

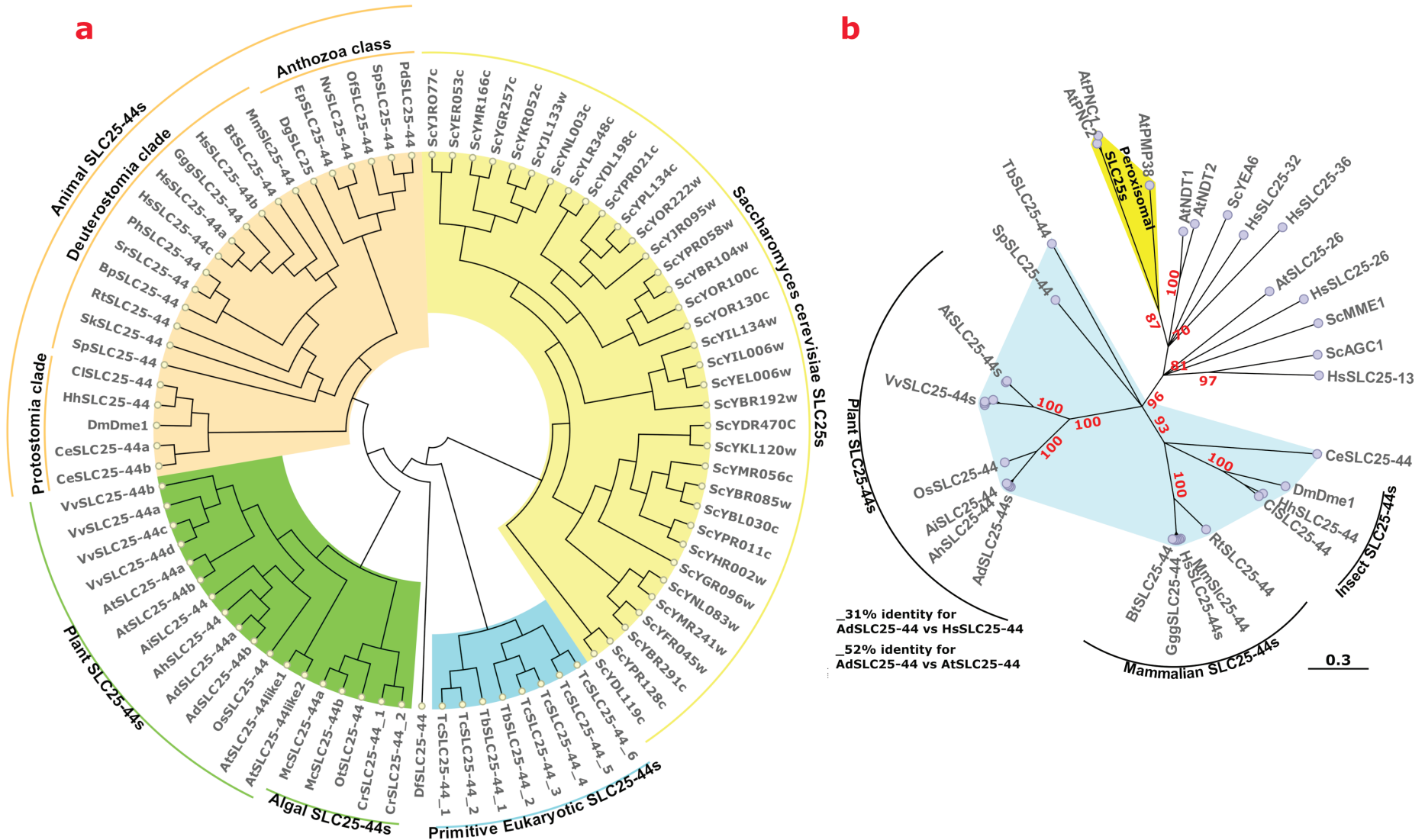
**The housekeeping transporter SLC25A44 bridges between the secondary
metabolism and mitochondrial electron transfer chains**

Behrooz Darbani

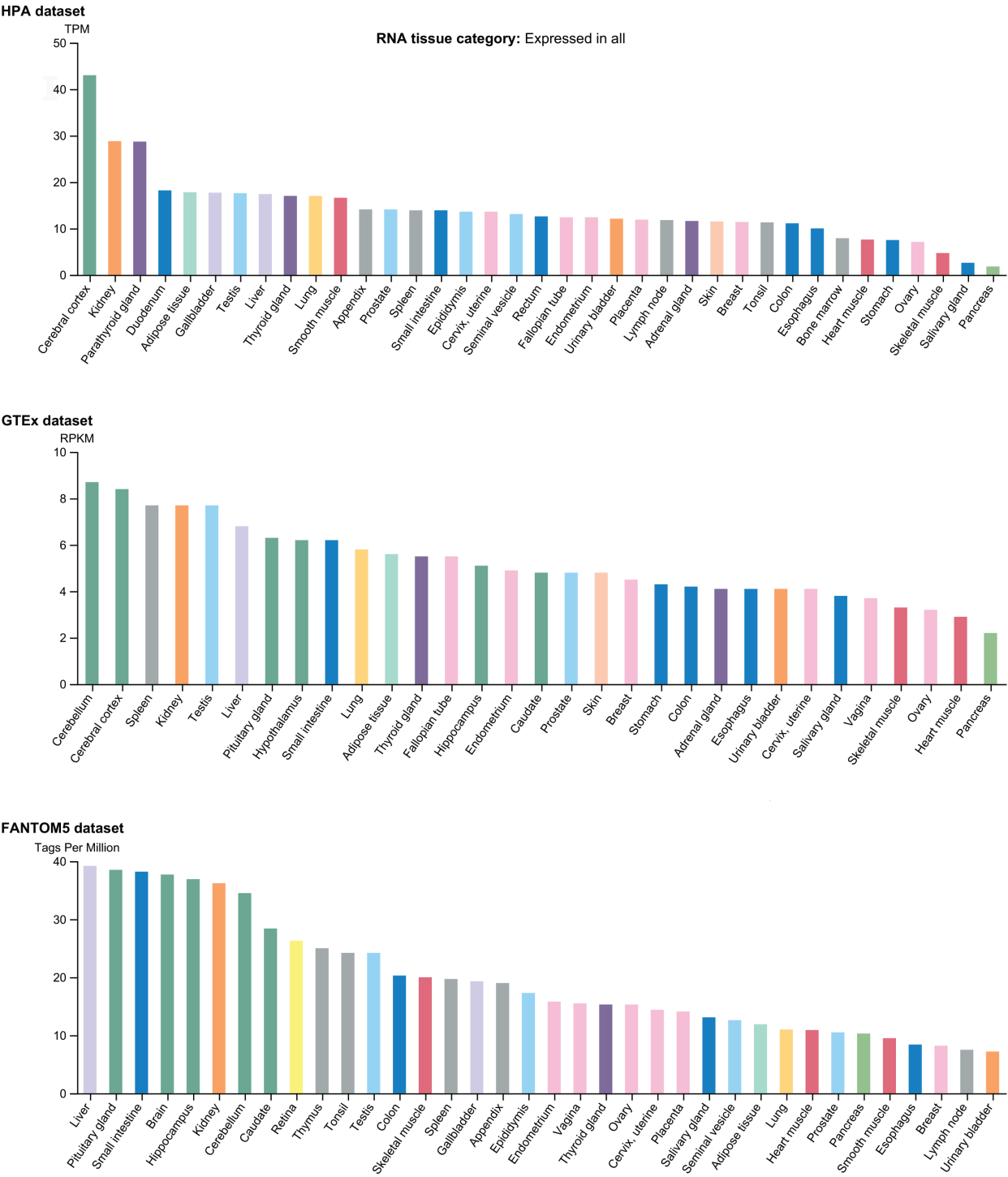
The Novo Nordisk Foundation Center for Biosustainability, Technical University of Denmark, Denmark

