

RESEARCH REPORTS

Clinical

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Fam83h is Associated with Intracellular Vesicles and ADHCAI

APPENDIX

Human Fam83 Sequences in Alignment

Gene	Location	No of AA	Accession #
FAM83H	8q24.3	1179 aa	NM_198488
FAM83A	8q24.13	434 aa	NM_032899
FAM83B	6p12.1	1011 aa	NM_001010872
FAM83C	20q11.22	747 aa	NM_178468
FAM83D	20q11.22-q12	615 aa	NM_030919
FAM83E	19q13.32-q13.33	478 aa	NM_017708
FAM83F	22q13.1	500 aa	NM_138435
FAM83G	17p11.2	823 aa	NM_001039999

Human Fam83 Alignment Summary

MARRSQSSSQDNPLAPGYLPPHYKEYYRLAVDALAEGGSEAYSRFLATEGAPDFLCP
LEHVSRLRPPQYVTTREPPESLLDMDGSSGTYPVNSDQAVPELDELGWPLTFGQGT
EVTTLVQPPPPSPSIKDEARRMTRSAQQ/2-3/VVAVVMDMFTDLDLLSEVLEAAARRV
PVYILLDEMNQHFLLDMADKCRVNLHVD/3-4/FLRVRTVAGPTYCRGTGKSFKGHVKE
KELLVDCAVVMSGSYS/4-5/FMWSFEKIHRS LAHVFOGELVSSFDEEFRLFAQSEPLV
PSAAALARMDAYALAPYAGAGPLVGVPGVGAAPTFFSFPKRAHLLFPPPREEGLGFPSFLD
PDRHFLSAFRREPPRMPGGALEPHAGLRPLSRRLAEAGPAGELAGARGFFQARHLEMD
AFKRHSFATEGAGAVENFAAARQVSRQTFLSHGDDFRFQTSHFHRDQLYQQYQWDPQLT
PARPQGLFEKLRGGRAGFADDDFTLGAGPRFPELGPDPGHQRLDYPSSASREVRHGSDP
AFAPGPRGLEPSGAPRPNLTQRFPCQAAARPGDPAPEAEPERRGGPEGRAGLRWRLAS
YLSGCHGEDGGDDGLPAPMEAEAYEDDVLAPGGRAPAGDLLPSAFRVPAAFPTKVPVPGP
GSGGNGPEREGPEEPGLAKQDSFRSRLNPLVQRSSRLRSLSLIFSTSQAEGAAGAAAATEK
VQLLHKEQTVSETLPGGGEAVRSAASTKVAELLEKYKGPARDPGGAGAITVASHSKAVV
SQAWREEVAAPGAVGGERRSLESCLLDLRDSFAQQLHQEAERQPGAASLTAAQLLDTLGR
SGSDRLPSRFLSAQSHSTSPQGLDPSPLPLEGSGAHQVVLHNEKSGSPTSAYPERKGSPTPG
FSTRRSPTTGFIEQKGSPTSAYPERRGSPVPPVPERRSSPVPPVPERRGSLTLTISGS
PKAGPAEBGPGSPMEVLRKGSRLRLRQLLSPKGERMEDEGGFPVQENGQPESPRRLSLG
QGDSTEAATEERGPRARLSSATANALYSNLRDDTKAILEQISAHGQKHRVAPAPSPGPT
HNSPELGRPPAAGVLPADMSDKDKCSAIFRSDSLGTQGRLSRTLPAEERDRLLRSMES
MRKEKRVYSRFEVFCKEEASSPGAGEGPAEEGTRDSKVGKFPVKILGTFKSKK

Identical in all

High homology

Variable

Appendix Figure 1. CLUSTAL 2.0.10 multiple sequence alignment of human FAM83 family of proteins.

Key: * identical amino acids in all; : Mostly Homologous; . Homologous

FAM83C -----MFGGPGPGVLGAQGMAGPLRGRVEELKLPWWRESSPLV--LRHSE 43
FAM83A -----MSRSRHLGKIRKRLLEDVKSQWVR-PARAD--FSDNE 33
FAM83G -----MAFSQVQCLDDNHVNWRSSSESKPE--FFYSE 29
FAM83F -----MAESQLNCLDEAHVNEKVTEAQAA--FFYCE 29
FAM83E -----MAASQLAALEGVDSGPRVPGASPG--FLYSE 29
FAM83H -----MARRSQSSSQGDNPLAPGYLP--PHYKE 26
FAM83D MARACLIQRLPIKRDCPTVFVRGLSSPSAAMALLSEGLDEVPAACLSPCGPPNPTELFSE 60
FAM83B -----METSSMLSSLNDECKSDNYIEP---HYKE 26

FAM83C AARLAADALLERGEAAAYLRVISEERELPFLSALDVDYMTSHVRGGPELSEAQQG----- 97
FAM83A SARLATDALLDGGSEAYWRVLSQEGEVDFLSSVEAQYIQAQAREPPCPPDTLGG----- 87
FAM83G EQRLALEALVARGRDAFYEVVKRENIRDFLSELELKRILETIEVYDPGSEDPRGTGPSQG 89
FAM83F RRRAALEALLGGGEQAYRERLKEEQRLRDFLSSPERQALRAAWSPYEDAVPAANARGKSK- 88
FAM83E GQRLALEALLSKGAEAFQTCVQREELWPFLLSADEVQGLAAAAEDWTVAKQEPSG----- 83
FAM83H YYRLAVDALAEGGSEAYSRLFATEGAPDFLCPEELEHVSRHLRPPQYVTREPPE----- 80
FAM83D SRRLALEELVAGGPEAFAAFLRRERLARFLNPDEVHAILRAAERPGEEGAAAAA----- 114
FAM83B WYRVAIDILIEHGLEAYQEFVLVQERVSDFLAEEEEINYILKNVQKVAQSTAHGTD----- 80
* * : * * * : : * ** : . :

