

Additional file 9

Amino acid sequences of ferric reductase (FRE) proteins of fungi and alignment of FRE protein and human Nox2 protein sequences

Sequences were obtained from the GenBank™ databases

(<http://www.ncbi.nlm.nih.gov/>). To describe species of the genes, we used the following

abbreviations: An, *A. nidulans*; Scerevisiae, *Saccharomyces cerevisiae*; Spombe,

Schizosaccharomyces pombe. Gray boxes in alignment indicate the

Nox/Duox-conserved amino acid residues shown in Figure 6.

>Scerevisiae-FRE1: GenBank™ No. NP_013315

MVRTRVLFCLFISFFATVQSSATLISTSCISQAALYQFGCSSKSKSCYCKNINWLGSVTACAYENSKSNKTLDS
ALMKLASQCSSIKVYTLEDMKNIYLNASNYLRAPEKSDKKTVVVSQPLMANETAYHYYYEENYGIHLNLMR
SQWCAWGLVFFWVAVLTAATILNILKRVRFGKNIMANSVKKSLIYPSVYKDYNERTFYLWKRLPFNFTRGK
GLVVLIFVILTILSLSFHGNIKLPHPYDRPRWRRSMAFVSRRADLMAIALFPVVYLFGIRNPNFIPITGLSFSTFN
FYHKWSAYVCFMLAVVHSIVMTASGVKRGVFQSLVRKFRWGVIVATILMSIIIFQSEKVFNRNGYEIFLLIH
KAMNIMFIAMYYHCHTLGWMGWISWAGILCFDRFCRIVRIIMNGGLKTATLSTDDSNVIKISVKKPKFF
KYQVGAFAYMYFLSPKSAWFYSFQSHPFVLSERHRDPNPDQLTMYVKANKGITRVLLSKVLSAPNHTVD
CKIFLEGPYGVTVPHIAKLRNLVGVAAGLVAAIYPHFVECLRLPSTDQLQHKFYWIVNDLSHLKWFENEL
QWLKEKSCEVSVIYTGSSVEDTNSDESTKGFDDKEESEITVECLNKRPDKELVRSEIKLSELENNITFYSCG
PATFNDDFRNAVVGIDSSLKIDVELEEEESFTW

>Spombe-FRE1: GenBank™ No. NP_595271

MILARDDKWTLGSIALIFVLLIGFALLFLLERFRVKEKSRTFKDCVNVYQCPSKGERVYLALRHWIFLATHK
AQMTLILSPLVMLVTIPFTGKETKNSIASYDWNLTGVAARLGYLSCGLFFVSYFFSLKNNPFCLMLFSSHEK
MNYLHRWLSVYAVLISVLHGILFMIFSAQSYKPLLYDKISYGYFITVVLFLMTVASLPSVRRKFFEFFVLH
HTCSVLIIFLIWLHHPRTIVYMKACIIYAFDRGCRLEFRSIWNRNFRILYLLNEDMIYMVGRKPKRSFFALPWA
AGSHVYINIPSLSYWQVHPFTLASAPFDDFIELFVAVHSGFTERLANRLYSMPHEYPNFSLAPGTPESLSNTYR
ELNSFKSYAVEIENTAQGHYEPEDLYLETTVMFDGPYGTTSNVFKEYSYVLLIAGGVGFSYTLPIRLDLIK
ECNVTISITFIWSCRSLKLVASKSLNLLHQSNVRLKIINHFTGSISCKESSEFSNQTENSEMEFFDDRPDL
MYIQKFFDYVGYQTAALAACGSQSFLKRIKNSVNKSISSTTDIYQHYEEL

>Spombe-FRE2: GenBank™ No. NP_595065

MAINSSDKWTVIAICLILGILLAFILMFWLERFRVIKSNAHKHDPSPDKRQIWLEKYYLFVRQIYTYLVTHKVI
LTLIAVPVVFAISIPFIGMQTPASSHGKQTTQVSTGNWSKNAVAARLGFLACGLYVTSYFFSIKNNPFALLIS
SHEKMNYVHRRLSQYAIMIGAIHGFAIYGLAAQGKRALLTARVTIIGYVILGLMVIMIVSSLPFFRRRFYEW
FVLHMHCSIGFLITIWLHHRRCVVYMKVCVAVYVDFRGCRLRSFLNRSKFDVVLVEDDLIYMKGPRPKKS
FFGLPWGAGNHMYINIPSLSYWQIHPFTIASVPSDDFIELFVAVRAGFTKRLAKKVSSKSLSDVSDINISDEKIE
KNGDVGIEVMERHLSLQEDLVFESSAAKVSFLMDGPYGPVSNPYKDYSYFLFAGGVGVSYLPIILDITIKKQ

SRTVHITFVWSARSSALLNIVHKSACEAVRYTEMNINIFCHLTNSYPVEEVSSLNSQSARNYSLQYLNGRPDV
NDYFKDFLHATGTQTAALASCGSDKLLRHLKSCVNTHSPSTVDLYQHYYEEI