behroozdarbani@gmail.com

behdas@biosustain.dtu.dk



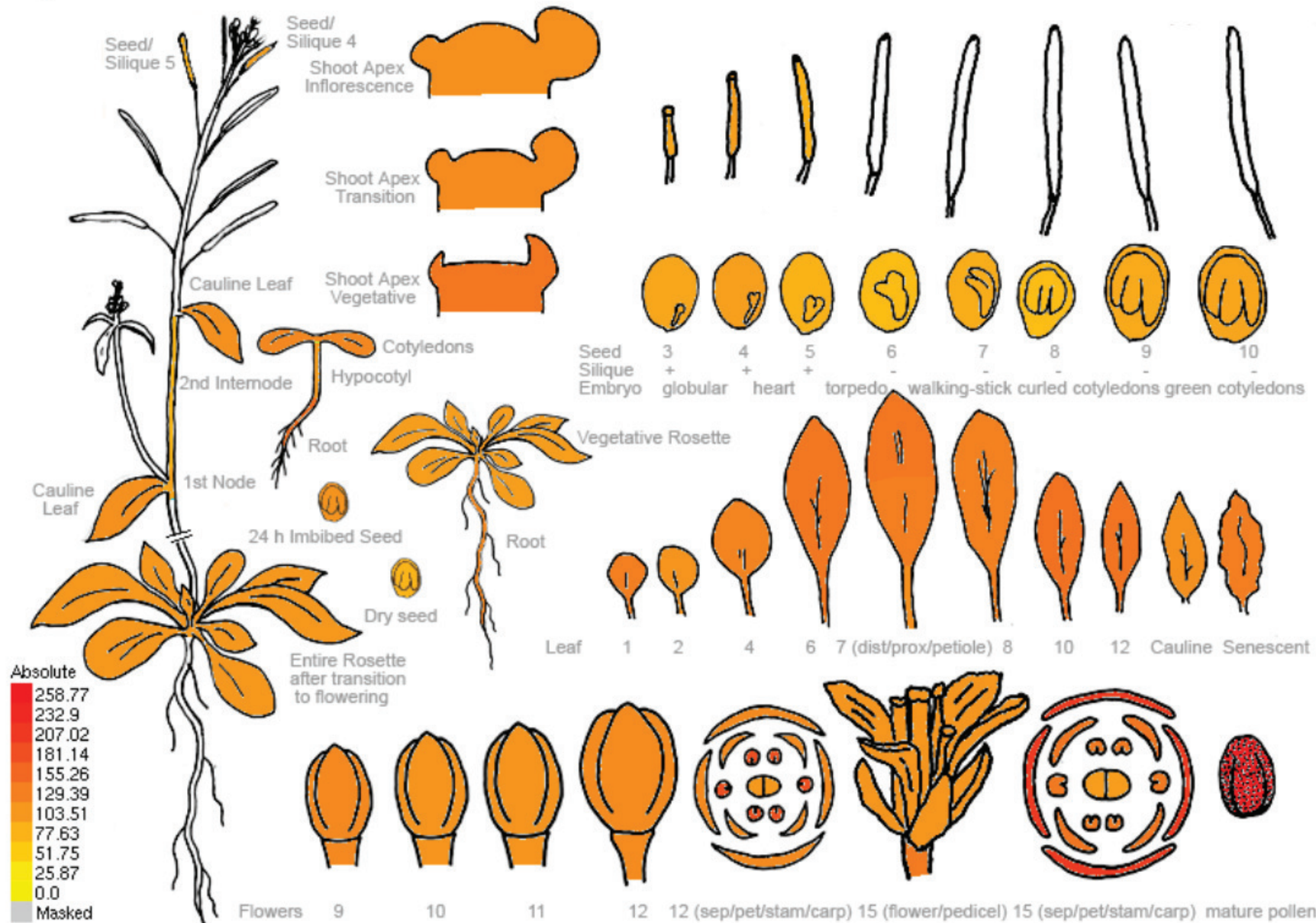
Extended Data Fig. 1: There is no eukaryotic orthologue for members of SLC25A44 (SLC25-44) in fungi. a, Members of the SLC25A44 have animal, plant, and primitive eukaryotic specific phylogenetic clusters which are completely different from any member of *S. cerevisiae* SLC25s. **b**, *S. cerevisiae* AGC1, MME1, and YEA6 are the most immediate blast hits for SLC25A44s. **a, b**, The maximum likelihood phylogenetic tree was built on the WAG matrix for amino acid sequences and bootstraps are shown as percentage of 1000. See Extended Data Table 2 for protein sequences.



Extended Data Fig. 2: Transcript levels of *SLC25A44* in human (From the human protein atlas at <https://www.proteinatlas.org/>; Nat. Biotechnol. 2010, 28:1248-50).

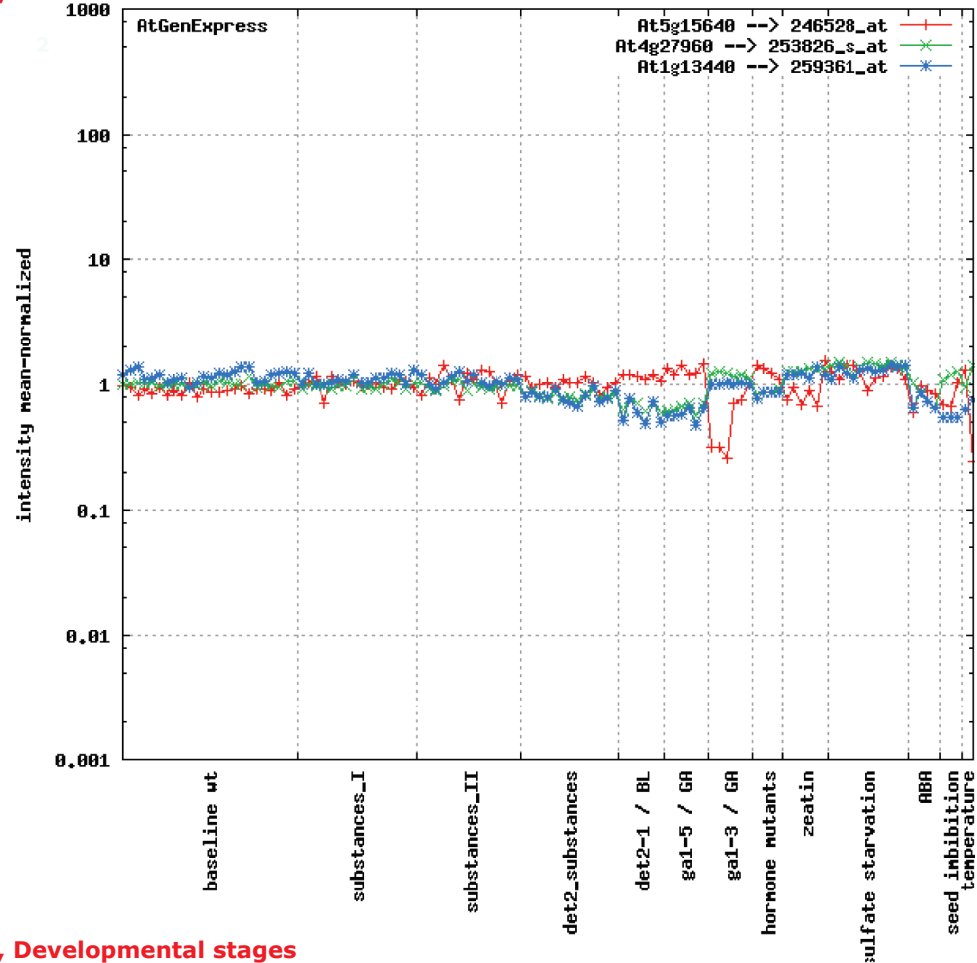
a, Absolute transcript levels for *AtSlc25A44*

At5g15640 246528_at

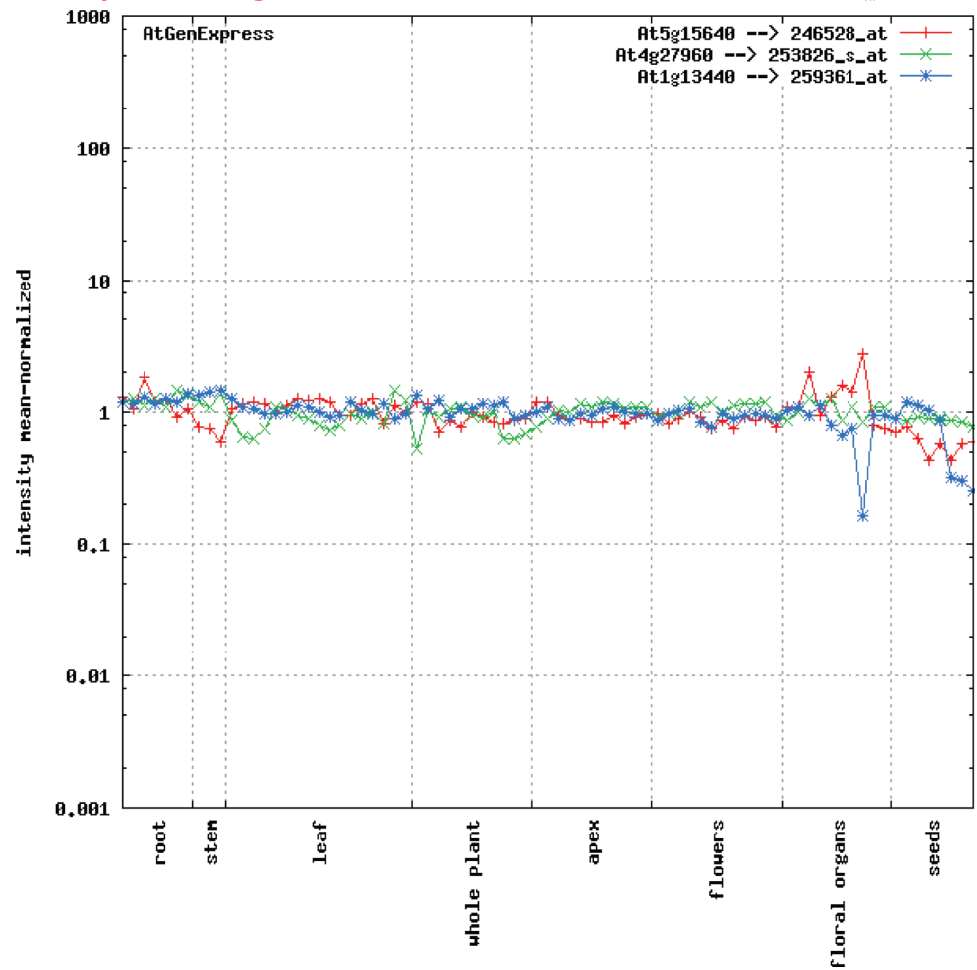


Extended Data Fig. 3: Constitutive expression of *Arabidopsis thaliana* *Slc25A44*. a-f, *AtSlc25A44* absolute and relative transcript levels in comparison with the housekeeping genes *Ubc9* and *Gapdh*. At5g15640: *Slc25A44*, At4g27960: *Ubc9*, At1g13440: *Gapdh* (Data from Nat. Genet. 37:501-6). g, *AtSLC25A44* protein levels (Data from Science 320, 938-41).

