

Supplementary Table 1.

A. Single Cpf1 crRNAs and SpCas9 gRNAs

Name	Spacer Sequence with Cpf1 PAM	Genomic coordinates
HBB_1 crRNA (H1)	TTTG TACTGATGGTATGGGGCCAA	Chr11: 5248505 - 5248528
HBB_2 crRNA (H2)	TTTGA AGTCCAACCTCCTAAGCCAG	Chr11: 5248452 - 5248475
HBB_3 crRNA (H3)	TTTGCA AGTGTATTTACGTAATAT	Chr11: 5248550 - 5248573
AR_1 crRNA (A1)	TTTGAG AGTCTGGATGAGAAATGC	ChrX: 66763209 - 66763232
AR_2 crRNA (A2)	TTTCT ACCCTCTTCTCTGCCTTTC	ChrX: 66763260 - 66763283
AR_3 crRNA (A3)	TTTGCT CTAGGAACCCTCAGCCCC	ChrX: 66763299 - 66763322
NPY1R_1 crRNA (N1)	TTTCA AGCCTCGGGAAACTGCCCT	Chr4: 164254005 - 164254028
NPY1R_2 crRNA (N2)	TTTCTTT GTTTGCAGGTCAGTGCC	Chr4: 164254048 - 164254071
NPY1R_3 crRNA (N3)	TTTGGG CTGGCGCTCGAGCTCTCC	Chr4: 164254099 - 164254122
CD22_1_crRNA	TTTCCT CCTCAATATCTATGTGCT	Chr19: 35819609 -35819632
CD22_2_crRNA	TTTCAT CATAGGCATAAATGGTGG	Chr19: 35819677- 35819700
CD22_3_crRNA	TTTATG CCTATGATGAAAAGAGTG	Chr19: 35819683 -35819706
CD22_4_crRNA	TTTAGT GACACCATCCAGTTATTA	Chr19: 35819714- 35819737
CD22_5_crRNA	TTTGTA GTTTAGTGACACCATCCA	Chr19: 35819721- 35819744
CD22_6_crRNA	TTTCAG CGGGCTGCAGTTCTCCTG	Chr19: 35819769 -35819792
CD22_7_crRNA	TTTCTG AGAGCTGGGTAGAGGGG	Chr19: 35819813- 35819836
CD22_8_crRNA	TTTCAGA ATGGGCTCCTCCACAAC	Chr19: 35819839- 35819862
CD22_9_crRNA	TTTGCA ATATCAGATCAGTTTCAG	Chr19: 35819857- 35819880
CD22_10_crRNA	TTTCCG TGTATGGGTTTGCAATAT	Chr19: 35819871-35819894
CD22_11_crRNA	TTTCCCC ACTCCCCAGATCACGGT	Chr19: 35819965- 35819988
CD22_12_crRNA	TTTCCC CTCCATGGCCACACCCCC	Chr19: 3582002- 35820046
CD22_13_crRNA	TTTGCT CTCAGATGCTGCCAGGGT	Chr19: 3582008- 35820104
CD22_14_crRNA	TTTCCG CGTGTCTTCCCTCTTCAG	Chr19: 35820107- 35820130
CD22_15_crRNA	TTTACCT GTTTCCGCGTGTCTTCC	Chr19: 35820115-35820138
CD22_16_crRNA	TTTGCA TTCAACAAGCAAGTTATT	Chr19: 35820156- 35820179
CD5_1_crRNA	TTTCCAT GTTGTGTGTTTGTGATT	Chr11: 60869058- 60869081
CD5_2_crRNA	TTTCTG TGTTGTGTGTGATCTCCA	Chr11: 60869176-60869199
CD5_3_crRNA	TTTGCT AGCAAGTACAAGAGATGG	Chr11: 60869454- 60869477
CD5_4_crRNA	TTTGAG CTGACTTTCCACAGGTGG	Chr11: 60869481- 60869504
CD5_5_crRNA	TTTGTG AGGGATGAGGTTGGAAGT	Chr11: 60869504 -60869527
CD5_6_crRNA	TTTGGC TTTCACTGGAGTCTGCAA	Chr11: 60869548 -60869571
CD5_7_crRNA	TTTACT GGAGTCTGCAACAAGAA	Chr11: 60869554- 60869577
CD5_8_crRNA	TTTCCC GCCTCTCCCCACCCAGAC	Chr11: 60869596 - 60869619
CD5_9_crRNA	TTTGA ATGGCAGCCCTGGCCTCTG	Chr11: 60869804- 60869827
CD5_10_crRNA	TTTGA AGTTGAACTGTCAACTTCC	Chr11: 60869852- 60869875
CD5_11_crRNA	TTTGCC AGGAGGAAGTTGACAGTT	Chr11: 60869842- 60869865
CD5_12_crRNA	TTTACCC AAGGCTGACTCTGGGAT	Chr11: 60870156 -60870179

CD5_13_crRNA	TTTGGGGCCACTGGGATCCCTGCC	Chr11: 6087021- 60870235
CD5_14_crRNA	TTTACCCTTCCAGTGCAAGAGAGA	Chr11: 60870331 60870354
CD5_15_crRNA	TTTGATGGGGCCCAGACAACTTGA	Chr11: 60870373 60870396
CD5_16_crRNA	TTTAGCAGAGCATTGAGGCCTCCC	Chr11: 60870416 60870439

Name	Spacer Sequence with SpCas9 PAM	Genomic coordinates
VEGFA_1	GTGTGCAGACGGCAGTCACT AGG	Chr6: 43737352 - 43737374
VEGFA_2	GAGCAGCGTCTTCGAGAGT AGG	Chr6: 43737414 - 43737436
VEGFA_3	GGTGAGTGAGTGTGTGCGT TGG	Chr6: 43737454- 43737476

B. Multiplex Cpf1 crRNAs targeting a single promoter

Name	Pair #	Oligonucleotides sequences to be ordered	Orientation
HBB_MST	Pair1	AGATTACTGATGGTATGGGGCCAAA	Top
		TAGTAGAAATTTGGCCCCATACCATCAGTA	Bottom
	Pair 2	ATTTCTACTAAGTGTAGATAAGTCCAACCTCCTA AGCCAGAATTTCTACTAA	Top
		ATCTACACTTAGTAGAAATTCTGGCTTAGGAG TTGGACTTATCTACTACT	Bottom
	Pair 3	GTGTAGATCAAGTGTATTTACGTAATATAATTT CTACTAAGTGTAGATTTTTTTTA	Top
		AGCTTAAAAAAAATCTACACTTAGTAGAAATTA TATTACGTAATACTACTTG	Bottom
AR_MST	Pair1	AGATAGAGTCTGGATGAGAAATGCA	Top
		TAGTAGAAATTGCATTTCTCATCCAGACTCT	Bottom
	Pair 2	ATTTCTACTAAGTGTAGATTACCCTCTTCTCTG CCTTTCAATTTCTACTAA	Top
		ATCTACACTTAGTAGAAATTGAAAGGCAGAGA AGAGGGTAATCTACTACT	Bottom
	Pair 3	GTGTAGATCTCTAGGAACCCTCAGCCCCAATT TCTACTAAGTGTAGATTTTTTTTA	Top
		AGCTTAAAAAAAATCTACACTTAGTAGAAATTG GGGCTGAGGGTTCCCTAGAG	Bottom
NPY1R_MST	Pair1	AGATAAGCCTCGGGAAACTGCCCTA	Top
		TAGTAGAAATTAGGGCAGTTTCCCGAGGCTT	Bottom

	Pair 2	ATTTCTACTAAGTGTAGATTTTGTTCAGGTC AGTGCCAATTTCTACTAA	Top
		ATCTACACTTAGTAGAAATTGGCACTGACCTG CAAACAAAATCTACTACT	Bottom
	Pair 3	GTGTAGATGGCTGGCGCTCGAGCTCTCCAAT TTCTACTAAGTGTAGATTTTTTTTA	Top
		AGCTTAAAAAAAATCTACACTTAGTAGAAATTG GAGAGCTCGAGCGCCAGCC	Bottom

C. Multiplex Cpf1 crRNAs targeting multiple promoters

Name	Pair #	Oligonucleotides sequences to be ordered	Orientation
HBB_AR_NPY1R _MST	Pair 1	AGATTACTGATGGTATGGGGCCAAA	Top
		TAGTAGAAATTTGGCCCCATACCATCAGTA	Bottom
	Pair 2	ATTTCTACTAAGTGTAGATCTCTAGGAACCCTC AGCCCCAATTTCTACTAA	Top
		ATCTACACTTAGTAGAAATTGGGGCTGAGGGT TCCTAGAGATCTACTACT	Bottom
	Pair 3	GTGTAGATAAGCCTCGGGAACTGCCCTAATT TCTACTAAGTGTAGATTTTTTTTA	Top
		AGCTTAAAAAAAATCTACACTTAGTAGAAATTA GGGCAGTTTCCCGAGGCTT	Bottom

Supplementary Table 2.

Primer name	Sequence	Orientation	Target Gene	Purpose
oET_173	ATGGTGAGCAGAGTGCCCTATC	Forward	<i>NPY1R</i>	RT-qPCR
oET_174	ATGGTCCCTGGCAGTCTCCAAA	Reverse		
oET_175	CCATCGGACTCTCATAGGTTGTC	Forward	<i>AR</i>	
oET_176	GACCTGTACTTATTGTCTCTCATC	Reverse		
oET_225	GCACGTGGATCCTGAGAACT	Forward	<i>HBB</i>	
oET_226	ATTGGACAGCAAGAAAGCGAG	Reverse		

qPCR condition	Number of Cycle	Temperature(°C)	Time(sec)
Denaturation	1	95	20
Amplification	45	95	3
		60	30

Supplementary Note 1

Initial characterization of dLbCpf1- and dAsCpf1-based activators

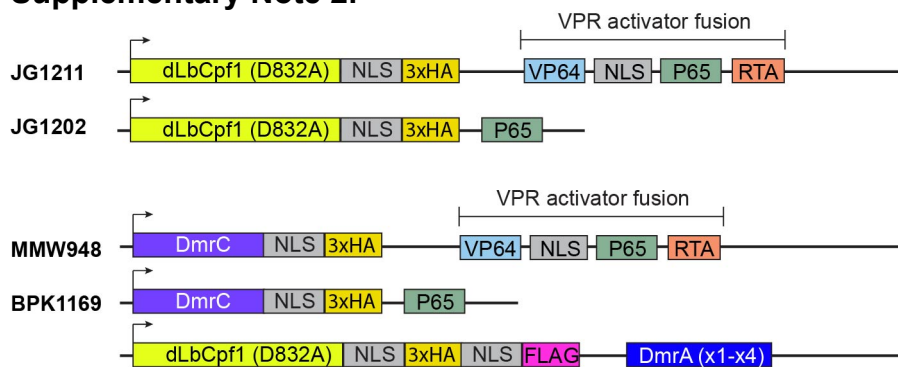
Initial GFP reporter-based assay experiments showed that a “dead” Cpf1 from *Lachnospiraceae* bacterium (**dLbCpf1**)-VPR fusion induced higher levels of gene activation than a “dead” *Acidaminococcus* sp. BV3L6 Cpf1 (**dAsCpf1**)-VPR fusion (**Supplementary Figs. 1a – 1c**). This difference is consistent with previous reports from our group showing that LbCpf1 generally exhibits higher genome-editing activities than AsCpf1 in human cells¹. Western blots performed with these fusions showed only modestly lower expression of the dAsCpf1-VPR compared with dLbCpf1-VPR (**Supplementary Fig. 1d**). Based on these results, we chose to use the dLbCpf1 protein for building activators.

