

## Supplementary information

### Regulating vitamin B12 biosynthesis via the *cblMCbl* riboswitch in *Propionibacterium* strain UF1

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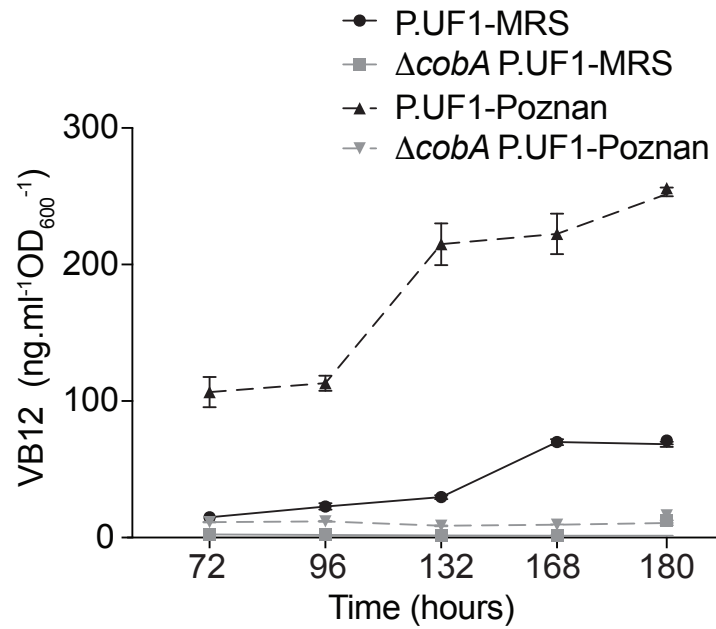
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Supplemental material

