

A

Arabidopsis IDH1	1	-MSRRSLTLL KNLARNANG-	-----	SGIQTRSVTY	MPRPGDGAPR	AVTLIPGDGI	GPLVTNAVEQ	VMEAMHAPIF	FEKYDVHG--	-----	EM
Arabidopsis IDH2	1	-MSRQSFSL KNLRSIASG-	-----	SKIQTRSVTY	MPRPGDGKPR	PVTLIPGDGV	GPLVTNAVQQ	VMEAMHAPVY	FEFFEVHG--	-----	DM
Arabidopsis IDH3	1	-MARRSVSIF NRRLLANPPS-	-----	PF TSLSR--SITY	MPRPGDGAPR	TVTLIPGDGI	GPLVTGAVEQ	VMEAMHAPVH	FERYEVLG--	-----	NM
Tobacco	1	-MAKRTLP LL RLLSSPSHG	F-----	SH SLTSTRSVTY	MPRPGDGTFR	AVTLIPGDGI	GPLVTGAVEQ	VMDAMHAPVY	FERYDVHG--	-----	DM
Rice	1	-MARRSAPLL QRLLSPTSPS	SPSPPHPLAA	AAVSRRRTVTY	MPRPGDGAPR	AVTLIPGDGI	GPLVTGAVRQ	VMEAMHAPVY	FESYEVRG--	-----	DM
Maize	1	-MARRSTPLL RRLAPSPS-	LTP-----	LA DAVSRRTVTY	MPRPGDGAPR	GVTLIPGDGI	GPLVTGAVRQ	VMEAMHAPVY	FETYEVEHG--	-----	DM
Chlamydomonas	1	MLSRLLGLLL ARAAVAGGE-	-----	GLA ARAFGTGSAY	LPLPGDARSQ	IVTLIPGDGI	GPEVTKAVVD	VVAAMQAPIT	WERFDYLSGS	EETAAGSVPR	
Mouse	1	MAALSNNRVL TRAVLAARNS	GAWRG--	LGT STAHAAASQS	AQDVRVGEAF	PVTMLPGDGV	GPELMHAYKE	VFKAAAVPVE	FKEHHLSEVQ	N-----	MAS
Yeast	1	MLNR---TIA KRTLATAAQ-	-----	-----	AERT LPKKYGGR-F	TVTLIPGDGV	GKEITDSVRT	IFEANIPID	WETINIKQT-	-----	DH

Arabidopsis IDH1	79	SRVPPEVMES	IRKNKVC LKG	GLKTPVGG--	-GVSSLVNQL	RKELDIFASL	VNCFNLPLGL	TRHENVDIVV	IRENTEGEYA	GLEHEVVPV	VESLKVITKF
Arabidopsis IDH2	79	KSLPEG LLES	IKKNKVC LKG	GLKTPVGG--	-GVSSLVNQL	RKELDIFASL	VNCFNLPLGL	SRHENVDIVV	IRENTEGEYA	GLEHEVVPV	VESLKVITKF
Arabidopsis IDH3	80	RKVPEEVIES	VKNKVC LKG	GLATPVGG--	-GVSSLMNQL	RKELDIFASL	VNCFNLPLGL	TRHENVDIVV	IRENTEGEYS	GLEHEVVPV	VESLKVITKF
Tobacco	83	KSVPPPEVMES	IRKNKVC LKG	GLKTPVGG--	-GVSSLVNQL	RKELDIFASL	VNCFNLPLGL	TRHENVDIVV	IRENTEGEYS	GLEHEVVPV	VESLKVITKF
Rice	90	PTVPPEVIDS	IRKNKVC LKG	GLATPVGG--	-GVSSLVNQL	RKELDIFASL	VNCFNLPLGL	TRHDNDIVV	IRENTEGEYS	GLEHEVVPV	VESLKVITKF
Maize	85	PTVPAEVIES	IRKNKVC LKG	GLATPVGG--	-GVSSLVNQL	RKELDIFASL	VNCFNLPLGL	TRHDNDIVV	IRENTEGEYS	GLEHEVVPV	VESLKVITKF
Chlamydomonas	93	TSVPKEVLDS	IRRNVC LKG	TLFTPLNKEN	TNTQSLNQL	RKDLDLHVN	VHGFSLPGL	TRYNNLDIVV	IRENTEGEYS	GLEHEVVPV	VESLKVITKF
Mouse	93	EKKLEQV LSS	MKENKVA IIG	KIYTPMEYKG	-ELASYDMQL	RRKLDLFAV	VHVKSLPGYK	TRHNNLDIVV	IREQTEGEYS	GLEHESAKGV	IECLKIVTRT
Yeast	71	KEGVYEAVES	LKRNKIG LKG	LWHTPADQT-	-GHGSLNVAL	RKQLDIYANV	ALFKSLKGVK	TRIPDIDLIV	IRENTEGEYS	GLEHESVPV	VESLKVITRF