FAM83C -----EASGPDRLSLLSEVTSGTYFPMASDIDPPDLDLGWPEVPQ--ATGFSPT 144
FAM83A -----AEAGPKGLDS-SSLQSGTYFPVASEGSEPALLHSWASAEEK--PYLKEKS 133
FAM83G PEDNGVGDGEEASGADGVPIEAEPPLPSLEYWPKSDRSIPQLDLGWPDITIA--YRGVTRA 147
FAM83F -----AKAKAPAPAPAESGESLAYWPDSDTEVPPLDLGWTDTGF--YRGVSRV 135
FAM83E -----MAEGATTTDVDAGLSYWPQSEQPAPVLRLLGWVSDA--WKGITRA 128
FAM83H -----GSLLDVDMDGSSGTYFPVNSDQAVPELDLGLWPLTFG--FQGETVT 123
FAM83D -----AAEDSFGSSHDCSSGTYFPEQSDLEPPLLELGPAPAFYQAYRGATRV 161
FAM83B -----DSCDDTLSSGTYWPVESDVEAPNLDLGPYPVMPG-LLGGTHI 121
* *:* * : * * .*

FAM83C QAVVHFQRDKAK---NIKDLLRFLFSQAHTVVAVVMDIFDTMELLCDLMEASSRRGVPVY 201
FAM83A SATVYFQTVKHN---NIRDLVRRICITRTSQVLVILMDVFTDVEIFCDILEANKRGVFVC 190
FAM83G SVYMQPPIDGQA---HIKEVVRKMSQAQKVIIVVMDMFTDVDIFKDLLDAGFKRKVAVY 204
FAM83F TLFTHPPKDEKAP---HLKQVVRQMIQQAQKVIIVVMDLFTDGDIFQDIVDAACKRRVPVY 193
FAM83E QLYTQPPGEGQP---PLKELVRLEIQAAHKLAVVMDVFTDPDLLLLDLVDAATRWRVPVY 185
FAM83H TLVQPPPPDPS---IKDEARRMIRSAQQVVAVVMDMFTDVDLLSEVLEAAARR-VPVY 178
FAM83D ETHFQPRGAGEGGPYGCKDALRQQLRSAREVIAVVMDVFTDIDIFRDLQEICRKQGVAVY 221
FAM83B DLLFHPPRAHLLT---IKETIRKMIKEARKVIALVMDIFTDVDIFKEIVEASTRG-VSVY 177
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FAM83C LLLAQEHLRHFLEMICYKMDLNGEHLPNMVRVSTCGDITYCSKAGRRTGQALEKFVLIDCE 261
FAM83A VLLDQGGVKLFQEMCDKVQISDSHLKNISIRSVEGEIYCAKSGRKFAGQIREKFIISDWR 250
FAM83G IIVDESNAVKYFLHMCERACMHLGHLKLNLRVSSSGTEFFTRSATKFKGALAQKFMFVDGD 264
FAM83F IILDEAGVKYFLEMCDLQLTDFRIRNIRVRSVTVGVGFYMPMG-RIKGTLSRFLMVDGD 252
FAM83E LLLDRQQLPAFLELAQQLGVNPNWNTENVVDRVVRGCSFQSRWRRQVSGTVREKFVLLDGE 245
FAM83H ILLDEMNAQHFLDMADKCRVNLHHVDFLRVRTVAGPTYTCRTGKSFKGHVKEKFLLDVDC 238
FAM83D ILLDQALLSQFLDMCDMLKVHPEQEKLMTVRTITGNIYYARSGTKIIGKVHEKFTLIDGI 281
FAM83B ILLDESNNFHFLLNMTKQGC SVQRLRNIRVRTVKGDYLSKTGAKFHGKMEQKFLLDVDCQ 237
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FAM83C	QVVAGSYSFTWLCSQAHTSMVLQLRGRIVEDFDREFRCLYAESQPVEGFCGGEDPLSPRA	321
FAM83A	FVLSGYSYSFTWLCGHVHRNLSKFTGQAVELFDEEFRHLYASSKPVMLK-----SPRL	304
FAM83G	RAVCGSYSFTWSAARTDRNIVSVLSGQVVMFDRQFQELYLMHSVSLKGIPEKEPEPE	324
FAM83F	KVATGSYRFTWSSSHVDRNLLLLLTGQNVPEFDTEFRELYAISEEVDLY-----R	302
FAM83E	RVISGYSYSFTWSDARLHRGLVTLLTGEIVDAFSLEFRTLYAASCPLPPA-----	294
FAM83H	VVMGYSYSFMWSFEKIHRS LAHV FQ GELVSSFDEEFRILFAQSEPLVPSAAALARMDAYA	298
FAM83D	RVATGSYSFTWTDGKLNSSNLVILSGQVVEHFDLEFRILYAQSKPISPKLLSHFQSS---	338
FAM83B	KVMYGSYSYMWSFEKAHLSMVQIITGQLVESFDEEFRRTLYARSCVPSSFAQEESARVKHG	297
	. *** : * : . . : * . * . * . : * : * : *	
FAM83C	LRPPP-----	326
FAM83A	VAPVP-----	309
FAM83G	PIVLP-----	329
FAM83F	QLSLA-----	307
FAM83E	PPQKP-----	299
FAM83H	LAPYAGAGPLVGVPGVGAPTFFSFPKRAHLLFPPPREEGLGFPSFLDPDRHFLSAFRREE	358
FAM83D	-----	
FAM83B	KALWENG-----	304
FAM83C	-----VALAFRPDVPSPTSSSLPSSLSLSSIK-----	352
FAM83A	-----PGAAPANGRLSSSSGSASDRTSS-----	332
FAM83G	-----SVVPLVPAGTVAKKLVNPKYALVKAKSVDEIAKISSEKQEAKKPLGL---	376
FAM83F	-----GRVGLHYSSTVARKLINPKYALVSG-----	332
FAM83E	-----SVIGGLQRGRSPHRVS-----	315
FAM83H	PPRMPPGALEPHAGLRPLSRRLAEAGPAGELAGARGFFQARHLEMDAFKRHSFATEGAG	418
FAM83D	-----NKFDHLTNRKPKQSKELT LGNLLR-----	361
FAM83B	-----TYQHSVSSLASVSSQRNLFGRQDKIHKLDSSYFKNRGIYTLNEHDKYNIRSHG	357
FAM83C	-----	
FAM83A	-----	
FAM83G	-----K	377
FAM83F	-----	
FAM83E	-----	
FAM83H	AVENFAAARQVSRQTFLSHGDDFRFQTSHFHRDQLYQQQYQWDPQLTPARPQGLFEKLRG	478
FAM83D	-----	
FAM83B	-----	
FAM83C	-----	
FAM83A	-----	
FAM83G	GPALAEHPGELPELLPPIHPGLLHLERANMFEYLPTWVEPDPEPGSDILGYINIIDPNIW	437
FAM83F	----CRHP-----	336
FAM83E	-----	
FAM83H	GRAGFADPDDFTLGAGPRFPELGPDPGHQRLDYVPSSASREVRHGSDPAFAPGPRGLEPSG	538
FAM83D	-----	
FAM83B	YKPHFVVPNFNGPNAIRQFQPNQINENWKRHSYAGEQPETVPYLLLNRLNRTNPPGNWK	417

