

Supplementary Materials for:

β -Farnesene Production from Low-cost Glucose in Lignocellulosic Hydrolysate by Engineered *Yarrowia lipolytica*

Table S1 Plasmids used in this work.

Plasmids	Descriptions	Source
pRSF-HUH	hisG-P _{ura3} -Ura3-T _{Ura3} -hisG (HUH), Kana ^r	Lab storage
pRSF-ku70-HUH	HR donor to disrupt <i>ku70</i> locus	This work
pRSF-ku80-Leu2-HUH	HR donor to integrate P _{TEF_{in}} -Leu2-T _{XPR2} into ku80 locus	This work
pRSF-intA1-aaBFS-HUH	HR donor to integrate P _{TEF_{in}} -aaBFS-T _{XPR2} into intA1 locus	This work
pRSF-intC1-ERG10-tHMGR-HUH	HR donor to integrate P _{TEF_{in}} -ERG10-T _{ERG10} and P _{TEF_{in}} -tHMGR-T _{HMGR} into intC1 locus	This work
pRSF-intC2-ERG12-ERG13-HUH	HR donor to integrate P _{EXP1} -ERG12-T _{ERG12} and P _{EXP1} -ERG13-T _{ERG13} into intC2 locus	This work
pRSF-intC3-IDI-ERG20-HUH	HR donor to integrate P _{TEF_{in}} -IDI-T _{IDI} and P _{TEF_{in}} -ERG20-T _{ERG20} into intC3 locus	This work
pRSF-intE1-ERG8-ERG19-HUH	HR donor to integrate P _{EXP1} -ERG8-T _{EXP1} and P _{EXP1} -ERG19-T _{ERG19} into intE1 locus	This work
pRSF-aaBFS-cjBFS-HUH	HR donor to integrate P _{TEF_{in}} -cjBFS-T _{XPR2} into aaBFS locus	This work
pRSF-aaBFS-mcBFS-HUH	HR donor to integrate P _{TEF_{in}} -mcBFS-T _{XPR2} into aaBFS locus	This work
pRSF-intE2-ERG10-tHMGR-HUH	HR donor to integrate P _{TEF_{in}} -ERG10-T _{ERG10} and P _{TEF_{in}} -tHMGR-T _{HMGR} into intE2 locus	This work
pRSF-intE3-ERG12-ERG13-HUH	HR donor to integrate P _{EXP1} -ERG12-T _{ERG12} and P _{EXP1} -ERG13-T _{ERG13} into intE3 locus	This work
pRSF-intE4-IDI-ERG20-HUH	HR donor to integrate P _{TEF_{in}} -IDI-T _{IDI} and P _{TEF_{in}} -ERG20-T _{ERG20} into intE4 locus	This work
pRSF-intF1-ERG8-ERG19-HUH	HR donor to integrate P _{EXP1} -ERG8-T _{EXP1} and P _{EXP1} -ERG19-T _{ERG19} into intF1 locus	This work

pRSF-intF2-tHMGR-tHMGR-HUH	HR donor to integrate $P_{TEF_{in}}-tHMGR-T_{HMGR}$ and $P_{TEF_{in}}-tHMGR-T_{HMGR}$ into intF2 locus	This work
pRSF-intF2-nadhHMGR-nadhHMGR-HUH	HR donor to integrate $P_{TEF_{in}}-nadhHMGR-T_{XPR2}$ and $P_{TEF_{in}}-nadhHMGR-T_{XPR2}$ into intF2 locus	This work
pRSF-intF2-nadhHMGR-tHMGR-HUH	HR donor to integrate $P_{TEF_{in}}-nadhHMGR-T_{XPR2}$ and $P_{TEF_{in}}-tHMGR-T_{HMGR}$ into intF2 locus	This work
pRSF-intF3-aaBFS-HUH	HR donor to integrate $P_{TEF_{in}}-aaBFS-T_{XPR2}$ into intF3 locus	This work
pRSF-intF3-aaBFS-aaBFS-HUH	HR donor to integrate $P_{TEF_{in}}-aaBFS-T_{XPR2}$ and $P_{TEF_{in}}-aaBFS-T_{XPR2}$ into intF3 locus	This work

Table S2 Primers used in this work.