Arabidopsis IDH1	176	C SERIAKYAF	EYAYLNNRKK	VTAVHKANIM	KLADGLFLES	C REVAKK-YP	SITYNEIIVD	NCCMQLVAKP	EQFDVMVTFN	LYGNLVANTA	AGIAGGTGVM
Arabidopsis IDH2	176	C SERIAKYAF	EYAYLNNRKK	VTAVHKANIM	KLADGLFLES	C QEVAKK-YP	SIAYNEIIVD	NCCMQLVAKP	EQFDVMVTFN	LYGNLVANTA	AGIAGGTGVM
Arabidopsis IDH3	177	C SERIAKYAF	EYAYLNNRKK	VTAVHKANIM	KLADGLFLES	C REVAKK-YS	GITYNEIIVD	NCCMQLVAKP	EQFDVMVTFN	LYGNLVANTA	AGIAGGTGVM
Tobacco	180	C SERIAKYAF	EYAYLNNRKK	VTAVHKANIM	KLADGLFLES	C PEVAATK-YP	GIKYNEIIVD	NCCMQLVAKP	EQFDVMVTFN	LYGNLVANTA	AGIAGGTGVM
Rice	187	C SERIAKYAF	EYAYLNNRKK	VTAVHKANIM	KLADGLFLES	C REVAATK-YP	GIKYNEIIVD	NCCMQLVAKP	EQFDVMVTFN	LYGNLVANTA	AGIAGGTGVM
Maize	182	C SERIAKYAF	EYAYLNNRKK	VTAVHKANIM	KLADGLFLES	C REVAKK-YP	GIKYNEIIVD	NCCMQLVAKP	EQFDVMVTFN	LYGNLVANTA	AGIAGGTGVM
Chlamydomonas	193	KSLRTAQYAF	EYAYLNNRKK	VTAVHKANIM	KLADGLFLES	C REVAKK-YP	GIKYNEIIVD	NCCMQLVAKP	EQFDVMVTFN	LYGNLVANTA	AGIAGGTGVM
Mouse	192	KSQRIAKFAF	DYATKKGRSK	VTAVHKANIM	KLADGLFLES	C REVAEL-YP	KIKFETMIID	NCCMQLVAKP	EQFDVMVTFN	LYGNLVANTA	AGIAGGTGVM
Yeast	169	KTERIARFAF	DFAKKNRKS	VTAVHKANIM	KLADGLFLES	C REVAEL-YP	KIKFETMIID	NCCMQLVAKP	EQFDVMVTFN	LYGNLVANTA	AGIAGGTGVM

Arabidopsis IDH1	275	PGGNVGADHA	VFEQGASAGN	VGKDKIVLEN	KANPVALLS	SAMMLRHLQF	PSFADRLETA	VKKVIAEGK-	C RTKDLGGT	STTQEVVDV	IAKLD----
Arabidopsis IDH2	275	PGGNVGAEYA	VFEQGASAGN	VGKDTTEEQK	NANPVALLS	SAMMLRHLQF	PSFADRLETA	VKKVIAEGK-	C RTEDLGGN	STTQEVVDV	IANLD----
Arabidopsis IDH3	276	PGGNVGAEHA	VFEQGASAGN	VGNDKMVEQK	KANPVALLS	SAMMLRHLQF	PTFADRLETA	VKKVIAEGK-	C YRTKDLGGD	STTQEVVDV	IAALE----
Tobacco	279	PGGNVGADHA	VFEQGASAGN	VGNEKIVEQK	KANPVALLS	SAMMLRHLQF	PSFADRLETA	VKKVIAEGK-	C YMTKDLGGN	STTQEVVDV	IANLD----
Rice	286	PGGNVGQDHA	VFEQGASAGN	VGNVQVVEQK	KANPVALLS	SAMMLRHLQF	PSFADRLETA	VKKVIAEGK-	C YRTKDLGGT	STTQEVVDV	IAHLD----
Maize	281	PGGNVGQDHA	VFEQGASAGN	VGNEKIVEQK	RANPVALLS	SAMMLRHLQF	PSFADRLETA	VKKVIAEGK-	C YRTKDLGGT	STTQEVVDV	IAKLG----
Chlamydomonas	292	PGGNIGDGYA	VFEQ--ARH	VAKD--LAGAG	VANPTATLLS	TAMLLRHLKL	AGFADRLEAA	VKKVIAEGK-	C YRTKDLGGT	STTQEVVDV	IAHLD----
Mouse	291	PGESYSAEYA	VFEQ--ARH	VAKD--LAGAG	VANPTATLLS	TAMLLRHLKL	AGFADRLEAA	VKKVIAEGK-	C YRTKDLGGT	STTQEVVDV	IAHLD----
Yeast	269	AGANFGRDYA	VFEQ--ARH	VAKD--LAGAG	VANPTATLLS	TAMLLRHLKL	AGFADRLEAA	VKKVIAEGK-	C YRTKDLGGT	STTQEVVDV	IAHLD----