FAM83C	--QSPLMGRSSYLALPGGGDCSDTGCVSSSLG-----	382
FAM83A	----NPFSGRS-----AGSHPGTRSVSASSG-----	354
FAM83G	NPQPSQMNRIKIRDTSQASAQHQLWKQSQDSR-----	469
FAM83F	---PGEMMRWAARQREAGGN---PEGQEEG-----	361
FAM83E	-----RRRSVAPASPPFPDGF LAHRLA-----	337
FAM83H	APRPNLTQRFPCQAAARPGDPAPEAEPERRGGPEGRAGLRRLASYSLSGCHGEDGGDD	598
FAM83D	-----MRLARLSSTPRKADLDPEMPAEGKAER-----	388
FAM83B	KPSDSLVSASSSREGYVSHHNTPAQSFANRLAQRKTTN-----LADRN	460
FAM83C	----PARREASQPSLHRQLSDPNHGSPPGLYRANLGKLGAYPWSQSSPALNHNSTSP--	437
FAM83A	----PCSPAAP-----HPPPPPRFQPHQG-----PWGAPSPQAHLS-----	386
FAM83G	----PRPEPCP-----PPEPSAPQDGVPAENG----LPQGDPEPLPPVPKPRTVP	511
FAM83F	----ASGGESA-----WRLESFLKDLVTVEQV----LPPVEPIPLG-----	394
FAM83E	----ACRVSPA-----TPGPALSDILRSVQRARTPSGPPARPS-----	371
FAM83H	GLPAPMEAEAYEDDLVAPGGRAPAGDLLPSAFRVPAAFPTKVPVPGPGSGGNGPEREGPE	658
FAM83D	---KPHDCESS-----TVSEEDYFSSHRDELQSRKAIDAATQTE-----	424
FAM83B	SNVRRSFGNGTDNHIRFLQQRMPLEHTTKSFLRNWRIESYLNHDHSEATPDSNGSALGDRF	520
FAM83C	-----TLAVGSPLLPRSRPLLQFHRGAPALS RFPENGLPGSQEPSPLRGRW	483
FAM83A	-----PR-----PHDGGP-----	394
FAM83G	VADVLARDSSDIGWVLELPKEEAPQNGTDHRLPRMAGPGHAPLQRQLSVTQDDPESLGVG	571
FAM83F	-----ELSQKDG-----RMVSHMRDLK---PKSREAPSRNGMG	425
FAM83E	-----RSMWDL S RLSQLSGSSDGDNELKKS WG	398
FAM83H	EPGLAKQDSFRSRLNPLVQRSSRLRSSLI FSTSQAEGAAGAAAATEKVQLLHKEQTVSET	718
FAM83D	-----PGEEMPGLSVSEVGTQTSITTACAG	449
FAM83B	EGYDNPENLKANALYTHSRLRSSLVFKPTLPEQKEVNSCTTGSSNSTIIGSQGETPKEV	580
FAM83C	VPGTTLETVEEKEKK-----	498
FAM83A	-----	
FAM83G	LPNGLDGVVEEEDDDYVTLSDQDSSHSGSSGRGPG-----	605
FAM83F	-----	
FAM83E	-----	
FAM83H	LGPGGEAVRSAASTKVAELLEKYKGPARDPGGGAGAITVASHSKAVVSQAWREEVAAPGA	778
FAM83D	-----	
FAM83B	PDTPTNVQHLLTDKPLPESIPKLPLOQSEAPKMHTLQVPEN-----	619
FAM83C	-----ASPSQSRGQLDLLVPFRAREVGDPSGVT P NSGPLRPGEQAPED	543
FAM83A	-----AAVYSNLGAYRPTRLQLEQ	413
FAM83G	-----PRRPSVASSVSEEYFEVREHSVPLRRRHSEQVANGPTPPRRQLSA	651
FAM83F	-----EAARGEAAPARRFSSR	441
FAM83E	-----SKDTPAKALMRQ	410
FAM83H	VGGERRSLESCLLDLRDSFAQQQLHQEAERQPGAASLTAAQLLDTLGRSGSDRLPSRFLSA	838
FAM83D	-----TQTAVITRIASSQTIIWS	467
FAM83B	-----HSVALNQTTNGHTESNNYIYKTLGVNKQ TENLKNQQTENLLKRRSFPL	667

