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SUPPLEMENTAL INFORMATION

**A novel F₄₂₀-dependent Thioredoxin Reductase Gated by Low Potential FAD:
A Tool for Redox Regulation in an Anaerobe**

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Running title: *A Novel Deazaflavin:Thioredoxin Reductase*

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Table S1. Thioredoxins and thioredoxin reductases of selected methanogens presented in Figure 8

Order Organism	NCBI Protein Accession Number			
	DTR	NTR	FTR	Trx
<i>Methanopyrales</i>				
<i>Methanopyrus kandleri</i> AV19	-	WP_011019929.1	-	-
<i>Methanococcales</i>				
<i>Methanocaldococcus infernus</i> ME	WP_013099833.1	-	-	YP_003616341.1 YP_003616835.1
<i>Methanocaldococcus</i> sp. FS406-22	WP_012980345.1	-	-	YP_003458495.1 YP_003458967.1
<i>Methanocaldococcus fervens</i> AG86	WP_015792073.1	-	-	YP_003128641.1 YP_003128672.1
<i>Methanocaldococcus vulcanius</i> M7	WP_015733468.1	-	-	YP_003247556.1 YP_003247403.1
<i>Methanocaldococcus jannaschii</i> DSM 2661	Q58931.1	-	-	NP_247280.1 NP_247560.1
<i>Methanotorris igneus</i> Kol 5	WP_013798844.1	-	-	YP_004484305.1 YP_004483931.1 YP_004484086.1 YP_004484049.1
<i>Methanothermococcus thermolithotrophicus</i> ATCC35097	WP_026182944	-	-	WP_018154025.1 WP_018154347.1 WP_018153852.1
<i>Methanococcus aeolicus</i> Nankai-3	WP_011973481.1	-	-	YP_001324655.1 YP_001324701.1 YP_001324529.1
<i>Methanothermococcus okinawensis</i> IH1	AEH07436.1	-	-	YP_004576182.1 YP_004577272.1 YP_004577341.1
<i>Methanococcus maripaludis</i> S2	WP_011170903.1	-	-	NP_988508.1 NP_987323.1 NP_988755.1
<i>Methanococcus vannielii</i> SB	WP_011971966.1	-	-	YP_001323456.1 YP_001323216.1 YP_001324188.1
<i>Methanococcus voltae</i> A3	WP_013180053.1	-	-	YP_003707881.1 YP_003707614.1
<i>Methanobacteriales</i>				
<i>Methanothermus fervidus</i> DSM 2088	-	WP_013413587.1	-	YP_004004242.1
<i>Methanothermobacter marburgensis</i> str. Marburg	-	WP_013295913.1	WP_013295001.1	YP_003850191.1 YP_003850106.1
<i>Methanothermobacter thermautotrophicus</i> str. ΔH	-	AAB85213.1	WP_010877186.1	NP_276032.1 NP_275946.1
<i>Methanosphaera stadtmanae</i> DSM 3091	-	WP_011406983.1	-	YP_447852.1 YP_447165.1
<i>Methanobacterium paludis</i> sp. SWAN-1	-	WP_013824744.1	-	YP_004519553.1

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Table S1. Thioredoxins and thioredoxin reductases of selected methanogens presented in Figure 8 (Continued)