Attempts to optimize MST crRNA-mediated transcriptional activation

We attempted to optimize the activities of MST crRNAs relative to single individually expressed crRNAs and focused on dLbCpf1-VPR because as a single protein system (as opposed to the two-protein drug-inducible systems) it has fewer parameters to vary. We altered the relative and absolute amounts of plasmids encoding crRNAs and dLbCpf1-VPR protein and also tested more extended post-transfection time points but did not observe any substantial improvements relative to our initial experimental conditions (compare **Supplementary Fig. 4** to **Fig. 2d**). For example, for the MST crRNA targeted to the *NPY1R* gene, the level of activation consistently remained between ~45% and 80% of that observed with the individually expressed crRNA across all biological replicates. For the *HBB* and *AR* genes, matched single individually

expressed and MST crRNAs still showed comparable activation levels across the different optimization conditions. We conclude from these results that differences observed between single and MST crRNAs are likely target site-dependent and that further optimization will be required to achieve consistently equivalent activities (e.g., changes to MST crRNA transcript architecture or other alterations to the activators).

Supplementary Note 2.



	Name	Addgene #	Description
1	MMW1578	TBD	pCAG-human dLbCpf1(D832A)-NLS-3xHA
2	BPK1169	TBD	pCAG-DmrC-NLS-FLAG-P65
3	MMW948	TBD	pCAG-DmrC-NLS-FLAG-VPR
4	JG1202	TBD	pCAG-human dLbCpf1(D832A)-NLS-3xHA-p65
5	JG1211	TBD	pCAG-human dLbCpf1(D832A)-NLS-3xHA-VPR
6	JG674	TBD	pCAG-human dLbCpf1(D832A)-NLS-3xHA-DmrA(X1)
7	JG676	TBD	pCAG-human dLbCpf1(D832A)-NLS-3xHA-DmrA(X2)
8	JG693	TBD	pCAG-human dLbCpf1(D832A)-NLS-3xHA-DmrA(X3)
9	YET1000	TBD	pCAG-human dLbCpf1(D832A)-NLS-3xHA-DmrA(X4)
10	BPK3082	78742	pU6-LbCpf1-crRNA-BsmBIcassette
11	BPK617	TBD	pCAG-NLS-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG-VP64
12	BPK1160	TBD	pCAG-NLS-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG-p65
13	BPK278	TBD	pCAG-VP64-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG
14	BPK1163	TBD	pCAG-p65-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG

15	BPK1019	TBD	pCAG-NLS-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG-DmrA
16	BPK1033	TBD	pCAG-NLS-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG-DmrA(x2)
17	BPK1040	TBD	pCAG-NLS-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG-DmrA(x3)
18	BPK1179	TBD	pCAG-NLS-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG-DmrA(x4)
19	BPK975	TBD	pCAG-DmrA-NLS-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG
20	BPK976	TBD	pCAG-DmrA(x2)-NLS-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG
21	BPK1143	TBD	pCAG-DmrA(x3)-NLS-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG
22	BPK1147	TBD	pCAG-DmrA(x4)-NLS-human-dSpCas9(D10A/H840)-NLS(SV40)-3xFLAG
23	JKNp44	TBD	pHR-SFFV-HA-NLS-dSpCas9(D10A/H840)-VPR-2PA-BFP
24	JKNp47	TBD	pHR-SFFV-HA-NLS-dLbCpf1(D832A)-VPR-2PA-BFP
25	JKNp49	TBD	pHR-SFFV-HA-NLS-dAsCpf1(D908A/E993A)-VPR-2PA-BFP

1. MMW1578: CAG-human dLbCpf1(D832A)-NLS-3xHA

Human codon optimized dLbCpf1: **bold**, NLS: *italic*, 3xHA: lower case

ATGAGCAAGCTGGAGAAGTTTACAAACTGCTACTCCCTGTCTAAGACCCTGAGGT
TCAAGGCCATCCCTGTGGGCAAGACCCAGGAGAACATCGACAATAAGCGGCTGC
TGGTGGAGGACGAGAAGAGAGCCGAGGATTATAAGGGCGTGAAGAAGCTGCTG
GATCGCTACTATCTGTCTTTTATCAACGACGTGCTGCACAGCATCAAGCTGAAGA
ATCTGAACAATTACATCAGCCTGTTCCGGAAGAAAACCAGAACCAGAGAAGGAGA
ATAAGGAGCTGGAGAACCTGGAGATCAATCTGCGGAAGGAGATCGCCAAGGCCT
TCAAGGGCAACGAGGGCTACAAGTCCCTGTTTAAAGAAGGATATCATCGAGACAA
TCCTGCCAGAGTTCCTGGACGATAAGGACGAGATCGCCCTGGTGAACAGCTTCA
ATGGCTTTACACAGCCTTACCAGGCTTCTTTGATAACAGAGAGAATATGTTTTCC
GAGGAGGCAAGAGCACATCCATCGCCTTCAGGTGTATCAACGAGAATCTGACC
CGCTACATCTCTAATATGGACATCTTCGAGAAGGTGGACGCCATCTTTGATAAGC
ACGAGGTGCAGGAGATCAAGGAGAAGATCCTGAACAGCGACTATGATGTGGAGG
ATTTCTTTGAGGGCGAGTTCTTTAACTTTGTGCTGACACAGGAGGGCATCGACGT
GTATAACGCCATCATCGGCGGCTTCGTGACCGAGAGCGGCGAGAAGATCAAGGG
CCTGAACGAGTACATCAACCTGTATAATCAGAAAACCAAGCAGAAGCTGCCTAA
GTTTAAAGCCACTGTATAAGCAGGTGCTGAGCGATCGGGAGTCTCTGAGCTTCTAC
GGCGAGGGCTATACATCCGATGAGGAGGTGCTGGAGGTGTTTAGAAACACCCTG
AACAAGAACAGCGAGATCTTCAGCTCCATCAAGAAGCTGGAGAAGCTGTTCAAG
AATTTTGACGAGTACTCTAGCGCCGGCATCTTTGTGAAGAACGGCCCCGCCATCA
GCACAATCTCCAAGGATATCTTCGGCGAGTGAACGTGATCCGGGACAAGTGGA
ATGCCGAGTATGACGATATCCACCTGAAGAAGAAGGCCGTGGTGACCGAGAAGT
ACGAGGACGATCGGAGAAAGTCCTTCAAGAAGATCGGCTCCTTTTCTCTGGAGCA
GCTGCAGGAGTACGCCGACCCGATCTGTCTGTGGTGGAGAAGCTGAAGGAGAT
CATCATCCAGAAGGTGGATGAGATCTACAAGGTGTATGGCTCCTCTGAGAAGCTG
TTCGACGCCGATTTTGTGCTGGAGAAGAGCCTGAAGAAGAACGACGCCGTGGTG
GCCATCATGAAGGACCTGCTGGATTCTGTGAAGAGCTTCGAGAATTACATCAAGG
CCTTCTTTGGCGAGGGCAAGGAGACAAACAGGGACGAGTCCTTCTATGGCGATTT
TGTGCTGGCCTACGACATCCTGCTGAAGGTGGACCACATCTACGATGCCATCCGC
AATTATGTGACCCAGAAGCCCTACTCTAAGGATAAGTTCAAGCTGTATTTTCAGAA

CCCTCAGTTCATGGGCGGCTGGGACAAGGATAAGGAGACAGACTATCGGGCCAC
CATCCTGAGATACGGCTCCAAGTACTATCTGGCCATCATGGATAAGAAGTACGCC
AAGTGCCTGCAGAAGATCGACAAGGACGATGTGAACGGCAATTACGAGAAGATC
AACTATAAGCTGCTGCCCGGCCCTAATAAGATGCTGCCAAAGGTGTTCTTTTCTA
AGAAGTGGATGGCCTACTATAACCCAGCGAGGACATCCAGAAGATCTACAAGA
ATGGCACATTCAAGAAGGGCGATATGTTTAACTGAATGACTGTCACAAGCTGAT
CGACTTCTTTAAGGATAGCATCTCCCGGTATCCAAAGTGGTCCAATGCCTACGAT
TTCAACTTTTCTGAGACAGAGAAGTATAAGGACATCGCCGGCTTTTACAGAGAGG
TGGAGGAGCAGGGCTATAAGGTGAGCTTCGAGTCTGCCAGCAAGAAGGAGGTG
GATAAGCTGGTGGAGGAGGGCAAGCTGTATATGTTCCAGATCTATAACAAGGACT
TTTCCGATAAGTCTCACGGCACACCCAATCTGCACACCATGTACTTCAAGCTGCT
GTTTGACGAGAACAATCACGGACAGATCAGGCTGAGCGGAGGAGCAGAGCTGTT
CATGAGGCGCGCCTCCCTGAAGAAGGAGGAGCTGGTGGTGCACCCAGCCAACTC
CCCTATCGCCAACAAGAATCCAGATAATCCCAAGAAAACCACAACCCTGTCCTAC
GACGTGTATAAGGATAAGAGGTTTTCTGAGGACCAGTACGAGCTGCACATCCCAA
TCGCCATCAATAAGTGCCCAAGAACATCTTCAAGATCAATACAGAGGTGCGCGT
GCTGCTGAAGCACGACGATAACCCCTATGTGATCGGCATCGCCAGGGGCGAGCG
CAATCTGCTGTATATCGTGGTGGTGGACGGCAAGGGCAACATCGTGGAGCAGTA
TTCCCTGAACGAGATCATCAACAACCTTCAACGGCATCAGGATCAAGACAGATTAC
CACTCTCTGCTGGACAAGAAGGAGAAGGAGAGGTTTCGAGGCCCGCCAGAAGTG
GACCTCCATCGAGAATATCAAGGAGCTGAAGGCCGGCTATATCTCTCAGGTGGT
GCACAAGATCTGCGAGCTGGTGGAGAAGTACGATGCCGTGATCGCCCTGGAGGA
CCTGAAGTCTGGCTTTAAGAATAGCCGCGTGAAGGTGGAGAAGCAGGTGTATCA
GAAGTTCGAGAAGATGCTGATCGATAAGCTGAACTACATGGTGGACAAGAAGTC
TAATCCTTGTGCAACAGGCGGCGCCCTGAAGGGCTATCAGATCACCAATAAGTTC
GAGAGCTTTAAGTCCATGTCTACCCAGAACGGCTTCATCTTTTACATCCCTGCCTG
GCTGACATCCAAGATCGATCCATCTACCGGCTTTGTGAACCTGCTGAAAACCAAG
TATACCAGCATCGCCGATTCCAAGAAGTTCATCAGCTCCTTTGACAGGATCATGT
ACGTGCCCGAGGAGGATCTGTTGAGTTTGGCCCTGGACTATAAGAACTTCTCTCG
CACAGACGCCGATTACATCAAGAAGTGGAAAGCTGTAATCCTACGGCAACCGGAT
CAGAATCTTCCGGAATCCTAAGAAGAACAACGTGTTGACTGGGAGGAGGTGTG
CCTGACCAGCGCCTATAAGGAGCTGTTCAACAAGTACGGCATCAATTATCAGCAG
GGCGATATCAGAGCCCTGCTGTGCGAGCAGTCCGACAAGGCCTTCTACTTAGCT
TTATGGCCCTGATGAGCCTGATGCTGCAGATGCGGAACAGCATCACAGGCCGCA
CCGACGTGGATTTTCTGATCAGCCCTGTGAAGAACTCCGACGGCATCTTCTACGA
TAGCCGGAAGTATGAGGCCAGGAGAATGCCATCCTGCCAAAGAACGCCGACGC
CAATGGCGCCTATAACATCGCCAGAAAGGTGCTGTGGGCCATCGGCCAGTTCAA
GAAGGCCGAGGACGAGAAGCTGGATAAGGTGAAGATCGCCATCTCTAACAAGGA
GTGGCTGGAGTACGCCAGACCAGCGTGAAGCACAAAAGGCCGGCGGCCACGAA
AAAGGCCGGCCAGGCCAAAAAAGAAAAAGGGATCCtaccatacgatgtccagattacgcttatccc
tacgacgtgcctgattatgcataccatgatgtccccgactatgccTAA