>An-FRE: GenBank™ No. AAN61438

MGVDLLPPGQERQRHVHPPMNIALATPLFALAGGFLILFVGRLAIRMRHHLRLRAVLRNDDQTPFTNRNGF
MAWTNRHVYFAPLFGARHSRELRIGRAHMGTVPLRIETLILALYIAINFAFFVCLVDWWEDYQEKLYQVKY
AGGH LAVMNT PGLVLA AARNNPLIPLLGISFDTFNLFHRWVGRVIVVGAIIHMSAVIAGLIAEHGFETTTHII
WEVPPFIWGMIALFGFILIAIQSVLLRHAFYEVFLHLHVALAVMSFVGLWYHLRGLSEQQNVVLGTIILWGL
ERVTRVASLVWRNVGKQRTVADFELLPGNVIRATVTLARTGEFRAGQHMYLYVPSVGLWTSHPFSVAWTS
TEEVSVDSDSNESFKMLLDRKQPQTISFLIKREDGFTRELQRKAANS DTCQFTTTVFAEGPYGLEDLNSYGT
VLLIASGVGITNTMSYLYQFLEGFSARKTAVRRVNLVWVTRSVEDLHWIDPWMKSVFTHPAIATKESFQNN
RLAVSVQVYVTRKEASEASVG DSEN LWAFSAPSGVSVSVGFGRPGFAVVIEREMETQVGAMAVSVCNGC
VTDDVRQAVREAQKGAKTISLHDEAFCW

Spombe-FRE1	-----MILARDDKWTLSIALIFVLLIGFALLFLERFRVKEKSR	40
Spombe-FRE2	-----MAINSSDKWTVIAICLILGILLAFILMFWLERFRVIKSN	40
Scerevisiae-FRE1	-----	
Aspergillus-FRE	MGVDLLPPGQERQRHVHPPMNIALATPLFALAGGFLILFVGRLAIRMRHHLRLRAVLRND	60
human-Nox2	-----MGNWAVNEGLSIFVILVWGLNVFLFVWYRVDI	35
Spombe-FRE1	TFKDCVNVYQCPKGERVYLALRHWFIFLATHK--AQMTLILSPLVMLVTIPFTGKETKN	98
Spombe-FRE2	AHKHDP-SDKRQIWLEKYLVFRQIYTYLVTHK--VILTIAVPVFAISIPFIMGQTPA	97
Scerevisiae-FRE1	-----YLWKRLPFNFTTRGK--GLVVLIFVILTILSLSFGHNIKLPH	40
Aspergillus-FRE	DQTPFTNRNGFMAWTNRHVYFAPLFGARHSRELRIGRAHMGTVPLRIETLILALYIAINF	120
human-Nox2	P-----PKFFYTRKLLGSALALARA PAACLNFNCMLILLPVCRNLSFLR	81
Spombe-FRE1	S-----IASYDWNLTGVAARLGYLSCGLFFVSYFFSLKNNPFCLMLFSSHEKMNLYLH	150
Spombe-FRE2	SSHGKQTTQVSTGNWSKNAVAARLGFACGLYVTSYFFS IKNPFALLL I SSHEKMNLYVH	157
Scerevisiae-FRE1	PYD-----RPRWRRSMAFVSRADLMAIALFPVVYLFGRNPFIPITGLSFSTFNFYH	94
Aspergillus-FRE	AFFVCLVDWWEDYQEKLYQVKYAGGH LAVMNT PGLVLA AARNNPLIPLLGISFDTFNLFH	180
human-Nox2	SSACCSTRVRRQLDRNLTFFHKMVAWMI ALHSAIHTIAHLFNVEVCVNARVNSDPYSVAL	141
Spombe-FRE1	RWLSVYAVLISVLHGILFMIFSAQS-----YKPLLYDKISYGYFITVVLFLMTVASLP	204
Spombe-FRE2	RRLSQYAIMIGAIHGFAIYGLAAG-----KRALLTARVTIIGYVILGLMVIIVSSLP	211
Scerevisiae-FRE1	KWSAYVCFMLAVVHSIVMTASGVKRG----VFQSLVRKFYFRWIVATILMSIIFQSEK	150
Aspergillus-FRE	RWVGRVIVVGAIIHMSAVIAGLIAEHGFETTTHIIWEVPPFIWGMIALFGFILIAIQSVS	240
human-Nox2	SELGDRQNESYLNFAKRRIKNPEGG-----LYLAVTLLAGITGVVITLCLILITTSSTK	195
Spombe-FRE1	SVRRKFFEFVFLHHTCSVLIIFLIWLHHPRT--IVYMKACIIYAFDRGRCRLFRSIWNR	262
Spombe-FRE2	FFRRRFYEFVFLHHCISIGFLITIWLHHRRC--VVYMKVCVAVYVDRGRCRLRSFLNR	269
Scerevisiae-FRE1	VFRNRGYEIFLLIHKAMNIMFIIAMYYHCHTLGWMGWIWSMAGILCFDRFCRIVRIIMNG	210
Aspergillus-FRE	LLRHAFYEVFLHLHVALAVMSFVGLWYHLRGLSEQQNVVLGTIILWGLERVTRVASLVWRN	300
human-Nox2	TIRRSYFEVFWYTHHLFVIFFIG--LAIHGAERI VRGQTAESLAVHNI TVCEQKISEWG	252
Spombe-FRE1	-SNFRIYLLNEDMIYVGRKPKRSFFALPWAAGSHVYINIPS--LSYWQVHPFTLASAP	318
Spombe-FRE2	-SKFDVVLVEDDLIYMKGPRPKSFFGLPWGAGNHMYINIPS--LSYWQIHPFTIASVP	325
Scerevisiae-FRE1	GLKTATLSTDDSNVIKISVKKPKFFKYQVGAFAYMYFLSPKSAWFYSFQSHPFVLSER	270
Aspergillus-FRE	VGKQRTVADFELLPGNVIRATVTLARTGEFRAGQHMYLYVPS--VGLWTSHPFSVAWTS	357
human-Nox2	KIKECPIQFAGNPPMTWKWIVGPMFLYLCELRVRFWRSQOK-VVITKVVTHPFKTIELQ	311
Spombe-FRE1	PDFDIELFVAVHSGFTERLANRLYSMPHEYNFSIAPGTPESLSNTYRELNSFKSYAVEI	378
Spombe-FRE2	SDDFIELFVAVRAGFTKRLAKKVSSK-----SLSDVSDINI SDEKTEKNGDVGIEVME	378
Scerevisiae-FRE1	HR-----DPNPDQLTMYVKANKG-----I	290