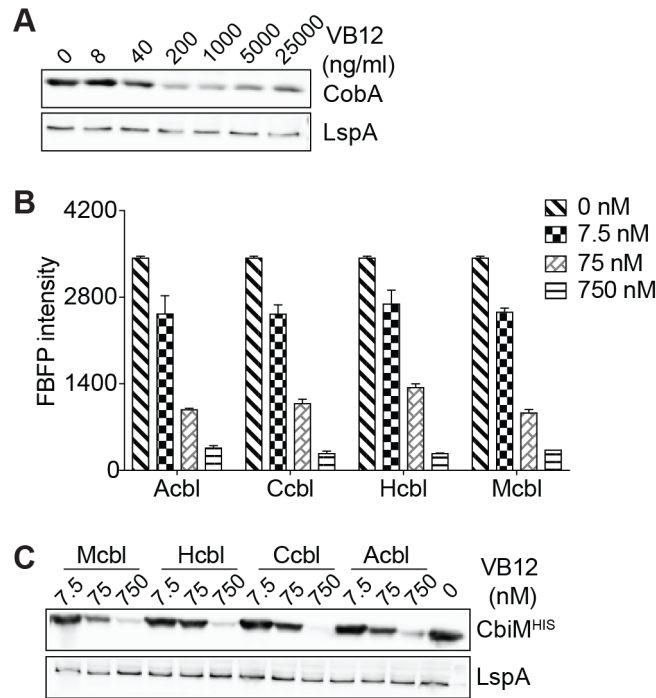
Figures. S1 to S4

Table S1 to S2

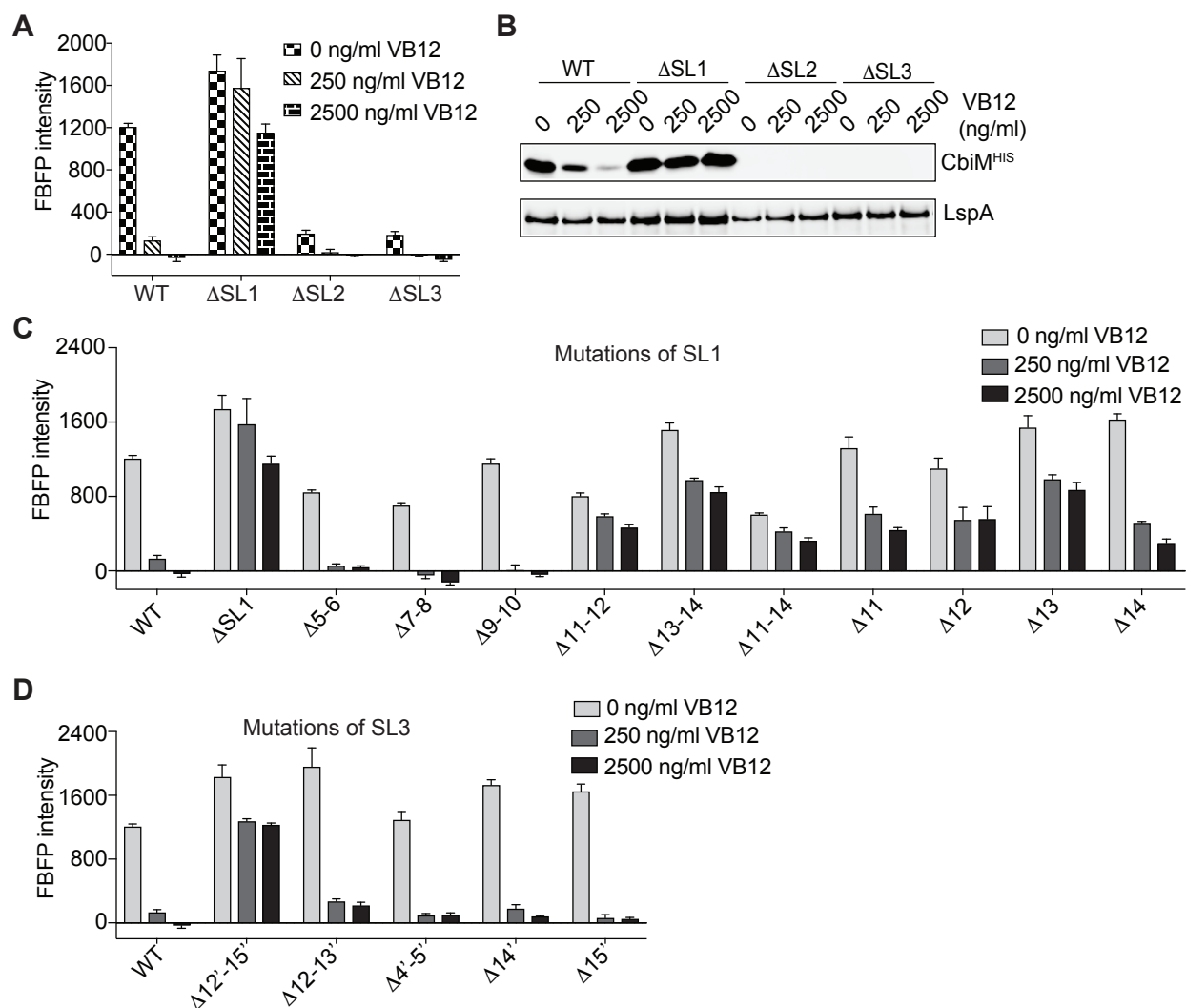
## Supplementary Figure Legends



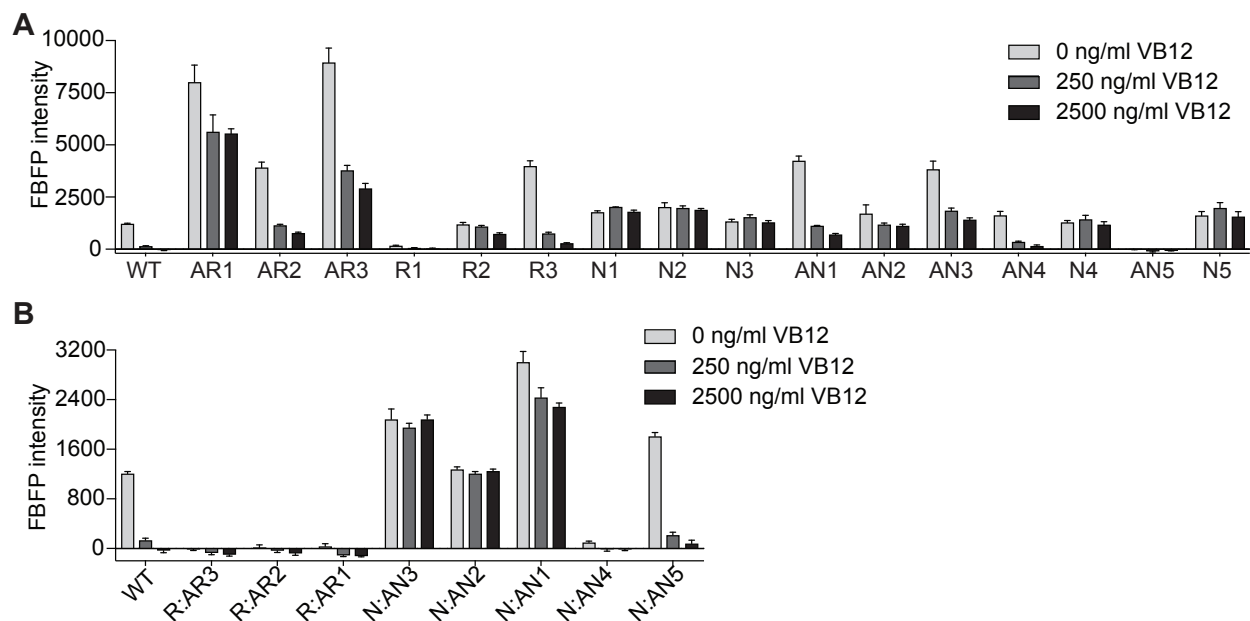
**Figure S1** *cobA* is an essential gene for VB12 biosynthesis by P. UF1. Time-course analysis of VB12 production by P. UF1 and  $\Delta cobA$  P. UF1 strains in MRS and Poznan medium. Data are representative of three independent experiments. Error bars indicate SEM.



**Figure S2** The *cobA* operon is feedback-regulated by VB12. (A) WB analysis of *cobA* expression of P. UF1 incubated with increasing VB12 (0-25000 ng/ml) using mouse serum antibodies against CobA. (B) FbFP fluorescence intensity of FbFP- $\Delta cobA$  P. UF1 strain incubated with different VB12 analogues. Acbl: adenosylcobalamin, Ccbl: Cyanocobalamin, Hcbl: Hydroxocobalamin, Mcbl: Methylcobalamin. (C) WB analysis of *cbiM* expression in CbiM- $\Delta cobA$  P. UF1 strain incubated with different VB12 analogues using anti-His antibody. Data are representative of three independent experiments (B). Error bars indicate SEM.



**Figure S3** Key stem-loops of *cbiMCbl* riboswitch (A) FbFP fluorescence intensity of FbFP- $\Delta cobA$  P. UF1 strain incubated with various concentrations of VB12, wild-type, SL1, SL2 and SL3 deleted mutant *cbiMCbl* riboswitch. (B) WB analysis of *cbiM* expression of CbiM- $\Delta cobA$  P. UF1 strain incubated with various concentrations of VB12 using anti-His antibody, wild-type, SL1, SL2 and SL3 deleted mutant *cbiMCbl* riboswitch. (C) FbFP fluorescence intensity driven by SL1-mutated riboswitches in response to VB12 (0, 250, 2500 ng/ml). (D) FbFP fluorescence intensity directed by SL3-mutated riboswitches with various concentrations of VB12. Data are representative of three independent experiments (A, C and D).



**Figure S4** *cbiMCbl* riboswitch regulates *cbiM* expression by RBS-mediated base pairing. (A) FbFP fluorescence intensity by a series of riboswitches mutated in Pkn, Pkn', sequester, or antisequester. (B) FbFP fluorescence intensity by riboswitches with paired double mutations in Pkn and Pkn' or sequester and antisequester. Data are representative of three independent experiments (A and B). Error bars indicate SEM.