ku70up-F	CGCACTTAATTAACACTACACTACTTGTACCATTCTACCC
ku70up-R	ttttacaacTGGTTTCGTGTTTCGTGTTTCGTGTCG
ku70-HUH-F	ACACGAACCAgttgtaaacgacggccagtcgaac
ku70-HUH-R	GTACTTTTTGGTAGCCGTAGGTCTCGTACTGCTTGAC
ku70dn-F	CTACCAAAAAGTACTATGGGAAGTGACTAGGGAGGC
ku70dn-R	agacacAGTGAACGACCAAGACTAAAGGGTGG
ku70-line-F	CACTACACTACACTACTTGTACCATTCTACCC
ku70-line-R	AGTGAACGACCAAGACTAAAGGGTGGC
ku80up-F	CGTTGCGCAGCAACCCACTGCCGCTCAACCC
ku80up-R	ccggtctctGCTCAAAGTCACTGGTATGGCAGTGTG
ku80-Leu2-tef-F	CTTTGAGCagagaccgggttgccggcgctatttg
ku80-Leu2-tef-R	gtttcgggttctcgcggttagtactgcaaaaagtgtg
ku80-Leu2-F	ctaaccgcaggaacccgaaactaagaagaccaagactgac
ku80-Leu2-R	gtttacaacGACACGGGCATCTCACTTGCATATG
ku80-Leu2-HUH-F	CCGTGTCgttgtaaacgacggccagtcgaac
ku80-Leu2-HUH-R	TGTATCCGTAGCCGTAGGTCTCGTACTGCTTGAC
ku80down-F	GGCTACGGATACATATTGGTGACAGTTACCGCAATC
ku80down-R	TCTCAAATGCCTGGATTCTGGATCCATTCCCTTTGGTGCTGCTTC
ku80-line-F	AGCAACCCACTGCCGCTCAACC
ku80-line-R	GATTCTGGATCCATTCCCTTTGGTGCTGCTTC

intA1-aabfs-up-F	CGTTGCGCgaatgcgtgcgatttattatcccaaaaatac
intA1-aabfs-up-R	CCCGGTCTCTgtcgcactcgccgatatggtttgatc
intA1-aabfs-tef-F	gcgacaAGAGACCGGGTTGGCGGCGTATTT
intA1-aabfs-tef-R	GTGGACATTCTAGAGAATGATTCTTATACTCAGAAGGAAATG
intA1-aabfs-F	TTCTCTAGAATGTCCACCCTGCCCATCTCCTCTGTC
intA1-aabfs-R	AGGCTCGAGTTACACGACCATGGGGTGCACGAAGAAAG
intA1-aabfs-xpr-F	CTCGAGCCTGTCCCCACGTTGCCGGTCTTGC
intA1-aabfs-xpr-R	cgttttacaacACGGGCATCTCACTTGCGTATGTATG
intA1-aabfs-HUH-F	AGATGCCCCGTgttgtaaaacgacggccagtcgaac
intA1-aabfs-HUH-R	ctagtggatGTAGCCGTAGGTCTCGTACTGCTTGAC
intA1-aabfs-dn-F	ACGGCTACatccactagtggcctgccatagcactattg
intA1-aabfs-dn-R	TCTCAAATGCCTGgatttaaatgcggccgcaatgcacgc
intA1-aabfs-line-F	gaatgcgtgcgatttattatcccaaaaataccc
intA1-aabfs-line-R	gatttaaatgcggccgcaatgcac
intA1-cjbfs-tef-R	ATGTCCTTTCTAGAGAATGATTCTTATACTCAGAAGGAAATG
intA1-cjbfs-F	AATCATTCTCTAGAAAGGACATGAGCATTCCACTTTTGGCG
intA1-cjbfs-R	GGGGACAGGCTCGAGTCAAATGGCAAGAGGCTCTGTCAACAGC AGAG
intA1-cjbfs-xpr-F	TGCCATTTGACTCGAGCCTGTCCCCACGTTGCCGGTCTTGC
intA1-mc-bfs-tef-R	TATGGTGCTTCTAGAGAATGATTCTTATACTCAGAAGGAAATG
intA1-mcbfs-F	ATCATTCTCTAGAAGCACCATACCCGTCTCCTCTGTAAGTTTTTC
intA1-mcbfs-R	GGACAGGCTCGAGTCAAATAACCATGGGGTGCACAAAG
intA1-mcbfs-xpr-F	GTTATTTGACTCGAGCCTGTCCCCACGTTGCCGGTCTTGCCTC
intC1-up-F	CGTTGCGCttgctggccttttgcacatgttcttctg
intC1-up-R	TGCAGTACaaaatcataaataatagatgaatag
intC1-ERG10-tef-F	gattttGTACTGCAAAAAGTGCTGGTCGGATG
intC1-ERG10-tef-R	GACACAAATGCGCCGCCAACCCGGTCTCTGAGCCCCG
intC1-ERG10-F	GTCTCTGAGCCCGTCTACATTGTTTCTACTG
intC1-ERG10-R	CGTGTCTGTCAGGCCGTGACGAATACGACTCTCG
intC1-ERG10-xpr-F	CTGCAGGACACGGGCATCTCACTTGCAT
intC1-ERG10-xpr-R	tcatagGTAGGATCCAACTACGGAACCTGTGTTG
intC1-tHMGR-F	GGATCCTACctatgaccgtatgcaaatattcgaaccg
intC1-tHMGR-R	CTTTTTGCAGTACaccagctctgtaaggtggttgagaagc
intC1-tHMGR-tef-F	gactgggtGTACTGCAAAAAGTGCTGGTCGGATGACGTGG

