

Main Line Monoderm-Diderm Signature in the Hsp70 Protein

Gupta and Singh (1992) J. Bacteriol. 174, 4594-4605; Gupta, R.S.(1998) Microbiol.Mol.Biol.Rev 62:1435-91;
Gupta, and Golding (1993) J. Mol. Evol. 37, 573-582.; Griffiths and Gupta (2004) Int. Microbiol. 7, 41-52

			65		102		
Proteobacteria	<i>E. coli</i>	SP/ P04475	NPQNTLFAIKRLIG	RRF QD	EEVQRDVSIMPFKIIAAD	NGDAWVEVKGQK	MAPPQISAEVLLKM
	<i>Pas. multocida</i>	2738813	--K-----	T	A-----IE---E-SK--	-----T---D-	L-----I-K--
	<i>V. cholerae</i>	NP_230502	-----	E	-----IK---Y--VK--	-----A----	--A--V-----K--
	<i>Pse. aeruginosa</i>	AAG08147	-----Y-V-----	EE	NV--K-IQMV-YS-VK--	-----	-----K--
	<i>X. fastidiosa</i>	AAF85139	--K--FY-V-----	K	G--A--K-LDLV-Y--TQH-	-----ATADAK	L--QE---K--E--
	<i>Nei. meningitidis</i>	H81185	-AK--IY-A-----	HK	E--K---IES---E--K-N	-----KAQ-KE	LS-----R--
	<i>Ral. solanacearum</i>	NP_520756	--R---Y-V-----	K	EE--K--K-IGL--YT-SK--	-----RDK-	-----R--
	<i>A. tumefaciens</i>	SP/ P20442	--T---V-----	Y	PT-EK-KALV--E-VKG-	-----KAQDKN	YS-S---MI-Q--
	<i>C. crescentus</i>	GB/ M95799	--T-----	TA	S--PV-EK-KGMV-YRSSR-R	A----KAH-KD	YS-QEV---FI-Q--
	<i>Ri. conorii</i>	15892156	--R--IY-V-----	N	I--PM-RK-QG-V-YN-VK--	-----ADNN-	YS-S---FI-Q--
	<i>Geo. sulfurreducens</i>	ZP_00080430	--E-----	KY	DT---RK-I--S---VK--	-----AR-KM	YSA-E---M-Q--
	<i>Desulf. vulgaris</i>	ZP_00130430	--ER-V-V---M-	G	DA--G-WKEHS-YR-V-GA	----A---Q-RP	YSA-E---MI-Q-L
	<i>Camp. jejuni</i>	NP_178852	--K-IYS---IM-	MI	N--DAAKEAKNRL-YH-TER	---ACAI-IA-KI	YT-QE---K--M-L
	<i>Hel. pylori</i>	2072520	--EK-IYS---IM-	LM	NE--DKAKEAEKRL-Y--VDRN	GA-CAI-IS-KI	YT-QE---KI-M-L
	Aquificales	<i>Cal. hydrogenophilum</i>	AA086573	D-E--IYES-F--	K	---KEEAKRVSY-VVPDE	K---SFD-PNAGRLVR
<i>Hydro. marinus</i>		AA083541	D---IYES-F--	K	D--KEEIKYV-Y-VV-D-	K---AFD-PNAGKIVR	EEVG-Q--K-L
<i>Aqu. aeolicus</i>		2983493	D-E--VYES-F--	K	N---KEAKRVSY-VVPDE	K---AFDIP-KL	VR-EEVG-H--R-L
Chlamydiales, Planctomycetes, Verrucomicrobium	<i>Proto. amoebophila</i>	YP_008498	--E--ITSS-F--	KY	Q--LSEIKTV-Y-VTNNN	----VF-IQ-KI	VT-EE-A-QI-I--
	<i>Sim. negevensis</i>	TIGR	--EK--YST-F--	KY	A--AEEIKTV-Y-VVPSN	----VF--D-KT	LT-EEVG-QI-I--
	<i>Chl. trachomatis</i>	SP/ P17821	--EK--AST-F--	K	S--ESEIKTV-Y-VAPNS	K---VFD-EQKL	YT-EE-G-QI-M--
	<i>Chlam. pneumoniae</i>	AAF38114	--EK--GS--F--	KY	S--ASEIQTV-YTVTSGS	K---VF--D-KQ	YT-EE-G-QI-N--
	<i>Gem. obscuriglobus</i>	TIGR	--RRTIYS--FM-	H	N--ESEEKLVPI--VGG	--DLVK-DID-KM	FT--E---M-LR-L
	<i>Ver. spinosum</i>	TIGR	--R--V-SV---M-	K	S-LTAADKQV-Y--V--S	----H---EVGG*VYS	QE---MI-A-L
	<i>Bla. marina</i>	EAQ77046	--KK-VYS--FM-	H	N--DSEEKMI-YEVVGG	DEYVK-KIGDAE	YT-QE---K--Q-L
Bacteroidetes- Chlorobi Group	<i>Rho. baltica</i>	NP_866709	--KR-VYSAK-FM-	H	N---SEEKMY-YG-TGGP	GDDYVKIQ-GDSE	YT-QE---K--R-L
	<i>Fi. succinogenes</i>	AY017382	--EK-IYS--FM-	TA	G-CSAAEKN--Y-LVGTG	SDPVR-QIIDDQK	F---E---A-QT-
	<i>Po. gingivalis</i>	Q9ZAD3	--TK-IYS--FM-	ETY	DQ-S-E-ERV---VVRG-	-NTPR-DID-RL	YT-QE---MI-Q-L
	<i>Cb. tepidum</i>	AF130447	--K--I-S--FM-	KY	D--PNEKKLASYDVVN-E	G-Y-K-KIGDKT	YS-QE---MI-Q--