**Table S1 P. UF1 derivative strains and plasmids used in this study**

Plasmids/strains	Description
Plasmids	
pYMZ	Expressing vector in P. UF1, <i>hygB</i> <sup>R</sup> .
pUCC	Vector used for chromosomal insertion in P.UF1, derived of pUC19, <i>cm</i> <sup>R</sup> .
pUCH	Vector used for complementary expression in P.UF1, derived of pUC19, <i>hygB</i> <sup>R</sup> .
pET21b	Vector used for protein overexpression in <i>E. coli</i> , <i>Amp</i> <sup>R</sup>
Strains	
NEB 5-alpha	Competent <i>E. coli</i> used for gene cloning.
Rosetta <i>E. coli</i>	Protein overexpression
E-21CobA	Rosetta <i>E. coli</i> overexpressing CobA protein
P. UF1	Propionibacterium UF1 was isolated from human breast milk.
$\Delta$ cobA P. UF1	Deletion of <i>cobA</i> gene in P. UF1 using pUCC
C- $\Delta$ cobA P. UF1	Complementary expression of <i>cobA</i> gene in $\Delta$ cobA P. UF1 by the native promoter of <i>cobA</i> using pUCH.
FbFP-WT	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch and <i>FbFP</i> into P. UF1.
CbiM-WT	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch and <i>cbiM</i> <sup>HIS6</sup> into P. UF1.
FbFP- $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch and <i>FbFP</i> into $\Delta$ cobA P. UF1.
CbiM- $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch and <i>cbiM</i> <sup>HIS6</sup> into $\Delta$ cobA P. UF1.
CbiN- $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch and <i>cbiN</i> <sup>HIS6</sup> into $\Delta$ cobA P. UF1.
CbiO- $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch and <i>cbiO</i> <sup>HIS6</sup> into $\Delta$ cobA P. UF1.
CobA- $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch and <i>cobA</i> <sup>HIS6</sup> into $\Delta$ cobA P. UF1.
DSL1F- $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch deleting SL1 mutant and <i>FbFP</i> into $\Delta$ cobA P. UF1.
DSL1CM $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch deleting SL1 mutant and <i>cbiM</i> <sup>HIS6</sup> into $\Delta$ cobA P. UF1.
DSL2F $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch deleting SL2 mutant and <i>FbFP</i> into $\Delta$ cobA P. UF1.
DSL2CM $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch deleting SL2 mutant and <i>cbiM</i> <sup>HIS6</sup> into $\Delta$ cobA P. UF1.
DSL3F $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch deleting SL3 mutant and <i>FbFP</i> into $\Delta$ cobA P. UF1.
DSL3CM $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch deleting SL3 mutant and <i>cbiM</i> <sup>HIS6</sup> into $\Delta$ cobA P. UF1.
D5-6F $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D5-6 mutant and <i>FbFP</i> into $\Delta$ cobA P. UF1.
D5-6CM $\Delta$ cobA	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D5-6 mutant and <i>cbiM</i> <sup>HIS6</sup> into $\Delta$ cobA P. UF1.
D7-8F $\Delta$ cobA	

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D7-8CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D7-8 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D9-10F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D7-8 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D9-10CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D9-10 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D11-12F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D9-10 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D11-12CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D11-12 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D13-14F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D11-12 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D13-14CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D13-14 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D11-14F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D13-14 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D11-14CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D11-14 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D11F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D11-14 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D11CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D11 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D12F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D11 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D12CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D12 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D13F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D12 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D13CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D13 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D14F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D13 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D14CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D14mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D12'-15'F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D13 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D12'-15'CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D12'-15' mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D12'-13'F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D12'-15' mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D12'-13'CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D12'-13' mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D4'-5'F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D12'-13' mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D4'-5'CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D4'-5' mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D14'F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D4'-5' mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.

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D14'CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D14' mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
D15'F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D14' mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
D15'CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D15' mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
N1F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch D15' mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
N1CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N1mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
N2F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N1 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
N2CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N2 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
N3F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N2 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
N3CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N3 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
N4F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N3 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
N4CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N4mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
N5F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N4 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
N5CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N5 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
AN1F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N5 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
AN1CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AN1mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
AN2F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AN1 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
AN2CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AN2 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
AN3F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AN2 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
AN3CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AN3 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
AN4F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AN3 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
AN4CM $\Delta cob$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AN4mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
AN5F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AN4 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
AN5CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AN5 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
N:AN1F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AN5 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
N:AN1CM $\Delta cobA$	

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N:AN2F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N:AN1mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
N:AN2CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N:AN1 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
N:AN3F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N:AN2 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
N:AN3CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N:AN2 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
N:AN4F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N:AN3 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
N:AN4CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N:AN3 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
N:AN5F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N:AN4mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
N:AN5CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N:AN4 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
R1F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N:AN5 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
R1CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch N:AN5 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
R2F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R1mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
R2CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R1 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
R3F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R2 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
R3CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R2 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
AR1F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R3 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
AR1CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R3 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
AR2F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AR1mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
AR2CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AR1 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
AR3F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AR2 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
AR3CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AR2 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
R:AR1F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AR3 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
R:AR1CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch AR3 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
R:AR2F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R:AR1mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
R:AR2CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R:AR1 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.