intC1-tHMGR-tef-R	tacaacAGAGACCGGGTTGGCGGCGCATTTG
intC1-tHMGR-HUH-F	CGGTCTCTgttgtaaacgacggccagtcgaac
intC1-tHMGR-HUH-F	ggatctgaGTAGCCGTAGGTCTCGTACTGCTTGAC
intC1-dn-F	TACGGCTACtcagatccactagtgccctagtcgtg
intC1-dn-R	TCTCAAATGCCTGgaagtggggatttaaatgcggccgc
intC1-line-F	ttgctggcctttgctcacatgttc
intC1-line-R	gaagtggggatttaaatgcggccgc
intC3-up-F	GCGTTGCGCccttattcgactcactatagaagttcctatc
intC3-up-R	CTTTTTGCAGTACcgtatacgggcctctcctctgac
intC1-IDI-tef-F	gtatacgTACTGCAAAAAGTGCTGGTCGGATG
intC1-IDI-tef-R	GTAAGACGTCGTAGAGACCGGGTTGGCGGCGCATTTG
intC1-IDI-F	CGGTCTCTACGACGTCTTACAGCGACAAAATCAAGAG
intC1-IDI-R	ATGAATACAGTTGTATCTGGAGTCGAGACATGATG
intC1-ERG20-F	CAGATACAACGTGATTTCATTGTGGGCCGAAGTGAAGAGG
intC1-ERG20-R	CTTTTTGCAGTACTCCAAGGCGAAATTCGAAAGCGTGTTCC
intC1-ERG20-tef-F	GCCTTGGAGTACTGCAAAAAGTGCTGGTCGGATGACGTG
intC1-ERG20-HUH-R	cgacacgaacaatGTAGCCGTAGGTCTCGTACTGCTTGAC
intC3-dn-F	CGGCTACattgttcgtgtcgatccgtacgacg
intC3-dn-R	TCTCAAATGCCTGaaatgcggccgcgaatgcacgcgataatta
intC3-line-F	cgactcactatagaagttcctattctctagaaagtataggaacttc
intC3-line-R	aatgcggccgcgaatgcacgcgataatta
intC2-up-F	CATTAATTGCGTTGCGCggttctgataacgagtaatcgtaatcc
intC2-up-R	ggcgccaaactcctctagagaataggaacttctatagtgtg
intC2-ERG12-exp-F	cctattcttagaaggagtttggcgcccggtttttcg
intC2-ERG12-exp-R	AATGATGTAGTCCATgctgtagatatgtctgtgtgaagggggttg
intC2-ERG12-F	atatctacagcATGGACTACATCATTTTCGGCGCCAGG
intC2-ERG12-R	GAGCTCGGGAAGAATGGAGATGGGCCTATGACTCC
intC2-ERG13-F	ATTCTTCCCGAGCTCCACTTCTCGTGTTTTTCGTGTGCACAGATG
intC2-ERG13-R	ctacagcATGTCGCAACCCAGAACGTTGGAATCAAAG
intC2-ERG13-exp-F	GGGGTTGCGACATgctgtagatatgtctgtgtgaagggggttg
intC2-ERG13-exp-R	cgttttacaacaaggagtttggcgcccggtttttcg
intC2-HUH-F	ccaaactcctgttgtaaacgacggccagtcgaacc
intC2-HUH-R	gtatccgaggagttcGTAGCCGTAGGTCTCGTACTGCTTGAC
intC2-dn-F	CCTACGGCTACgaactcctcgatacctccgagtgtgcagc