2. BPK1169: CAG-DmrC-NLS-FLAG-P65

DmrC: **bold**, NLS-Flag: *italic*, P65: lower case

ATGGGATCCAGAATCCTCTGGCATGAGATGTGGCATGAAGGCCTGGAAGAGGCA
TCTCGTTTGTACTTTGGGGAAAGGAACGTGAAAGGCATGTTTGAGGTGCTGGAGC
CCTTGATGCTATGATGGAACGGGGACCCAGACTCTGAAGGAAACATCCTTTAA
TCAGGCCTATGGTCGAGATTTAATGGAGGCCCAAGAGTGGTGCAGGAAGTACAT

**GAAATCAGGGAATGTCAAGGACCTCCTCCAAGCCTGGGACCTCTATTATCATGTG
TTCCGACGAATCTCAAAGGGCGGCGGATCCCCAAGAAGAAGAGGAAAGTCTCGA
GCGACTACAAAGACCATGACGGTGATTATAAAGATCATGACATCGATTACAAGGAT
GACGATGACAAGGCTGCAGGAGGCGGTGGAAGCGG**Gatggagtccagtacctgccagataca
gacgatcgtcaccggattgaggagaaacgtaaaaggacatatgacacctcaagagcatcatgaagaagagtcctttca
gcgaccaccgacccccggcctccacctgacgcattgctgtgccttcccgcagctcagcttctgtcccaagccagcac
cccagccctatcccttacgtcatccctgagcaccatcaactatgatgagttcccaccatgggtttccttctgggcagatcag
ccaggcctcggccttgccccggccccctcccgaagtctgccccaggctccagcccctgcccctgctccagccatggtatc
agctctggcccaggccccagcccctgtcccagtctagccccaggccctcctcaggctgtggccccacctgcccccaagc
ccaccaggctggggaaggaacgctgtcagaggccctgctgcagctgcagttgatgatgaagacctgggggcttgctt
ggcaacagcacagaccagctgtgttcacagacctggcatccgtcgataactccgagtttcagcagctgctgaaccaggg
catacctgtggccccacacaactgagccatgctgatggagtaccctgaggctataactcgcctagtgcagggggccc
agaggccccccgaccagctcctgctccactggggggccccggggctcccgaatggcctccttcaggagatgaagacttc
tcctccattgcgacatggacttctcagccctgctgagtcagatcagctctTAA

3. MMW948: CAG-DmrC-NLS-FLAG-VPR

DmrC: **bold**, NLS-Flag: *italic*, VP64: **red**, NLS: *italic and underline*, p65: **blue**, Rta: **orange**

ATGGGATCCAGAATCCTCTGGCATGAGATGTGGCATGAAGGCCTGGAAGAGGCA
TCTCGTTTGTACTTTGGGGAAAGGAACGTGAAAGGCATGTTTGAGGTGCTGGAGC
CCTTGCATGCTATGATGGAACGGGGACCCAGACTCTGAAGGAAACATCCTTTAA
TCAGGCCTATGGTCGAGATTTAATGGAGGCCAAGAGTGGTGCAGGAAGTACAT
**GAAATCAGGGAATGTCAAGGACCTCCTCCAAGCCTGGGACCTCTATTATCATGTG
TTCCGACGAATCTCAAAGGGCGGCGGATCCCCAAGAAGAAGAGGAAAGTCTCGA
GCGACTACAAAGACCATGACGGTGATTATAAAGATCATGACATCGATTACAAGGAT
GACGATGACAAGGCTGCAGGAGGCGGTGGAAGCGGTCGGAGGCCAGCGGTTCC
GGACGGGCT****GACGCATTGGACGATTTT****GATCTGGATATGCTGGGAAGTGACGCC
TCGATGATTTTGACCTTGACATGCTTGGTTCCGATGCCCTTGATGACTTTGACCTCG
ACATGCTCGGCAGTGACGCCCTTGATGATTTCGACCTGGACATGCTG**ATTAActCT
AGAAGTTCCGGATCTCCGAAAAAGAAACGCAAAGTTGGTAGCCAGTACCTGCCCGA
CACCGACGACCGGCACCGGATCGAGGAAAAGCGGAAGCGGACCTACGAGACATT
CAAGAGCATCATGAAGAAGTCCCCCTCAGCGGCCCCACCGACCCTAGACCTCCA
CCTAGAAGAATCGCCGTGCCAGCAGATCCAGCGCCAGCGTGCCAAAACCTGCC
CCCAGCCTTACCCCTTACCAGCAGCCTGAGCACCATCAACTACGACGAGTTCCT
ACCATGGTGTTCGCCAGCGGCCAGATCTCTCAGGCCTCTGCTCTGGCTCCAGCCC
CTCCTCAGGTGCTGCCTCAGGCTCCTGCTCCTGCACCAGCTCCAGCCATGGTGT
TGCACTGGCTCAGGCACCAGCACCCGTGCCTGTGCTGGCTCCTGGACCTCCACAG
GCTGTGGCTCCACCAGCCCCTAAAC**CTACACAGGCCGGCGAGGGCACACTGTCTG
AAGCTCTGCTGCAGCTGCAGTTCGACGACGAGGATCTGGGAGCCCTGCTGGGAAA
CAGCACCGATCCTGCCGTGTTACCGACCTGGCCAGCGTGGACAACAGCGAGTTC
CAGCAGCTGCTGAACCAGGGCATCCCTGTGGCCCTCACACCACCGAGCCATGC
TGATGGAATACCCCGAGGCCATCACCCGGCTCGTGACAGGCGCTCAGAGGCCCTCC
TGATCCAGCTCCTGCCCTCTGGGAGCACAGGCCTGCCTAATGGACTGCTGTCT
GGCGACGAGGACTTCAGCTCTATCGCCGATATGGATTTCTCAGCCTTGCTGGGCTC
TGGCAGCGGCAGC****CGGGATTCCAGGGAAGGGATGTTTTTGCCGAAGCCTGAGGC
CGGCTCCGCTATTAGTGACGTGTTT****GAGGGCCGCGAGGTGTGCCAGCCAAAACGA**

ATCCGGCCATTTTCATCCTCCAGGAAGTCCATGGGCCAACCGCCCACTCCCCGCCA
GCCTCGCACCAACACCAACCGGTCCAGTACATGAGCCAGTCGGGTCCTGACCCC
GGCACCAGTCCCTCAGCCACTGGATCCAGCGCCCGCAGTGAATCCCGAGGCCAGT
CACCTGTTGGAGGATCCCGATGAAGAGACGAGCCAGGCTGTCAAAGCCCTTCGGG
AGATGGCCGATACTGTGATTCCCCAGAAGGAAGAGGCTGCAATCTGTGGCCAAAT
GGACCTTTCCCATCCGCCCCCAAGGGGCCATCTGGATGAGCTGACAACCACACTT
GAGTCCATGACCGAGGATCTGAACCTGGACTCACCCCTGACCCCGGAATTGAACG
AGATTCTGGATACCTTCCGTAACGACGAGTGCCTCTTGCATGCCATGCATATCAGC
ACAGGACTGTCCATCTTCGACACATCTCTGTTT

4. JG1202: CAG-human dLbCpf1(D832A)-NLS-3xHA-P65

Human codon optimized dLbCpf1: **bold**, NLS: *italic*, 3xHA: lower case, P65: lower case and **bold**

ATGAGCAAGCTGGAGAAGTTTACAAACTGCTACTCCCTGTCTAAGACCCTGAGGT
TCAAGGCCATCCCTGTGGGCAAGACCCAGGAGAACATCGACAATAAGCGGCTGC
TGGTGGAGGACGAGAAGAGAGCCGAGGATTATAAGGGCGTGAAGAAGCTGCTG
GATCGCTACTATCTGTCTTTTATCAACGACGTGCTGCACAGCATCAAGCTGAAGA
ATCTGAACAATTACATCAGCCTGTTCCGGAAGAAAACCAGAACCAGAGAAGGAGA
ATAAGGAGCTGGAGAACCCTGGAGATCAATCTGCGGAAGGAGATCGCCAAGGCCT
TCAAGGGCAACGAGGGCTACAAGTCCCTGTTAAGAAGGATATCATCGAGACAA
TCCTGCCAGAGTTCCTGGACGATAAGGACGAGATCGCCCTGGTGAACAGCTTCA
ATGGCTTTACCACAGCCTTACCAGGCTTCTTTGATAACAGAGAGAATATGTTTTCC
GAGGAGGCCAAGAGCACATCCATCGCCTTCAGGTGTATCAACGAGAATCTGACC
CGCTACATCTCTAATATGGACATCTTCGAGAAGGTGGACGCCATCTTTGATAAGC
ACGAGGTGCAGGAGATCAAGGAGAAGATCCTGAACAGCGACTATGATGTGGAGG
ATTTCTTTGAGGGCGAGTTCTTTAACTTTGTGCTGACACAGGAGGGCATCGACGT
GTATAACGCCATCATCGGCGGCTTCGTGACCGAGAGCGGCGAGAAGATCAAGGG
CCTGAACGAGTACATCAACCTGTATAATCAGAAAACCAAGCAGAAGCTGCCTAA
GTTTAAGCCACTGTATAAGCAGGTGCTGAGCGATCGGGAGTCTCTGAGCTTCTAC
GGCGAGGGCTATACATCCGATGAGGAGGTGCTGGAGGTGTTTAGAAACACCCTG
AACAAGAACAGCGAGATCTTCAGCTCCATCAAGAAGCTGGAGAAGCTGTTCAAG
AATTTTGACGAGTACTCTAGCGCCGGCATCTTTGTGAAGAACGGCCCCGCCATCA
GCACAATCTCCAAGGATATCTTCGGCGAGTGGAACGTGATCCGGGACAAGTGGA
ATGCCGAGTATGACGATATCCACCTGAAGAAGAAGGCCGTGGTGACCGAGAAGT
ACGAGGACGATCGGAGAAAGTCCTTCAAGAAGATCGGCTCCTTTTCTCTGGAGCA
GCTGCAGGAGTACGCCGACGCCGATCTGTCTGTGGTGGAGAAGCTGAAGGAGAT
CATCATCCAGAAGGTGGATGAGATCTACAAGGTGTATGGCTCCTCTGAGAAGCTG
TTCGACGCCGATTTTGTGCTGGAGAAGAGCCTGAAGAAGAACGACGCCGTGGTG
GCCATCATGAAGGACCTGCTGGATTCTGTGAAGAGCTTCGAGAATTACATCAAGG
CCTTCTTTGGCGAGGGCAAGGAGACAAACAGGGACGAGTCTTCTATGGCGATTT
TGTGCTGGCCTACGACATCCTGCTGAAGGTGGACCACATCTACGATGCCATCCGC
AATTATGTGACCCAGAAGCCCTACTCTAAGGATAAGTTCAAGCTGTATTTTCAGAA
CCCTCAGTTCATGGGCGGCTGGGACAAGGATAAGGAGACAGACTATCGGGCCAC
CATCCTGAGATACGGCTCCAAGTACTATCTGGCCATCATGGATAAGAAGTACGCC
AAGTGCCTGCAGAAGATCGACAAGGACGATGTGAACGGCAATTACGAGAAGATC
AACTATAAGCTGCTGCCCGGCCCTAATAAGATGCTGCCAAAGGTGTTCTTTTCTA