Order Species name	NCBI Protein Accession Number			
	DTR	NTR	FTR	Trx
<i>Methanobacterium lacus</i> sp. AL-21	-	WP_013646010.1		YP_004291104.1
<i>Methanobrevibacter ruminantium</i> M1	-	ADC47275.1	-	YP_003424420.1
<i>Methanobrevibacter smithii</i> ATCC 35061	-	WP_004034556.1	-	YP_001273411.1
<i>Methanobrevibacter wolinii</i> SH	-	WP_042707727.1	-	WP_042706851.1
Methanomicrobiales				
<i>Methanosaeta harundinacea</i> 6Ac	-	AET63616.1	WP_014587647.1	YP_005920527.1 YP_005920150.1 YP_005919905.1 YP_005920855.1
<i>Methanosaeta thermophila</i> PT	-	ABK14932.1	ABK14695.1	YP_843556.1 YP_843121.1 YP_843141.1
<i>Methanosaeta concilii</i> GP6	-	WP_013719139.1	WP_013718007.1	YP_004385149.1 YP_004383748.1 YP_004385304.1 YP_004382986.1
<i>Methanosalsum zhilinae</i> DSM 4017	-	WP_013898016.1	WP_013897959.1 WP_013899231.1	YP_004615470.1 YP_004615797.1 YP_004616482.1 YP_004615169.1 YP_004615284.1
<i>Methanohalobium evestigatum</i> Z-7303	-	WP_013194180.1	WP_013194855.1 WP_013195589.1	YP_003725801.1 YP_003726675.1 YP_003726409.1 YP_003726719.1 YP_003725836.1
<i>Methanomethylovorans hollandica</i>	-	WP_015324339.1	WP_015325159.1 WP_015325586.1 WP_015323758.1	WP_015325246.1 WP_015324323.1
<i>Methanococcoides burtonii</i> DSM 6242	-	WP_011498283.1	WP_048063468.1 WP_011500370.1	YP_566484.1 YP_564870.1 YP_564987.1 YP_565635.1 YP_565021.1 YP_566957.1 YP_565881.1 YP_566314.1
<i>Methanohalophilus mahii</i> DSM 5219	-	WP_013037647.1	WP_013037416.1 WP_013037976.1	YP_003542631.1 YP_003542351.1 YP_003541974.1 YP_003542119.1 YP_003543047.1 YP_003542300.1

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Table S1. Thioredoxins and thioredoxin reductases of selected methanogens presented in Figure 8 (Continued)

Order	NCBI Protein Accession Number				
	Species name	DTR	NTR	FTR	Trx
	<i>Methanobrevibacter smithii</i> R15	-	AFV23072.1	WP_015054856.1 WP_015053933.1 WP_015053273.1	YP_006921816.1 YP_006923638.1 YP_006922441.1 YP_006922879.1 YP_006921643.1
	<i>Methanosarcina mazei</i> Gö1	-	WP_011034277.1	WP_011032011.1 WP_011035159.1	NP_632761.1 NP_632460.1 NP_634273.1 NP_634378.1 NP_633015.1 NP_634264.1 NP_634103.1
	<i>Methanosarcina acetivorans</i> C2A	-	AAM04784.1	WP_011022822.1 WP_048065175.1	YP_306068.1 YP_304192.1 YP_307062.1 YP_305238.1 NP_616305.1 NP_618813.1 NP_619119.1 NP_618103.1
	<i>Methanosarcina barkeri</i> str. Fusaro	-	WP_011307837.1	WP_011307856.1 WP_048102842.1	YP_303720.1 YP_305814.1 YP_305788.1 YP_305232.1 YP_305379.1 YP_306068.1 YP_304192.1 YP_307062.1 YP_305238.1
	<i>Methanocella arvoryzae</i> MRE50	-	CAJ38047	WP_048198866.1 WP_012035034.1	YP_686211.1 YP_684546.1 YP_685724.1 YP_685723.1
	<i>Methanocella paludicola</i> SANAE	-	BAI61976.1 BAI60692.1 BAI60752.1	BAI61049.1 BAI62469.1	YP_003355731.1 YP_003357232.1 YP_003355094.1 YP_003357453.1 YP_003356785.1 YP_003357331.1
	<i>Methanocella conradii</i> HZ254	-	WP_014406803.1 WP_014405558.1 AFD00237.1	-	YP_005379709.1 YP_005380235.1 YP_005381598.1
	<i>Methanosphaerula palustris</i> E1-9c	-	WP_012617099.1	WP_012617650.1 WP_012617194.1	YP_002466095.1 YP_002467560.1 YP_002466961.1
	<i>Methanospirillum hungatei</i> JF-1	-	ABD42736	WP_011448273.1 WP_011447956.1	YP_502331.1 YP_503912.1 YP_502981.1 YP_504576.1 YP_502286.1

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Table S1. Thioredoxins and thioredoxin reductases of selected methanogens presented in Figure 8 (Continued)