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R:AR3F $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R:AR2 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
R:AR3CM $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R:AR2 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
R:AR3CO $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R:AR3 mutant and <i>FbFP</i> into $\Delta cobA$ P. UF1.
R:tR $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R:AR3 mutant and <i>cbiM<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
R:AR3tR $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R:AR3 mutant and <i>cbiO<sup>HIS6</sup></i> into $\Delta cobA$ P. UF1.
OW-operon $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch and <i>tetR</i> into $\Delta cobA$ P. UF1.
ODSL1-operon $\Delta cobA$	Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch R:AR3 mutant and <i>tetR</i> into $\Delta cobA$ P. UF1. Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch and <i>cobA</i> operon into $\Delta cobA$ P. UF1. Transforming pYMZ harboring <i>cbiMCbl</i> riboswitch deleting SL1 mutant and <i>cobA</i> operon into $\Delta cobA$ P. UF1.

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**Table S2 Primers used in this study**

Name	Sequence (5'-3')	Usage
cobAbam-F	CCCGGATCCctcgtcggcgccgggcccggc	Deletion of <i>cobA</i> gene in P.
cobAxba-R	CCCTCTAGAgcggacgcacgtggtgcgcgtcca	UF1
P1	gtggcactcgtggtgatctt	For identifying <i>cobA</i> mutant
P2	GAGCGAGGAAGCGGAAGAG	and complementary strain
P3	ccccggcgctacaaggacatcga	
P4	ccgccctcctgttgatgttctggt	
Amy-cobA-1	CCCGGATCCcagacgccggcggtccaccc	For constructing strain for
Amy-cobA-2	cgtdggggccgtcgtagtdgggacgatgcatgtgagcgactggcgacgaga	complementary expression of
Amy-cobA-3	tctcgtgccagtcgctcacatgcatgctccactacgacgccccacg	<i>cobA</i> gene in $\Delta cobA$ P.
Amy-cobA-4	gccccggcaacagtggtggtcatgacgcacgatccccgagaaaggaatgcc	
Amy-cobA-5	ggcattcctttctcgggatcgtgcgcatgaccaccacactgttccccggc	
Amy-cobA-6	CCCTCTAGAtcagtggtcgtggcgcgcgat	
21-cobA-F	CCCGGATCCatgaccaccacactgttccccggca	Overexpression of <i>cobA</i> in
21-cobA-R	GCGCTCGAGgtggtcgtggcgcgcgatgg	<i>E. coli</i>
S-cobA-1	CCCGGATCCcgtcccactacgacggccc	For constructing FbFP-WT
		and CbiM-WT mutants
S-cobA-22	TGGTGGTGCGACGAGCCCATggcattcctttctcgggatcgtg	For constructing FbFP-WT
S-cobA-33	cacgatcccagagaaaggaatgccATGGGCTCGTCGCACCA	mutant
S-cobA-4	CCCTCTAGATCAGTGCTTGGCCTGGCCCT	For constructing FbFP-WT
		mutant
ScbiM-5	CCCTCTAGAtcaGTGGTGGTGGTGGTGGTGgacatgtgccacctccggaacct	For constructing W-CM mutant
DSL1-F	gttcacagtggcgcgaccgtg cttcctgcaccacgggcgagg	For constructing DSL1F/CM
DSL1-R	cctgcgccgtggtgcaggaag cacggtcgcgccactgtgaac	mutants
DSL2-F	ggggcatttgcctcgaatggt tcggtgaaccgacttctgcac	For constructing DSL2F/CM
DSL2-R	gtgcaggaagtcggttaagccga aacatttcggagcaaatgcccc	mutants
DSL3-F	gtccgtggccagttcctgactct gttcacagtggcgcgaccgtg	For constructing DSL3F/CM
DSL3-R	cacggtcgcgccactgtgaac agagtcaggaactggccacggac	mutants
SL1-5-6F	tcgcccgtggtgcaggaagtcggGCcaagccgacacggtcgcgccactgtgaacatttc	For constructing D5-6F/CM
SL1-5-6R	gaaatgttcacagtggcgcgaccgtgtcggcttGCccgacttctgcaccacgggcgA	mutants
SL1-7-8F	TcgcccgtggtgcaggaagtcggtTGagccgacacggtcgcgccactgtgaacatttc	For constructing D7-8F/CM
SL1-7-8R	gaaatgttcacagtggcgcgaccgtgtcggctCAaaccgacttctgcaccacgggcgA	mutants
SL1-9-10F	TcgcccgtggtgcaggaagtcggttcaCTccgacacggtcgcgccactgtgaacatttc	For constructing D9-10F/CM
SL1-9-10R	gaaatgttcacagtggcgcgaccgtgtcggAGtgaaccgacttctgcaccacgggcgA	mutants
SL1-11-12F	TcgcccgtggtgcaggaagtcggttaagTAGacacggtcgcgccactgtgaacatttc	For constructing D11-12F/CM
SL1-11-12R	gaaatgttcacagtggcgcgaccgtgtcTActtgaaccgacttctgcaccacgggcgA	mutants
SL1-13-14F	TcgcccgtggtgcaggaagtcggttaagccTGcacggtcgcgccactgtgaacatttc	For constructing D13-14F/CM
SL1-13-14R	gaaatgttcacagtggcgcgaccgtgCAggcttgaaccgacttctgcaccacgggcgA	mutants
SL1-11-14F	tcgcccgtggtgcaggaagtcggttaagATAGcacggtcgcgccactgtgaacatttc	For constructing D11-14F/CM
SL1-11-14R	gaaatgttcacagtggcgcgaccgtgCTATcttgaaccgacttctgcaccacgggcgA	mutants
A9G-F	tcgcccgtggtgcaggaagtcggttca GgccgacacggtcgcgccactgtgaaCA	For constructing D9F/CM
A9G-R	TGttcacagtggcgcgaccgtgtcggcCtgaaccgacttctgcaccacgggcgA	mutants
C11A-F	gccccgtggtgcaggaagtcggttcaagAcgacacggtcgcgccactgtgaacatt	For constructing D11F/CM
C11A-R	aatgttcacagtggcgcgaccgtgtcTctgaaccgacttctgcaccacggg	mutants
C12A-F	gccccgtggtgcaggaagtcggttcaagcAgacacggtcgcgccactgtgaacatt	For constructing D12F/CM
C12A-R	aatgttcacagtggcgcgaccgtgtcTgcttgaaccgacttctgcaccacggg	mutants
G10T-F	tcgcccgtggtgcaggaagtcggttca aTccgacacggtcgcgccactgtgaaCA	For constructing D10F/CM
G10T-R	TGttcacagtggcgcgaccgtgtcggAttgaaccgacttctgcaccacgggcgA	mutants