AGAAGTGGATGGCCTACTATAACCCCAGCGAGGACATCCAGAAGATCTACAAGA
ATGGCACATTCAAGAAGGGCGATATGTTTAACTGAATGACTGTCACAAGCTGAT
CGACTTCTTTAAGGATAGCATCTCCCGGTATCCAAAGTGGTCCAATGCCTACGAT
TTCAACTTTTCTGAGACAGAGAAGTATAAGGACATCGCCGGCTTTTACAGAGAGG
TGGAGGAGCAGGGCTATAAGGTGAGCTTCGAGTCTGCCAGCAAGAAGGAGGTG
GATAAGCTGGTGGAGGAGGGCAAGCTGTATATGTTCCAGATCTATAACAAGGACT
TTTCCGATAAGTCTCACGGCACACCCAATCTGCACACCATGTACTTCAAGCTGCT
GTTTGACGAGAACAATCACGGACAGATCAGGCTGAGCGGAGGAGCAGAGCTGTT
CATGAGGCGCGCCTCCCTGAAGAAGGAGGAGCTGGTGGTGCACCCAGCCAACCTC
CCCTATCGCCAACAAGAATCCAGATAATCCCAAGAAAACCACAACCCTGTCCTAC
GACGTGTATAAGGATAAGAGGTTTTCTGAGGACCAGTACGAGCTGCACATCCCAA
TCGCCATCAATAAGTGCCCAAGAACATCTTCAAGATCAATACAGAGGTGCGCGT
GCTGCTGAAGCACGACGATAACCCCTATGTGATCGGCATCGCCAGGGGCGAGCG
CAATCTGCTGTATATCGTGGTGGTGGACGGCAAGGGCAACATCGTGGAGCAGTA
TTCCCTGAACGAGATCATCAACAACCTTCAACGGCATCAGGATCAAGACAGATTAC
CACTCTCTGCTGGACAAGAAGGAGAAGGAGAGGTTTCGAGGCCCGCCAGAAGCTG
GACCTCCATCGAGAATATCAAGGAGCTGAAGGCCGGCTATATCTCTCAGGTGGT
GCACAAGATCTGCGAGCTGGTGGAGAAGTACGATGCCGTGATCGCCCTGGAGGA
CCTGAAGCTCTGGCTTTAAGAATAGCCGCGTGAAGGTGGAGAAGCAGGTGTATCA
GAAGTTCGAGAAGATGCTGATCGATAAGCTGAACTACATGGTGGACAAGAAGTC
TAATCCTTGTGCAACAGGGCGGCCCTGAAGGGCTATCAGATCACCAATAAGTTC
GAGAGCTTTAAGTCCATGTCTACCCAGAACGGCTTCATCTTTTACATCCCTGCCTG
GCTGACATCCAAGATCGATCCATCTACCGGCTTTGTGAACCTGCTGAAAACCAAG
TATACCAGCATCGCCGATTCCAAGAAGTTCATCAGCTCCTTTGACAGGATCATGT
ACGTGCCCGAGGAGGATCTGTTTCGAGTTTGCCCTGGACTATAAGAACTTCTCTCG
CACAGACGCCGATTACATCAAGAAGTGGAAGCTGTACTCCTACGGCAACCGGAT
CAGAATCTTCCGGAATCCTAAGAAGAACAACGTGTTTCGACTGGGAGGAGGTGTG
CCTGACCAGCGCCTATAAGGAGCTGTTCAACAAGTACGGCATCAATTATCAGCAG
GGCGATATCAGAGCCCTGCTGTGCGAGCAGTCCGACAAGGCCTTCTACTCTAGCT
TTATGGCCCTGATGAGCCTGATGCTGCAGATGCGGAACAGCATCACAGGCCGCA
CCGACGTGGATTTTCTGATCAGCCCTGTGAAGAACTCCGACGGCATCTTCTACGA
TAGCCGGAAGTATGAGGCCAGGAGAATGCCATCCTGCCAAAGAACGCCGACGC
CAATGGCGCCTATAACATCGCCAGAAAGGTGCTGTGGGCCATCGGCCAGTTCAA
GAAGGCCGAGGACGAGAAGCTGGATAAGGTGAAGATCGCCATCTCTAACAAGGA
GTGGCTGGAGTACGCCAGACCAGCGTGAAGCACAAAAGGCCGGCGGCCACGAA
AAAGGCCGGCCAGGCCAAAAAAGAAAAAGGGATCCtaccatacagatgtccagattacgcttatccc
tacgacgtgctgattatgcatacccatatgatgtccccgactatgccGGAAGCgagttccagtacctgccagataca
gacgatcgtcaccggattgaggagaaacgtaaaggacatatgagacctcaagagcatcatgaagaagagtc
ctttcagcggaccaccgacccccggcctccacctgcagcattgctgtgccttcccgcagctcagcttctgtcc
ccaagccagcaccaccagccctatcccttacgtcatccctgagcaccatcaactatgatgagttcccaccatggt
gtttccttctgggcagatcagccaggcctcgcccttggccccggccccctcccgaagtctgcccaggctccag
cccctgcccctgctccagcatggtatcagctctggcccaggccccagcccctgtcccagctcctagccccagg
ccctctcaggctgtggccccacctgcccccaagcccaccaggctggggaaggaacgctgtcagaggccct
gctgcagctgcagtttgatgatgaagacctgggggcttggcaacagcacagaccagctgtgttcacag
acctggcatcctgcataactccgagtttcagcagctgctgaaccagggcatacctgtggccccccacacaact
gagcccatgctgatggagtaccctgaggctataactgcctagtgcaggggcccagaggccccccgaccca
gctcctgctccactgggggccccgggctccccaatggcctccttcaggagatgaagacttctcctcattgcg
gacatggacttctcagccctgctgagtcagatcagctctTAA

5. JG1211: CAG-human dLbCpf1(D832A)-NLS-3xHA-VPR

Human codon optimized dLbCpf1: **bold**, NLS: *italic*, 3xHA: lower case, VP64: **red**, NLS: *italic and underline*, p65: **blue**, Rta: **orange**

ATGAGCAAGCTGGAGAAGTTTACAAACTGCTACTCCCTGTCTAAGACCCTGAGGT
TCAAGGCCATCCCTGTGGGCAAGACCCAGGAGAACATCGACAATAAGCGGCTGC
TGGTGGAGGACGAGAAGAGAGCCGAGGATTATAAGGGCGTGAAGAAGCTGCTG
GATCGCTACTATCTGTCTTTTATCAACGACGTGCTGCACAGCATCAAGCTGAAGA
ATCTGAACAATTACATCAGCCTGTTCCGGAAGAAAACCAGAACCAGAGAAGGAGA
ATAAGGAGCTGGAGAACCCTGGAGATCAATCTGCGGAAGGAGATCGCCAAGGCCT
TCAAGGGCAACGAGGGGCTACAAGTCCCTGTTAAGAAGGATATCATCGAGACAA
TCCTGCCAGAGTTCCTGGACGATAAGGACGAGATCGCCCTGGTGAACAGCTTCA
ATGGCTTTACCACAGCCTTCACCGGCTTCTTTGATAACAGAGAGAATATGTTTTCC
GAGGAGGCCAAGAGCACATCCATCGCCTTCAGGTGTATCAACGAGAATCTGACC
CGCTACATCTCTAATATGGACATCTTCGAGAAGGTGGACGCCATCTTTGATAAGC
ACGAGGTGCAGGAGATCAAGGAGAAGATCCTGAACAGCGACTATGATGTGGAGG
ATTTCTTTGAGGGCGAGTTCTTTAACTTTGTGCTGACACAGGAGGGGCATCGACGT
GTATAACGCCATCATCGGCGGCTTCGTGACCGAGAGCGGCGAGAAGATCAAGGG
CCTGAACGAGTACATCAACCTGTATAATCAGAAAACCAAGCAGAAGCTGCCTAA
GTTTAAGCCACTGTATAAGCAGGTGCTGAGCGATCGGGAGTCTCTGAGCTTCTAC
GGCGAGGGCTATACATCCGATGAGGAGGTGCTGGAGGTGTTTAGAAACACCCTG
AACAAGAACAGCGAGATCTTCAGCTCCATCAAGAAGCTGGAGAAGCTGTTCAAG
AATTTTGACGAGTACTCTAGCGCCGGCATCTTTGTGAAGAACGGCCCCGCCATCA
GCACAATCTCCAAGGATATCTTCGGCGAGTGAACGTGATCCGGGACAAGTGGA
ATGCCGAGTATGACGATATCCACCTGAAGAAGAAGGCCGTGGTGACCGAGAAGT
ACGAGGACGATCGGAGAAAGTCCTTCAAGAAGATCGGCTCCTTTTCTCTGGAGCA
GCTGCAGGAGTACGCCGACCCGATCTGTCTGTGGTGGAGAAGCTGAAGGAGAT
CATCATCCAGAAGGTGGATGAGATCTACAAGGTGTATGGCTCCTCTGAGAAGCTG
TTCGACGCCGATTTTGTGCTGGAGAAGAGCCTGAAGAAGAACGACGCCGTGGTG
GCCATCATGAAGGACCTGCTGGATTCTGTGAAGAGCTTCGAGAATTACATCAAGG
CCTTCTTTGGCGAGGGCAAGGAGACAAACAGGGACGAGTCCTTCTATGGCGATTT
TGTGCTGGCCTACGACATCCTGCTGAAGGTGGACCACATCTACGATGCCATCCGC
AATTATGTGACCCAGAAGCCCTACTCTAAGGATAAGTTCAAGCTGTATTTTCAGAA
CCCTCAGTTCATGGGCGGCTGGGACAAGGATAAAGGAGACAGACTATCGGGCCAC
CATCCTGAGATACGGCTCCAAGTACTATCTGGCCATCATGGATAAGAAGTACGCC
AAGTGCCTGCAGAAGATCGACAAGGACGATGTGAACGGCAATTACGAGAAGATC
AACTATAAGCTGCTGCCCGGCCCTAATAAGATGCTGCCAAAGGTGTTCTTTTCTA
AGAAGTGGATGGCCTACTATAACCCCAGCGAGGACATCCAGAAGATCTACAAGA
ATGGCACATTCAAGAAGGGCGATATGTTTAACTGAATGACTGTCACAAGCTGAT
CGACTTCTTTAAGGATAGCATCTCCCGGTATCCAAAGTGGTCCAATGCCTACGAT
TTCAACTTTTCTGAGACAGAGAAGTATAAGGACATCGCCGGCTTTTACAGAGAGG
TGGAGGAGCAGGGCTATAAGGTGAGCTTCGAGTCTGCCAGCAAGAAGGAGGTG
GATAAGCTGGTGGAGGAGGGCAAGCTGTATATGTTCCAGATCTATAACAAGGACT
TTTCCGATAAGTCTCACGGCACACCCAATCTGCACACCATGTACTTCAAGCTGCT
GTTTGACGAGAACAATCACGGACAGATCAGGCTGAGCGGAGGAGCAGAGCTGTT
CATGAGGCGCGCCTCCCTGAAGAAGGAGGAGCTGGTGGTGCACCCAGCCAACCTC
CCCTATCGCCAACAAGAATCCAGATAATCCCAAGAAAACCACAACCCTGTCCTAC
GACGTGTATAAGGATAAGAGGTTTTCTGAGGACCAGTACGAGCTGCACATCCCAA
TCGCCATCAATAAGTGCCCCAAGAACATCTTCAAGATCAATACAGAGGTGCGCGT
GCTGCTGAAGCACGACGATAACCCCTATGTGATCGGCATCGCCAGGGGGCGAGCG
CAATCTGCTGTATATCGTGGTGGTGGACGGCAAGGGCAACATCGTGGAGCAGTA