B

Arabidopsis IDH5	1	MTMAANLARR	LIGNRSTQIL	GAVNSSSGAA	SSVARAFCS	TT--PITATL	FPDGGIGPEI	AESVKVFTT	AGVPIEWEEH	YVGTEDIPRT	QSFLTWSLE
Arabidopsis IDH6	1	MTMTAFIARR	LIGNSSSQIL	GTSSSSSGPF	ISVSRAFFSS	ST--PIKATL	FPDGGIGPEI	AESVKVFTT	AGVPIEWEEH	YVGTEDIPRT	NSFLTWNLDQ
Tobacco	1	-MAFQTARR	LLRSR----	---ASSIRY	LDRSFSSES	SN--LIRATL	FPDGGIGPEI	ADSVRQIFNT	AEVPIEWEEH	YVGTEDIPRT	NSFLTWSLE
Rice	1	-----MALRR	LLQGS----	-VLPFRMGR	---AAAFFST	ASGETIRATL	FPDGGIGPEI	AESVKVFTT	AGVPIEWEEH	YVGTEDIPRT	ESFLTWSLE
Maize	1	-----MALRR	LLQGS----	-VLPFRMGR	---AAAFFST	ASGETIRATL	FPDGGIGPEI	AESVKVFTT	AGVPIEWEEH	YVGTEDIPRT	ESFLTWSLE
Chlamydomonas	1	-----MLKTAG	-----	-SALFSSAQA	AASMTGRFAS	KS---FEATL	FPDGGIGPEI	AASVREIFA	ARIPVVWDEQ	HIGKTPDPR	NSMVTRENLD
Mouse	1	-----MAGSA	VWSKVS----	--RLGAFHN	TQKQVTRFAG	GV---QTVTL	IPDGGIGPEI	SASVMKIFDA	AKAPIQWEER	NVTAIQPGG	KWMIPPEAKE
Yeast	1	-----MLRNT	FFRNTSR--	-RFLATVKQP	SIGRYTGKPN	PSTGKYTVSF	IEGDGIGPEI	SKSVKIFSA	ANVPIEWES	DVSPFVNG-	LTTIPDPAVQ

Arabidopsis IDH5	99	SVRRNKVG LK	GP MATPIGK	HRS LNLTLRK	ELN LYNVPR	C YSLPGYKTR	YDDVDLITIR	ENTEGEYSGL	EHQVVRGVVE	SLKIITRQAS	LRVAEYAFLY
Arabidopsis IDH6	99	SVLRNKVG LK	GP MATPIGK	HRS LNLTLRK	ELN LYNVPR	C YSLPGYKTR	YDDVDLITIR	ENTEGEYSGL	EHQVVRGVVE	SLKIITRQAS	MRVAEYAFLY
Tobacco	89	SVRRNKVG LK	GP MATPIGK	HRS LNLTLRK	ELN LYNVPR	C YSLPGYKTR	YDDVDLITIR	ENTEGEYSGL	EHQVVRGVVE	SLKIITRQAS	LRVAEYAFLY
Rice	87	SVRRNKVG LK	GP MATPIGK	HRS LNLTLRK	ELG LYNVPR	C NSLPGYKTR	YDDVDLITIR	ENTEGEYSGL	EHQVVRGVVE	SLKIITRQAS	LRVAEYAFLY
Maize	90	SVRRNKVG LK	GP MATPIGK	HRS LNLTLRK	ELG LYNVPR	C NSLPGYKTR	YDDVDLITIR	ENTEGEYSGL	EHQVVRGVVE	SLKIITRQAS	LRVAEYAFLY
Chlamydomonas	83	SVLKHKIG LK	GP MATPIGK	FRS LNLTLRK	ELD LYNVPR	C FNIPGYKTR	YDGINLVTIR	ENTEGEYSGL	EHEVVPVGV	SLKIITRQAS	SRIAEFAFAY
Mouse	87	SMDKNMGLK	GP LKTPIAAG	HPSMNL L LK	TFD LYNVPR	C VSIEGYKTR	YTDVNLVTIR	ENTEGEYSGL	EHVIVDGVVQ	SIKLITEAS	KRIAEFAFAY
Yeast	91	SITKNLVALK	GP LATPIGK	HRS LNLTLRK	TFGLFANVPR	AKSIEGFKTT	YENVDLVTIR	ENTEGEYSGL	EHVIVDGVVQ	SIKLITEAS	ERVIRYAFAY