FAM83C	RRLSPSQADSQDLDSRALGTGGAPELGSLRPGDRALEDRLSLNQSRGQSDLLMQYPKA	603
FAM83A	LGLVPR-----	419
FAM83G	PHITRGT-----FVGPQGGSPWAQSRGEEADALKRMQ	684
FAM83F	LFSRRAK-----RPAAPNGMASSVSTETSEVEFLTGKR	474
FAM83E	RGTGGGP-----WGEVDSRPPWGGALPLPPAHLRLRYLS	443
FAM83H	QSHSTSPQGLDSPLPLEGSGAHQVLHNEKSGSPTSAYPERKGSPTPGFSTRRGSPPTGFI	898
FAM83D	RSTTTQT-----DMDENILFPRGTQSTEGSPVSKMS	498
FAM83B	FDNSKANLDPGNSKHVYSTLTRNRVRQPEPKEDLLKSSKSMHNVTHNLEEDDEEVTKR	727
FAM83C	QGSRVPLETNSARPARRAPDERRQTLGHSQDLITKFGPFRGEGPGNLPISSP---A	660
FAM83A	-----LTPTRPFLQASPHF-----	434
FAM83G	AQRSTDKEAQGQFHHHRVPASGTRDKDGFPPRYRSAADSVQSSTRNAGPAMAG---P	741
FAM83F	PNENSSADISG-----KTSPSSAK-----PSNCVIS-----	500
FAM83E	PAR---RRFGGDATFKLQEPGRV-----PSDWAPRAGLGGQP-----	478
FAM83H	EQKGSPTSAYPERRGSPVPPVPERSSPVPVPERGSLTLTISGESPKAGPAEEGSPGP	958
FAM83D	VSRSSSLKSSSSVSSQGSVASSTG-----SPASIRTTDFHNPYKYLGTPHL	546
FAM83B	NSPSGTTTKSVSIAALLDVNKEESNKEKELASKKEVKGSPSFLKKGSKLRSLLSLTPDKKE	787
FAM83C	RTAGAGSGDEKRLTLGHSKLDLITKYHQLHGARGTEPGGPKGGHLNGNSDLVRDEKRL	720
FAM83A	-----	
FAM83G	HHWQAKGGQVPRLLPDPGSPRLAQNARPMTDGRATEEHPSPFPIPYSKLSQSKHLKARTG	801
FAM83F	-----	
FAM83E	-----	
FAM83H	MEVLRKGSRLRLRQLLSPKGERRMEDEGGFPVPQENGQPEPRRLSLGQGDSTEAAATEERG	1018
FAM83D	ELYLSDSLRNLNKERQFHFAGIRSRNLHMLAMLSRRTLFTENHLGLHSGNFSRVNLLAVR	606
FAM83B	NLSKNKAPAFYRLCSSSDTLVSEGEENQPKKSDTKVDSSPRRKHSSSSNSQGSIHKSKE	847
FAM83C	TLGHSKLDLITKYNKSKFKQLRSRFES-----	747
FAM83A	-----	
FAM83G	GSQWASSDKRRAQAPRDRKDP-----	823
FAM83F	-----	
FAM83E	-----	
FAM83H	PRARLSSATANALYSSNLRDDTKAILEQISAHGQKHRAVPAPSPGPTHNSPELGRPPAAG	1078
FAM83D	DVALYPSYQ-----	615
FAM83B	DVTVSPSQEINAPPDENKRTSPSPGPVESKFLERAGDASAPRFNTEQIQYRDSREINAVVT	907
FAM83C	-----	
FAM83A	-----	
FAM83G	-----	
FAM83F	-----	
FAM83E	-----	
FAM83H	VLAPDMSDKDKCSAIFRSDSLGTQGRSLRSLPASAEERDRLLRMESMRKEKRVYSRFEV	1138
FAM83D	-----	
FAM83B	PERRPTSSPRPTSSELLRSHSTDRRVYSRFEFCKIESSIQPTSNMPTSINRPEIKSAT	967
FAM83C, A, G, F, E, & D	-----	
FAM83H	FCKKEEASSPGAGEGPAEEGTRDSKVGKFPKILGTFKSKK---	1179
FAM83B	MGNSYGRSSPLLNYNTGVYRSYQPNENKFRGFMQKFGNFHKNK	1011

Fam83h Vertebrate Homologues in Alignment

Vertebrate	Species	Accession #
Human	<i>Homo sapiens</i>	NM_198488
Mouse	<i>Mus musculus</i>	AK035531
Bovine	<i>Bos Taurus</i>	XM_603315
Opossum	<i>Monodelphis domestica</i>	XM_001370407
Bird	<i>Gallus gallusor</i>	XM_423955
African Frog	<i>Xenopus laevis</i>	BC078004
Zebrafish	<i>Danio rerio</i>	NM_001045090

Vertebrate Fam88h Alignment Summary

MARRSQSSSQGDNPLAPGYLPPHYKEYYRLAVDALAEGGSEAYSRFLATEGAPDFLCPEE
 LEHVSRLRPFQYVTREPPEGSLLDVIDMDSGTYWPNVSDQAVPEL DLGWPLTFGFQGT
 EVTTLVQPPPPDPSPIKDEARRMIRSAQQ/2-3/VVAVVMDMFTDVDLLSEVLEAAARRV
 PVYILLDEMNAQHFLDMADKCRVNLHHDV/3-4/FLRVRTVAGPTYYCRTGKSFKGHVKE
 KFLLVDCAVVMMSGSYS/4-5/FMWSFEKIHRSLAHVFQGELVSSFDEEFRI LFAQSEPLV
 PSAAALARMDAYALAPYAGAGPLVGVPGVGA TPFSFPKRAHLLFPPPREEGLGFPSFLD
 PDRHFLSAFRREEPPRMPGGALEPHAGLRPLSRRL EAEAGPAGELAGARGFFQARHLEMD
 AFKRHSFATEGAGAVENFAAARQVSRQTF LSHGDDFRFQTSHFHRDQLYQQQYQWDPQLT
 PARPQGLFEKLRGGRAFADPDDFTL GAGPRFPELGPDPGHQRLDYVPSSASREVRHGS DP
 AFAPGPRGLEPSGAPRPNLTQRFPQAAARPGDPAPEAEPERRGGPEGRAGLRRLAS
 YLSGCHGEDGDDGLPAPMEAEAYEDDV LAPGGRAPAGDLLPSAFRVPAAFPTKVPVPGP
 GSGNGPEREGPEEPGLAKQDSFRSRLNPLVQRSSRLRSSLIFSTSQAEGAAGAAAATEK
 VQLLHKEQTVSETLGPGEAVRSAASTKVAELLEKYKGPARDPGGGAGAITVASHSKAVV
 SQAWREEVAAPGAVGGERRSLESCLLDLRDSFAQQLHQEAERQPGAASLTAAQLLDTLGR
 SGSDRLPSRFLSAQSHSTSPQGLDSPLPLEGSGAHQVLHNESKGSPTSAYPERKGSPTPG
 FSTRRGSPTTGFI EQKGSPTSAYPERRGSPVPPVPERSSPVPPVPERRGS LTLTISGES
 PKAGPAEEGPGSPMEVLRKGSRLRLRQLLSPKGERRMEDEGGFPVPQENGQPE SPRRLSLG
 QGDSTEAAATEERGPRARLSATANALYSSNLRDDTKAI LEQISAHGQKHRVAPAPSPGPT
 HNSPELGRPPAAGVLAPDMSDKDKCSAIFRSDSLGTQGRLSRTL PASAEERDRLLRMES
 MRKEKRVYSRFEVFCCKEEASPGAGEGPAEEGTRDSKVGKVFVKILGTFKSKK