TTCCCTGAACGAGATCATCAACAACCTTCAACGGCATCAGGATCAAGACAGATTAC
CACTCTCTGCTGGACAAGAAGGAGAAGGAGAGGTTTCGAGGCCCGCCAGAAGT
GACCTCCATCGAGAATATCAAGGAGCTGAAGGCCGGCTATATCTCTCAGGTGGT
GCACAAGATCTGCGAGCTGGTGGAGAAGTACGATGCCGTGATCGCCCTGGAGGA
CCTGAACTCTGGCTTTAAGAATAGCCGCGTGAAGGTGGAGAAGCAGGTGTATCA
GAAGTTCGAGAAGATGCTGATCGATAAGCTGAACTACATGGTGGACAAGAAGTC
TAATCCTTGTGCAACAGGGCGGCGCCCTGAAGGGCTATCAGATCACCAATAAGTTC
GAGAGCTTTAAGTCCATGTCTACCCAGAACGGCTTCATCTTTTACATCCCTGCCTG
GCTGACATCCAAGATCGATCCATCTACCGGCTTTGTGAACCTGCTGAAAACCAAG
TATACCAGCATCGCCGATTCCAAGAAGTTCATCAGCTCCTTTGACAGGATCATGT
ACGTGCCCGAGGAGGATCTGTTGAGTTTGCCTGGACTATAAGAACTTCTCTCG
CACAGACGCCGATTACATCAAGAAGTGGAAAGCTGTAATCCTACGGCAACCGGAT
CAGAATCTTCCGGAATCCTAAGAAGAACAACGTGTTGACTGGGAGGAGGTGTG
CCTGACCAGCGCCTATAAGGAGCTGTTCAACAAGTACGGCATCAATTATCAGCAG
GGCGATATCAGAGCCCTGCTGTGCGAGCAGTCCGACAAGGCCTTCTACTTAGCT
TTATGGCCCTGATGAGCCTGATGCTGCAGATGCGGAACAGCATCACAGGCCGCA
CCGACGTGGATTTTCTGATCAGCCCTGTGAAGAACTCCGACGGCATCTTCTACGA
TAGCCGGAAGTATGAGGCCAGGAGAATGCCATCCTGCCAAAGAACGCCGACGC
CAATGGCGCCTATAACATCGCCAGAAAGGTGCTGTGGGCCATCGGCCAGTTCAA
GAAGGCCGAGGACGAGAAGCTGGATAAGGTGAAGATCGCCATCTCTAACAAGGA
GTGGCTGGAGTACGCCAGACCAGCGTGAAGCACAAAAGGCCGGCGGCCACGAA
AAAGGCCGGCCAGGCCAAAAAGAAAAGGGATCtaccatacagatgtccagattacgctatccc
tacgacgtgcctgattatgcataccatgatgtccccgactatgccGAAGCGAGGCCAGCGGTTCCGG
ACGGGCTGACGCGATTGGACGATTTTGATCTGGATATGCTGGGAAGTGACGCCCTC
GATGATTTTGACCTTGACATGCTTGGTTGCGATGCCCTTGATGACTTTGACCTCGAC
ATGCTCGGCAGTGACGCCCTTGATGATTTGACCTGGACATGCTGATTAATCTAG
AAGTTCGGATCTCCGAAAAAGAAACGCAAAGTTGGTAGCCAGTACCTGCCCGACA
CCGACGACCGGCACCGGATCGAGGAAAAGCGGAAGCGGACCTACGAGACATTCAA
GAGCATCATGAAGAAGTCCCCCTTCAGCGGCCCCACCGACCCTAGACCTCCACCT
AGAAGAATCGCCGTGCCAGCAGATCCAGCGCCAGCGTGCCAAAACCTGCCCCCC
AGCCTTACCCCTTACCAGCAGCCTGAGCACCATCAACTACGACGAGTTCCCTACC
ATGGTGTTCCCGAGCGGCCAGATCTCTCAGGCCTCTGCTCTGGCTCCAGCCCTC
CTCAGGTGCTGCCTCAGGCTCCTGCTCCTGCACCAGCTCCAGCCATGGTGTCTGC
ACTGGCTCAGGCACCAGCACCCGTGCCTGTGCTGGCTCCTGGACCTCCACAGGCT
GTGGCTCCACCAGCCCTAAACCTACACAGGCCGGCGAGGGCACACTGTCTGAAG
CTCTGCTGCAGCTGCAGTTCGACGACGAGGATCTGGGAGCCCTGCTGGGAAACAG
CACCGATCCTGCCGTGTTACCGACCTGGCCAGCGTGGACAACAGCGAGTTCAG
CAGCTGCTGAACCAGGGCATCCCTGTGGCCCTCACACCACCGAGCCCATGCTGA
TGAATAACCCGAGGCCATCACCCGGCTCGTGACAGGCGCTCAGAGGCCTCCTGA
TCCAGCTCCTGCCCTCTGGGAGCACCAGGCCTGCCTAATGGACTGCTGTCTGGC
GACGAGGACTTCAGCTCTATCGCCGATATGGATTTCTCAGCCTTGCTGGGCTCTGG
CAGCGGCAGCCGGGATTCCAGGGAAGGGATGTTTTTGCCGAAGCCTGAGGCCGG
CTCCGCTATTAGTGACGTGTTTGAGGGCCGCGAGGTGTGCCAGCCAAAACGAATC
CGGCCATTTTCATCCTCCAGGAAGTCCATGGGCCAACCGCCACTCCCCGCCAGCC
TCGCACCAACACCAACCGGTCCAGTACATGAGCCAGTCCGGTCACTGACCCCGGC
ACCAAGTCCCTCAGCCACTGGATCCAGCGCCCGCAGTGAATCCCGAGGCCAGTCA
CTGTTGGAGGATCCCGATGAAGAGACGAGCCAGGCTGTCAAAGCCCTTCGGGAGA
TGGCCGATACTGTGATTCCCCAGAAGGAAGAGGCTGCAATCTGTGGCCAAATGGA
CCTTTCCCATCCGCCCCCAAGGGGCCATCTGGATGAGCTGACAACCACACTTGAGT
CCATGACCGAGGATCTGAACCTGGACTCACCCCTGACCCCGGAATTGAACGAGATT

CTGGATACCTTCCTGAACGACGAGTGCCTCTTGCATGCCATGCATATCAGCACAGG
ACTGTCCATCTTCGACACATCTCTGTTT

6. JG674: CAG-human dLbCpf1(D832A)-NLS-3xHA-DmrA(X1)

Human codon optimized dLbCpf1: **bold**, NLS: *italic*, 3xHA: lower case, DmrA: lowercase and **bold**

ATGAGCAAGCTGGAGAAGTTTACAAACTGCTACTCCCTGTCTAAGACCCTGAGGT
TCAAGGCCATCCCTGTGGGCAAGACCCAGGAGAACATCGACAATAAGCGGCTGC
TGGTGGAGGACGAGAAGAGAGCCGAGGATTATAAGGGCGTGAAGAAGCTGCTG
GATCGCTACTATCTGTCTTTTATCAACGACGTGCTGCACAGCATCAAGCTGAAGA
ATCTGAACAATTACATCAGCCTGTTCCGGAAGAAAACCAGAACCAGAGAAGGAGA
ATAAGGAGCTGGAGAACCCTGGAGATCAATCTGCGGAAGGAGATCGCCAAGGCCT
TCAAGGGCAACGAGGGCTACAAGTCCCTGTTAAGAAGGATATCATCGAGACAA
TCCTGCCAGAGTTCCTGGACGATAAGGACGAGATCGCCCTGGTGAACAGCTTCA
ATGGCTTTACCACAGCCTTCACCGGCTTCTTTGATAACAGAGAGAATATGTTTTCC
GAGGAGGCCAAGAGCACATCCATCGCCTTCAGGTGTATCAACGAGAATCTGACC
CGCTACATCTCTAATATGGACATCTTCGAGAAGGTGGACGCCATCTTTGATAAGC
ACGAGGTGCAGGAGATCAAGGAGAAGATCCTGAACAGCGACTATGATGTGGAGG
ATTTCTTTGAGGGCGAGTTCTTTAACTTTGTGCTGACACAGGAGGGCATCGACGT
GTATAACGCCATCATCGGCGGCTTCGTGACCGAGAGCGGCGAGAAGATCAAGGG
CCTGAACGAGTACATCAACCTGTATAATCAGAAAACCAAGCAGAAGCTGCCTAA
GTTTAAGCCACTGTATAAGCAGGTGCTGAGCGATCGGGAGTCTCTGAGCTTCTAC
GGCGAGGGCTATACATCCGATGAGGAGGTGCTGGAGGTGTTTAGAAACACCCTG
AACAAGAACAGCGAGATCTTCAGCTCCATCAAGAAGCTGGAGAAGCTGTTCAAG
AATTTTGACGAGTACTCTAGCGCCGGCATCTTTGTGAAGAACGGCCCCGCCATCA
GCACAATCTCCAAGGATATCTTCGGCGAGTGGAACGTGATCCGGGACAAGTGGA
ATGCCGAGTATGACGATATCCACCTGAAGAAGAAGGCCGTGGTGACCGAGAAGT
ACGAGGACGATCGGAGAAAGTCCTTCAAGAAGATCGGCTCCTTTTCTCTGGAGCA
GCTGCAGGAGTACGCCGACGCCGATCTGTCTGTGGTGGAGAAGCTGAAGGAGAT
CATCATCCAGAAGGTGGATGAGATCTACAAGGTGTATGGCTCCTCTGAGAAGCTG
TTCGACGCCGATTTTGTGCTGGAGAAGAGCCTGAAGAAGAACGACGCCGTGGTG
GCCATCATGAAGGACCTGCTGGATTCTGTGAAGAGCTTCGAGAATTACATCAAGG
CCTTCTTTGGCGAGGGCAAGGAGACAAACAGGGACGAGTCCTTCTATGGCGATTT
TGTGCTGGCCTACGACATCCTGCTGAAGGTGGACCACATCTACGATGCCATCCGC
AATTATGTGACCCAGAAGCCCTACTCTAAGGATAAGTTCAAGCTGTATTTTCAGAA
CCCTCAGTTCATGGGCGGCTGGGACAAGGATAAAGGAGACAGACTATCGGGCCAC
CATCCTGAGATACGGCTCCAAGTACTATCTGGCCATCATGGATAAGAAGTACGCC
AAGTGCTGCAGAAGATCGACAAGGACGATGTGAACGGCAATTACGAGAAGATC
AACTATAAGCTGCTGCCCGGCCCTAATAAGATGCTGCCAAAGGTGTTCTTTTCTA
AGAAGTGGATGGCCTACTATAACCCCAGCGAGGACATCCAGAAGATCTACAAGA
ATGGCACATTCAAGAAGGGCGATATGTTTAACTGAATGACTGTCACAAGCTGAT
CGACTTCTTTAAGGATAGCATCTCCCGGTATCCAAAGTGGTCCAATGCCTACGAT
TTCAACTTTTCTGAGACAGAGAAGTATAAGGACATCGCCGGCTTTTACAGAGAGG
TGGAGGAGCAGGGCTATAAGGTGAGCTTCGAGTCTGCCAGCAAGAAGGAGGTG
GATAAGCTGGTGGAGGAGGGCAAGCTGTATATGTTCCAGATCTATAACAAGGACT
TTTCCGATAAGTCTCACGGCACACCCAATCTGCACACCATGTAAGTCAAGCTGCT
GTTTGACGAGAACAATCACGGACAGATCAGGCTGAGCGGAGGAGCAGAGCTGTT