intC2-dn-R	TCTCAAATGCCTGgCGaatgcacgcgatgattgaaacgcctg
intC2-line-F	ggttctgataacgagtaatcgtaatccgcaaataac
intC2-line-R	gcgaatgcacgcgatgattgaaacgcctg
intE1-up-F	TTAATTGCGTTGCGCtaacaatgataaaccaaggccattgattgagac
intE1-up-R	aaactccttgcatgtccaagtacaataactaaacatactgtac
intE1-ERG8-exp-F	tggacaatgcaaggagtgttgccgccccgtttttcgagccc
intE1-ERG8-exp-R	CGAATAGGTGGTCATgctgtagatatgtcttgtgtgtaagggggttg
intE1-ERG8-F	atctacagcATGACCACCTATTCGGCTCCGGGAAAGGC
intE1-ERG8-R	GCACTTGGACTIONGAGCCATTACAGACGCGGAAAAG
intE1-ERG19-F	CTCGAGTCCAAGTGCGAGATCCAGGACCGAGCGTTTG
intE1-ERG19-R	tacagcATGATCCACCAGGCCTCCACCACCGCTCCGGTGAAC
intE1-ERG19-exp-F	CCTGGTGGATCATgctgtagatatgtcttgtgtgtaagggggttg
intE1-ERG19-exp-R	ttttacaacccccacagctttcggtgagtatgagcggcggcagattcgagcgtttcc
intE1-HUH-F	acgtgtgggggttgtaaaacgacggccagtcgaac
intE1-HUH-R	tatgctgtgcagcctGTAGCCGTAGGTCTCGTACTGCTTGAC
intE1-dn-F	CCTACGGCTACagcgtcgacaagcatacagccctcg
intE1-dn-R	TCTCAAATGCCTGgaatgcacgcgatgttagaagcaattgga
intE1-line-F	taacaatgataaaccaaggccattgattgagac
intE1-line-R	gaatgcacgcgatgttagaagcaattggag
intE2-up-F	CGTTGCGCttcagtcgataccatggccgcaactttcttg
intE2-up-R	ACTTTTTGCAGTACcagggatatacgagctacgtggtggtgc
intE2-dn-F	CCTACGGCTACgtgtggattgcgatattgaagtgttgactcg
intE2-dn-R	TCTCAAATGCCTGgcgatgaaatacgccagggtttagactatacc
intE2-line-F	cagtcgataccatggccgcaacttc
intE2-line-R	gcgatgaaatacgccagggtttagactatacc
intE3-up-F	CTTACATTAATTGCGTTGCGCtaagcggcttctatccatggtttactg
intE3-up-R	ggcgccaaactccttgattccgaacagaaggaatgcacgcgac
intE3-dn-F	TACGAGACCTACGGCTACctgaactgtataccaatgtactgtacgcctgaac
intE3-dn-R	TCTCAAATGCCTGtgaaggaaatgcctaaacctaattgaacgaagcg
intE3-line-F	cggcttctatccatggtttactgaggagaaatgttc
intE3-line-R	tgaaggaaatgcctaaacctaattgaacgaagcg
intE4-up-F	AATTGCGTTGCGCgccccctggcggttctgataacgagtaat
intE4-up-R	GCACTTTTTGCAGTACaatgaagtgaagttcctatactttctagagaataggaactct
intE4-dn-F	AGACCTACGGCTACgatagggaacaccgcggaacagggaacac

intE4-dn-R	TCTCAAATGCCTGcacgcgatttaacactggaccgtactgccc
intE4-line-F	ctgggcggttctgataacgagtaatcg
intE4-line-R	cacgcgatttaacactggaccgtactgccc
intF1-up-F	CATTAATTGCGTTGCGCacacacaagtttcagacttgctcctttg
intF1-up-R	ccaaactccttatttatgcccttactcgtacagtgtgcaatactgc
intF1-dn-F	GAGACCTACGGCTACgtggcctttctggggaccgagaattagtg
intF1-dn-R	TCTCAAATGCCTGggattttaatgcggccgcaatgcac
IntF1-line-F	caagtttcagacttgctccttttgagtcttc
intF1-line-R	ggattttaatgcggccgcaatgcac
intF2-up-F	CATTAATTGCGTTGCGCgaggaaagtggttacagtatgtacatac
intF2-up-R	TGCAGTACtctcgggtgggtgattcggtagagctttcggtctttgg
intF2-1-tef-F	ccgaggaGTACTGCAAAAAGTGCTGGTCGGATGACGT
intF2-1-tef-R	cagactgggtAGAGACCGGGTTGGCGGCGCATTTG
intF2-1-thmgr-F	CCCGGTCTCTAcccagtcgtgaagtggttgagaagcacgttc
intF2-1-thmgr-R	catagGTAGctatgaccgtatgcaaatttcgaaccgtttt
intF2-2-thmgr-F	catagCTACctatgaccgtatgcaaatttcgaaccgtttt
intF2-2-HUH-F	actggccgctgttttacaacAGAGACCGGGTTGGCGGCGCATTTGTG
intF2-2-HUH-R	taattgagaaggccactGTAGCCGTAGGTCTCGTACTGCTTGAC
intF2-dn-F	ACCTACGGCTACagtggccttctcaattaaaataaac
intF2-dn-R	TCTCAAATGCCTGgcacgcgatttccctgattactatgatatttc
IntF2-line-F	ggtacagtatgtacatactgtgaaggtgcaca
intF2-line-R	gcacgcgatttccctgattactatgatatttc
intF2-nadh-tef-R	GCCAGTCTTGCCGGTAGAGACCGGGTTGGCGGCGCATTTGTG
intF2-nadh-thmgr-F	ACCCGGTCTCTACCGGCAAGACTGGCCACATCGACGGACTG
intF2-nadh-thmgr-R	CGTAGTTGGATCTTAAGTGTTCTCCAGCACTTGTTTAGCTCTA
intF2-nadh-xpr-F	GAGAACACTTAAGATCCAACACTACGGAACCTTGTGTTGATG
intF2-nadh-xpr-R	cggtcatagGTAGGACACGGGCATCTCACTTGCAT
intF2-2nsdh-xpr-R	AAGTGAGATGCCCCGTGTCAGGACACGGGCATCTCACTTGCAT
intF2-2nsdh-xpr-F	AGATGCCCCGTGTCCTGACACGGGCATCTCACTTGCATAT
intF3-up-F	TAATTGCGTTGCGCctgaagacaaggccgacgatgatgagc
intF3-up-R	GAGTGAATTGgagggttgacgtatagcaggttgatggtgat
intF3-1-tef-F	cgtaaccctcCAATTCACCTCACTCTCCCGACTATCCAACaacg
intF3-2-tef-R	aagacactgcggAGAGACCGGGTTGGCGGCGTATTTG
intF3-2-HUH-F	cgcagtgtcttgctctctggatctccagtggatgaacg