Identical in all

High homology

Variable

Appendix Figure 2. CLUSTAL 2.0.10 multiple sequence alignment of vertebrate Fam83H proteins.

Key: * identical amino acids in all; : Mostly Homologous; . Homologous

Human	MARRSQSSSQGDNPLAPGYLPPHYKEYYRLAVDALAEGGSEAYSRFLATEGAPDFLCPEE	60
Mouse	MARRSQSSSQGDNPLAPGYLPPHYKEYYRLAVDALTEGGPEAYNRFLASEGAPDFLCPEE	60
Bovine	MARRSQSSSQGDNPLAPGYLPPHYKEYYRLAVDALAEGGPEAYSRFLASEGAPAFLCPEE	60
Opossum	MALE--RSREGRD-----VRELQGLCVSLSAGVGPSSP-----	31
Bird	MARRSQSSSQGDNPLDPNYLPPHYKEYYRLALDILTEEGKESYERFLAEEGAPDFLCNSE	60
Frog	MAHRSQSSSQGDNPLDPNYLPPHYKEYYRIAIDVLAERGPEDYEQFLIEEGVPDFLCPSE	60
Zfish	MARRSQSSSLGDNPLDPNYLRPHYREYYRMAIDALVEDDIEGYNFLQANVVDFLSRSE	60
	** . * * : : * : :	
Human	LEHVSRLRPPQYVTR---PPEGSLLDVMMDGSSSGTYWPNVDQAVPELDLWGWLPTFG-	116
Mouse	LEHVSRLRPPQYVARE---PPEGTPSDVMMDGSSSGTYWPNVDQAVPELDLWGWLPTFG-	116
Bovine	LEHVSRLRPPQHVAPE---PPDGSPNLDLFDGSSSGTYWPNVDQAVPELDLWGWLPTFG-	116
Opossum	-----PPQRCCPG---RPGRHR-----GGWAGLWGEACSVRGAGRQGAASGW-	73
Bird	VDHILQNLQKPYANQE---GGTDTAGDNDVDGSSSGTYWPMNSDLAVPELDLWGWPMVFG-	116
Frog	VEHITKCFQRPPECSQENQYPDNVYSTQEEADGSSSGTYWPMESDTAAPELDLWGPITYG-	119
Zfish	IENIKSTVQTPQSAGNV---PELPYGEIDQDESSDQTYWPLHSDLDAPGLDLGWPMQOHS	116
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Human	-FQGTEVTTLVQPPPPDPSIKDEARRMIRSAQQVAVVMDMFTDVDLLSEVLEAAARRV	175
Mouse	-FQGTEVTTLVQPPPPDPSIKDEARRMIRSAQQVAVVMDMFTDVDLLSEVLEAAARRV	175
Bovine	-FQGTEVTTLVQPPPPDPSIKDEARRMIRSAQQVAVVMDMFTDVDLLSEVLEAAARRV	175
Opossum	-GAGTEGTTWARHRVTG-----HLQRALDLHLDQVVAIVMDMFTDVDLLSEILEAAARRV	127
Bird	-FRGTEVTTLVQPPPPDNPSIKEEARRMIRAAQQVVAIVMDVFTDVDLLFEVLDAAARRV	175
Frog	-FQGTEVTTLVHPPSPDNPTIKEEIRRMIRSAQQVIGIVMDIFTDADILSELLDAANRRI	178
Zfish	FVGPTEVTMLVNPAPERPSIKEQARRLIKNAHQVIAVMDIFTDVIDIFSDLLEAAARRHV	176
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Human	PVYILLDEMNAQHFLDMADKCRVNLHHVDFLRVRTVAGPTYTCRTGKSFKGHVKEKFLLV	235
Mouse	PVYILLDEMNAQHFLDMADKCRVNLHHVDFLRVRTVAGPTYTCRTGKSFKGLKKEKFLLV	235
Bovine	PVYILLDEMNAQHFLDMADKCRVNLHHVDFLRVRTVAGPTYTCRTGKSFKGHVKEKFLLV	235
Opossum	PVYILLDEMNAQHFLDMAEKCRVNLHHVDFLRVRTVSGPTYTCRTGKSFKGHVKEKFLLV	187
Bird	PVYILLDEMNSQLFLDTAAKCRVNLNYVEFLRVRTVSGPTYTCRTGMSFKGHVKEKFLLV	235
Frog	PVYIILDQMNCQLFLDMAAKCRVNLNYVEFLRVRTVPGPTYFCRNQTTFKGNLQEKFLLV	238
Zfish	PVYILLDEQNAHYFVNMVASCNVLEMIHMMRVRTVSGVTYFCRTGKSFQVMDRFLLT	236
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Human	DCAVVMGSYSFMWSFEKIHRSLAHVFQGELVSSFDEEFRILFAQSEPLVPSAAALAR--	293
Mouse	DCAVVMGSYSFMWSFEKIHRSLAHVFQGELVSSFDEEFRILFAQSEPLVPSAGALAR--	293
Bovine	DCAVVMGSYSFMWSFEKIHRSLAHVFQGELVSSFDEEFRILFAQSEPLVPSAGALAR--	293
Opossum	DCAVVLSGSYSFMWSFEKIHRSLAHVFQGELVSSFDEEFRILFAQSEPLIPAAGALALAL	247
Bird	DCMVVLSGNYSFMWSFEKIHRSLAHVFQGELVSSFDEEFRILFAQSEPLVPPANVLAK--	293
Frog	DCTVVLSGTYSMWSFEKIHRSLAHVFQGELVSSFDEEFRILFAQSDPLIPSEALAMMD	298
Zfish	DCRAVISGNYSFMWSFEKIHRSLAHVFQGELVATFDEEFRILFAQSQPLVVENALVPMP-	295
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Human	--MDAYALAPYAGAGPLVGVPGVGAPTPFSFPKRAHLLFPPPREEGLGFPSF-LDPDRHF	350
Mouse	--MDAYALAPYSGAGPLVGVPGVGAPTPFSFPKRAHLLFPPPREEGLGFPSF-LDPDRHF	350
Bovine	--MDTYALAPYAGAGPLMGSPGAPTPFSFPKRAHLLFPPPREEGLGFPSF-LDPDRHF	350
Opossum	THADTYALTPYGGPGPLMGGP-MGGPGSF-FPKRAHLLFPP-RDEGLGFPSF-LDPDRHF	303