CATGAGGCGCGCCTCCCTGAAGAAGGAGGAGCTGGTGGTGCACCCAGCCAACTC
CCCTATCGCCAACAAGAATCCAGATAATCCCAAGAAAACCACAACCCTGTCCTAC
GACGTGTATAAGGATAAGAGGTTTTCTGAGGACCAGTACGAGCTGCACATCCCAA
TCGCCATCAATAAGTGCCCAAGAACATCTTCAAGATCAATACAGAGGTGCGCGT
GCTGCTGAAGCACGACGATAACCCCTATGTGATCGGCATCGCCAGGGGCGAGCG
CAATCTGCTGTATATCGTGGTGGTGGACGGCAAGGGCAACATCGTGGAGCAGTA
TTCCCTGAACGAGATCATCAACAACCTTCAACGGCATCAGGATCAAGACAGATTAC
CACTCTCTGCTGGACAAGAAGGAGAAGGAGAGGTTTCGAGGCCCGCCAGAAGT
GACCTCCATCGAGAATATCAAGGAGCTGAAGGCCGGCTATATCTCTCAGGTGGT
GCACAAGATCTGCGAGCTGGTGGAGAAGTACGATGCCGTGATCGCCCTGGAGGA
CCTGAACTCTGGCTTTAAGAATAGCCGCGTGAAGGTGGAGAAGCAGGTGTATCA
GAAGTTCGAGAAGATGCTGATCGATAAGCTGAACTACATGGTGGACAAGAAGTC
TAATCCTTGTGCAACAGGCGGCGCCCTGAAGGGCTATCAGATCACCAATAAGTTC
GAGAGCTTTAAGTCCATGTCTACCCAGAACGGCTTCATCTTTTACATCCCTGCCTG
GCTGACATCCAAGATCGATCCATCTACCGGCTTTGTGAACCTGCTGAAAACCAAG
TATACCAGCATCGCCGATTCCAAGAAGTTCATCAGCTCCTTTGACAGGATCATGT
ACGTGCCCGAGGAGGATCTGTTGAGTTTGCCTGGACTATAAGAACTTCTCTCG
CACAGACGCCGATTACATCAAGAAGTGAAGCTGTACTCCTACGGCAACCGGAT
CAGAATCTTCCGGAATCCTAAGAAGAACAACGTGTTGACTGGGAGGAGGTGTG
CCTGACCAGCGCCTATAAGGAGCTGTTCAACAAGTACGGCATCAATTATCAGCAG
GGCGATATCAGAGCCCTGCTGTGCGAGCAGTCCGACAAGGCCTTCTACTTAGCT
TTATGGCCCTGATGAGCCTGATGCTGCAGATGCGGAACAGCATCACAGGCCGCA
CCGACGTGGATTTTCTGATCAGCCCTGTGAAGAACTCCGACGGCATCTTCTACGA
TAGCCGGAACCTATGAGGCCAGGAGAATGCCATCCTGCCAAAGAACGCCGACGC
CAATGGCGCCTATAACATCGCCAGAAAGGTGCTGTGGGCCATCGGCCAGTTCAA
GAAGGCCGAGGACGAGAAGCTGGATAAGGTGAAGATCGCCATCTCTAACAAGGA
GTGGCTGGAGTACGCCAGACCAGCGTGAAGCACAAAAGGCCGGCCGACGAA
AAAGGCCGGCCAGGCCAAAAAAGAAAAAGGGATCtaccatacagatgtccagattacgcttatccc
tacgacgtgcctgattatgcataccatgatgtccccgactatgccTCGAGCGACTACAAAGACCATGAC
GGTGATTATAAAGATCATGACATCGATTACAAGGATGACGATGACAAGGCTGCAGG
AGGCGGTGGAAGCGGGaggggagtgaggtggaaccatctcccaggagacggggcgcaccttccc
caagcgcggccagacctgcgtggtgcactacaccgggatgcttgaagatggaagaaatttgattcctcccgg
gacagaaacaagcccttaagttatgctaggcaagcaggaggtatccgaggctgggaagaaggggtgcc
agatgagtggtgagagccaaactgactatatctccagattatgctatggtgccactgggcaccaggc
atcatcccaccatgccactctcgtcttcgatgtggagcttctaaaactggaGGATAA

7. JG676: CAG-human dLbCpf1(D832A)-NLS-3xHA-DmrA(X2)

Human codon optimized dLbCpf1: **bold**, NLS: *italic*, 3xHA: lower case, DmrA: lowercase and **bold**

ATGAGCAAGCTGGAGAAGTTTACAACTGCTACTCCCTGTCTAAGACCCTGAGGT
TCAAGGCCATCCCTGTGGGCAAGACCAGGAGAACATCGACAATAAGCGGCTGC
TGGTGGAGGACGAGAAGAGAGCCGAGGATTATAAGGGCGTGAAGAAGCTGCTG
GATCGCTACTATCTGTCTTTTATCAACGACGTGCTGCACAGCATCAAGCTGAAGA
ATCTGAACAATTACATCAGCCTGTTCCGGAAGAAAACCAGAACCGAGAAGGAGA
ATAAGGAGCTGGAGAACCTGGAGATCAATCTGCGGAAGGAGATCGCCAAGGCCT
TCAAGGGCAACGAGGGCTACAAGTCCCTGTTAAGAAGGATATCATCGAGACAA

TCCTGCCAGAGTTCCTGGACGATAAGGACGAGATCGCCCTGGTGAACAGCTTCA
ATGGCTTTACCACAGCCTTCACCGGCTTCTTTGATAACAGAGAGAATATGTTTTCC
GAGGAGGCCAAGAGCACATCCATCGCCTTCAGGTGTATCAACGAGAATCTGACC
CGCTACATCTCTAATATGGACATCTTCGAGAAGGTGGACGCCATCTTTGATAAGC
ACGAGGTGCAGGAGATCAAGGAGAAGATCCTGAACAGCGACTATGATGTGGAGG
ATTTCTTTGAGGGCGAGTTCTTTAACTTTGTGCTGACACAGGAGGGCATCGACGT
GTATAACGCCATCATCGGCGGCTTCGTGACCGAGAGCGGCGAGAAGATCAAGGG
CCTGAACGAGTACATCAACCTGTATAATCAGAAAACCAAGCAGAAGCTGCCTAA
GTTTAAGCCACTGTATAAGCAGGTGCTGAGCGATCGGGAGTCTCTGAGCTTCTAC
GGCGAGGGCTATACATCCGATGAGGAGGTGCTGGAGGTGTTTAGAAACACCCTG
AAACAAGAACAGCGAGATCTTCAGCTCCATCAAGAAGCTGGAGAAGCTGTTCAAG
AATTTTGACGAGTACTCTAGCGCCGGCATCTTTGTGAAGAACGGCCCCGCCATCA
GCACAATCTCCAAGGATATCTTCGGCGAGTGGAACGTGATCCGGGACAAGTGA
ATGCCGAGTATGACGATATCCACCTGAAGAAGAAGGCCGTGGTGACCGAGAAGT
ACGAGGACGATCGGAGAAAGTCCTTCAAGAAGATCGGCTCCTTTTCTCTGGAGCA
GCTGCAGGAGTACGCCGACGCCGATCTGTCTGTGGTGGAGAAGCTGAAGGAGAT
CATCATCCAGAAGGTGGATGAGATCTACAAGGTGTATGGCTCCTCTGAGAAGCTG
TTCGACGCCGATTTTGTGCTGGAGAAGAGCCTGAAGAAGAACGACGCCGTGGTG
GCCATCATGAAGGACCTGCTGGATTCTGTGAAGAGCTTCGAGAATTACATCAAGG
CCTTCTTTGGCGAGGGCAAGGAGACAAACAGGGACGAGTCCTTCTATGGCGATTT
TGTGCTGGCCTACGACATCCTGCTGAAGGTGGACCACATCTACGATGCCATCCGC
AATTATGTGACCCAGAAGCCCTACTCTAAGGATAAGTTCAAGCTGTATTTTCAGAA
CCCTCAGTTCATGGGCGGCTGGGACAAGGATAAGGAGACAGACTATCGGGCCAC
CATCCTGAGATACGGCTCCAAGTACTATCTGGCCATCATGGATAAGAAGTACGCC
AAGTGCTGCAGAAGATCGACAAGGACGATGTGAACGGCAATTACGAGAAGATC
AACTATAAGCTGCTGCCCGGCCCTAATAAGATGCTGCCAAAGGTGTTCTTTTCTA
AGAAGTGGATGGCCTACTATAACCCCAGCGAGGACATCCAGAAGATCTACAAGA
ATGGCACATTCAAGAAGGGCGATATGTTTAACTGAATGACTGTCACAAGCTGAT
CGACTTCTTTAAGGATAGCATCTCCCGGTATCCAAAGTGGTCCAATGCCTACGAT
TTCAACTTTTCTGAGACAGAGAAGTATAAGGACATCGCCGGCTTTTACAGAGAGG
TGGAGGAGCAGGGCTATAAGGTGAGCTTCGAGTCTGCCAGCAAGAAGGAGGTG
GATAAGCTGGTGGAGGAGGGCAAGCTGTATATGTTCCAGATCTATAACAAGGACT
TTTCCGATAAGTCTCACGGCACACCCAATCTGCACACCATGTACTIONCAAGCTGCT
GTTTGACGAGAACAATCACGGACAGATCAGGCTGAGCGGAGGAGCAGAGCTGTT
CATGAGGCGCGCCTCCCTGAAGAAGGAGGAGCTGGTGGTGCACCCAGCCAACTC
CCCTATCGCCAACAAGAATCCAGATAATCCCAAGAAAACCACAACCCTGTCCTAC
GACGTGTATAAGGATAAGAGGTTTTCTGAGGACCAGTACGAGCTGCACATCCCAA
TCGCCATCAATAAGTGCCCCAAGAACATCTTCAAGATCAATACAGAGGTGCGCGT
GCTGCTGAAGCACGACGATAACCCCTATGTGATCGGCATCGCCAGGGGCGAGCG
CAATCTGCTGTATATCGTGGTGGTGGACGGCAAGGGCAACATCGTGGAGCAGTA
TTCCCTGAACGAGATCATCAACAACCTTCAACGGCATCAGGATCAAGACAGATTAC
CACTCTCTGCTGGACAAGAAGGAGAAGGAGAGGTTTCGAGGCCCGCCAGAAGT
GACCTCCATCGAGAATATCAAGGAGCTGAAGGCCGGCTATATCTCTCAGGTGGT
GCACAAGATCTGCGAGCTGGTGGAGAAGTACGATGCCGTGATCGCCCTGGAGGA
CCTGAACTCTGGCTTTAAGAATAGCCGCGTGAAGGTGGAGAAGCAGGTGTATCA
GAAGTTCGAGAAGATGCTGATCGATAAGCTGAACTACATGGTGGACAAGAAGTC
TAATCCTTGTGCAACAGGGCGGCCCTGAAGGGCTATCAGATCACCAATAAGTTC
GAGAGCTTTAAGTCCATGTCTACCCAGAACGGCTTCATCTTTTACATCCCTGCCTG
GCTGACATCCAAGATCGATCCATCTACCGGCTTTGTGAACCTGCTGAAAACCAAG
TATACCAGCATCGCCGATTCCAAGAAGTTCATCAGCTCCTTTGACAGGATCATGT
ACGTGCCCGAGGAGGATCTGTTTCGAGTTGCCCTGGACTATAAGAAGTCTCTCG

CACAGACGCCGATTACATCAAGAAGTGGAAAGCTGTACTCCTACGGCAACCGGAT
CAGAATCTTCCGGAATCCTAAGAAGAACAACGTGTTGACTGGGAGGAGGTGTG
CCTGACCAGCGCCTATAAGGAGCTGTTCAACAAGTACGGCATCAATTATCAGCAG
GGCGATATCAGAGCCCTGCTGTGCGAGCAGTCCGACAAGGCCTTCTACTCTAGCT
TTATGGCCCTGATGAGCCTGATGCTGCAGATGCGGAACAGCATCACAGGCCGCA
CCGACGTGGATTTTCTGATCAGCCCTGTGAAGAACTCCGACGGCATCTTCTACGA
TAGCCGGAAGTATGAGGCCAGGAGAATGCCATCCTGCCAAAGAACGCCGACGC
CAATGGCGCCTATAACATCGCCAGAAAGGTGCTGTGGGCCATCGGCCAGTTCAA
GAAGGCCGAGGACGAGAAGCTGGATAAGGTGAAGATCGCCATCTCTAACAAGGA
GTGGCTGGAGTACGCCAGACCAGCGTGAAGCACAAAAGGCCGGCCGACGAA
AAAGGCCGGCCAGGCCAAAAAGAAAAAGGGATCCtaccatacagatgtccagattacgcttacc
tacgacgtgcctgattatgataccatgatgtccccgactatgccTCGAGCGACTACAAAGACCATGAC
GGTGATTATAAAGATCATGACATCGATTACAAGGATGACGATGACAAGGCTGCAGG
AGGCCGTGGAAGCGGG**Gaggggagtcaggtggaaccatctcccaggagacggg**gcacctccc
caagcgcgccagacctgcgtggtgcactacaccgggatgcttgaagatggaagaaatttgattcctcccgg
gacagaaacaagcccttaagttatgctaggcaagcaggaggtgatccgaggctgggaagaaggggtgcc
agatgagtggtgagagccaaactgactatatctccagattatgcctatggtgccactggcaccaggc
atcatcccaccatgccactctcgtcttcgatgtggagcttctaaaactggaaGGTTCtaggggagtcaggt
ggaaccatctcccaggagacggggcacctcccgaagcgcgccagacctgcgtggtgactacaccg
ggatgcttgaagatggaagaaatttgattcctcccgggacagaaacaagcccttaagttatgctaggcaagc
aggaggtgatccgaggctgggaagaaggggtgccagatgagtggtgagagccaaactgactatatc
tccagattatgcctatggtgccactggcaccaggcatcatcccaccacatgccactctcgtcttcgatgtggag
cttctaaaactggaaGGATAA