b, Hormone treatments

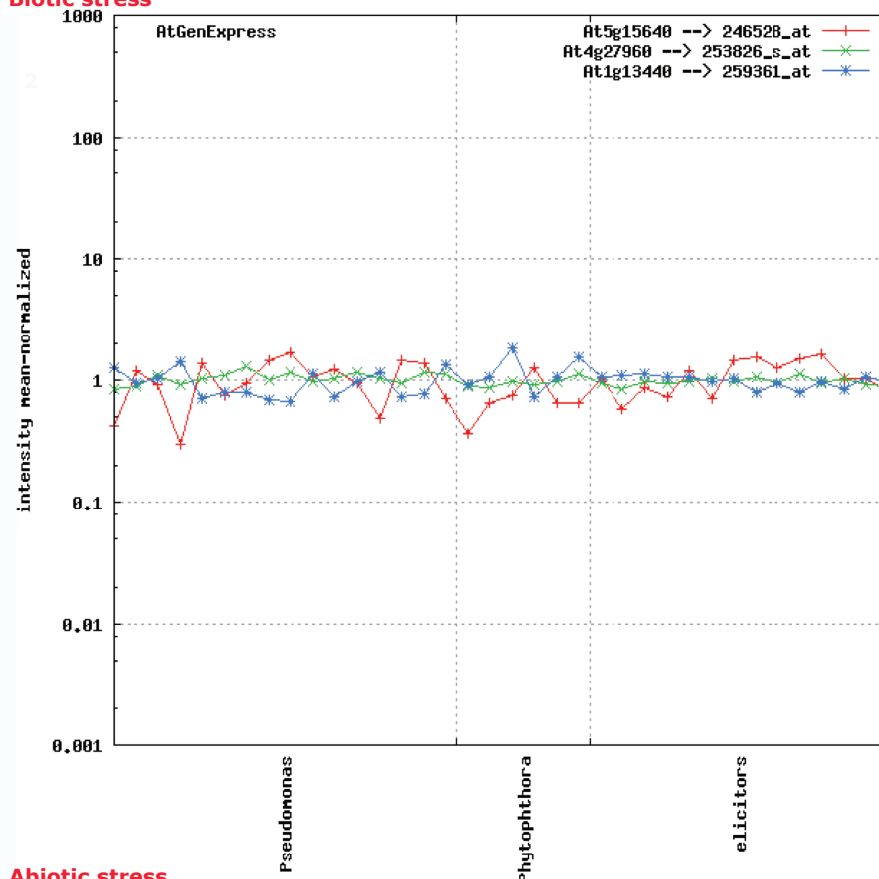


c, Developmental stages

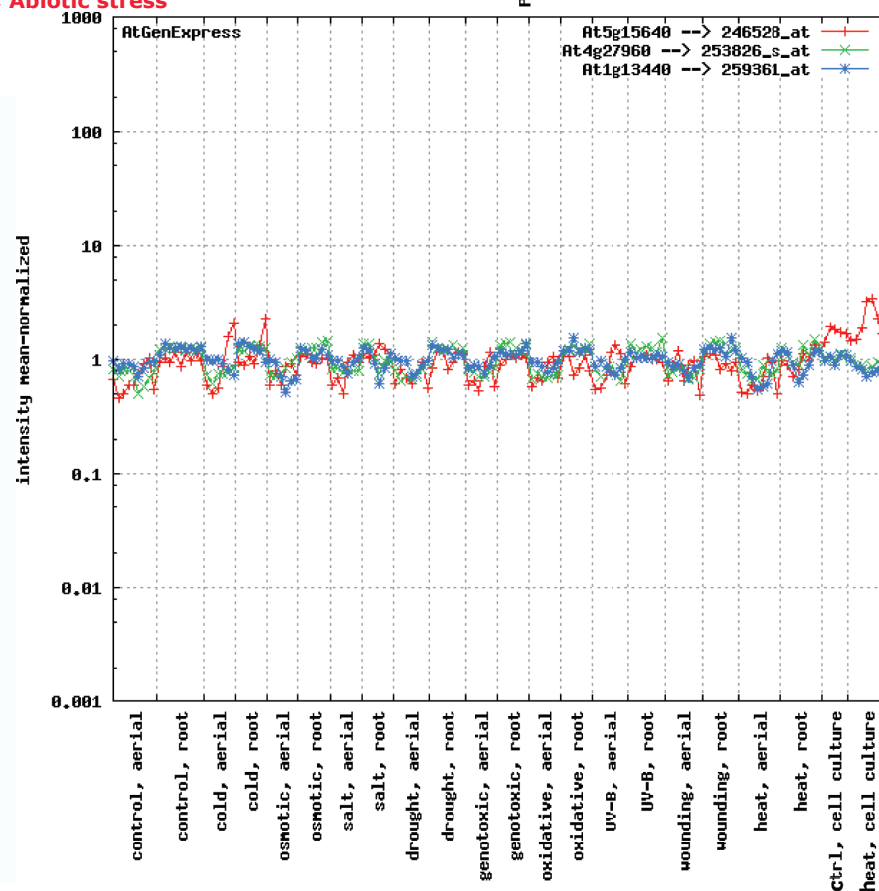


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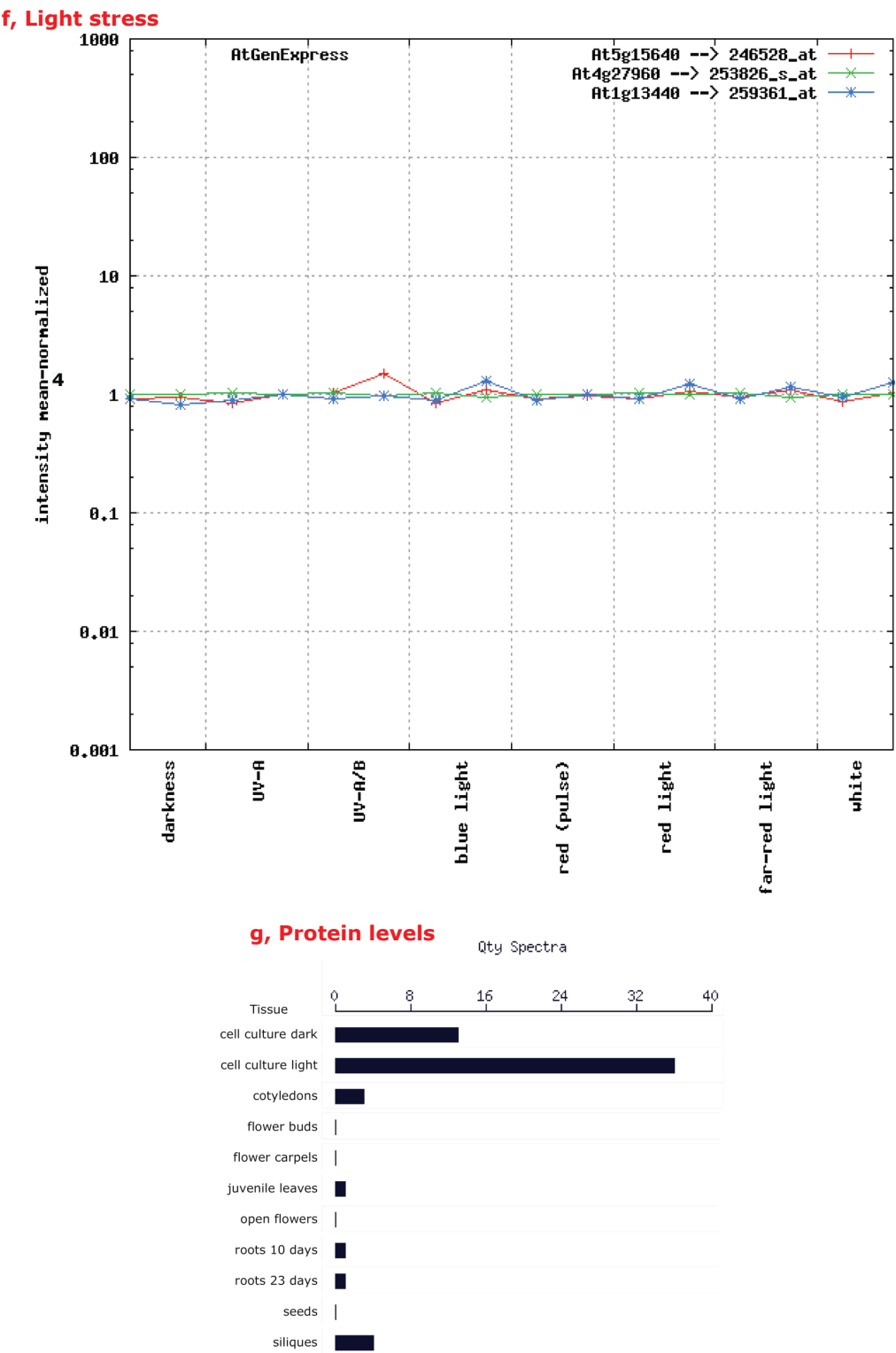
d, Biotic stress