G13T-F	cccgtggtgcaggaagtgcggttcaagcc Tacacggtcgcgccactgtgaacatttcg	For constructing D13'F/CM
G13T-R	cgaaatgtcacagtggcgcgaccgtgtAggcttgaaccgacttctgcaccacggg	mutants
A14G-F	cccgtggtgcaggaagtgcggttcaagcc gGcacggtcgcgccactgtgaacatttcg	For constructing D14F/CM
A14G-R	cgaaatgtcacagtggcgcgaccgtgCcggttgaaccgacttctgcaccacggg	mutants
SL3-DF	gttctgacttcatcgcggggcgtccgaaatgtcacagtggcgc	For constructing D12'-15'F/CM
SL3-DR	gcgccactgtgaacatttcggagc gccccgcgatgagagtcaggaac	mutants
SL3-LSF	cgcgccactgtgaacatttcggagcGGatgccccgcgatgagagtcaggaac	For constructing D12'-13'F/CM
SL3-LSR	ttctgacttcatcgcggggcatCCgctccgaaatgtcacagtggcgcg	mutants
SL3-SSF	acacggtcgcgccactgtgaacatCCcgagcaaatgccccgcgatga	For constructing D4'-5'F/CM
SL3-SSR	catcgcggggcattgtctccgGGatgtcacagtggcgcgaccgtgt	mutants
3AGF	tcgcgccactgtgaacatttcggagcaaGtgccccgcgatgagagtcaggaact	For constructing D14'F/CM
3AGR	agttctgacttcatcgcggggcaCttgctccgaaatgtcacagtggcgcgga	mutants
4TCF	tcgcgccactgtgaacatttcggagcaaaCgccccgcgatgagagtcaggaact	For constructing D15'F/CM
4TCR	agttctgacttcatcgcggggcGttgctccgaaatgtcacagtggcgcgga	mutants
2-T-F	gaagtcggttcaagccgacacggt TATAT cactgtgaacatttcggagcaaatgcccc	For constructing N3F/CM
2-T-R	ggggcattgtctccgaaatgtcacagtGATATAaccgtgtcggttgaaccgacttc	mutants
2-AT-F	aactggccacggacgagccttcaa ATATAggacgcacgatcccagaaaaggaatg	For constructing N2F/CM
2-AT-R	cattccttctcgggatcgtgctgctTATATttaaaggctcgtccgtggccagtt	mutants
3-T-F	gaagtcggttcaagccgacacggt GGGGC cactgtgaacatttcggagcaaatgcccc	For constructing N1F/CM
3-T-R	ggggcattgtctccgaaatgtcacagtGCCCCaccgtgtcggttgaaccgacttc	mutants
3-AT-F	aactggccacggacgagccttcaa GCCCCggacgcacgatcccagaaaaggaatg	For constructing AN3F/CM
4-AT-R	cattccttctcgggatcgtgctgctGGGGCttaaaggctcgtccgtggccagtt	and N-AN3F/CM mutants
4-T-F	gaagtcggttcaagccgacacggt GGAGC cactgtgaacatttcggagcaaatgcccc	For constructing AN2F/CM
4-T-R	ggggcattgtctccgaaatgtcacagtGCTCCaccgtgtcggttgaaccgacttc	and N-AN2F/CM mutants
4-AT-F	aactggccacggacgagccttcaa GCTCCggacgcacgatcccagaaaaggaatg	For constructing AN1F/CM
4-AT-R	cattccttctcgggatcgtgctgctGGAGCttaaaggctcgtccgtggccagtt	and N-AN1F/CM mutants