8. JG693: CAG-human dLbCpf1(D832A)-NLS-3xHA-DmrA(X3)

Human codon optimized dLbCpf1: **bold**, NLS: *italic*, 3xHA: lower case, DmrA: lowercase and **bold**

ATGAGCAAGCTGGAGAAGTTTACAAACTGCTACTCCCTGTCTAAGACCCTGAGGT
TCAAGGCCATCCCTGTGGGCAAGACCCAGGAGAACATCGACAATAAGCGGCTGC
TGGTGGAGGACGAGAAGAGAGCCGAGGATTATAAGGGCGTGAAGAAGCTGCTG
GATCGCTACTATCTGTCTTTTATCAACGACGTGCTGCACAGCATCAAGCTGAAGA
ATCTGAACAATTACATCAGCCTGTTCCGGAAGAAAACCAGAACCAGAGAAGGAGA
ATAAGGAGCTGGAGAACCCTGGAGATCAATCTGCGGAAGGAGATCGCCAAGGCCT
TCAAGGGCAACGAGGGCTACAAGTCCCTGTTAAGAAGGATATCATCGAGACAA
TCCTGCCAGAGTTCCTGGACGATAAGGACGAGATCGCCCTGGTGAACAGCTTCA
ATGGCTTTACCACAGCCTTCACCGGCTTCTTTGATAACAGAGAGAATATGTTTTCC
GAGGAGGCCAAGAGCACATCCATCGCCTTCAGGTGTATCAACGAGAATCTGACC
CGCTACATCTCTAATATGGACATCTTCGAGAAGGTGGACGCCATCTTTGATAAGC
ACGAGGTGCAGGAGATCAAGGAGAAGATCCTGAACAGCGACTATGATGTGGAGG
ATTTCTTTGAGGGCGAGTTCTTTAACTTTGTGCTGACACAGGAGGGCATCGACGT
GTATAACGCCATCATCGGCGGCTTCGTGACCGAGAGCGGCGAGAAGATCAAGGG
CCTGAACGAGTACATCAACCTGTATAATCAGAAAACCAAGCAGAAGCTGCCTAA
GTTTAAGCCACTGTATAAGCAGGTGCTGAGCGATCGGGAGTCTCTGAGCTTCTAC
GGCGAGGGCTATACATCCGATGAGGAGGTGCTGGAGGTGTTTAGAAACACCCTG
AACAAGAACAGCGAGATCTTCAGCTCCATCAAGAAGCTGGAGAAGCTGTTCAAG
AATTTTGACGAGTACTCTAGCGCCGGCATCTTTGTGAAGAACGGCCCCGCCATCA

GCACAATCTCCAAGGATATCTTCGGCGAGTGGAACGTGATCCGGGACAAGTGGA
ATGCCGAGTATGACGATATCCACCTGAAGAAGAAGGCCGTGGTGACCGAGAAGT
ACGAGGACGATCGGAGAAAGTCCTTCAAGAAGATCGGCTCCTTTTCTCTGGAGCA
GCTGCAGGAGTACGCCGACGCCGATCTGTCTGTGGTGGAGAAGCTGAAGGAGAT
CATCATCCAGAAGGTGGATGAGATCTACAAGGTGTATGGCTCCTCTGAGAAGCTG
TTCGACGCCGATTTTGTGCTGGAGAAGAGCCTGAAGAAGAACGACGCCGTGGTG
GCCATCATGAAGGACCTGCTGGATTCTGTGAAGAGCTTCGAGAATTACATCAAGG
CCTTCTTTGGCGAGGGCAAGGAGACAAACAGGGACGAGTCCTTCTATGGCGATTT
TGTGCTGGCCTACGACATCCTGCTGAAGGTGGACCACATCTACGATGCCATCCGC
AATTATGTGACCCAGAAGCCCTACTCTAAGGATAAGTTCAAGCTGTATTTTCAGAA
CCCTCAGTTCATGGGCGGCTGGGACAAGGATAAAGGAGACAGACTATCGGGCCAC
CATCCTGAGATACGGCTCCAAGTACTATCTGGCCATCATGGATAAGAAGTACGCC
AAGTGCTGCAGAAGATCGACAAGGACGATGTGAACGGCAATTACGAGAAGATC
AACTATAAGCTGCTGCCCGGCCCTAATAAGATGCTGCCAAAGGTGTTCTTTTCTA
AGAAGTGGATGGCCTACTATAACCCCAGCGAGGACATCCAGAAGATCTACAAGA
ATGGCACATTCAAGAAGGGCGATATGTTTAACTGAATGACTGTCACAAGCTGAT
CGACTTCTTTAAGGATAGCATCTCCCGGTATCCAAAGTGGTCCAATGCCTACGAT
TTCAACTTTTCTGAGACAGAGAAGTATAAGGACATCGCCGGCTTTTACAGAGAGG
TGGAGGAGCAGGGCTATAAGGTGAGCTTCGAGTCTGCCAGCAAGAAGGAGGTG
GATAAGCTGGTGGAGGAGGGCAAGCTGTATATGTTCCAGATCTATAACAAGGACT
TTTCCGATAAGTCTCACGGCACACCCAATCTGCACACCATGTACTTCAAGCTGCT
GTTTGACGAGAACAATCACGGACAGATCAGGCTGAGCGGAGGAGCAGAGCTGTT
CATGAGGCGCGCCTCCCTGAAGAAGGAGGAGCTGGTGGTGCACCCAGCCAACTC
CCCTATCGCCAACAAGAATCCAGATAATCCCAAGAAAACCACAACCCTGTCCTAC
GACGTGTATAAGGATAAGAGGTTTTCTGAGGACCAGTACGAGCTGCACATCCCAA
TCGCCATCAATAAGTGCCCCAAGAACATCTTCAAGATCAATACAGAGGTGCGCGT
GCTGCTGAAGCACGACGATAACCCCTATGTGATCGGCATCGCCAGGGGCGAGCG
CAATCTGCTGTATATCGTGGTGGTGGACGGCAAGGGCAACATCGTGGAGCAGTA
TTCCCTGAACGAGATCATCAACAACCTTCAACGGCATCAGGATCAAGACAGATTAC
CACTCTCTGCTGGACAAGAAGGAGAAGGAGAGGTTTCGAGGCCCGCCAGAAGT
GACCTCCATCGAGAATATCAAGGAGCTGAAGGCCGGCTATATCTCTCAGGTGGT
GCACAAGATCTGCGAGCTGGTGGAGAAGTACGATGCCGTGATCGCCCTGGAGGA
CCTGAACTCTGGCTTTAAGAATAGCCGCGTGAAGGTGGAGAAGCAGGTGTATCA
GAAGTTCGAGAAGATGCTGATCGATAAGCTGAACTACATGGTGGACAAGAAGTC
TAATCCTTGTGCAACAGGGCGGCGCCCTGAAGGGCTATCAGATCACCAATAAGTTC
GAGAGCTTTAAGTCCATGTCTACCCAGAACGGCTTCATCTTTTACATCCCTGCCTG
GCTGACATCCAAGATCGATCCATCTACCGGCTTTGTGAACCTGCTGAAAACCAAG
TATACCAGCATCGCCGATTCCAAGAAGTTCATCAGCTCCTTTGACAGGATCATGT
ACGTGCCCGAGGAGGATCTGTTGAGTTTGGCCTGGACTATAAGAACTTCTCTCG
CACAGACGCCGATTACATCAAGAAGTGAAGCTGTACTCCTACGGCAACCGGAT
CAGAATCTTCCGGAATCCTAAGAAGAACAACGTGTTGACTGGGAGGAGGTGTG
CCTGACCAGCGCCTATAAGGAGCTGTTCAACAAGTACGGCATCAATTATCAGCAG
GGCGATATCAGAGCCCTGCTGTGCGAGCAGTCCGACAAGGCCTTCTACTCTAGCT
TTATGGCCCTGATGAGCCTGATGCTGCAGATGCGGAACAGCATCACAGGCCGCA
CCGACGTGGATTTTCTGATCAGCCCTGTGAAGAACTCCGACGGCATCTTCTACGA
TAGCCGGAACATGAGGCCAGGAGAATGCCATCCTGCCAAAGAACGCCGACGC
CAATGGCGCCTATAACATCGCCAGAAAGGTGCTGTGGGCCATCGGCCAGTTCAA
GAAGGCCGAGGACGAGAAGCTGGATAAGGTGAAGATCGCCATCTCTAACAAGGA
GTGGCTGGAGTACGCCAGACCAGCGTGAAGCACAAAAGGCCGGCGGCCACGAA
AAAGGCCGGCCAGGCCAAAAAAGAAAAGGGATTCtaccatacagatgtccagattacgctatccc
tacgacgtgcctgattatgcataccatgatgtccccgactatgccTCGAGCGACTACAAAGACCATGAC

GGTGATTATAAAGATCATGACATCGATTACAAGGATGACGATGACAAGGCTGCAGG
AGGCGGTGGAAGCGGG**Gaggggagtg**caggtgga**aac**ctctcccag**gagacggg**cg**cac**ctccc
caag**cgcg**g**ccagac**ctgc**gtg**gtgc**actacacc**gggatg**cttga**agatgga**aga**aattg**attc**ctccc**g**
gacagaa**acaag**ccctta**agttat**g**ctag**gcaagcag**gaggt**gatcc**gag**gctg**gga**aga**aggg**gtgccc
agatgag**tg**gg**tcagag**ag**ccaa**actg**actata**tctccag**attat**gc**ctat**g**gtg**cc**actg**g**gc**acc**ag**gc
atcatccc**acc**acatg**ccact**ctc**gtct**tcgat**gtg**gag**ctt**ctaa**aa**actgga**ag**gat**ctg**gtg**gaa**GCGG**Ga**
ggggag**tg**cag**gtg**ga**aac**ctctcccag**gagac**gg**gc**cac**ctccc**aag**cg**g**ccag**ac**ctg**cg**tg**
gtgc**actacacc**gggatg**cttga**agatgga**aga**aattg**attc**ctccc**gg**acagaa**acaag**ccctta**ag**ttta
tg**ctag**gcaagcag**gag**gtgatcc**gag**gctg**gga**aga**aggg**gtgcccagatgag**tg**gg**tcagag**agcc
aa**actg**actatctccag**attat**gc**ctat**g**gtg**cc**actg**g**gc**acc**ag**gc**at**ccc**acc**acatg**ccact**ctc**g**
t**cttc**gat**gtg**gag**ctt**ctaa**aa**ctg**gaa**GTT**CT**ag**ggg**ag**tg**cag**gtg**ga**aac**ctctcccag**gag**ac**g**
gg**gc**cac**ctccc**aag**cg**g**ccag**ac**ctg**cg**tg**gtg**ctac**acc**gg**gatg**cttga**agatgga**aga**aatt
tg**attc**ctccc**gg**acagaa**acaag**ccctta**ag**ttatg**ctag**gcaagcag**gag**gtgatcc**gag**gctg**gga**ag
a**aggg**gtgcccagatgag**tg**gg**tcagag**ag**ccaa**actg**actata**tctccag**attat**gc**ctat**g**gtg**cc**actg**
gg**cacc**ag**gc**atcatccc**acc**acatg**ccact**ctc**gtct**tcgat**gtg**gag**ctt**ctaa**aa**ctg**gaa**GGATAA

9. YET1000: CAG-human dLbCpf1(D832A)-NLS-3xHA-DmrA(X4)

Human codon optimized dLbCpf1: **bold**, NLS: *italic*, 3xHA: lower case, DmrA: lowercase and **bold**