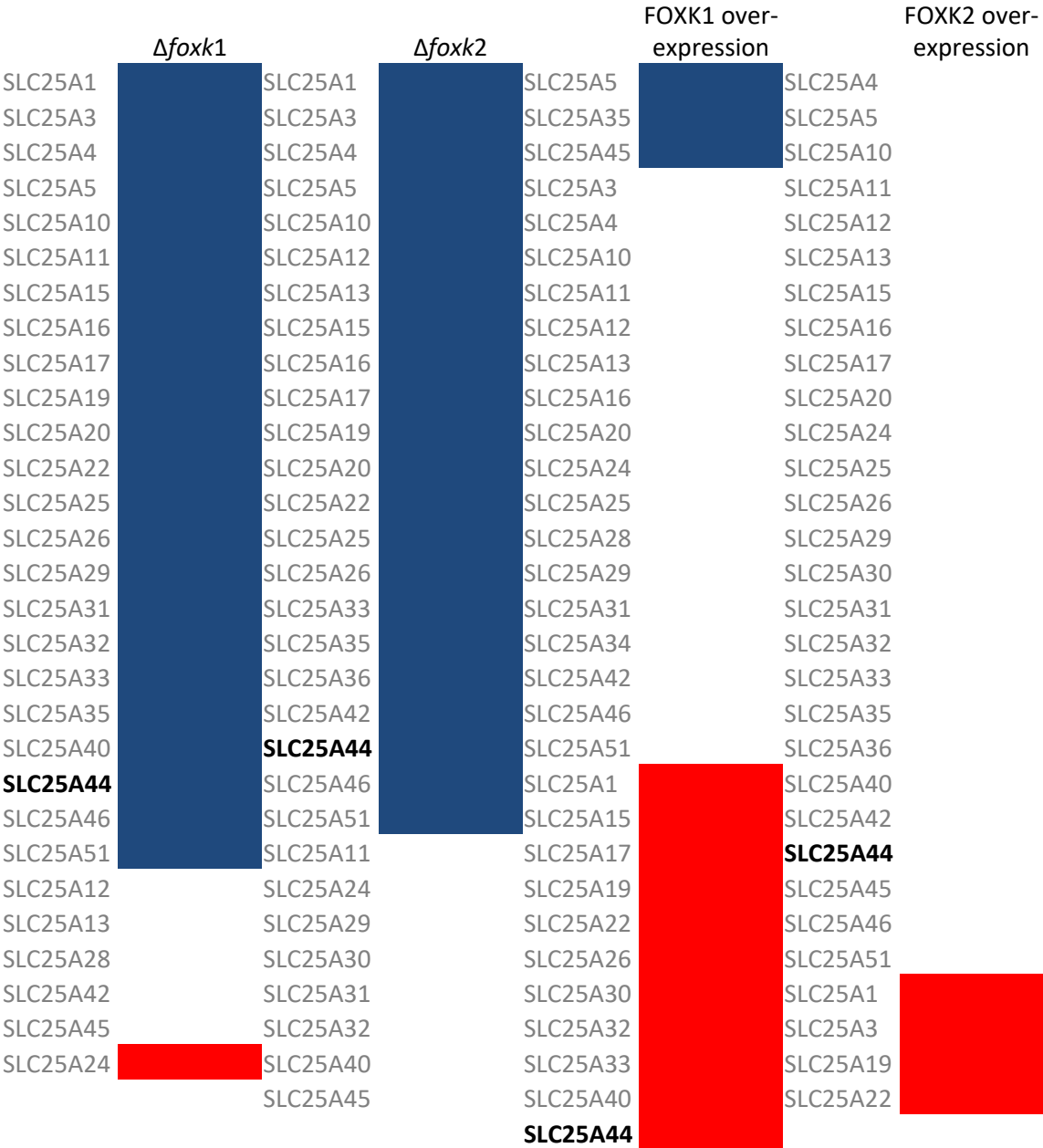
e, Abiotic stress



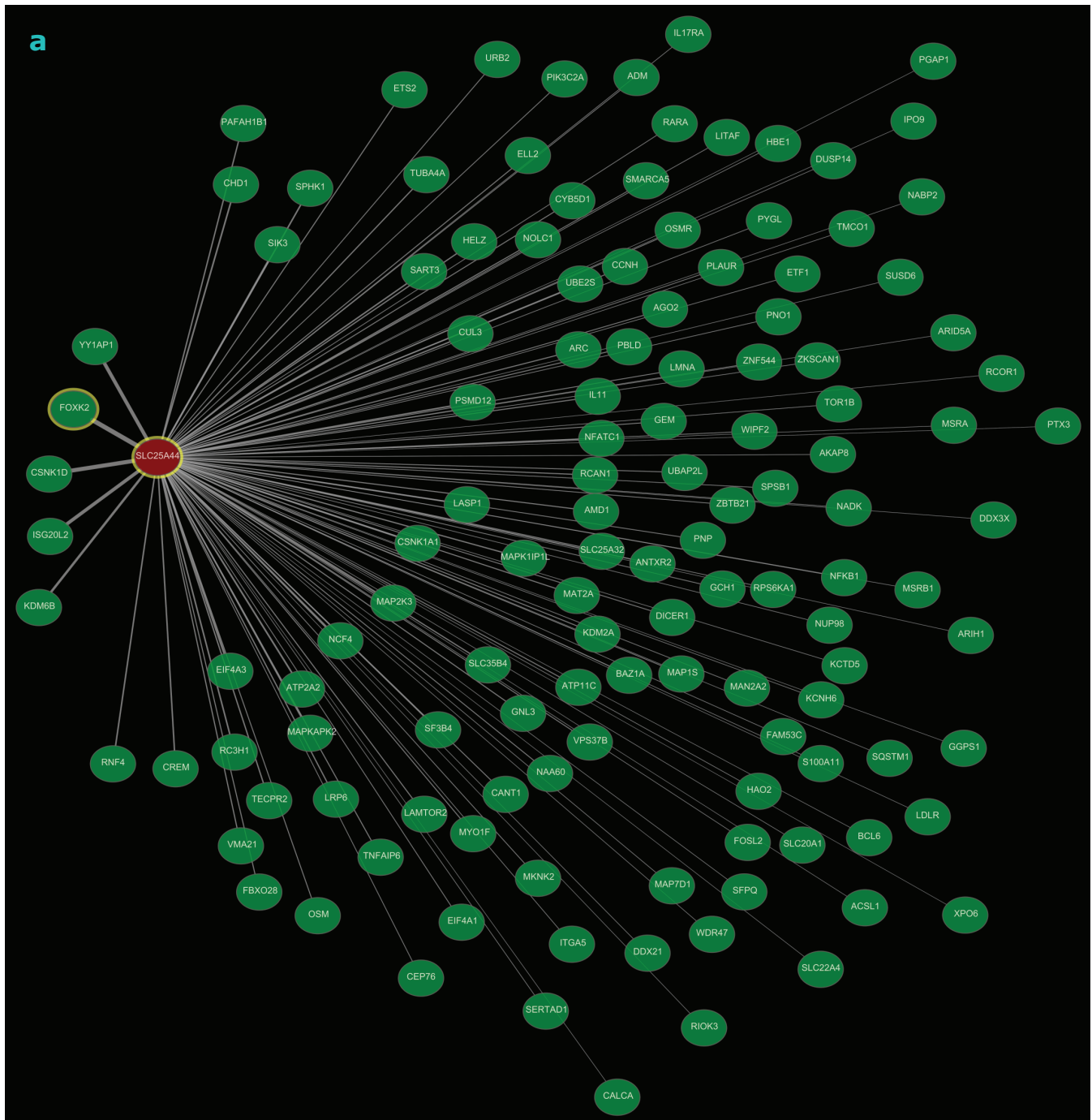
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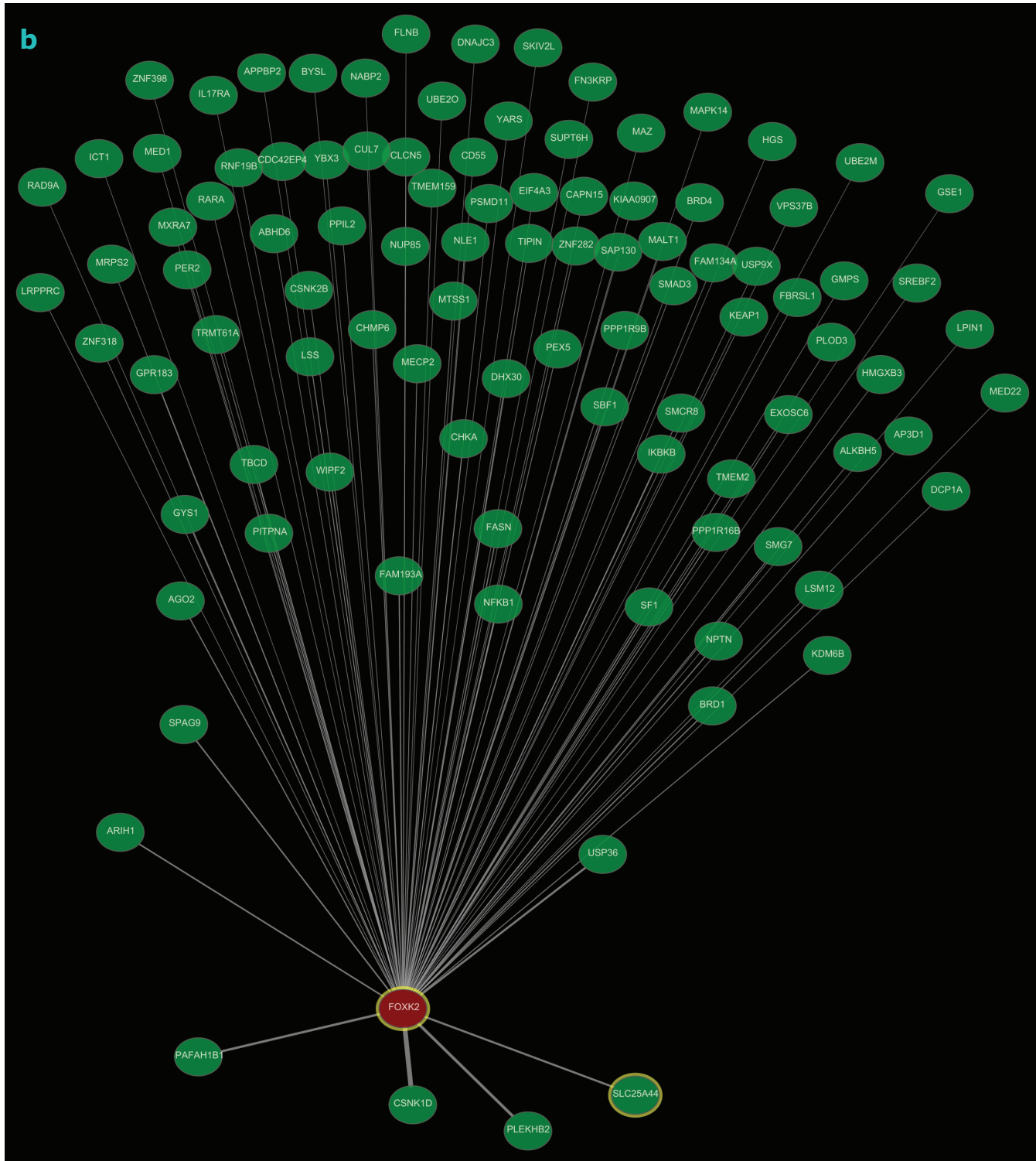
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Extended Data Fig. 4: The effects of FOXK1 and FOXK2 on the cellular levels of SLC25 transporter proteins (Data from *Nature*, 566:279–83). Blue: downregulation ($p < 0.05$), White: no significant changes, Red: upregulation ($p < 0.05$).



