

Additional file 4: Table S3. Thiamin and cobalamin biosynthesis genes of *P. carbinolicus*.

Locus tag	Gene symbol	Annotation
Common enzymes of thiamin/molybdopterin/iron-sulfur cluster biosynthesis		
Pcar_0050	<i>nifS-1</i>	nitrogen fixation iron-sulfur cluster assembly cysteine desulfurase NifS
Pcar_0234		cysteine desulfurase family protein
Pcar_0304		cysteine desulfurase family protein
Pcar_1729		cysteine desulfurase family protein
Pcar_1841		cysteine desulfurase
Pcar_1860	<i>nifS-2</i>	iron-sulfur cluster assembly cysteine desulfurase NifS
Pcar_2513	<i>thiF-1</i>	thiamin biosynthesis thiocarboxylate synthase
Pcar_0611	<i>thiF-2</i>	thiamin biosynthesis thiocarboxylate synthase
Pcar_0338	<i>thiS-1</i>	thiamin biosynthesis sulfur carrier protein
Pcar_0610	<i>thiS-2</i>	thiamin biosynthesis sulfur carrier protein
Pcar_3369	<i>thiS-3</i>	thiamin biosynthesis sulfur carrier protein
Thiamin biosynthesis		
Pcar_0340	<i>thiH-1</i>	tyrosine lyase
Pcar_0608	<i>thiH-2</i>	tyrosine lyase
Pcar_0603		fumarylacetoacetate hydrolase family protein
Pcar_0339	<i>thiG-1</i>	carboxythiazole phosphate tautomer synthase
Pcar_0609	<i>thiG-2</i>	carboxythiazole phosphate tautomer synthase
Pcar_0342	<i>tenI-1</i>	carboxythiazole phosphate tautomerase
Pcar_0607	<i>tenI-2</i>	carboxythiazole phosphate tautomerase
Pcar_2235	<i>thiE, thiD</i>	4-amino-5-hydroxymethyl-2-methylpyrimidine-phosphate kinase and thiamin monophosphate synthase
Pcar_0028	<i>thiL</i>	thiamin monophosphate kinase
Pcar_0035		thiamin biosynthesis protein ApbE
Common enzymes of cobalamin/siroheme/heme biosynthesis		
Pcar_3064	<i>hemA</i>	glutamyl-tRNA reductase
Pcar_0266	<i>hemL</i>	glutamate-1-semialdehyde 2,1-aminomutase
Pcar_3061	<i>hemB</i>	porphobilinogen synthase
Pcar_3063	<i>hemC</i>	hydroxymethylbilane synthase
Pcar_3062	<i>hemD</i>	uroporphyrinogen III C2,C7-methyltransferase and uroporphyrinogen III synthase
Cobalamin biosynthesis		
Pcar_3066	<i>cysG-1</i>	precorrin-2 dehydrogenase and sirohydrochlorin ferrochelatase, putative
Pcar_0489	<i>cysG-2</i>	precorrin-2 dehydrogenase, sirohydrochlorin ferrochelatase, and uroporphyrinogen III C2,C7-methyltransferase, putative
Pcar_2740	<i>cbiX</i>	sirohydrochlorin cobaltochelatase
Pcar_0478	<i>cbiK</i>	sirohydrochlorin cobaltochelatase, putative
Pcar_0476	<i>cbiL</i>	cobalt-sirohydrochlorin C20-methyltransferase
Pcar_0484	<i>cobD, cbiH-</i>	L-threonine-0-3-phosphate decarboxylase, cobalt-precorrin-

	<i>1, cbiP</i>	3 <i>C17</i> -methyltransferase and adenosylcobyrinic acid synthase
Pcar_0471	<i>cbiH-2</i>	cobalt-precorrin-3 <i>C17</i> -methyltransferase
Pcar_0473	<i>cbiF</i>	cobalt-precorrin-4 <i>C11</i> -methyltransferase
Pcar_0472	<i>cbiG</i>	cobalt-precorrin-5A hydrolase
Pcar_0475	<i>cbiD</i>	cobalt-precorrin-5B <i>C1</i> -methyltransferase
Pcar_0470	<i>cbiJ</i>	precorrin-6A reductase
Pcar_2739	<i>cbiET</i>	cobalt-precorrin-6B <i>C5,C15</i> -methyltransferase and <i>C12</i> -decarboxylase
Pcar_0474	<i>cbiE</i>	cobalt-precorrin-6B <i>C5</i> -methyltransferase, putative
Pcar_0480	<i>cbiC</i>	cobalt-precorrin-8X methylmutase
Pcar_0481	<i>cbiA</i>	cob(II)yrinate a,c-diamide synthase
Pcar_0482	<i>cobA-1</i>	cob(I)yrinate a,c-diamide adenosyltransferase
Pcar_3106	<i>cobA-2</i>	cob(I)yrinate a,c-diamide adenosyltransferase
Pcar_0483	<i>cbiB</i>	adenosylcobinamide-phosphate synthase
Pcar_0487	<i>cobU</i>	adenosylcobinamide kinase and adenosylcobinamide phosphate guanylyltransferase
Pcar_0486	<i>cobT</i>	nicotinate-nucleotide--dimethylbenzimidazole phosphoribosyltransferase
Pcar_0485	<i>cobS</i>	cobalamin-5'-phosphate synthase
Pcar_2741	<i>cobC-1</i>	adenosylcobalamin-5'-phosphate phosphatase, putative
Pcar_0229	<i>cobC-2</i>	adenosylcobalamin-5'-phosphate phosphatase, putative
Pcar_0488	<i>cobC-3</i>	adenosylcobalamin-5'-phosphate phosphatase, putative