Order Species name	NCBI Protein Accession Number			
	DTR	NTR	FTR	Trx
<i>Methanoregula boonei</i> 6A8	-	ABS54608.1	WP_012107777.1 WP_012106373.1	YP_001403264.1 YP_001404957.1 YP_001403239.1 WP_015285335.1
<i>Methanoregula formicica</i> SMSP	-	AGB01149	WP_048111086.1 WP_015286077.1	YP_006545581.1 YP_006543753.1 YP_006543653.1 YP_006543652.1
<i>Methanoculleus bourgensis</i> MS1	-	WP_014865992.1	WP_014866447.1 WP_014868468.1	YP_001046143.1 YP_001047567.1 YP_001045935.1 YP_001045936.1 YP_001047892.1
<i>Methanoculleus marisnigri</i> JR1	-	ABN56104.1	WP_011844677.1 WP_011845284.1	YP_001030253.1 YP_001029754.1
<i>Methanocorpusculum labreanum</i> Z	-	WP_011833868.1	WP_011832588.1	WP_004078007.1
<i>Methanoplanus limicola</i> DSM 2279	-	WP_004079794.1	WP_004078612.1 WP_004076569.1 WP_004075880.1	
<i>Methanolacinia petrolearia</i> DSM 11571	-	ADN37372.1	WP_013328670.1 WP_013329279.1	YP_003894886.1 YP_003893564.1 YP_003895646.1 YP_003894694.1

Table S2. Selected flavin containing thioredoxin reductases as presented in Figure 9

Label	Organism name	NCBI protein accession number	References
<i>A.fulgidus</i>	<i>Archaeoglobus fulgidus</i>	WP_01087905.1.1	(1)
<i>A.pernix</i>	<i>Aeropyrum pernix K1</i>	BAA80046	
<i>A.profundu</i>	<i>Archaeoglobus profundus</i>	WP_012939759.1	
<i>A.saccharo</i>	<i>Acidolobus saccharovorans</i>	WP_013266177.1	
<i>A.veneficu</i>	<i>Archaeoglobus veneficus</i>	WP_013684632.1	
<i>B.fragilis</i>	<i>Bacteroides fragilis</i>	WP_010536932.1	
<i>C.aceti</i>	<i>Clostridium acetibutylicum</i>	_1 WP_010964187.1	(2)
		_2 WP_010966363.1	
		_3 WP_010964856.1	
<i>C.pasteu</i>	<i>Clostridium pasteurianum</i>	_1 WP_015617437	
		_2 WP_003445687.1	
<i>C.symbiosu</i>	<i>Cenarchaeum symbiosum A</i>	ABK76999.1	
<i>D.desul</i>	<i>Desulfovibrio desulfuricans</i>	_1 WP_014320910.1	
		_2 WP_014322191.1	
		_3 WP_014321324.1	
<i>D.fermenta</i>	<i>Desulfurococcus fermentans</i>	WP_014768119.1	(4)
<i>D.kamchat</i>	<i>Desulfurococcus kamchatkensis</i>	ACL11588.1	
		_1 AAS96314.1	
		_2 AAS94860.1	
		_3 AAS95935.1	
<i>E.coli</i>	<i>Escherichia coli</i>	EGJ07907	(4)
<i>F.acidar</i>	<i>Ferroplasma acidarmanus</i>	_1 WP_009886661.1	
		_2 WP_009886229.1	
<i>F.placidus</i>	<i>Ferroglobus placidus</i>	WP_012966986.1	(4)
<i>H. walsb</i>	<i>Haloquadratum walsbyi</i>	_1 WP_011570931.1	
		_2 WP_011570872.1	
<i>H.borin</i>	<i>Halogeometricum borinquense DSM11551</i>	_1 WP_006056860.1	
		_2 WP_013440645.1	
		_3 ELY23545.1	
<i>H.butylicu</i>	<i>Hyperthermus butylicus</i>	WP_011821369.1	(4)
<i>H.jeotgali</i>	<i>Halalkalicoccus jeotgali</i>	WP_008417299.1	
<i>H.lacus</i>	<i>Halorubrum lacusprofundi</i>	_1 WP_012659568.1	
		_2 WP_015909766.1	
		_1 WP_007190140.1	
<i>H.marism</i>	<i>Haloarcula marismortui ATCC 43049</i>	_2 WP_049938535.1	
		_3 AAV44795.1	
<i>H.salinaru</i>	<i>Halobacterium salinarum</i>	WP_010902912.1	
		_1 WP_008526266.1	
<i>H.tiama</i>	<i>Halorhabdus tiamatea</i>	_2 WP_008528393.1	
		_3 WP_008523862.1	
		_1 WP_012943598.1	
<i>H.turkm</i>	<i>Haloterrigena turkmenica</i>	_2 WP_012945283.1	