	<i>Cyt. aquatilis</i>	AF013110	--TK-IAS--FM-	HT	A-TTNEKRVSY-VVKGV	QQYST-DID-RL	YTAQEL--MT-Q--
	<i>Fl. ferrugineum</i>	AF013111	----ITSV--FM-	G	N--TEEI-HWSY-VAQG-	-NTVRIDID-RL	YT-QE---M-Q--
	<i>Tre. pallidum</i>	3322484	--EH-IYS--F--	S--	N-LTGEAKKV-Y--VPGQ	-D-VR---E-KL	YSTQE---FI-Q--
Spirochetes	<i>Bor. burgdorferi</i>	SP/ P28608	--E--IYS--FM-	---	---ASEIKMV-Y--EKGL	----R-NISNI-KQ-S-	E---AT-T--
	<i>Lep. interrogans</i>	AAN50903	--AV--IRSA-F--	L	N-CESEMKHVSY-V-RSG	-EGVKF-TSAGE	FT-QE---R--M--
	<i>Synechococcus PCC7942</i>	GB/ D29668	--R--FAN--F--	Y	D-LTDESKRV-YTVRRDP	E-NVRIQVQLSREF-	EEVA-MI-R-L
Cyanobacteria	<i>Nostoc sp. PCC 7120</i>	NP_486486	--AE--I-S--F--	W	-DTETERDRV-YGCVKGR	DDTVD-QIR-RN	YT-QE---MI-Q-L
	<i>Gloe. violaceus</i>	NP_927210	--E--FYSV-F--	KY	D-ITDEAKQVAYRVRRDG	SNVKLHSTNED	DFA-EE---L--R-L
Deinococcus- Thermus Group	<i>Cfx. aurantiacus</i>	AF130446	--E--YSV-F--	S	D--TEERDV---VVKGP	RN-VRIY-PQTNKEY-	QE---M-Q-L
	<i>D. radiodurans</i>	A75557	--AA--EV-F--	W	D--KEEAARS--TVKEGP	S-SVRI--N-KD	L--E-V-----R-L
Thermotoga	<i>The. thermophilus</i>	GB/ Y07826	--EG-I-E--F--	---	----EEAKRV-Y-VVPGP	D-GVR-----KL	YT-EE---MI-R-L
	<i>T. maritima</i>	3882431	--ER-IKS--KM-	---		T-YK-RIDDKE	YT-QE---FI-K-L
Actinobacteria	<i>Myc. tuberculosis</i>	GB/ X58406	-VDR-IRSV--HM-	---		T-WSI-ID-K	YTAQEV--R--M-L
	<i>Str. coelicolor</i>	GB/ 014499	-VDR-IRSV--HM-	---		T-WK-NLD-KD	FN-Q---F--Q-L
	<i>Bif. longum</i>	AAN24348	-VDR-ISSV--HM-	---		S-WT-DID-K	WT-QE--AQILMKL
	<i>Cor. glutamicum</i>	Q8NLY6	-VDR-IRSV--H--	---		T-WS-AIDDKN	YTSQE---RT-M-L
Firmicutes	<i>Bac. subtilis</i>	GB/ U39711	-- --IMS--HM-	---		T-YK--IE-KD	YT-QEV---II-QHL
	<i>Strep. mutans</i>	2145133	--E-ILS--SKM-	---		TSEK-SANAKE	YT-QE---MI-QYL
	<i>M. pneumoniae</i>	1674090	-- --IVS---M-	---		TSNK-T--NPD	GSTKEL--QI-SYL
	<i>Clo. acetobutylicum</i>	118726	--DK-IIS--KM-	---		TAEK-AIDDKN	YT-QE---MI-Q-L
	<i>Sta. aureus</i>	GB/ X75428	-- --VQS--HM-	---		T-YK-DIE-KS	YT-QE---MI-QNL

A conserved 21-23 insert in Hsp70 homologs (boxed) that is specific for different bacterial phyla comprising of Gram-negative bacteria or diderm bacteria (i.e. those bacteria containing both an inner and out membrane). This insert is not present in any of the homologs from monoderm bacteria (i.e. cells bounded by a single unit lipid membrane) comprising mainly of the Gram-positive phyla (viz. *Actinobacteria*, *Firmicutes*) and Thermotoga. This insert is also not found in various archaeal homologs, where this protein is found, indicating that the groups lacking this insert are ancestral. Several other lines of evidence also support the ancestral nature of the prokaryotic lineages lacking this indel. The smaller box (in blue) shows a 2 aa insert within the large insert that is specific for proteobacteria. Sequence information for only representative species is presented. However, all other available sequences from these groups behaved in the indicated manner. Sequences for some species were obtained by blast searches at The Institute for Genomic Research website at <http://www.tigr.org>