Extended Data Fig. 5: The *Slc25A44* (a) and *Foxk2* (b) co-expressed genes in human (Data from Nucleic Acids Res. 45,D389-D396).



Extended Data Fig. 5: The *Slc25A44* (a) and *Foxk2* (b) co-expressed genes in human (Data from Nucleic Acids Res. 45,D389-D396).

Extended Data Table 1: The *Slc25A44* co-expressed genes

<i>Mus musculus</i>		
Gene ID	Gene Symbol	Description
12908	Crat	carnitine acetyltransferase
67326	1700037H04Rik	RIKEN cDNA 1700037H04 gene
56384	Letm1	leucine zipper-EF-hand containing transmembrane protein 1
20528	Slc2a4	solute carrier family 2 (facilitated glucose transporter), member 4
108958	Miga2	mitoguardin 2
28169	Agpat3	1-acylglycerol-3-phosphate O-acyltransferase 3
13430	Dnm2	dynamitin 2
12686	Elov3	elongation of very long chain fatty acids (FEN1/Elo2, SUR4/Elo3, yeast)-like 3
12974	Cs	citrate synthase
16890	Lipe	lipase, hormone sensitive
116939	Pnpla3	patatin-like phospholipase domain containing 3
23945	Mgll	monoglyceride lipase
15258	Hipk2	homeodomain interacting protein kinase 2
66853	Pnpla2	patatin-like phospholipase domain containing 2
68465	Adipor2	adiponectin receptor 2
27280	Phlda3	pleckstrin homology like domain, family A, member 3
330189	Tmem120b	transmembrane protein 120B
67283	Slc25a19	solute carrier family 25 (mitochondrial thiamine pyrophosphate carrier), member 19
11652	Akt2	thymoma viral proto-oncogene 2
235169	Foxred1	FAD-dependent oxidoreductase domain containing 1
232370	Clstn3	calsyntenin 3
102247	Gpat4	glycerol-3-phosphate acyltransferase 4
11637	Ak2	adenylate kinase 2
14245	Lpin1	lipin 1
170768	Pfkfb3	6-phosphofructo-2-kinase/fructose-2,6-biphosphatase 3
11554	Adrb1	adrenergic receptor, beta 1
17308	Mgat1	mannoside acetylglucosaminyltransferase 1
76308	Rab1b	RAB1B, member RAS oncogene family
105245	Txndc5	thioredoxin domain containing 5
14555	Gpd1	glycerol-3-phosphate dehydrogenase 1 (soluble)
104111	Adcy3	adenylate cyclase 3
20411	Sorbs1	sorbin and SH3 domain containing 1
23921	Sh2b2	SH2B adaptor protein 2
50772	Mapk6	mitogen-activated protein kinase 6
76219	Arxes1	adipocyte-related X-chromosome expressed sequence 1
21754	Tesk1	testis specific protein kinase 1
97212	Hadha	hydroxyacyl-Coenzyme A dehydrogenase, alpha subunit

11640	Akap1	A kinase (PRKA) anchor protein 1
83679	Pde4dip	phosphodiesterase 4D interacting protein (myomegalin)
73102	Slc22a23	solute carrier family 22, member 23
71767	Tysnd1	trypsin domain containing 1
18633	Pex16	peroxisomal biogenesis factor 16
76976	Arxes2	adipocyte-related X-chromosome expressed sequence 2
22123	Psmd3	proteasome (prosome, macropain) 26S subunit, non-ATPase, 3
57080	Gtf2ird1	general transcription factor II I repeat domain-containing 1
75483	Cox8c	cytochrome c oxidase subunit 8C
18534	Pck1	phosphoenolpyruvate carboxykinase 1, cytosolic
63955	Cables1	CDK5 and Abl enzyme substrate 1
67039	Rbm25	RNA binding motif protein 25
12651	Chkb	choline kinase beta
14433	Gapdh	glyceraldehyde-3-phosphate dehydrogenase
11861	Arl4a	ADP-ribosylation factor-like 4A
71998	Slc25a35	solute carrier family 25, member 35
66916	Ndufb7	NADH:ubiquinone oxidoreductase subunit B7
75552	Paqr9	progesterone and adiponectin receptor family member IX
14751	Gpi1	glucose phosphate isomerase 1
64138	Ctsz	cathepsin Z
53893	Nudt5	nudix (nucleoside diphosphate linked moiety X)-type motif 5
18631	Pex11a	peroxisomal biogenesis factor 11 alpha
13202	Ddt	D-dopachrome tautomerase
73095	Slc25a42	solute carrier family 25, member 42
101966	D8Ertd738e	DNA segment, Chr 8, ERATO Doi 738, expressed
216134	Pdxk	pyridoxal (pyridoxine, vitamin B6) kinase
52710	Slc52a2	solute carrier protein 52, member 2
14291	Fpr-rs4	formyl peptide receptor, related sequence 4
353172	Gars	glycyl-tRNA synthetase
14311	Cidec	cell death-inducing DFFA-like effector c
72787	Ndc1	NDC1 transmembrane nucleoporin
103841	Cuedc1	CUE domain containing 1
67899	Cmc1	COX assembly mitochondrial protein 1
18641	Pfkl	phosphofructokinase, liver, B-type
116746	Defb6	defensin beta 6
100705	Acacb	acetyl-Coenzyme A carboxylase beta
18604	Pdk2	pyruvate dehydrogenase kinase, isoenzyme 2
235339	Dlat	dihydrolipoamide S-acetyltransferase
104816	Aspg	asparaginase
22245	Uck1	uridine-cytidine kinase 1
11518	Add1	adducin 1 (alpha)

56332	Amotl2	angiomotin-like 2
66973	Mrps18b	mitochondrial ribosomal protein S18B
67384	Bag4	BCL2-associated athanogene 4
11302	Aatk	apoptosis-associated tyrosine kinase
67477	Abhd15	abhydrolase domain containing 15
11832	Aqp7	aquaporin 7
212862	Chpt1	choline phosphotransferase 1
66168	Grina	glutamate receptor, ionotropic, N-methyl D-aspartate-associated protein 1
14081	Acs1	acyl-CoA synthetase long-chain family member 1
228966	Ppp1r3d	protein phosphatase 1, regulatory subunit 3D
97998	Deptor	DEP domain containing MTOR-interacting protein
268291	Rnf217	ring finger protein 217
110095	Pygl	liver glycogen phosphorylase
116701	Fgfr1	fibroblast growth factor receptor-like 1
26940	Ecsit	ECSIT signalling integrator
18754	Prkce	protein kinase C, epsilon
67883	Uxs1	UDP-glucuronate decarboxylase 1
12234	Btrc	beta-transducin repeat containing protein
75678	Ippk	inositol 1,3,4,5,6-pentakisphosphate 2-kinase
66477	Atp5md	ATP synthase membrane subunit DAPIT
16527	Kcnk3	potassium channel, subfamily K, member 3
110935	Atp6v1b1	ATPase, H ⁺ transporting, lysosomal V1 subunit B1
18071	Nhlh1	nescient helix loop helix 1
14792	Lpcat3	lysophosphatidylcholine acyltransferase 3
16828	Ldha	lactate dehydrogenase A
11980	Atp8a1	ATPase, aminophospholipid transporter (APLT), class I, type 8A, member 1
16500	Kcnb1	potassium voltage gated channel, Shab-related subfamily, member 1
217869	Eif5	eukaryotic translation initiation factor 5
241556	Tspan18	tetraspanin 18
329910	Acot11	acyl-CoA thioesterase 11
78653	BolA3	bolA-like 3 (E. coli)
20514	Slc1a5	solute carrier family 1 (neutral amino acid transporter), member 5
18746	Pkm	pyruvate kinase, muscle
654795	Sdr39u1	short chain dehydrogenase/reductase family 39U, member 1
228998	Arfgap1	ADP-ribosylation factor GTPase activating protein 1
15587	Hyal2	hyaluronoglucosaminidase 2
228359	Arhgap1	Rho GTPase activating protein 1
78286	Nav2	neuron navigator 2
27362	Dnajb9	DnaJ heat shock protein family (Hsp40) member B9
56535	Pex3	peroxisomal biogenesis factor 3
26457	Slc27a1	solute carrier family 27 (fatty acid transporter), member 1

67382	Brd3	bromodomain containing 3
624219	Angptl8	angiopoietin-like 8
12846	Comt	catechol-O-methyltransferase
12041	Bckdk	branched chain ketoacid dehydrogenase kinase
13177	Eci1	enoyl-Coenzyme A delta isomerase 1
50785	Hs6st1	heparan sulfate 6-O-sulfotransferase 1
13850	Ephx2	epoxide hydrolase 2, cytoplasmic
72077	Gcnt3	glucosaminyl (N-acetyl) transferase 3, mucin type
17480	Mpl	myeloproliferative leukemia virus oncogene
21379	Tbrg4	transforming growth factor beta regulated gene 4
22294	Uxt	ubiquitously expressed prefoldin like chaperone
20481	Ski	ski sarcoma viral oncogene homolog (avian)
21835	Thrsp	thyroid hormone responsive
76355	Tgds	TDP-glucose 4,6-dehydratase
67900	Mtfp1	mitochondrial fission process 1
105670	Rcbtb2	regulator of chromosome condensation (RCC1) and BTB (POZ) domain containing protein 2
77037	Mrap	melanocortin 2 receptor accessory protein
224116	Muc20	mucin 20
227697	Dolk	dolichol kinase
22418	Wnt5a	wingless-type MMTV integration site family, member 5A
18127	Nos3	nitric oxide synthase 3, endothelial cell
13593	Ebf3	early B cell factor 3
20351	Sema4a	sema domain, immunoglobulin domain (Ig),semaphorin 4A
100163	Pafah2	platelet-activating factor acetylhydrolase 2
237781	Mief2	mitochondrial elongation factor 2
218639	Arl15	ADP-ribosylation factor-like 15
83961	Nrg4	neuregulin 4
66459	Pyurf	Pigy upstream reading frame
75735	Pank1	pantothenate kinase 1
66892	Eif4e3	eukaryotic translation initiation factor 4E member 3
101631	Pwwp2b	PWWP domain containing 2B
20743	Sptbn2	spectrin beta, non-erythrocytic 2
17287	Mep1a	meprin 1 alpha
13358	Slc25a1	solute carrier family 25 (mitochondrial carrier, citrate transporter), member 1
68202	Ndufa5	NADH:ubiquinone oxidoreductase subunit A5
27049	Etv3	ets variant 3
19294	Nectin2	nectin cell adhesion molecule 2
319518	Pdpr	pyruvate dehydrogenase phosphatase regulatory subunit
66855	Tcf25	transcription factor 25 (basic helix-loop-helix)
56044	Rala	v-ral simian leukemia viral oncogene A (ras related)
50768	Dlc1	deleted in liver cancer 1