intF3-2-HUH-R	cagaatgcagcGTAGCCGTAGGTCTCGTACTGCTTGAC
intF3-dn-F	GGCTACgctgacattctgcgtctgtacatctgtc
intF3-dn-R	TCTCAAATGCCTGgaaaggcacagagatgcccttgagaggatcacg
IntF3-line-F	ctgaagacaaggccgacgatgatgagc
intF3-line-R	gaaaggcacagagatgcccttgagaggatcacg

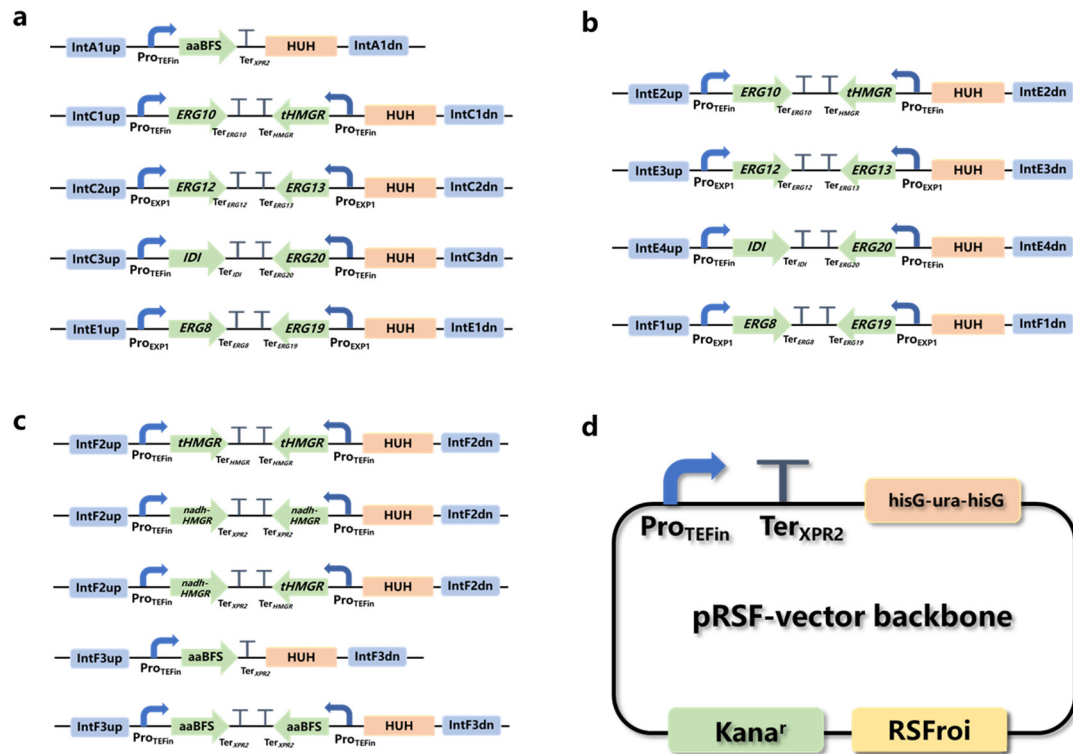


Figure S1 (a-c) Schematic representation of gene chromosome integration in this study and (b) schematic representation of pRSF vector backbone. Blue rectangular boxes represent homologous arms, orange rectangular box represents the his-ura-his box, green arrow boxes represent genes, blue curved arrows represent promoters and the dark blue T represents terminators.

Table S3 The exogenous DNA used in this study.