Aspergillus-FRE	TEEVSVSDSDSNES-----FKMLDRKPOTTISFLIKREDG-----F	393
human-Nox2	MKKKGFKMEVQYIFVKCPKVKLEWHP----FTLTSAPPEEDFFSIHIRIVG--DWTEGL	365
Spombe-FRE1	ENTAQGHTEPEDLYLETTVMFMDGPYGTTS-NVFKEYSYVLLIAGGVGFSYTLPILRDLI	437
Spombe-FRE2	RHSLSQEDLVFESSAAKVSVLMDGPYGPVS-NPYKDYSYLFLFAGGVGVSYLPIILDTI	437
Scerevisiae-FRE1	TRVLLSKVLSAPNHTVDCKIFLEGPYGTVPHIAKLRNLVGVAAAGLVAAIYPHFVECL	350
Aspergillus-FRE	TRELQRKAANSBTCQFTTTVFAEGPYGGLE--DLNSYGTVLLIASGVGITNTMSYLYQFL	451
human-Nox2	FNACGCDKQEFQDAWKLPKIAVDGPPGTAS-EDVFSYEVVMLVGAGIGVTPFASILKSVW	424
Spombe-FRE1	LK-----ECNVTSITFIWSCRSLSLKVKASKLSNLLHQ-----SNVRLKIIN--	480
Spombe-FRE2	KK-----QSRTVHITFVWSARSSALLNI VHKS LCEAVRY-----TEMNINIFC--	480
Scerevisiae-FRE1	RLP-----STDQLQHKFYWIVNDLSHLKWFENELQWLKEK-----SCEVSVIYTG	396
Aspergillus-FRE	EGFS--ARKTAVRRVNLVWVTRSVEDLHWIDPMMKSVFTHPAIATKESFQNNRLAVSVQV	509
human-Nox2	YKYCNNATNLKLLKIYFYWLCRDTHAFEFADLLQLLESQMQE-----RNNAGFLSYNI	478
Spombe-FRE1	HFTGSI SCKESSEFSN----QTTENSEMEFFDDRPDLDMYIQKFFDYVGYQT--AALAA	533
Spombe-FRE2	HLTNSYPVEEVSSLNS----QSARNYSLQYLNGRPDVNDYFKDFLHATGTQT--AALAS	533
Scerevisiae-FRE1	SVEDTNSDESTKGFDD----KEESEITVECLNKRPDLKELVRSEIKLSELENNNITFYS	451
Aspergillus-FRE	YVTRKEASEASVGDSENWAFSAPSGVSVSVGFGRPGFAVVIEREMET---QVGAMAVSV	566
human-Nox2	YLTGWDESQANHFVHHDEEKDVI TGLKQKTLYGRPNWDNEFKTIASQHPNTR--IGVEL	536
Spombe-FRE1	CGSQSFLKRIKN-SVNKSI SSTTDIYQHYEEL----	564
Spombe-FRE2	CGSDKLLRHLKS-CVNTHSPSTVDLYQHYEEL----	564
Scerevisiae-FRE1	CGPATFNDDFRN-AVVQGI DSSLKIDVELEEEESFTW	486
Aspergillus-FRE	CGNGCVTDDVRQ-AVREAQKGAKTISLHDEAFCW--	599
human-Nox2	CGPEALAEI LSKQSI SNSESGPRGVHIFNKENE--	570