Bird	-AENPFAMTPFGNNMPF-----FPKKSPLMFQRDDNLFPSFMDR-VDPDRFF	338
Frog	--KSYMGMVFPAGPRPM-----FDRKLHFMYPREENPSQPFPSFGVDPDRHY	343
Zfish	--QDSYLGNGQFG-----LKRTQSLRNPRGYLRQPELGGYQYGDRLDS	335
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Human	LSAFRREEPPRMPGGALEPHAGLRPLSRRLEAEAGPAGELAGARGFFQARHLE-MDAFKR	409
Mouse	LSAFRREELQRMPPGGALEPHTGLRPLAR--PTEAGPFGELAGPRGFFQSRHLE-MDAFKR	407
Bovine	LSAFRREESSRMPGGALEPHTGLRPLSRRLEAEAGPAGELAGARGFFQARHLE-MDAFKR	409
Opossum	LSAFRRDILLRHSGGAGDIHG-LRMLSR--EMEAGNSGDP-GSRGFLRAKHLE-MDAFKR	358
Bird	LSNFRRDDMLRHT-----VEGSAMRMYKKVEMEN---AQMDPVRGFRLRSKQLE-LDAFKR	389
Frog	FQSFRRDDMMRQN-----MDPAGMRMYAKNFGDPMQMSFIQNKQLEALEAYKR	394
Zfish	ILPFRDDPFRHTIEP--SAGPMQVTKYATQQFRMQQSFLDQGRSMLASRQLE-MNAFKR	392
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Human	HSFAT-EGAGAVENFAAARQVS-RQTFLS-HGDDFRFQTSHFHRDQLYQQQYQWDPQLTP	466
Mouse	HSYATPDGAGAVENFAAARQVS-RQTFLS-HGDDFRFQTSHFQRDQLYQQHYQWDPQFAP	465
Bovine	YSYAADGAGAVENLAAARQVS-RQTFLS-HGDDLRFQTSHFHRDQLYQQHYQWDPQLAP	467
Opossum	HNFAD----GAVENFAASRQVS-RQMFVS-HGDDFRFQTSHFHRDQLYQQHYQFEPQFTA	412
Bird	HSFAE----GTFENFASSKQYA-RQMFMN-NMDEFKIQSSHFQKQDFYQ--YQFEHPLS	441
Frog	HSFAE----GTFENYTSRQYSSRQMLMNNNDEYRFQSSQVQKSQFMQ----FQSPLAT	446
Zfish	HSYAE----GTRETYASSRQYMKQRMN-----LEETESHYQREQHYQ-----SEGMG	438
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Human	ARPQGLFEKLRGGRAGFADPDD----FTLGAGPRFPPELGP-----DGHQRLDYVPS	513
Mouse	ARPQGLFEKLRAGRPGFADPDD----FALGAGHRFPPELGA-----DVHQRLEYVPS	512
Bovine	TRPQGLFEKLRAGRPGFDPHDE----FMLGTGPRFPPELGL-----DGHQRLDYVPS	514
Opossum	TRPQGLFEKLRAGRPGFGEPEP----FGIDGSPHFPELEPGFGPHPEGPGGHLRLDYVPS	468
Bird	GRPQGFDFDIRGGRPGFNELEEGP-LPYGEGPRYHELESGFPQE----GFPLRLDYVPS	496
Frog	TRPQGLFEKIRGGRQGLQEMDEFDSRYPNKGLPGESHFALE-----GPPMRPGYNV	498
Zfish	HDDRGHYDRFNYGLADQHSDSG-----YPPELEAP-----GNINV	473
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Human	SASREVRHGSDPAFAPGPRGLEPSGAPRPNLTQRFPCQAAARPG-----PDPAPEA	564
Mouse	SASREVRHGSDPAFGPSPRGLEPSGASRPNLGQRFPCQATLRQG-----LDTASEA	563
Bovine	SASREVRHGSDPAFGPGPRGLEPSGAPRPNLGQRFSCQAMTRLG-----PEMAPEP	565
Opossum	SASREVRHGSD----PEPRGLEPGAPQRPNIQRFQCSPTQKQSLRWFPPPEAPEM	524
Bird	NSSREVRHGSD-QLNPAGNGPMGMLRRQNIQKFCQTSPTQKQSLRQ-LFLQDKDED	554
Frog	NSSREVKHGSD----QAVIGGEGRFQGRSLGRQKFCVQISPTQKQG-----MEQKHFFHD	549
Zfish	LSSDDLKSDSEKQYNIGGR-YDPQGHKRPAAAGHAYACQSSPTQPHPPDQK---QLFSTGD	529
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Human	EPERRGGPEGRAGLRRLASYSLSGCHGEDGGDDGLPAPMEAEAYEDDVLAPGGRA--PA	622
Mouse	EPERRGGPEGRAGLRHWRLASYSLSGCHG-DGGEGLP--MEAEACEDEVLPAGGR-----	615
Bovine	EPEHRGGPEGRAGLRHWRLTSYLSGCHSEDAGDEGLPTMETEAYDDDDVLVSGGRA--TA	623
Opossum	EPSRKGGAEGRAGLRNWRISSYLSGCHS-DGGDEGLPGPMEAEASYDEVLDGPTGRFPLPT	583
Bird	QDQDKSTQENRTGLRNWRISSYLSAYQS--EPEEGLPMPMESEAYNDVLGDPLTKHP---	609
Frog	QDADKKPPENKQGLRSWRISSYLSGIQS-DQDEEGLPIPLEPELYDDALVPVERAVP---	605
Zfish	QVRQSQDPSVKQGLRSWRINSYLSYED--GGEEGLHPMGSDAFEDSHQPPDSRLYGSE	587
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Human GDLLPSAFRVPAAFPTKV-----PVPG 644
 Mouse -DLLPSAFRTPAAFPAG-----PKPG 636
 Bovine GDLLPSAFRVPAFPFGK-----PAPG 645
 Opossum GDLPSFRTGGSFPPK----- 600
 Bird TDLIP-AFKSPISFNSKS-----LG-V 629
 Frog -----ASETLLKYSTDP----- 617
 Zfish GPGIHSNIRERPNIPTKPNLDRPRFGKPIIQDRNQVKDNTSDLGPTSTDTLKPAISASS 647