Arabidopsis IDH5	199	AKTHGRERVS	AIHKANIMQK	TDGLFLKCC	EVAEKYPEIT	YEEVVIDNCC	MMLVKNPALF	D--VLVMPNL	YGDIIISDICA	GLVGG-LGLT	PSCNIGEDGV
Arabidopsis IDH6	199	AKTHGRKRVVS	AIHKANIMQK	TDGLFLQCC	EVAEKYPEIT	YEEVVIDNCC	MMLVKNPALF	D--VLVMPNL	YGDIIISDICA	GLVGG-LGLT	PSMNIGEDGI
Tobacco	189	AKAHGRERVS	AIHKANIMQK	TDGLFLKCC	EVAEKYPEIT	YEEVVIDNCC	MMLVKNPALF	D--VLVMPNL	YGDIIISDICA	GLVGG-LGLT	PSCNIGEGGI
Rice	187	AKTNGRERVS	AIHKANIMRK	TDGLFLKCC	EVAEKYPEIT	YEEVVIDNCC	MMLVKNPALF	D--VLVMPNL	YGDIIISDICA	GLVGG-LGLT	PSCNIGEGGI
Maize	190	AKANGRERVS	AIHKANIMRK	TDGLFLKCC	EVAEKYPEIT	YEEVVIDNCC	MMLVKNPALF	D--VLVMPNL	YGDIIISDICA	GLVGG-LGLT	PSCNIGEGGI
Chlamydomonas	183	ARENGRSKVT	AVHKANIMRK	ADGLFLECC	EVS AKYGDIT	YEEVVIDNCC	MMLVKNPALF	D--VLVMPNL	YGDIIISDICA	GLVGG-LGLT	PSMNIGETNG
Mouse	187	ARNNRSNVT	AVHKANIMRM	SDGLFLQCC	EVAENKDKIK	FNEMYLDVTC	LNMVQDPSQF	D--VLVMPNL	YGDIIISDICA	GLVGG-LGLT	PSGNIGANGV
Yeast	191	ARAIGRPRVI	VVHKSTIQRL	ADGLFVNVA	ELSKYEDIST	LETFLDINSV	LKVVTNPSAY	TDVSVCCNL	YGDIIISDICA	GLVGG-LGLT	PSANIG-HKI

Arabidopsis IDH5	296	ALAEAVHGSA	PDIAGKNLAN	PTALLSSGVM	MLRHLKFNEQ	AEQIHSAIN	TIAEG-KYRT	ADLGGSSSTTT	EFTKATCDHL	----	----
Arabidopsis IDH6	296	ALAEAVHGSA	PDIAGKNLAN	PTALLSSGVM	MLRHLKFNKQ	AEQIHSAIN	TIAEG-KYRT	ADLGGSSSTTT	DFTKATCDHL	----	----
Tobacco	286	ALAEAVHGSA	PDIAGKNLAN	PTALLSSAVT	MLRHLHDXD	ADRIQGAVIN	TIAEG-KYRT	ADLGGSSSTTT	DFTKATCDHL	----	----
Rice	284	ALAEAVHGSA	PDIAGKNLAN	PTALLSSAVM	MLRHLQFNQ	ADRIHNAILQ	TISEG-KFRT	ADLGGKASTS	DFTKATCDHI	----	----
Maize	287	ALAEAVHGSA	PDIAGKNLAN	PTALLSSAVM	MLRHLQFNKQ	ADRIHNAILQ	TIAEG-KYRT	ADLGGKASTS	EFTKATCDHI	----	----
Chlamydomonas	280	ALAEAVHGSA	PDIAGKNLAN	PTALLSSAVM	MLRHLGRQ	ADRIHNAILQ	TIAEG-KYRT	ADLGGKASTS	DFTKATCDHI	----	----
Mouse	284	ATFESVHGTA	PDIAGKDMAN	PTALLSSAVM	MLRHLGFDH	AAKIEAACA	TIKDG-KSLT	KDLGGNAKS	DFTETECRRV	KDLD	----
Yeast	290	SIFEAVHGSA	PDIAGQDKAN	PTALLSSVM	MLNMGFLTNH	ADQIQNAVL	TIASGPENRT	ADLGGATTS	SFTAEVIRKL	----	----

Supplementary Fig. S1 Alignment comparison of the amino acid sequences of IDH-r (A) and IDH-c (B).

Critical Cys residue for intermolecular disulfide bond formation in yeast IDH-c is highlighted in blue (Garcia et al. 2009). Other Cys residues are highlighted in green. Key residues for AMP-dependent allosteric activation of yeast IDH are highlighted in red (Lin and McAlister-Henn 2003).