ATGAGCAAGCTGGAGAAGTTTACAAACTGCTACTCCCTGTCTAAGACCCTGAGGT
TCAAGGCCATCCCTGTGGGCAAGACCCAGGAGAACATCGACAATAAGCGGCTGC
TGGTGGAGGACGAGAAGAGAGCCGAGGATTATAAGGGCGTGAAGAAGCTGCTG
GATCGCTACTATCTGTCTTTTATCAACGACGTGCTGCACAGCATCAAGCTGAAGA
ATCTGAACAATTACATCAGCCTGTTCCGGAAGAAAACCAGAACCAGAGAAGGAGA
ATAAGGAGCTGGAGAACCCTGGAGATCAATCTGCGGAAGGAGATCGCCAAGGCCT
TCAAGGGCAACGAGGGCTACAAGTCCCTGTTAAGAAGGATATCATCGAGACAA
TCCTGCCAGAGTTCCTGGACGATAAGGACGAGATCGCCCTGGTGAACAGCTTCA
ATGGCTTTACCACAGCCTTACC**GGCTTCTTTGATAACAGAGAGAATATGTTTTCC**
GAGGAGGCCAAGAGCACATCCATCGCCTTCAGGTGTATCAACGAGAATCTGACC
CGCTACATCTCTAATATGGACATCTTCGAGAAGGTGGACGCCATCTTTGATAAGC
ACGAGGTGCAGGAGATCAAGGAGAAGATCCTGAACAGCGACTATGATGTGGAGG
ATTTCTTTGAGGGCGAGTTCTTTAACTTTGTGCTGACACAGGAGGGGCATCGACGT
GTATAACGCCATCATCGGCGGCTTCGTGACCGAGAGCGGCGAGAAGATCAAGGG
CCTGAACGAGTACATCAACCTGTATAATCAGAAAACCAAGCAGAAGCTGCCTAA
GTTTAAGCCACTGTATAAGCAGGTGCTGAGCGATCGGGAGTCTCTGAGCTTCTAC
GGCGAGGGCTATACATCCGATGAGGAGGTGCTGGAGGTGTTTAGAAACACCCTG
ACAAGAACAGCGAGATCTTCAGCTCCATCAAGAAGCTGGAGAAGCTGTTCAAG
AATTTTGACGAGTACTCTAGCGCCGGCATCTTTGTGAAGAACGGCCCCGCCATCA
GCACAATCTCCAAGGATATCTTCGGCGAGTGGAACGTGATCCGGGACAAGTGGA
ATGCCGAGTATGACGATATCCACCTGAAGAAGAAGGCCGTGGTGACCGAGAAGT
ACGAGGACGATCGGAGAAAGTCTTCAAGAAGATCGGCTCCTTTTCTCTGGAGCA
GCTGCAGGAGTACGCCGACGCCGATCTGTCTGTGGTGGAGAAGCTGAAGGAGAT
CATCATCCAGAAGGTGGATGAGATCTACAAGGTGTATGGCTCCTCTGAGAAGCTG
TTCGACGCCGATTTTGTGCTGGAGAAGAGCCTGAAGAAGAACGACGCCGTGGTG
GCCATCATGAAGGACCTGCTGGATTCTGTGAAGAGCTTCGAGAATTACATCAAGG
CCTTCTTTGGCGAGGGCAAGGAGACAAACAGGGACGAGTCCTTCTATGGCGATTT
TGTGCTGGCCTACGACATCCTGCTGAAGGTGGACCACATCTACGATGCCATCCGC

AATTATGTGACCCAGAAGCCCTACTCTAAGGATAAGTTCAAGCTGTATTTTCAGAA
CCCTCAGTTCATGGGCGGCTGGGACAAGGATAAGGAGACAGACTATCGGGCCAC
CATCCTGAGATACGGCTCCAAGTACTATCTGGCCATCATGGATAAGAAGTACGCC
AAGTGCCTGCAGAAGATCGACAAGGACGATGTGAACGGCAATTACGAGAAGATC
AACTATAAGCTGCTGCCCGGCCCTAATAAGATGCTGCCAAAGGTGTTCTTTTCTA
AGAAGTGGATGGCCTACTATAACCCAGCGAGGACATCCAGAAGATCTACAAGA
ATGGCACATTCAAGAAGGGCGATATGTTTAACTGAATGACTGTCACAAGCTGAT
CGACTTCTTTAAGGATAGCATCTCCCGGTATCCAAAGTGGTCCAATGCCTACGAT
TTCAACTTTTCTGAGACAGAGAAGTATAAGGACATCGCCGGCTTTTACAGAGAGG
TGGAGGAGCAGGGCTATAAGGTGAGCTTCGAGTCTGCCAGCAAGAAGGAGGTG
GATAAGCTGGTGGAGGAGGGCAAGCTGTATATGTTCCAGATCTATAACAAGGACT
TTTCCGATAAGTCTCACGGCACACCCAATCTGCACACCATGTAAGCTGCT
GTTTGACGAGAACAATCACGGACAGATCAGGCTGAGCGGAGGAGCAGAGCTGTT
CATGAGGGCGCGCTCCCTGAAGAAGGAGGAGCTGGTGGTGCACCCAGCCAACTC
CCCTATCGCCAACAAGAATCCAGATAATCCCAAGAAAACCACAACCTGTCCTAC
GACGTGTATAAGGATAAGAGGTTTTCTGAGGACCAGTACGAGCTGCACATCCCAA
TCGCCATCAATAAGTGCCCAAGAACATCTTCAAGATCAATACAGAGGTGCGCGT
GCTGCTGAAGCACGACGATAACCCCTATGTGATCGGCATCGCCAGGGGCGAGCG
CAATCTGCTGTATATCGTGGTGGTGGACGGCAAGGGCAACATCGTGGAGCAGTA
TTCCCTGAACGAGATCATCAACAACCTTCAACGGCATCAGGATCAAGACAGATTAC
CACTCTCTGCTGGACAAGAAGGAGAAGGAGAGGTTTCGAGGCCCGCCAGAAGTG
GACCTCCATCGAGAATATCAAGGAGCTGAAGGCCGGCTATATCTCTCAGGTGGT
GCACAAGATCTGCGAGCTGGTGGAGAAGTACGATGCCGTGATCGCCCTGGAGGA
CCTGAACTCTGGCTTTAAGAATAGCCGCGTGAAGGTGGAGAAGCAGGTGTATCA
GAAGTTCGAGAAGATGCTGATCGATAAGCTGAACTACATGGTGGACAAGAAGTC
TAATCCTTGTGCAACAGGCGGCGCCCTGAAGGGCTATCAGATCACCATAAGTTC
GAGAGCTTTAAGTCCATGTCTACCCAGAACGGCTTCATCTTTTACATCCCTGCCTG
GCTGACATCCAAGATCGATCCATCTACCGGCTTTGTGAACCTGCTGAAAACCAAG
TATACCAGCATCGCCGATTCCAAGAAGTTCATCAGCTCCTTTGACAGGATCATGT
ACGTGCCCGAGGAGGATCTGTTTCGAGTTTGGCCCTGGACTATAAGAACTTCTCTCG
CACAGACGCCGATTACATCAAGAAGTGAAGCTGTAAGCTCCTACGGCAACCGGAT
CAGAATCTTCCGGAATCCTAAGAAGAACAACGTGTTTCGACTGGGAGGAGGTGTG
CCTGACCAGCGCCTATAAGGAGCTGTTCAACAAGTACGGCATCAATTATCAGCAG
GGCGATATCAGAGCCCTGCTGTGCGAGCAGTCCGACAAGGCCTTCTACTCTAGCT
TTATGGCCCTGATGAGCCTGATGCTGCAGATGCGGAACAGCATCACAGGCCGCA
CCGACGTGGATTTTCTGATCAGCCCTGTGAAGAACTCCGACGGCATCTTCTACGA
TAGCCGGAAGTATGAGGCCAGGAGAATGCCATCCTGCCAAAGAACGCCGACGC
CAATGGCGCCTATAACATCGCCAGAAAGGTGCTGTGGGCCATCGGCCAGTTCAA
GAAGGCCGAGGACGAGAAGCTGGATAAGGTGAAGATCGCCATCTCTAACAAGGA
GTGGCTGGAGTACGCCAGACCAGCGTGAAGCACAAAAGGCCGGCGGCCACGAA
AAAGGCCGGCCAGGCCAAAAAAGAAAAGGGATCtaccatacagatgtccagattacgctatccc
tacgacgtgcctgattatgcataccatgatgtccccgactatgccTCGAGCGACTACAAAGACCATGAC
GGTGATTATAAAGATCATGACATCGATTACAAGGATGACGATGACAAGGCTGCAGG
AGGCGGTGGAAGCGGGGGAaggggagtgagggtggaaccatctcccaggagacggggcacc
ttcccaagcgcggccagacctgcgtggtgactacaccgggatgcttgaagatggaagaaatttgattcctc
cgggacagaaacaagcccttaagttatgctaggcaagcaggaggtgatccgaggctgggaagaaggggtg
cccagatgagtggtgagagagccaaactgactatctccagattatgcctatggtgccactgggcccag
gcatcatcccaccatgccactctcgtcttcgatgtggagcttctaaaactggaaGGTTCTaggggagtgca
ggtggaaccatctcccaggagacggggcgacctcccaagcgcggccagacctgcgtggtgactacac
cgggatgcttgaagatggaagaaattgattcctccgggacagaaacaagcccttaagttatgctaggcaa
gcaggaggtgatccgaggctgggaagaaggggtgcccagatgagtggtgagagagccaaactgactat

atctccagattatgcctatggtgccactgggcacccaggcatcatcccaccacatgccactctcgtcttcgatg
gagcttctaaaactggaaGGGGGAAGCGGTGGAAGCGGGaggggagtgaggtggaaaccatctc
cccaggagacggg'gcaccttccccagcgcggccagacctgcgtggtgcactacaccgggatgcttgaag
atggaaagaaatttgattcctcccgggacagaacaagcccttaagtattatgctaggcaagcaggaggtgatcc
gaggctgggaagaaggggtgcccagatgagtggtgggtcagagagccaaactgactatatctccagattatgcc
tatggtgccactgggcacccaggcatcatcccaccacatgccactctcgtcttcgatgtggagcttctaaaactgg
aaGGTTCTaggggagtgaggtggaaaccatctcccaggagacggg'gcaccttccccagcgcggcc
agacctgcgtggtgcactacaccgggatgcttgaagatggaaagaaatttgattcctcccgggacagaacaag
cccttaagtattatgctaggcaagcaggaggtgatccgaggctgggaagaaggggtgcccagatgagtggtgg
tcagagagccaaactgactatatctccagattatgcctatggtgccactgggcacccaggcatcatcccaccaca
tgccactctcgtcttcgatgtggagcttctaaaactggaaGGATAA

10. BPK3082: U6-Lb-crRNA-BsmBIcassette

U6 promoter: **bold**, Lb crRNA: *italic*, BsmBI sites: lower case, U6 terminator: *italic* and **bold**

**TGTACAAAAAAGCAGGCTTTAAAGGAACCAATTCAGTCGACTGGATCCGGTACCA
AGGTCGGGCAGGAAGAGGGCCTATTTCCCATGATTCCTTCATATTTGCATATACG
ATACAAGGCTGTTAGAGAGATAATTAGAATTAATTTGACTGTAACACAAAGATAT
TAGTACAAAATACGTGACGTAGAAAGTAATAATTTCTTGGGTAGTTTGCAGTTTTA
AAATTATGTTTTAAAATGGACTATCATATGCTTACCGTAACTTGAAAGTATTTTCGAT
TTCTTGGCTTTATATATCTTGTGGAAAGGACGAAACACCGAATTTCTACTAAGTGTA
GATGgagacgATTAATGcgtctcTTTTTTT**

REFERENCES

1. Kleinstiver, B.P. et al. Genome-wide specificities of CRISPR-Cas Cpf1 nucleases in human cells. *Nature biotechnology* **34**, 869-874 (2016).