Genes	Sequence (codon optimized)
<i>aaBFS</i>	ATGTCCACCCTGCCCATCTCCTCTGTCTCCTCTTCCCTCTTCCACCTCCCC ATTGTCGTGGACGACAAGGACTCTACCAAGCCCGACGTGATCCGACACA CCACCACCTTCAACGCCTCTATTTGGGGTGACCAGTTCCTCACCTACGA CGAGCCCAGGACCTGGTCATGAAGAAGCAGCTGGTGGAGGAGCTCAA GGAAGAGGTCAAGAAGGAGCTGATCACCATTAAGGGCTCCAACGAGCC CATGCAGCACGTCAAGCTGATCGAGCTCATTGACGCCGTGCAGCGACTC

	<p>GGTATCGCTTACCACTTCGAGGAAGAGATCGAGGAAGCCCTGCAGCAC ATTCACGTCACCTACGGAGAGCAGTGGGTGGACAAGGAGAACCTCCAG TCTATTTCCCTGTGGTTCCGACTGCTCCGACAGCAGGGTTTCAACGTCTC TTCCGGAGTGTTCAAGGACTTCATGGACGAGAAGGGAAAGTTCAAGGA GTCTCTGTGCAACGACGCCCAGGGCATCCTGGCTCTCTACGAGGCCGCT TTCATGCGAGTCGAGGACGAGACCATTCTGGACAACGCCCTGGAGTTCT CCAAGGTGCACCTCGACATCATTGCTAAGGACCCCTCTTGTGACTCTTCC CTGCGAACCCAGATTACCAAGGCTCTGAAGCAGCCTCTCCGACGACGA CTGGCTCGAATCGAGGCTCTGCACTACATGCCCATCTACCAGCAGGAGA CCTCCACGACGAGGTCCTGCTCAAGCTGGCTAAGCTCGACTTCTCCGT GCTCCAGTCTATGCACAAGAAGGAGCTGTCTCACATCTGCAAGTGGTG AAGGACCTGGACCTCCAGAACAAGCTCCCCCTTCGTCCGAGACCGAGTC GTGGAGGGATACTTCTGGATCCTGTCCATCTACTACGAGCCCCAGCACG CCCGAACCCGAATGTTCTCATGAAGTCTTGATGTGGCTGGTCGTGCTC GACGACACCTTCGACAACCTACGGCACCTACGAGGAGCTGGAGATCTTC ACCCAGGCTGTCGAGAAGTGGTCTATTTCTGTCTGGACATGCTCCCCG AGTACATGAAGCTGATCTACCAGGAGCTGGTCAACCTCCACGTGGAGAT GGAGGAGTCCCTGGAGAAGGAAGGCAAGGCCTACCAGATTCACTACGT GAAGGAGATGGCTAAGGAGCTCGTCCGAACTACCTGGTGGAGGCCCG ATGGCTCAAGGAAGGCTACATGCCACCCTGGAGGAGTACATGTCTGTC TCCATGGTGACCGGAACCTACGGCCTGATGACCGCTCGATCTTACGTCG GCCGAGGTGACATCGTGAACGAGGACACCTTCAAGTGGGTGTCTTCCTA CCCTCCCATCGTCAAGGCCTCCTGCGTGATCATTGCACTCATGGACGACA TTGTCTCTCACAAGGAAGAGCAGGAGCGAGGTCACGTGGCTTCTTCCAT TGAGTGCTACTCTAAGGAGTCCGGAGCCTCTGAGGAAGAGGCCTGTGA GTACATCTCCCGAAAGGTCGAGGACGCCTGGAAGGTCATCAACCGAGA GTCTCTCCGACCTACCGCTGTCCCTTTCCCTCTGCTCATGCCTGCCATCA ACCTCGCTCGAATGTGTGAGGTCTGTACTCCGTGAACGACGGCTTCAC CCACGCCGAGGGTGACATGAAGTCCTACATGAAGTCTTTCTTCGTGCAC CCCATGGTCGTGTAA</p>
<i>cjBFS</i>	<p>ATGAAGGACATGAGCATTCCACTTTTGGCGGCGGTGTCTTCATCCACGG AGGAGACTGTGCGACCCATTGCTGACTTCCATCCGACACTGTGGGGCAA CCACTTCTTGAAATCTGCTGCCGATGTGGAGACTATTGACGCCGCGACT CAGGAACAGCACGCCGCTCTCAAGCAGGAGGTGCGTCGCATGATCACC ACAACGGCCAACAAGCTGGCCCAAAAGCTCCACATGATTGATGCCGTTT AACGGTTAGGAGTGGCCTACCACTTTGAGAAGGAGATTGAGGACGAGC TGGGAAAGGTTTCCCATGATCTGGACTCTGACGATCTCTACGTGGTCTCC CTTCGGTTCAGACTATTCCGACAGCAGGGCGTTAAGATCAGTTGTGACG TCTTTGACAAGTTCAAGGATGATGAGGGTAAGTTCAAGGAAAGTCTGAT CAACGATATCAGAGGCATGCTGTCCCTTTATGAAGCAGCCTATTTGGCAA TCCGAGGAGAGGATATCCTGGACGAGGCTATTGTGTTTACAACCAACCA CCTGAAGTCTGTCATCTCCATTTCCGACCACTCGCATGCCAATTCCAACC TGGCTGAGCAGATCAGACACAGCTTGCAGATTCCTCTGCGAAAGGCCGC AGCCCGTCTGGAGGCTCGATACTTTTGGACATCTACTCGCGAGACGAC</p>

