

Main line Signature in Hsp90 Protein Distinguishing Gram-positive and Gram-negative Bacteria

Gupta, R.S.(1998) Microbiol. Mol. Biol Rev. 62, 1435-1491;
Gupta and Griffiths (2002) Theoret. Pop. Biol. 61, 423-434.

	166		206
Bacillus clausii	56962744	GTVITLHIK	ENTDD
Bacillus sp. NRRL B-14911	89097614	---E-I-K--	---EE
Clostridium sp. OhILAs	106895644	---E-V-R--	-D-E-
Clostridium perfringens	110802200	---D-I--L-	A-DE-
Alk. metalliredigenes	77684830	---E-I-KL-	---E-
Oceanobac. iheyensis	23100613	---T---Y--	--QEE
Exi. sibiricum	68055355	---D-----	A-EE-
Desulfito. hafniense	89894812	R--S----L-	-DAHSFAQADTV-R---Q--S-VP--V
Str. coelicolor	21225782	Q--AV---L-	PADVE
Str. ambofaciens	126347881	Q--SV---L-	PADSE
Myc. leprae	15827855	Q--SV---L-	PEDFE
Myc. tuberculosis	15609436	Q--SV---L-	PEDAE
Nocardia farcinica	54022079	Q--AVS--L-	PADEE
Rhodococcus sp. RHA1	111022855	Q--SSV--L-	PEDAE
Micromonospora sp. ML1	81681145	Q--AV---L-	PADAE
Frankiasp. EAN1pec	68228465	Q--AV---L-	PEDSE
Rhodococcus opacus	126215766	Q--SSV--L-	PEDAE
Frankia sp. Cc13	86738960	R--AV-V-L-	PEDSE
Salinispora arenicola	119884072	Q--AV---L-	PVDSE
Salinispora tropica	113944107	Q--AV---L-	PADSE
Frankia alni	111223389	Q--AV--QL-	PEDAE
Escherichia coli	75514596	R--E----LR	-GE--F-DDW-VRS--S----H-AL-V
Buch. aphidicola	21623378	R--E---FL-	KEEE--F--LW--EG-VS----H-TV-V
Yersinia pestis	77635872	R--E----LR	-GE---DDW-LRSV-S----H-AL-V
Xylella fastidiosa	71897791	R--RVV--L-	-NEQHFA-GWTLRSTL-----H-GL--
Pasteurella multocida	12721356	R--E----LR	-DEKAF--NDW-LRE--G----H-GL-V
H. influenzae	1573053	R--DVI--LR	-DEK--F--N-W-LRE--G----H-GL-V
Vibrio cholerae	75829798	R--D-I--LR	-EGK--F--S-W-LRDV-S----H-GI-V
Xanthomonas campestris	21113545	R--R-V--L-	DGE-SFADGWTLRN-L-----H-GL--
Ralstonia solanacearum	83745750	R--T----LR	-GE-DF--SAW--L-S-VQ----H-SL--
Bordetella pertussis	33591335	R--DVV--LR	ADE--L--NGWKLRE-LRR---H-SL--
Dechloromonas aromatica	71906766	R--DV--LR	-GE--F--GGWKL-S--R----H-TL--
Chrom. violaceum	34496773	R--E-V--L-	-GE--L--NDWKL-G--R----H-SI--
Mag. magneticum	83313442	R-AA---KLR	-GET--F--DAF--L-S-V--R---H-AI-V
Rhodospirillum rubrum	48766441	R-AA---LR	-DARDF--D-H-LRE-V-T---H-AI-V
Brad. japonicum	27356073	R--E-V--L-	DDAKK---T-E-ER-VGA---N-LF--
Bdello. bacteriovorus	42523293	---T---M-	DFKEE
Geo. metallireducens	78223699	R--E----L-	-EMK---D-WK-RS-VR---YVQ--V
Geo. sulfurreducens	39997485	R--E----L-	-EMK---D-WK-RS-VR---YVQ--
Wolinella succinogenes	34483764	---E-K-FL-	-EEK-FASRW-LEE-----H-PF--
Hel. pylori	4154717	Q--E---FL-	-EDSHFASRWE-DSVV---EH-PF--
Camp. jejuni	6967987	Q--S---YL-	DDE FANA-K-ES--E---NH-QF--
Cb. chlorochromatii	78171237	R--R-SFKL-	-EHQ--FA---VEQ-----N-VDF--
Cb. tepidum	21646776	R--R-SFIL-	-EFR-FAQ--VEQ-----N-VE---
Treponema pallidum	15639968	---CVV--LS	QENS-FATRW-LEE-----H-AF--
Bor. burgdorferi	2688473	---E-K-YLN	KEGL--ANKWK-QE-----NH-N---
Lep. interrogans	45655627	R--K----LD	GDSG---DQWKL-EL-RR-C--LPV--
Chl. aurantiacus	76258509	R--T----L-	-DAT-FADPW--EQ-VRRH-NYVAF--
Anab. variabilis	75700091	R--T---TLL	PDEE----SA-V-NLV-T-C--MPV--
Thermo. elongatus	22294915	---TV--TLQ	D-EL---PA--RQLVR--C--LPV--
Nostoc sp. PCC 7120	17131415	---T---TLL	PDEE----SA-V-NLV-T-C--MPV--

The boxed 5 aa indel in the Hsp90 protein appears to be specific for the Gram-positive bacteria (i.e. *Actinobacteria* and *Firmicutes*), with two exceptions. It is missing in the firmicute *Desulfito. hafniense* and it is present in *Bdello. bacteriovorus* (a δ -proteobacteria). These could be due to LGTs. This indel suggests that the species from these two Gram-positive phyla are closely related. Based upon other signatures, which provide evidence that Firmicutes and Actinobacteria are the deepest branching lineages within the Bacteria, it is possible that the ancestral Hsp90 contained this indel and it was later deleted from a common ancestor of other bacteria after the branching of Firmicutes and Actinobacteria. However, based upon the fact that sequence of this indel is not conserved in Firmicutes and Actinobacteria, the possibility that this indel was independently introduced in ancestors of these lineages cannot be excluded.