30853	Mlf2	myeloid leukemia factor 2
12733	Clcnka	chloride channel, voltage-sensitive Ka
69662	2310061I04Rik	RIKEN cDNA 2310061I04 gene
66414	Ndufa12	NADH:ubiquinone oxidoreductase subunit A12
67333	Stk35	serine/threonine kinase 35
22378	Wbp2	WW domain binding protein 2
27393	Mrpl39	mitochondrial ribosomal protein L39
74549	Mau2	MAU2 sister chromatid cohesion factor
20600	Smr2	submaxillary gland androgen regulated protein 2
24108	Ubd	ubiquitin D
16322	Inha	inhibin alpha
67026	Thap4	THAP domain containing 4
78894	Aacs	acetoacetyl-CoA synthetase
19299	Abcd3	ATP-binding cassette, sub-family D (ALD), member 3
225887	Ndufs8	NADH:ubiquinone oxidoreductase core subunit S8
75104	Mmd2	monocyte to macrophage differentiation-associated 2
17187	Max	Max protein
72739	Zkscan3	zinc finger with KRAB and SCAN domains 3
94044	Bcl2l13	BCL2-like 13 (apoptosis facilitator)
269275	Acvr1c	activin A receptor, type IC
170826	Ppargc1b	peroxisome proliferative activated receptor, gamma, coactivator 1 beta
17261	Mef2d	myocyte enhancer factor 2D
22228	Ucp2	uncoupling protein 2 (mitochondrial, proton carrier)
21351	Taldo1	transaldolase 1
192970	Dhrs11	dehydrogenase/reductase (SDR family) member 11
20965	Syn2	synapsin II
78920	Dlst	dihydrolipoamide S-succinyltransferase (E2 component of 2-oxo-glutarate complex)
67389	C1qtnf12	C1q and tumor necrosis factor related 12
192195	Ash1l	ASH1 like histone lysine methyltransferase
68778	Gucd1	guanylyl cyclase domain containing 1
223917	Krt79	keratin 79
20286	Zc3h7b	zinc finger CCCH type containing 7B
68614	Letmd1	LETM1 domain containing 1
23882	Gadd45g	growth arrest and DNA-damage-inducible 45 gamma
26358	Aldh1a7	aldehyde dehydrogenase family 1, subfamily A7
103844	Inca1	inhibitor of CDK, cyclin A1 interacting protein 1
22670	Trim26	tripartite motif-containing 26
94249	Slc24a3	solute carrier family 24 (sodium/potassium/calcium exchanger), member 3
227731	Slc25a25	solute carrier family 25 (mitochondrial carrier, phosphate carrier), member 25
14227	Fkbp2	FK506 binding protein 2
22272	Uqcrcq	ubiquinol-cytochrome c reductase, complex III subunit VII

67373	2210010C04Rik	RIKEN cDNA 2210010C04 gene
11519	Add2	adducin 2 (beta)
76585	Lce1i	late cornified envelope 1l
14050	Eya3	EYA transcriptional coactivator and phosphatase 3
76282	Gpt	glutamic pyruvic transaminase, soluble
26446	Psmb3	proteasome (prosome, macropain) subunit, beta type 3
18293	Ogdh	oxoglutarate (alpha-ketoglutarate) dehydrogenase (lipoamide)
80912	Pum1	pumilio RNA-binding family member 1
22375	Wars	tryptophanyl-tRNA synthetase
72475	Ssbp3	single-stranded DNA binding protein 3
67062	Slc25a53	solute carrier family 25, member 53
67811	Poldip2	polymerase (DNA-directed), delta interacting protein 2
18555	Cdk16	cyclin-dependent kinase 16
14936	Gys1	glycogen synthase 1, muscle
211548	Nomo1	nodal modulator 1
18628	Per3	period circadian clock 3
27425	Atp5l	ATP synthase, H ⁺ transporting, mitochondrial F0 complex, subunit G
68385	Tlcd1	TLC domain containing 1
66530	Ubxn6	UBX domain protein 6
216161	Sbno2	strawberry notch 2
14571	Gpd2	glycerol phosphate dehydrogenase 2, mitochondrial
269642	Nat8l	N-acetyltransferase 8-like
19013	Ppara	peroxisome proliferator activated receptor alpha
67512	Agpat2	1-acylglycerol-3-phosphate O-acyltransferase 2
110826	Etfb	electron transferring flavoprotein, beta polypeptide
20768	Sephs2	selenophosphate synthetase 2
230082	Nol6	nucleolar protein family 6 (RNA-associated)
320265	Tafa1	TAFA chemokine like family member 1
212933	Pm20d1	peptidase M20 domain containing 1
74148	Cluh	clustered mitochondria (cluA/CLU1) homolog
26922	Mecr	mitochondrial trans-2-enoyl-CoA reductase
20732	Spint1	serine protease inhibitor, Kunitz type 1
67311	Nanp	N-acetylneuraminic acid phosphatase
67231	Tbc1d20	TBC1 domain family, member 20
14261	Fmo1	flavin containing monooxygenase 1
69596	Ap5s1	adaptor-related protein 5 complex, sigma 1 subunit
57316	C1d	C1D nuclear receptor co-repressor
67809	Rmdn3	regulator of microtubule dynamics 3
14674	Gna13	guanine nucleotide binding protein, alpha 13
14071	F9	coagulation factor IX
117160	Ttyh2	tweety family member 2

98845	Eps8l2	EPS8-like 2
112405	Egl-1	egl-9 family hypoxia-inducible factor 1
19298	Pex19	peroxisomal biogenesis factor 19
67469	Abhd5	abhydrolase domain containing 5
233890	Zfp768	zinc finger protein 768

Arabidopsis thaliana

Gene ID	Gene Symbol	Description
831418	AT5G15640	Mitochondrial substrate carrier family protein
837196	AT1G06840	Leucine-rich repeat protein kinase family protein
816321	AT2G18090	PHD finger family protein / SWIB complex BAF60b domain-containing protein
821198	AT3G02880	Leucine-rich repeat protein kinase family protein
831854	AT5G03380	Heavy metal transport/detoxification superfamily protein
816040	UGT73B5	UDP-glucosyl transferase 73B5
818371	AtIPCS2	Inositol phosphorylceramide synthase 2
838420	AT1G18390	Serine/Threonine kinase family catalytic domain protein
842275	ALA3	aminophospholipid ATPase 3
815850	GONST1	golgi nucleotide sugar transporter 1
838707	IGMT3	O-methyltransferase family protein
834206	AT5G42010	Transducin/WD40 repeat-like superfamily protein
829480	BAK1	BR1-associated receptor kinase
10723117	AT5G62865	hypothetical protein
822474	AT3G28450	Leucine-rich repeat protein kinase family protein
842043	SERAT2;1	serine acetyltransferase 2;1
836655	AT5G65300	hypothetical protein
844033	AT1G76970	Target of Myb protein 1
819274	AT2G46620	P-loop containing nucleoside triphosphate hydrolases superfamily protein
843708	EIL3	ETHYLENE-INSENSITIVE3-like 3
831070	AT5G11970	ABC family ABC transporter, putative (DUF3511)
832672	FC1	ferrochelataase 1
831778	AT5G03610	GDSL-like Lipase/Acylhydrolase superfamily protein
837711	AT1G11670	MATE efflux family protein
838501	JAZ1	jasmonate-zim-domain protein 1
829597	AGB1	GTP binding protein beta 1
836335	AT5G62150	peptidoglycan-binding LysM domain-containing protein
818237	AT2G36650	CHUP1-like protein
817754	CNX2	cofactor of nitrate reductase and xanthine dehydrogenase 2
828446	AT4G23470	PLAC8 family protein
835595	AT5G55040	DNA-binding bromodomain-containing protein
828606	AT4G25030	Serine/Threonine-kinase
842485	AT1G61890	MATE efflux family protein
837235	UGT71C5	UDP-glucosyl transferase 71C5