SL2-DLF	aagtcggttcaagccgacacggtcactgtgaacatttcggagcaaatgccc	For constructing N5F/CM
SL2-DLR	ggcattgtctccgaaatgtcacagtaccgtgtcggttgaaccgactt	mutants
ASL2-DLF	aactggccacggacgagccttcaaggacgcacgatcccagaaaaggaatg	For constructing AN5F/CM
ASL2-DLR	cattccttctcgggatcgtgctgctttaaaggctcgtccgtggccagtt	and N-AN5F/CM mutants
SL2-SLF	Aagtcggttcaagccgacacggt gctcgcactgtgaacatttcggagcaaatgccc	For constructing N4F/CM
SL2-SLR	ggcattgtctccgaaatgtcacagtgcgagaccgtgtcggttgaaccgactT	mutants
ASL2-SLF	Aactggccacggacgagccttcaacgagcggacgcacgatcccagaaaaggaatg	For constructing AN4F/CM
ASL2-SLR	cattccttctcgggatcgtgctgctgctttaaaggctcgtccgtggccagtt	and N-AN4F/CM mutants
A-site-F	GagtcaggaactggccacggacgagcctCtaagcgcgggacgcacgatccc	For constructing AR2F/CM
A-site-R	gggatcgtgctcccgcgcttgaGaggctcgtccgtggccagttctgactC	and N-AR2F/CM mutants
A-region-F	gagtcaggaactggccacggacgagTTCCTtaagcgcgggacgcacgatccc	For constructing AR3F/CM
A-region-R	gggatcgtgctcccgcgcttgaAGGAAactcgtccgtggccagttctgactc	and N-AR3F/CM mutants
R-S-cbimF	aagcgcgggacgcacgatcccgagaGaggaatgccgtgcatatcgagaaggcgt	For constructing AR2CM
R-S-cbimR	acgccttctcgatatacagggcattcctCtctcgggatcgtgctcccgcgcttg	mutant
R-R-cbimF	caagcgcgggacgcacgatcccgaAGGAAaatgccgtgcatatcgagaaggcgt	For constructing AR3CM
R-R-cbimR	acgccttctcgatatacagggcattTTCCTtcgggatcgtgctcccgcgcttg	mutant
R-S-GFPF	caagcgcgggacgcacgatcccgagaGaggaatgccatgggTCGTGCACCACCA	For constructing AR2F mutant
R-S-GFPR	TGGTGGTGCGACGAGCCCATggcattcctCtctcgggatcgtgctcccgcgcttg	
R-R-GFPF	caagcgcgggacgcacgatcccgaAGGAAaatgccatgggTCGTGCACCACCA	For constructing AR3F mutant
R-R-GFPR	TGGTGGTGCGACGAGCCCATggcattTTCCTtcgggatcgtgctcccgcgcttg	
NR-GPF-F	aagcgcgggacgcacgatcccgacttaggaatgccATGGGCTCGTGCACCACCA	For constructing AR1F mutant
NR-GPF-R	TGGTGGTGCGACGAGCCCATggcattcctAAGtcgggatcgtgctcccgcgctt	
NR-cbiM-F	aagcgcgggacgcacgatcccgaCTTaggaatgccgtgcatatcgagaaggcgt	For constructing AR1CM
NR-cbiM-R	acgccttctcgatatacagggcattcctAAGtcgggatcgtgctcccgcgctt	mutant
ANR-F	aggaactggccacggacgagcctAAGaagcgcgggacgcacgatcccga	

