Metabolic engineering of *Zymomonas mobilis* for xylonic acid production from lignocellulosic hydrolysate

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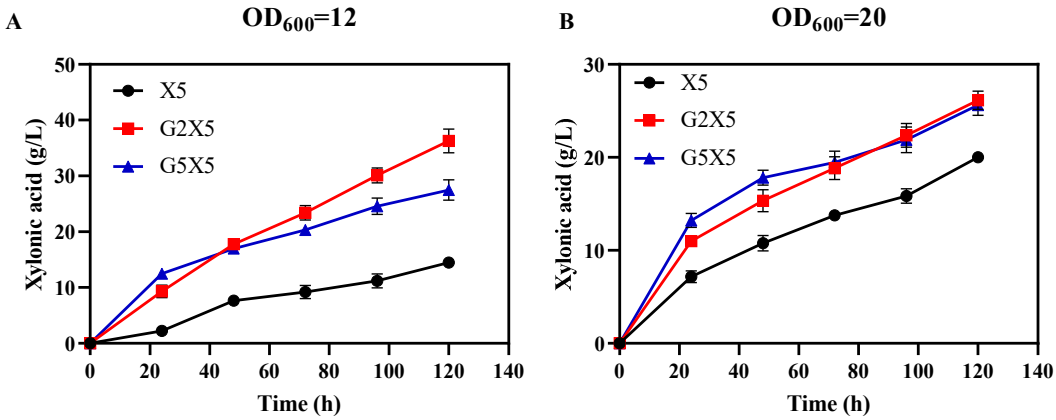


Figure S1. Effect of high cell density on xylonic acid production. Xylonic acid production with an initial OD_{600nm} value of 12 (**A**) and 20 (**B**) in RMX_{50}, $RMG_{20}X_{50}$, and $RMG_{50}X_{50}$, respectively.

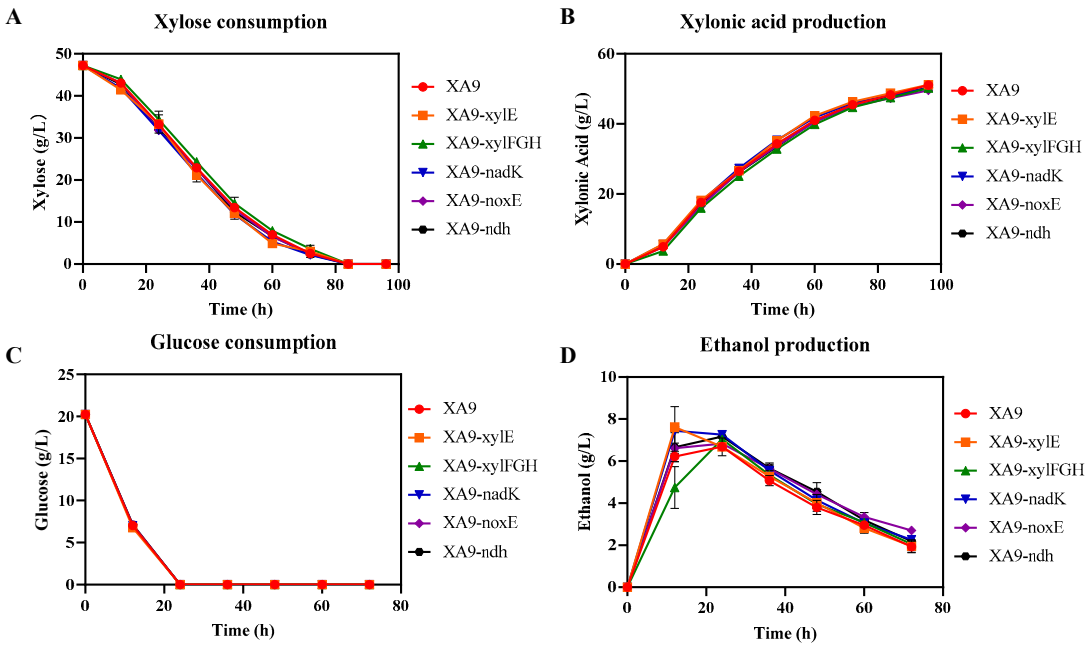


Figure S2. Application of metabolic strategies including xylose transporter and cofactor engineering for xylonic acid production. Xylose consumption (**A**) and xylonic acid production (**B**) of recombinant strain. Glucose utilization (**C**) and ethanol production (**D**) of recombinant strains.