820192	AT3G10300	Calcium-binding EF-hand family protein
819724	TOPP9	Calcineurin-like metallo-phosphoesterase superfamily protein
822517	AT3G28850	Glutaredoxin family protein
832326	ADT5	arogenate dehydratase 5
816336	AT2G18210	hypothetical protein
819811	NHX4	sodium hydrogen exchanger 4
824037	AT3G48760	DHHC-type zinc finger family protein
839722	AT1G28280	VQ motif-containing protein
836497	DGK2	diacylglycerol kinase 2
817197	PLA2A	phospholipase A 2A
836499	NAC102	NAC domain containing protein 102
832966	AT5G28630	glycine-rich protein
838305	AT1G17340	Phosphoinositide phosphatase family protein
839085	AT1G24807	Glutamine amidotransferase type 1 family protein
842285	AT1G59910	Actin-binding FH2 (formin homology 2) family protein
833862	AT5G38710	Methylenetetrahydrofolate reductase family protein
843026	AT1G67060	peptidase M50B-like protein
815625	CRCK3	calmodulin-binding receptor-like cytoplasmic kinase 3
818140	PGSIP7	Nucleotide-diphospho-sugar transferases superfamily protein
818166	PUB23	plant U-box 23
822252	AT3G26470	Powdery mildew resistance protein, RPW8 domain-containing protein
836068	AT5G59490	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein
832960	AT5G28610	LOW protein: ATP-dependent RNA helicase DRS1-like protein
824410	PUB22	plant U-box 22
829129	AT4G30060	Core-2/I-branching beta-1,6-N-acetylglucosaminyltransferase family protein
831109	AT5G12340	DUF4228 domain protein
826791	PLDGAMMA1	phospholipase D gamma 1
843936	CPK29	calcium-dependent protein kinase 29
825135	AT3G59660	C2 domain-containing protein / GRAM domain-containing protein
839423	AT1G03740	Protein kinase superfamily protein
828542	CIPK8	CBL-interacting protein kinase 8
829144	ATR2	P450 reductase 2
827831	AT4G20830	FAD-binding Berberine family protein
837415	AT1G08940	Phosphoglycerate mutase family protein
836638	TPPJ	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein
832285	CAF1b	Polynucleotidyl transferase, ribonuclease H-like superfamily protein
828516	AT4G24160	alpha/beta-Hydrolases superfamily protein
839536	BPS1	BPS1-like protein (DUF793)
821005	AT3G17410	Protein kinase superfamily protein
827481	CBL1	calcineurin B-like protein 1
834356	TOPP6	type one serine/threonine protein phosphatase 6

843120	AT1G67920	hypothetical protein
832225	BPM5	BTB-POZ and MATH domain 5
819684	ATL6	RING/U-box superfamily protein
814768	AT2G02370	SNARE associated Golgi protein family
816629	AT2G20950	phospholipase-like protein (PEARL1 4) family protein
816384	AT2G18690	transmembrane protein
824188	CEJ1	cooperatively regulated by ethylene and jasmonate 1
843412	AT1G70750	myosin-binding protein (Protein of unknown function, DUF593)
831037	AT5G11650	alpha/beta-Hydrolases superfamily protein
824405	SYP122	syntaxin of plants 122
816647	AT2G21120	magnesium transporter, putative (DUF803)
823846	AT3G46930	Protein kinase superfamily protein
834429	AT5G44060	embryo sac development arrest protein
819057	AT2G44500	O-fucosyltransferase family protein
830148	RABH1c	RAB GTPase homolog H1C
842527	WRKY6	WRKY family transcription factor
839519	AT1G03370	C2 calcium/lipid-binding and GRAM domain containing protein
838438	MYB51	myb domain protein 51
838114	AT1G15430	hypothetical protein (DUF1644)
843500	CK1	choline kinase 1
830333	MTM2	Myotubularin-like phosphatases II superfamily
825525	TTA2	fibronectin type III domain protein (DUF1423)
816909	LYK4	protein kinase family protein / peptidoglycan-binding LysM domain-containing protein
829753	AT4G35985	Senescence/dehydration-associated protein-like protein
819222	AT2G46150	Late embryogenesis abundant (LEA) hydroxyproline-rich glycoprotein family
824254	AT3G50900	hypothetical protein
822148	AT3G25610	ATPase E1-E2 type family protein / haloacid dehalogenase-like hydrolase family protein
824900	ACA11	autoinhibited Ca ²⁺ -ATPase 11
824693	MKP1	mitogen-activated protein kinase phosphatase 1
820018	TH9	thioredoxin H-type 9
819314	ABCB4	ATP binding cassette subfamily B4
839669	SAT32	interferon-related developmental regulator family protein / IFRD protein family
817553	AT2G30020	Protein phosphatase 2C family protein
842430	AT1G61360	S-locus lectin protein kinase family protein
828228	AT4G01870	tolB protein-like protein
830840	AT5G09800	ARM repeat superfamily protein
830295	AT5G04170	Calcium-binding EF-hand family protein
827630	AT4G18950	Integrin-linked protein kinase family
818143	AT2G35730	Heavy metal transport/detoxification superfamily protein
839545	AT1G01260	basic helix-loop-helix (bHLH) DNA-binding superfamily protein
821586	CPK9	calmodulin-domain protein kinase 9

822280	SNM1	DNA repair metallo-beta-lactamase family protein
817783	AT2G32235	hypothetical protein
819320	PTI1-4	Protein kinase superfamily protein
831058	AT5G11850	Protein kinase superfamily protein
826409	MEKK1	MAPK/ERK kinase kinase 1
839998	AT1G31130	polyadenylate-binding protein 1-B-binding protein
828271	MSRB7	methionine sulfoxide reductase B7
827984	ECA2	ER-type Ca ²⁺ -ATPase 2
829333	AT4G32020	serine/arginine repetitive matrix-like protein
831365	WRKY72	WRKY DNA-binding protein 72
833550	AT5G35735	Auxin-responsive family protein
838295	RLP2	receptor like protein 2
832662	AT5G25930	kinase family with leucine-rich repeat domain-containing protein
837198	Plsp2A	Peptidase S24/S26A/S26B/S26C family protein
817312	AT2G27660	Cysteine/Histidine-rich C1 domain family protein
835735	AT5G56350	Pyruvate kinase family protein
839508	GAOX6	gibberellin 2-oxidase 6
828426	CRK19	cysteine-rich RLK (RECEPTOR-like protein kinase) 19
824577	AT3G54100	O-fucosyltransferase family protein
820378	AT3G12040	DNA-3-methyladenine glycosylase (MAG)
821460	LOH2	LAG1 homologue 2
820023	ATSIK	Protein kinase superfamily protein
843939	AT1G76070	hypothetical protein
	None	None
839670	ACA1	autoinhibited Ca ²⁺ -ATPase 1
830396	AT5G05140	Transcription elongation factor (TFIIS) family protein
819401	AT2G47890	B-box type zinc finger protein with CCT domain-containing protein
835828	CYP81F2	cytochrome P450, family 81, subfamily F, polypeptide 2
818549	BIK1	botrytis-induced kinase1
837223	STN1	Nucleic acid-binding, OB-fold-like protein
837276	PLL5	pol-like 5
831784	AT5G02230	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein
818605	CZF1	zinc finger (CCCH-type) family protein
816819	AT2G22880	VQ motif-containing protein
843639	PEPR1	PEP1 receptor 1
821202	AT3G02070	Cysteine proteinases superfamily protein
841229	ECT7	evolutionarily conserved C-terminal region 7
819260	PI4K GAMMA 4	phosphoinositide 4-kinase gamma 4
827826	CML42	calmodulin like 42
842450	MLO6	Seven transmembrane MLO family protein
829100	AT4G29780	nuclease

837965	AT1G14040	EXS (ERD1/XPR1/SYG1) family protein
825844	NDB2	NAD(P)H dehydrogenase B2
821717	CERK1	chitin elicitor receptor kinase 1
817758	AT2G31990	Exostosin family protein
843106	AT1G67800	Copine (Calcium-dependent phospholipid-binding protein) family
836799	AT5G66670	pectinesterase, putative (DUF677)
828400	UTR2	UDP-galactose transporter 2
825139	HLECRK	lectin-receptor kinase
836094	EXO70H7	exocyst subunit exo70 family protein H7
837947	AT1G13880	ELM2 domain-containing protein
839846	CAD1	MAC/Perforin domain-containing protein
835329	AT5G52530	dentin sialophosphoprotein-like protein
838835	PAPP2C	phytochrome-associated protein phosphatase type 2C
824920	CPK32	calcium-dependent protein kinase 32
843988	AT1G76550	Phosphofructokinase family protein
824004	AT3G48450	RPM1-interacting protein 4 (RIN4) family protein
821796	AT3G22260	Cysteine proteinases superfamily protein
830683	AT5G01950	Leucine-rich repeat protein kinase family protein
816993	WRKY17	WRKY DNA-binding protein 17
843325	AT1G69890	actin cross-linking protein (DUF569)
832332	AT5G22690	Disease resistance protein (TIR-NBS-LRR class) family
816031	FUT4	fucosyltransferase 4
834430	CAD1	phytochelatin synthase 1 (PCS1)
841328	AT1G49050	Eukaryotic aspartyl protease family protein
837210	EXO70B2	exocyst subunit exo70 family protein B2
816864	WRKY15	WRKY DNA-binding protein 15
827435	SCL13	SCARECROW-like 13
835577	AT5G54860	Major facilitator superfamily protein
833803	AT5G38210	Protein kinase family protein
834721	AT5G46780	VQ motif-containing protein
818533	ABCB6	P-glycoprotein 6
824608	EP3	homolog of carrot EP3-3 chitinase
	None	None
818376	AT2G37980	O-fucosyltransferase family protein
844001	OPR1	12-oxophytodienoate reductase 1
837791	KEU	Sec1/munc18-like (SM) proteins superfamily
834824	AT5G47730	Sec14p-like phosphatidylinositol transfer family protein
824761	CCR3	CRINKLY4 related 3
826730	ACS6	1-aminocyclopropane-1-carboxylic acid (acc) synthase 6
820456	ALIS1	ALA-interacting subunit 1
838743	SCL1	SCARECROW-like 1