	<p>CTGCATGACGAAACTCTGCTCAAATTTGCCAAGCTTGATTTC AACATTCT GCAGGCTGCTCACCAGAAGGAGGCGTCCATCATGACCCGATGGTGGAA CGACCTCGGCTTCCCCAAGAAGGTTCCATATGCCAGAGACCGAATCATC GAGACCTACATCTGGATGCTTCTTGGTGTTCCTTACGAGCCCCAACCTCGC GTTTGGGCGAATCTTCGCTTCCAAGGTGGTGTGTATGATCACAACCATAG ATGACACTTTTGATGCATACGGTACCTTCGAGGAGCTCACTCTGTTCACT GAGGCCGTCACTAGGTGGGACATTGGTCTCATCGACACCCTGCCGGAGT ACATGAAATTCATTGTCAAGGCGCTGTTGGATATCTACCGAGAGGCCGA GGAAGAGCTCGCAAAGGAGGGCCGCTCGTACGGAATCCCCTACGCTAA ACAGATGATGCAGGAGCTGATTATCCTCTACTTCACCGAAGCCAAGTGG CTGTACAAGGGCTACGTTCTACTTTTGACGAGTATAAAAGCGTCGCACT ACGTTTCGATTGGCCTTCGAACCCTGGCCGTCGCTAGTTTTGTGCTAG GAGACTTTATTGCCACCAAGGACAACCTTCGAATGCATTCTCAAGAATGC TAAGTCGCTCAAGGCTACAGAAACCATTTGGACGGCTCATGGACGACATT GCAGGTTACAAGTTTGAGCAGAAACGGGGCCACAACCCCTCTGCTGTC GAGTGCTACAAGAACCAGCATGGAGTATCTGAAGAAGAAGCCGTGAAA GAACTCTTACTGGAAGTCGCCAATTCGTGGAAGGACATTAACGAGGAGC TGCTCAACCCTACGACGGTACCTCTCCCCATGCTCCAACGACTTCTGTAT TTTGCTCGGTCAGGTCATTTTCATCTACGACGATGGTCACGACAGATACAC CCATTCTCTAATGATGAAGCGACAAGTGGCTCTGCTGTTGACAGAGCCT CTTGCCATTTGA</p>
<i>mcBFS</i>	<p>ATGAGCACCATAACCCGTCTCCTCTGTAAGTTTTTCCTCGTCAAGCTCTCC GCTGGTCCCTTGATGACAAATTGAGTACCAAGCAGGACGTGGTGCGACAC ACCATGAACTTCTCGGCAAGCATTTGGGGAGACCAGTTTTTAACTTATCA TGAGCCAGAGGATCTGGTGATCAAGAAGCAACTCGTCGAGCAGCTCAA GGAGGAGGTTAAGAAGGAACTGATGACCATCAAGGGCTCCAACGAACC TATGCAGCATATCAAGCTTATGGAGCTGATTGATTCGGTCCAGAGACTGG GTATTGCCTACCACTTTGAGGAGGAAATCGAGGAGGCCCTCCAACACAT CCACGTCACGTACGGAGAGCAGTGGATCGACAAGGAGAACCTGCAATC TGTGTCTCTGTGGTTCCGACTGCTCAGACAGCAGGGGCTTCAACGTGTCT TCTGGTGTGTTCAAGGACTACACCGATGAGAAGGGGGACTTCAAAGAG TCGTTGTGCAACGACGCACACGGCATCCTGGCTCTCTATGAAGCTGCTT ACATGCGAGTTGAGGGCGAGACCACTTTGGACAAGGCGCTCGAGTTCA CCAAGGTGCATCTCGACATCATCAGTAAGGACCCCTCCTGTGACTCTTAT CTGCGAACGCGAGTCCACCAGGCTCTCAAACAACCTCTCCGCCGTCGG CTGGCAAGAATCGAAGCGCTGCACTACATGCCTGTCTACCAGCAAGACT CCTCGCATAATGAGGTTCTGTAAAGCTGGCCAAACTTGATTCTCCGTC CTACAGTCCATGCACAAGACGGAGCTCAGCCACATTTGCAAGTGGTGG AGGATCTCGATCTGCAGAACAAAGCTCCCCTACGTGCGAGACAGAGTGGT CGAGGGCTACTTCTGGATTCTGTGATCTACTACGAGCCCCAGCGGGCC CGAACTCGAATGTTCTGATGAAGACTTGTATGTGGCTGGTCGTTCTGG ATGATACCTTTGACAACATATGGAACATATGAGGAATTGGAGATTTTGCC CAGGCCGTTGAGCGGTGGTCCATAAGTTGCATGGATATGCTGCCCGAGT ACATGAAGCTGATTTACCAGGAGCTTGTGAATCTGCATGTGGACATGGA</p>

