CodonPlus (DE3)-RP-X and **BL21-CodonPlus (DE3)-RIL-X** are methionine auxotrophic variants that allow efficient labeling of recombinant proteins with selenomethionine or ^{35}S-methionine.

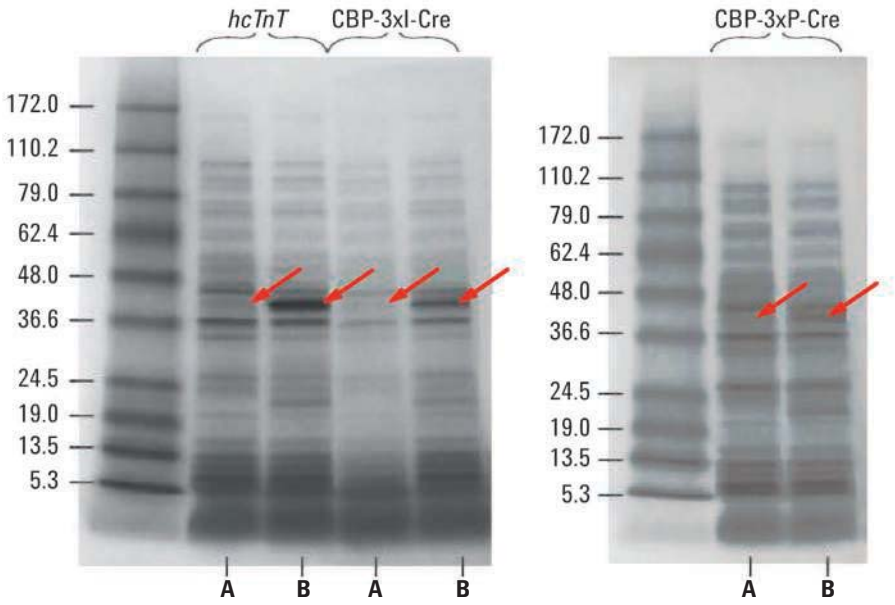

Figure 1. BL21-CodonPlus Provides Superior Eukaryotic Protein Expression in *E. coli*
The human cardiac troponin-T gene (*hcTnT*) (*argU* dependent) and two test genes, CBP-3xI-Cre (*ileW* dependent) and CBP-3xP-Cre (*proL* dependent) were expressed in either parental (**A**) BL21 (DE3) or (**B**) BL21-CodonPlus (DE3)-RIPL Competent Cells. As shown, the BL21-CodonPlus (DE3)-RIPL cells dramatically improve expression of proteins from both AT- and GC-rich genomes.

Ordering Information

Product Description	Extra Copies of tRNA Genes	Genotypes	Part Number
BL21-CodonPlus-RIL Competent Cells	argU, ileY, leuW	*E. coli* B F$^-$ *ompT hsdS*(r_B^- m_B^-) *dcm*+ Tet^r *gal endA* Hte [*argU ileY leuW* Cam^r]	230240
BL21-CodonPlus (DE3)-RIL Competent Cells	argU, ileY, leuW	*E. coli* B F$^-$ *ompT hsdS*(r_B^- m_B^-) *dcm*+ Tet^r *gal λ* (DE3) *endA* Hte [*argU ileY leuW* Cam^r]	230245
BL21-CodonPlus-RP Competent Cells	argU, proL	*E. coli* B F$^-$ *ompT hsdS*(r_B^- m_B^-) *dcm*+ Tet^r *gal endA* Hte [*argU proL* Cam^r]	230250
BL21-CodonPlus (DE3)-RP Competent Cells	argU, proL	*E. coli* B F$^-$ *ompT hsdS*(r_B^- m_B^-) *dcm*+ Tet^r *gal λ* (DE3) *endA* Hte [*argU proL* Cam^r]	230255
BL21-CodonPlus (DE3)-RIPL Competent Cells	argU, ileY, proL, leuW	*E. coli* B F$^-$ *ompT hsdS*(r_B^- m_B^-) *dcm*+ Tet^r *gal λ*(DE3) *endA* Hte [*argU proL* Cam^r] [*argU ileY leuW* Step/Spec^r]	230280
BL21-CodonPlus (DE3)-RIL-X Competent Cells	argU, ileY, leuW	*E. coli* B F$^-$ *ompT hsdS*(r_B^- m_B^-) *dcm*+ Tet^r *gal λ* (DE3) *endA* Hte *metA*::Tn5(Kan^r) [*argU ileY leuW* Cam^r]	230265
BL21-CodonPlus (DE3)-RP-X Competent Cells	argU, proL	*E. coli* B F$^-$ *ompT hsdS*(r_B^- m_B^-) *dcm*+ Tet^r *gal λ* (DE3) *endA* Hte *metA*::Tn5(Kan^r) [*argU proL* Cam^r]	230275

Note: *E. coli* B is naturally lonB-deficient.

For more information

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Learn more

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