ANR-R w-cbiOF w-cbiOR w-tetRF w-tetRR tetR-HidR	tcgggatcgtgctcccgcgcttCTTaggctcgtccgtggccagttcct gacgcacgatcccgagaaaggaatgcCatgagcgccctgctggccgccac gtggcgccagcagggcgctcatGgcattccttctcgggatcgtgctgc gacgcacgatcccgagaaaggaatgcatGTCCCGCCTCGACAAGTCCAAGGT ACCTTGACTTGTCTGAGGCGGGACATGgcattccttctcgggatcgtgctgc GGCAAGCTTTTAGGAGCCGGACTCGCACTTGAGCTG	For constructing AR1F/CM and N-AR1F/CM mutants For constructing CbiO- $\Delta$ cobA  For constructing tetR- $\Delta$ cobA
cbiN-hid	CCCAAGCTTtcaGTGGTGGTggtggtggtggcgcttccgtgatccgggggcccgtcggtc	For constructing R-AR3tR and tetR-WT
cbiQ-hid	CCCAAGCTTtcaGTGGTGGTGGTGGTggtgtcgggccaccaccaggctgatcga	For constructing CbiN- $\Delta$ cobA mutant
cbiO-hid	CCCAAGCTTtcaGTGGTGGTGGTGGTGGTgtcggggttctcatcggtgttgggtgt	For constructing CbiQ- $\Delta$ cobA mutant
cobA-hid	CCCAAGCTTtcaGTGGTGGTGGTGGTGGTGGTggtgctcgtgggcgcgcgatggtc	For constructing CbiO- $\Delta$ cobA mutant
m-cbiOF m-cbiOR m-tetRF m-tetRR GroL2-RT-F GroL2-RT-R qcbiM-F qcbiM-R qcbiN-F qcbiN-R qcbiQ-F qcbiQ-R qcbiO-F qcbiO-R qcobA-F qcobA-R cbop-hid-R cbop-sbf-F	gacgcacgatcccgagagaggaatgcCatgagcgccctgctggccgccac gtggcgccagcagggcgctcatGgcattcctctctcgggatcgtgctgc gacgcacgatcccgagagaggaatgcatGTCCCGCCTCGACAAGTCCAAGGT ACCTTGACTTGTCTGAGGCGGGACATGgcattcctctctcgggatcgtgctgc CAATGTCGTGTTGGAGAAG CGCCGATCTTGTGGTAGG ctcatcgtgctgatcttcca GAGCTTCTTGTTGAGCACATAG GGTTCCAGCCGCTGTT CCCAGGCAGTAGAAGATGATG CCATCGTGGCTTCGAGAC CCACCAGGCTGATCGAC TGCACCAGATGCGTGAC TCACAGACGATAGCGACCT CCAGGAGGAGATCAACCAAC GCCCCAAGACGAACGAG GGCAAGCTTtcagtgtcgtggtggcgcgat GCGCCTGCAGGcgtcccactacgacggccccacgg	For constructing CobA- $\Delta$ cobA mutant For constructing R-AR3CO mutant For constructing R-AR3tR mutant qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR qPCR For constructing OW- operon/ODS1-operon mutants