	AGAGTCCCTTGAGAAAGGTGGCAAGACTTATCAGATCCAGTACGTCAAG GAAATGGCCAAGGAACCTCGTAAGGAACCTACTTGGTGGAGGCTCGATGG CTCAAGGAGGGATATATGCCACACTAGAGGAGTACATGTCGGTTTCTAT GGTGACGGGAACCTTACGGCTTGATGATTGCGCGGTTCGTACGTCGGTCGT GACGACATTGTGACAGAGGACACCTTCAAGTGGGTAGTTCTTACCCTC CCATCATTAAAGGCTTCATGTGTCATTGTGAGATTGATGGACGATATTGTT CGCATCGTGAGGAACAGGAGCGAGGACACGTGGCTTCGTCTATTGAGT GCTACTCCAAAGAAAGTGGTGCCACCGAAGAAGAAGCCTGTGAATACA TCTCTTCCAAGGTCGAAGACGCTGGAAGGTAATCAACCGAGAGTCACT TCGCCCCGACAGCCGTTCTTTTCTCTGCTTATGCCAGCTATTAATTTAGC ACGAATGTGTGAGGTGCTGTACTCTGTCAACGATGGACTCACTCATGCC GAGGGTGACATGAAGTCCTACATGAAAAGCTACTTTGTGCACCCCATGG TTATTGA
<i>nadh-HMHR</i>	ATGACCGGCAAGACTGGCCACATCGACGGACTGAATTCTCGAATCGAGA AGATGCGAGACCTGGACCCCGCCCAAAGACTGGTGAGAGTGGCTGAAG CTGCTGGCCTGGAACCTGAAGCTATCTCTGCTCTGGCTGGCAATGGAGC TCTGCCCCCTGTCTCTTGCTAATGGCATGATTGAAAATGTGATCGGCAAGT TCGAGCTGCCCCCTGGGCGTTGCTACTAACTTTACTGTGAATGGCAGAGA TTACCTGATCCCCATGGCCGTGGAAGAGCCCTCTGTGGTTGCTGCTGCTT CTTACATGGCCAGAATCGCCCGAGAGAACGGCGGCTTTACTGCCCATGG AACTGCCCCCTCTGATGAGAGCTCAGATTCAAGTGGTGGGACTGGGCGAC CCCGAAGGAGCTAGACAAAGACTGCTGGCTCACAAAGCCGCCTTTATG GAAGCCGCCGATGCTGTGGATCCTGTGCTGGTTGGACTGGGAGGAGGAT GTAGAGATATTGAGGTGCACGTGTTTCGAGACACCCCGTGGGAGCTAT GGTGGTGCTGCATCTTATTGTGGACGTGCGAGACGCCATGGGCGCTAAT ACTGTGAATACCATGGCCGAGCGACTGGCCCCCGAAGTGGAAACGAATTG CTGGCGGAACCTGTGCGACTGCGAATTCTGTCTAATCTGGCCGACCTGCG ACTGGTGCGAGCCAGAGTGGAATTAGCTCCTGAAACCCTGACTACTCAG GGCTATGACGGAGCTGACGTGGCTCGAGGAATGGTGGAAAGCTTGTGCC CTGGCTATTGTGGACCCCTATAGAGCCGCCACTCATAACAAGGGAATCAT GAACGGCATCGACCCCGTGGTGGTGGCCACTGGAAACGATTGGAGAGC TATTGAGGCCGGAGCTCACGCCTATGCCGCTAGAAGTGGACACTATACTT CTCTGACCCGATGGGAGCTGGCCAACGACGGCAGACTGGTGGGAACATA TTGAGCTGCCCCCTGGCTCTGGGACTGGTGGGAGGAGCTACTAAAACCTCA CCCTACCGCCCCGAGCCGCCCTGGCTCTGATGCAAGTGGAAACCGCTACT GAGCTGGCCCAAGTGAAGTGGCGCTGTGGGACTGGCTCAAAATATGGCCG CTATCCGAGCCCTGGCTACCGAGGGAATTCAGAGAGGCCATATGACTCT GCACGCCCGAAATATTGCCATCATGGCCGGCGCTACTGGCGCCGATATTG ATAGAGTGACCAGAGTGATCGTGGAGGCCGGAGACGTTTCTGTGGCTAG AGCTAAACAAGTGTGGAGAACACTTAA