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Table S2. Selected flavin containing thioredoxin reductases as presented in Figure 9 (Continued)

Label	Organism name	NCBI protein accession number	References
<i>H.volcan</i>	<i>Haloferax volcanii</i>	_1 WP_004043814.1 _2 WP_004043912.1 _3 WP_004040826.1	
<i>I.hospital</i>	<i>Ignicoccus hospitalis</i>	WP_012123055.1	
<i>L.casei</i>	<i>Lactobacillus casei</i>	WP_012491289.1	
<i>M. mazei</i>	<i>Methanosarcina mazei</i>	WP_011034277.1	
<i>M. thermoli</i>	<i>Methanothermococcus thermolithotrophicus</i>	WP_026182944.1	
<i>M.acetivor</i>	<i>Methanosarcina acetivorans C2A</i>	AAM04784.1	(5)
<i>M.aeolicus</i>	<i>Methanococcus aeolicus</i>	WP_011973481.1	
<i>M.arvoryza</i>	<i>Methanocella arvoryzae MRE50</i>	_1 WP_048198865.1 _2 WP_012034618.1	
<i>M.barkeri</i>	<i>Methanosarcina barkeri</i>	WP_011307837.1	
<i>M.boonei</i>	<i>Methanoregula boonei 6A8</i>	ABS54608.1	
<i>M.bourgens</i>	<i>Methanoculleus bourgensis</i>	WP_014865992.1	
<i>M.burtonii</i>	<i>Methanococcoides burtonii</i>	WP_011498283.1	
<i>M.concilia</i>	<i>Methanosaeta concilia</i>	WP_013719139.1	
<i>M.conradii</i>	<i>Methanocella conradii HZ254</i>	_1 WP_014406803.1 _2 WP_014405558.1 _3 AFD00237.1	
<i>M.evestiga</i>	<i>Methanohalobium evestigatum</i>	WP_013194180.1	
<i>M.fervens</i>	<i>Methanocaldococcus fervens</i>	WP_015792073.1	
<i>M.fervidus</i>	<i>Methanothermus fervidus</i>	WP_013413587.1	
<i>M.FS406-22</i>	<i>Methanocaldococcus sp. FS406-22</i>	WP_012980345.1	
<i>M.harundin</i>	<i>Methanosaeta harundinacea</i>	WP_014585804.1	
<i>M.hungatei</i>	<i>Methanospirillum hungatei JF-1</i>	ABD42736.1	
<i>M.igneus</i>	<i>Methanotorris igneus</i>	WP_013798844.1	
<i>M.infernus</i>	<i>Methanocaldococcus infernus</i>	WP_013099833.1	
<i>M.jannasch</i>	<i>Methanocaldococcus jannaschii</i>	Q58931	This study
<i>M.kandleri</i>	<i>Methanopyrus kandleri</i>	WP_011019929.1	
<i>M.labreanu</i>	<i>Methanocorpusculum labreanu</i>	WP_011833868.1	
<i>M.mahii</i>	<i>Methahalophilus mahii</i>	WP_013037647.1	
<i>M.marburge</i>	<i>Methanothermobacter marburgnesis</i>	WP_013295913.1	
<i>M.maripalu</i>	<i>Methanococcus maripaludis S2</i>	WP_011170903.1	
<i>M.marisnig</i>	<i>Methanoculleus marisnigri JR1</i>	ABN56104.1	
<i>M.okinawen</i>	<i>Methanococcus okinawensis</i>	WP_013867617.1	

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Table S2. Selected flavin containing thioredoxin reductases as presented in Figure 9 (Continued)