Human PGSGG-NGPEREGPEEPGLAKQDSFRSRLNPLVQRSSRLRSSLIFSTSQAEAGAAG---AA 700
 Mouse SGSGGGDSSEREGPEETS LAKQDSFRSRLNPLIQRSSRLRSSLIFAS-QAEGAVGT--AA 693
 Bovine SGSGGGDGPEREGL EEVGLAKQDSFRSRLNPLIQRSSRLRSSLIFASQEGGTGGP--TG 703
 Opossum -ALGGGDGPEREVTEGVTL SKQDSFRSRLNPLIQRSSRLRSSLIFSSSQKEGPGVGPAG 659
 Bird ENAKEFADPERGG-EEAPMMKQDAFRTRINPLIQRSSRLRSSLIFNAAKLDQPNT----- 683
 Frog --MQPYKSSLVPHNVFPDRSNENFMKYSDMPVQLHKPSVPSQDVPMLERAGAGNESLMK 675
 Zfish LASSTDNEKELAEPREISITKHESFRTRINPMLQRSSRLRSSLIFSSSKLEQHNSQAKS 707

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Human AATEKVQLLHKEQTVSETLPGGGEAVRSAASTKVAELLEKYKGPARD----PGGGAGAIT 756
 Mouse ATTEKVQLMHKEQTVSETLPGSGEAVRSSASAKVAELLEKYKGPARD----PGGAGGAVT 749
 Bovine ASTEKVQLLHKEQTVSEMLPGGNEAVRSAASTKVAELLEKYKGPSRD----PGGVGTAVT 759
 Opossum ATNEKVQLFQKEQTVSETVGEGETVRTASSKVAELLEKYKGPARDRDRDQDRTGGLVT 719
 Bird -TVEKVQMIHKEQVSELTKD-NETIKTAASSKVAELLEKYKAVGKD-----AERA 732
 Frog YSVNPIPPFKSSSDVPTLFRIVPAIENLS-KYSLEPIPPYKNFGST-----GELS 725
 Zfish GGELQEEKEESEPIRYSSIVAEILEKRRSLSREPFWDNKKHKADEKD--VKHASTGDLTT 765

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Human VASHKAVVSQAWREEVAAPG-AVGGER-RSLESCLLDLRDS--FAQ-QLHQEAERQPGA 811
 Mouse SSSHKAVVSQAWREEVAPG-GAGTER-RSLESCLLDLRDS--FAQ-QLHQEAERHPGA 804
 Bovine AASHKAVVSQAWREEVSAPGGGSGSER-RSLESCLLDLRES--FAQ-QLHQEAERQPGA 815
 Opossum VSSHKA AVTQAWREETGTGSGGKGER-RSLESCLLDLRDS--FAN-RLHEESERQPGA 775
 Bird TVTHTKAVSSFLQEESQNAEKKCTKSVQYKILES RVLESKDS--CSTYKMHGETDRFTFGM 790
 Frog VEKPKETPPAEKEKEEALLSRHDSFRTRTNPLIQRSRLRSSLIFSSSKLEQHTSTTESI 785
 Zfish IQDTKEEPIKEKEKPDNPKPEENKVTQPTVPSASQQITSSLMNDPASRLQYFKDQOQEKR 825

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Human ASLTAAQLLDTLGR-----SGSDRLPSRFLSAQSHSTSPQGLDSPLPL----- 854
 Mouse ASLTAAQLLDTLG-----GTDRLPSRFLSAQGRSLSPQGRDSPPP----- 844
 Bovine ATLASTQLLDTLGRG-----SSGTDRLPSRFLSTQGHSTSPQGRDSPPP----- 859
 Opossum ATLSAAQLLDTLGR-----GTDRLPSRFLASDGRAALPQGKASPPPERKGSPTP 824
 Bird SS-STPQLIDALSKDPLAH---LGTKVDKLSRFYPMENKPALPEKESLIFVG----- 839
 Frog QEMQQAQSTSEVVSE-----NETEKTTSRVAEILQKYRGVSRDS----- 824
 Zfish KTSKLELDLGTKSQEAAIKKPETLDTATKVPDVLITSEQSTVKAQEPTVSQTDFVPHRPV 885

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Human ---EGSGAHQVLHNESKG----- 869
 Mouse ---EGLGTHQLPYSEPKGNPTPAYPERKGS PAPANPERKGSPTPAYPERKGSPTPAYPER 901
 Bovine ---EGPGGQQ---SEPKG----- 871
 Opossum VYPERKGSVPPVPERKGS PILAYPERKGSVPPVPERKGSPTTAYPERKGSVPPPIPER 884
 Bird -----
 Frog -----
 Zfish IETKPKPSEVSVD RPYTTN-----K 905