Table S1. Primers used in this work

Primer	Oligo Sequence (5′ → 3′)
pEZ15A-f	GGCAAAGCCACCCTATTTTTAG
pEZ15A-r	CACTTCACTGACACCCTCAT
pEZ15A-fk-f	TGCGATGGCATCGGGG
pEZ15A-fk-r	AAGTACGAGGCTTAGAACCACC
XDH-f	ATGTATCTGTTGAGCTATCCGGAACA
XDH-r	TTATTCACCATACCAACCAGCATCAACAAAATAATC
P*pdc*-f	TATCGCTCATGATCGCGGC
P*pdc-XDH*-r	GTTCCGGATAGCTCAACAGATACATTGCTTACTCCATATATTCAAAACACTATGTC
1094-us-P*pdc*-f	GAACACAGCTTTTGAGAGCCGTATCGCTCATGATCGCGGCAT
XDH-1094-ds-r	CTGCCCGATTATTGATTTTATTTATTCACCATACCAACCAGCATCAACA
1094-us-r	CGGCTCTCAAAAGCTGTGTTCG
1094-ds-f	ATAAAATCAATAATCGGGCAGGGGG
1094-out-f	GATTATCGCAACCGCTGAACGC
1094-out-r	CACTAAGGCACCAGAATCACTGG
1094-in-r	CGTGTCGGATATGCGACTG
BioBrick-P*gap(6M)*-f	TCGCGGCCGCTTCTAGAGGTTCGATCAACAACCCGAATCCTAT
P*gap(6M)-XDH*-r	CAACAGATACATGTTTATTCTCCTAACTTATTAAGTAGCTACTATATTCCATAGC
P*gap(6M)-XDH*-f	AAGTTAGGAGAATAAACATGTATCTGTTGAGCTATCCGGAACAG
xyra-gRNA-1-f	GAAAGATAATGTTCAAAGCGCGGTTTCTGGAATTTC
xyra-gRNA-1-r	GAACGAAATTCCAGAAACCGCGCTTTGAACATTATC
xyra-gRNA-2-f	GAAACCTAAAACGACCAGATCGTTTTTCTTGGCATA
xyra-gRNA-2-r	GAACTATGCCAAGAAAAACGATCTGGTCGTTTTAGG
xyra-gRNA-3-f	GAAAGCCGATAGAACGGATTTTGCCTTCTTTTCTGA
xyra-gRNA-3-r	GAACTCAGAAAAGAAGGCAAAATCCGTTCTATCGGC
0976-us-f	CAGGTCACCAGCTCACCGTCTAAAAAATTGTCCCCGGTGCCG
0976-us-r	GAGCGGATATAAAACAAGCCGTCAC
pl2r-f	TGATATCAGATCTCTCGAGCGTCCC
pl2r-r	GAGCGGATATAAAACAAGCCGTCAC
0976-us-ds-f	CGGCTTGTTTTATATCCGCTCCAGAAACTCTCCACATTTTTTAAAAAAGACCCC
0976-ds-f	CAGAAACTCTCCACATTTTTTAAAAAAGACCCC
0976-ds-r	CGCTCGAGAGATCTGATATCATGCTTTGGCGGTCGGC
0976-us-P*pdc*-f	CGGCTTGTTTTATATCCGCTCTATCGCTCATGATCGCGGCAT
XDH-0976-ds-r	AAAAAATGTGGAGAGTTTCTGTTATTCACCATACCAACCAGCATCAACA
XDH-1547-ds-r	ACCCATACGAAACAGACAAATTTATTCACCATACCAACCAGCATCAACAAAATAATC
1547-us-P*pdc*-f	GAATGAAATAATGAGGTATTTTATCGCTCATGATCGCGGCAT
1547-us-r	AAATACCTCATTATTTCATTCCATCCGGCT
1547-ds-f	ATTTGTCTGTTTCGTATGGGTATTGACAG
1547-out-f	TTCTCATAAGAGCGGTTGCCTC
1547-out-r	CGCCTTTTTCAGCAATCCATG
1547-in-r	TGCGGATATGCCTTGCCTCTTCGGATTG
1577-us-r	ACTATCCTCAATATTAGAAAATATTCTATGGGTTATTTATTTGGTTC
1577-ds-f	TTTATTGGCACGATACTGATCGGCA

1577-us-P*pdc*-f	TCTAATATTGAGGATAGTTATCGCTCATGATCGCGGC
XDH-1577-ds-r	CAGTATCGTGCCAATAAATTATTCACCATACCAACCAGCATCAACA
1577-out-f	TTCTATCGTCGCTAAGGGTGGTCAA
1577-out-r	ACCATTCAGGTTAGTCGAAATGATGCGA
1577-in-r	CGACAAGCCTCATGGCAATAGCTA
P*eno*-f	TGTCTATACTCCAGTTACTCAATACGTAACAATAATCAG
P*eno*-xylF-f	TAAAAGATTTTAAGAAAGGTTTCGATATGAAAATAAAGAACATTCTACTACCCTTTGC
P*eno*-r	ATCGAAACCTTTCTTAAAATCTTTTAGACGAGTCT
xylH-p15A-r	CTGCAGCGGCCGCTACTAGTTCAAGAACGGCGTTTGGTTGC
P*eno*-*xylE*-new-r	AACTGGAATTATACTGGGTATTCATATCGAAACCTTTCTTAAAATCTTTAGACGAGT
xylE-new-f	ATGAATACCCAGTATAATTCCAGTTATATATTTTCGATTACC
xylE-new-p15A-r	CTGCAGCGGCCGCTACTAGTTTACAGCGTAGCAGTTTGTTGTGTTTTC
BioBrick-f	ACTAGTAGCGGCCGCTGC
P*eno*-*noxE*-f	TTTAAGAAAGGTTTCGATATGAAAATCGTAGTTATCGGTACGAACCAC
noxE-p15A-r	GCAGCGGCCGCTACTAGTTTATTTTGCATTTAAAGCTGCAACAGTCATG
P*eno*-*nadK*-f	TTTAAGAAAGGTTTCGATATGAATAATCATTTCAAGTGTATTGGCATTGTG
nadK-p15A-r	GCAGCGGCCGCTACTAGTTTAGAATAATTTTTTTGACCAGCCGAGCTT
P*eno*-*ndh*-f	TTTAAGAAAGGTTTCGATATGTCGAAGAATGGTAGACCTGACC
ndh-p15A-r	GCAGCGGCCGCTACTAGTTCAGTATAATTTGACTTTAGGGCGTAACATG