Label	Organism name	NCBI protein accession number	References
<i>M.paludi</i>	<i>Methanocella paludicola</i> SANA E	_1 BAI61976.1	
		_2 BAI60692.1	
		_3 BAI60752.1	
<i>M.palustri</i>	<i>Methanospaerula palustris</i>	WP_012617099.1	
<i>M.petrolea</i>	<i>Methanolacinia petrolearia</i> DSM11571	ADN37372.1	
<i>M.psychrop</i>	<i>Methanobolus psychrophilus</i> R15	AFV23072.1	
<i>M.ruminant</i>	<i>Methanobrevibacter ruminantium</i> M1	WP_004034556.1	
<i>M.sedula</i>	<i>Methanosphaera sedula</i>	WP_012020594.1	
<i>M.smithii</i>	<i>Methanobrevibacter smithii</i>	WP_004034556.1	
<i>M.stadtman</i>	<i>Methanospaera stadtmanae</i>	WP_011406983.1	
<i>M.thermaut</i>	<i>Methanothermobacter thermautotrophicus</i> strain Delta H	AAB85213.1	
<i>M.thermop</i>	<i>Methanosaeta thermophile</i>	WP_011696325.1	
<i>M.vanniell</i>	<i>Methanococcus vanniellii</i>	WP_011971966.1	
<i>M.villosus</i>	<i>Methanocaldococcus villosus</i>	WP_026152912.1	
<i>M.voltae</i>	<i>Methanococcus voltae</i>	WP_013180053.1	
<i>M.vulvaniu</i>	<i>Methanocaldococcus vulcanius</i>	WP_015733468.1	
<i>M.zhilinae</i>	<i>Methanosalsum zhilinae</i>	WP_013898016.1	
<i>N.asia</i>	<i>Natrialba asiatica</i>	_1 WP_006108828.1	
		_2 WP_006107481.1	
		_3 WP_006111138.1	
<i>N.equitans</i>	<i>Nanoarchaeum equitans</i>	AAR39333.1	
<i>N.magadi</i>	<i>Natrialba magadii</i>	_1 WP_004266946.1	
		_2 WP_004216554.1	
		_3 WP_004216895.1	
		_4 WP_004267016.1	
<i>N.pharao</i>	<i>Natromonas pharaonis</i>	_1 WP_011323056.1	
		_2 WP_011322420.1	
<i>P.abyssi</i>	<i>Pyrococcus abyssi</i> GE5	CAB49645.1	
<i>P.aero</i>	<i>Pyrobaculum aerophilum</i> str. IM2	_1 AAL64407.1	
		_2 AAL63684.1	
<i>P.furiosus</i>	<i>Pyrococcus furiosus</i> DSM 3638	AAL81546.1	
<i>P.island</i>	<i>Pyrobaculum islandium</i>	WP_011763430.1	
<i>P.torridus</i>	<i>Picrophilus torridus</i>	WP_011177535.1	
<i>S.acido</i>	<i>Sulfolobus acidocaldarius</i>	_1 WP_011277795.1	
		_2 WP_011278018.1	
<i>S.marinus</i>	<i>Staphylothermus marinus</i>	WP_011839218.1	
<i>S.solfa</i>	<i>Sulfolobus solfataricus</i>	_1 WP_010923960.1	(6, 7)
		_2 WP_009989411.1	
<i>S.tokodai</i>	<i>Sulfolobus tokodai</i> str.7	BAB65543.1	
<i>T.acido</i>	<i>Thermoplasma acidophilum</i>	WP_010901395.1	(8)

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Table S2. Selected flavin containing thioredoxin reductases as presented in Figure 9 (Continued)

Label	Organism name	NCBI prote in accession number	References
<i>T.aggregan</i>	<i>Thermosphaera aggragans</i>	WP_013130151.1	
<i>T.barophil</i>	<i>Thermococcus barophilus</i>	WP_013467810.1	
<i>T.kodakaren</i>	<i>Thermococcus kodakarensis</i>	WP_011251050.1	
<i>T.maritima</i>	<i>Thermotoga maritima</i>	WP_004080734	(9)
<i>T.onnurine</i>	<i>Thermococcus onnurineus</i>	WP_012572565.1	
<i>T.pendens</i>	<i>Thermoifilum pendens</i>	WP_052885356.1	
<i>T.tenax</i>	<i>Thermoproteus tenax</i>	WP_014127378.1	
<i>T.volvanic</i>	<i>Thermoplasma volcanicum</i>	BAB60295.1	

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