Human	--SPTSAYPERKGSPTPGFSTRRGSPTTGFIQKGSPTSAYPERRGS-----PV	916
Mouse	KGSPTQAYPERKGSPTSGFPNRRGSPTTGLMEQKGSPTSTYPDRRGS-----PV	950
Bovine	--SPTLAYPERKGSPTPGFPTRRGSPTAGFTEQKGSPTSAYPERRGS-----PV	918
Opossum	KGSPTSTYPERKGSVPPIPERKGSPTSAYLERKGSPTSAYPERKGSPTSAYPDQRSSPF	944
Bird	-DTQKLALPEKKERVTFKEDAELKLVSAELKK-----	869
Frog	--NSTTMTQAKAASRT-----IHEESEDGQCTSTEAVAY-----	856
Zfish	TLTESIADAPKKEPVKEPTKSLKPFPSPKFLKPFKSSQSSSRRISCG-----E	953
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Human	PPVPERRSSPVPPVPERRGSLTLTISGESPKAGPAEEGPGS-----PMEVLRKGSRLRQ	971
Mouse	PPVPERRGSPVPPVPERRG--SLTFAGESSTGTPTTEEVSSG-----PMEVLRKGSRLRQ	1003
Bovine	PPVPERRGSPVPPVPERRGSLTLPFSGESPKAGPTEEAVGG-----PMEVLRKGSARLRQ	973
Opossum	PPVSEWRDNPIPPVPERKS--SLTFSGDTQKIGSAGEEDAGRSEPSPMFLRKGSHRLKQ	1002
Bird	PQVRTGATSAIENLSKGQG-----SDSSLNRSEEECSKQ--EQNTMEFLRKGSLRQ	920
Frog	-KAVESAIDKNGSVSRMQQ-----ESQYKSVATSHLEG-----LLSKEQQSFMSK	901
Zfish	EILTDATDAEKSELKKSRSFSTSGMSRTEPRESLSLGNSESKDTKALDFLKKQTQRLKG	1013
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Human	LLSPKGERRMEDEGGFPVQENGQPEsprRLSLGQGDSTEAAATEE-----	1016
Mouse	LLSPKNERRGEDEGSFPTQENGQPEsprRPSLSRGDSTEAAAE-----	1048
Bovine	LMSPKGERRADDEGSFPTQENGQPESPQWPSLVRVDSTEAAAE-----	1018
Opossum	LLSPKGEKLEEEGGFGPQENGQPEGPHRP--SRGDSPELGVED-----	1045
Bird	FLNPKGEKKLEEEPNSEIGKSDKQPMGLKRS--SMGDCQEMLGEEKNHKFATLLPPKSS	978
Frog	VEQVTSSIQTIGNISSALPERNESGPTVTEPVEEHKQSSISHMQQ-----	946
Zfish	ILGPKGDKKHSVNSQEDKSMKTVPEVQEEISDKGKPSESISSTAVEN-----KPSA	1067
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Human	RGPRARLSSATANALYSSNLRDDTKAILEQISAHGQKHRVAVPASP-----GPTHNSPEL	1071
Mouse	RGSRVRLASATANALYSSNLRDDTKAILEQISAHGQKHRGVPAP-----GPAHSSPDV	1101
Bovine	RGPRARVASATANALYSSNLRDDTKAILEQISAHGQKHRGVPAPGP-----TPAHSSPEL	1073
Opossum	RGSRSLASATANALYSSNLRDDTKVILEQISAHGQKHRGGAGSGGGTGTGGAHSSPEL	1105
Bird	QPTQGRFPSSSTANILYSSNLRDDTKVILEQISANSQKNRAELAKQL-----PSTSNPDL	1032
Frog	---ESHYKSVVTSQLDGLLNRDHQVISMSKVEQKTSSVQTIGNISP-----APPENRES	997
Zfish	KPTTSRYQSSTSNIFSSNLRDDTKVILEQISANSQKTRQQNEESG-----	1113
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Human	GRPPAAGVLAP---DMSDKDKCSAIFRSDSLGTQGRSRTLPASAEERDRLLRMESMRK	1128
Mouse	GRPTTAGDLAP---DMSDKDKCSAIFRSDSLGTQGRSRTLPASAEERDRLLRMESMRK	1158
Bovine	GHPVAVAGGLAP---DMSDKDKCSAIFRSDSLGTQGRSRTLPASAEERDRLLRMESMRK	1130
Opossum	YRSPAAALDASRAHEMSDKDKCSAIFRSDSFGGQSRFSRTLPASLEERDRLLRMESMRK	1165
Bird	SKSTMSLERKT-----EKEKSCNIHRSEFSGQKRNLRQPS--EDRDTLLKKNEMMRK	1084
Frog	GPTITELTEVP-----QTPENAPIRSNSSFHFGSALESMSQNPTPSSSLNKSEDLAK	1050
Zfish	-----KGDGGKDDVANSFPQSRNRFSRAPVNPQERDNLKRIESMRK	1155
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Human	EKRVSRYFEVFCCKEEASS--PGAGE-GPAEEGTRDSKVGKFPKILGTFKSKK	1179
Mouse	EKRVSRYFEVFCCKDEAGS--SGAGD-NLADEDTRDSKMGKFPKILGTFKSKK	1209
Bovine	EKRVSRYFEVFCCKKEEPGA--LGAAE-GPAEEDARDSKVGKFPKILGTFKSKK	1181
Opossum	EKRVSRYFEVFCCKEDSGAGEAGAGETGASEADTRDRKVGKFPKILGTFKTKK	1219
Bird	EKRVSRYFEVFCCKDEHTS--QSEEE---YDTDAKDKKMGKFPKILGTFKTKK	1133
Frog	TDQNFLRKGSIKQLQFLQS----KAE-----KSKK	1076
Zfish	EKKVYSRYFEVLYRSRECCWERSVE-----QANQFLIKSIE-----	1192
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