837540	AT1G10050	glycosyl hydrolase family 10 protein / carbohydrate-binding domain-containing protein
839735	NSL1	MAC/Perforin domain-containing protein
824713	AT3G55470	Calcium-dependent lipid-binding (CaLB domain) family protein
842064	AT1G56120	Leucine-rich repeat transmembrane protein kinase
839028	FH4	formin homologue 4
820141	AT3G09830	Protein kinase superfamily protein
821990	GATA1	GATA transcription factor 1
838928	AT1G23200	Plant invertase/pectin methylesterase inhibitor superfamily
824627	BZIP25	basic leucine zipper 25
837352	AT1G08315	ARM repeat superfamily protein
834736	AT5G46910	Transcription factor jumonji (jmi) family protein / zinc finger (C5HC2 type) family protein
838236	AT1G16670	Protein kinase superfamily protein
818429	WRKY33	WRKY DNA-binding protein 33
843411	AT1G70740	Protein kinase superfamily protein
821780	AT3G22160	VQ motif-containing protein
822169	AOC3	allene oxide cyclase 3
820019	S6K2	serine/threonine protein kinase 2
834069	AT5G40690	histone-lysine N-methyltransferase trithorax-like protein
834867	PAT1	GRAS family transcription factor
824077	AT3G49160	pyruvate kinase family protein
829536	AT4G33920	Protein phosphatase 2C family protein
839748	GRX480	Thioredoxin superfamily protein
830621	BON2	Calcium-dependent phospholipid-binding Copine family protein
838184	WAKL4	wall associated kinase-like 4
822594	UGD2	UDP-glucose 6-dehydrogenase family protein
824711	PBL1	PBS1-like 1
835538	FQR1	flavodoxin-like quinone reductase 1
824707	AT3G55410	2-oxoglutarate dehydrogenase, E1 component
829346	AT4G32140	EamA-like transporter family
816877	AT2G23450	Protein kinase superfamily protein
824762	AT3G55960	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein
840339	STOP1	C2H2 and C2HC zinc fingers superfamily protein
831876	AT5G03320	Protein kinase superfamily protein
839942	MUR4	NAD(P)-binding Rossmann-fold superfamily protein
820543	AT3G13430	RING/U-box superfamily protein
818171	YLS9	Late embryogenesis abundant (LEA) hydroxyproline-rich glycoprotein family
827622	HSF A4A	heat shock transcription factor A4A
842431	AT1G61370	S-locus lectin protein kinase family protein
831688	AT5G01720	RNI-like superfamily protein
832514	AT5G24430	Calcium-dependent protein kinase (CDPK) family protein
835600	MAPKKK15	mitogen-activated protein kinase kinase kinase 15

831543	AT5G16800	Acyl-CoA N-acyltransferases (NAT) superfamily protein
829282	WRKY11	WRKY DNA-binding protein 11
836860	SKIP2	SKP1/ASK1-interacting protein 2
2745879	SAG20	senescence associated gene 20
842676	AT1G63720	hydroxyproline-rich glycoprotein family protein
835575	AT5G54850	hexon
838182	WAKL2	wall associated kinase-like 2
843914	AT1G75810	transmembrane protein
831322	AT5G14700	NAD(P)-binding Rossmann-fold superfamily protein
840158	MYC2	Basic helix-loop-helix (bHLH) DNA-binding family protein
820355	SYP121	syntaxin of plants 121
839523	MPK11	MAP kinase 11
829894	CYP81F3	cytochrome P450, family 81, subfamily F, polypeptide 3
844421	CCR2	cinnamoyl coa reductase
817159	AT2G26190	calmodulin-binding family protein
821071	AT3G01820	P-loop containing nucleoside triphosphate hydrolases superfamily protein
832415	AT5G23490	hypothetical protein
831444	AT5G15870	glycosyl hydrolase family 81 protein
843174	PDE337	VQ motif-containing protein
816630	pEARLI4	phospholipase-like protein (PEARLI 4) family protein
843584	LOX4	PLAT/LH2 domain-containing lipoxygenase family protein
829559	UGT73B3	UDP-glucosyl transferase 73B3
832660	RLP52	receptor like protein 52
836381	MOS14	ARM repeat superfamily protein
831159	AT5G13200	GRAM domain family protein
828355	TPPG	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein
837881	ACA.I	autoinhibited Ca ²⁺ /ATPase II
818422	AT2G38410	ENTH/VHS/GAT family protein
837061	AT1G05575	transmembrane protein
828950	AT4G28350	Concanavalin A-like lectin protein kinase family protein
842249	ZCF37	ZCF37
816041	UGT73B4	UDP-glycosyltransferase 73B4
817774	AT2G32150	Haloacid dehalogenase-like hydrolase (HAD) superfamily protein
827165	GPAT3	glycerol-3-phosphate acyltransferase 3
830618	XBAT33	hypothetical protein
831325	AT5G14730	hypothetical protein
831967	AT5G18490	vacuolar sorting-associated protein (DUF946)
830334	AT5G04550	type-1 restriction enzyme mjapx r protein (DUF668)
816520	AT2G20010	Gls protein (DUF810)
843560	ERO1	endoplasmic reticulum oxidoreductins 1
834112	AT5G41100	hydroxyproline-rich glycoprotein family protein

824671	AT3G55050	Protein phosphatase 2C family protein
820264	AT3G10930	hypothetical protein
836869	AT5G67340	ARM repeat superfamily protein
844423	WRKY40	WRKY DNA-binding protein 40
826735	MPK5	MAP kinase 5
842407	EDA16	SNF2 domain-containing protein / helicase domain-containing protein
824808	AT3G56410	hypothetical protein (DUF3133)
829158	AT4G30350	Double Clp-N motif-containing P-loop nucleoside triphosphate hydrolases superfamily protein
829918	ACA2	calcium ATPase 2
823815	RDUF1	zinc finger (C3HC4-type RING finger) family protein
822580	SDR4	NAD(P)-binding Rossmann-fold superfamily protein
821309	HIR2	SPFH/Band 7/PHB domain-containing membrane-associated protein family
834157	AT5G41550	Disease resistance protein (TIR-NBS-LRR class) family
830154	CYP79B2	cytochrome P450, family 79, subfamily B, polypeptide 2
814749	TOM3	tobamovirus multiplication protein 3
828798	AT4G26910	Dihydrolipoamide succinyltransferase
821806	AOX1A	alternative oxidase 1A
830720	AT5G08240	transmembrane protein
817855	ZFN2	zinc finger nuclease 2
828696	AT4G25900	Galactose mutarotase-like superfamily protein
844163	AT1G78280	transferases, transferring glycosyl groups
816996	AT2G24600	Ankyrin repeat family protein
5007832	AT1G62422	hypothetical protein
829589	XLG2	extra-large GTP-binding protein 2
826541	CPK4	calcium-dependent protein kinase 4
822119	AGC2-1	AGC (cAMP-dependent, cGMP-dependent and protein kinase C) kinase family protein
838289	GSTU25	glutathione S-transferase TAU 25
817084	AT2G25460	EEIG1/EHBP1 protein amino-terminal domain protein
821400	MKS1	MAP kinase substrate 1
837321	AT1G08050	Zinc finger (C3HC4-type RING finger) family protein
843799	GSTU10	glutathione S-transferase TAU 10
819413	RKF3	receptor-like kinase in in flowers 3
836103	RHL41	C2H2-type zinc finger family protein
841222	AT1G48040	Protein phosphatase 2C family protein
839303	TPK1	thiamin pyrophosphokinase1
843246	AT1G69150	Cysteine/Histidine-rich C1 domain family protein
821877	IAA2	indole-3-acetic acid inducible 2
834120	AT5G41180	leucine-rich repeat transmembrane protein kinase family protein
820249	BZIP28	Basic-leucine zipper (bZIP) transcription factor family protein
824331	SDR2	NAD(P)-binding Rossmann-fold superfamily protein
835722	PRA1.G2	prenylated RAB acceptor 1.G2

836242	SNAP33	soluble N-ethylmaleimide-sensitive factor adaptor protein 33
828484	LACS4	AMP-dependent synthetase and ligase family protein
836074	RDUF2	zinc finger (C3HC4-type RING finger) family protein
822462	GATL10	galacturonosyltransferase-like 10
839561	MC1	metacaspase 1
841992	AT1G55450	S-adenosyl-L-methionine-dependent methyltransferases superfamily protein
817115	AT2G25735	hypothetical protein
823908	AT3G47540	Chitinase family protein
820622	CAX9	cation exchanger 9
830078	AT4G39230	NmrA-like negative transcriptional regulator family protein
834695	AT5G46520	Disease resistance protein (TIR-NBS-LRR class) family
816382	AT2G18670	RING/U-box superfamily protein
842203	ZF14	MATE efflux family protein
839666	STZ	salt tolerance zinc finger
817194	AR781	AR781, pheromone receptor-like protein (DUF1645)
831039	NADP-ME2	NADP-malic enzyme 2
817753	AT2G31945	transmembrane protein
842164	PUP17	purine permease 17
835568	AT5G54780	Ypt/Rab-GAP domain of gyp1p superfamily protein
834210	AT5G42050	DCD (Development and Cell Death) domain protein
823551	CAF1a	Polynucleotidyl transferase, ribonuclease H-like superfamily protein
835008	CP1	Ca ²⁺ -binding protein 1
842686	AT1G63830	PLAC8 family protein
830470	PIRL1	plant intracellular ras group-related LRR 1
814817	SUT2	sucrose transporter 2
841778	AT1G53430	Leucine-rich repeat transmembrane protein kinase
830058	EDS5	MATE efflux family protein
838470	CDPK1	calcium-dependent protein kinase 1
832530	TIP	TCV-interacting protein
842951	ETR1	Signal transduction histidine kinase, hybrid-type, ethylene sensor
820357	PUB24	E3 ubiquitin-protein ligase PUB24-like protein
836739	AT5G66070	RING/U-box superfamily protein
835012	WRKY48	WRKY DNA-binding protein 48
820491	NiaP	Major facilitator superfamily protein
827062	RHF1A	RING-H2 group F1A
830012	AT4G38550	phospholipase-like protein (PEARL1 4) family protein
843814	AT1G74750	Pentatricopeptide repeat (PPR) superfamily protein
838207	OCT6	organic cation/carnitine transporter 6
832060	SMG7	Telomerase activating protein Est1
820155	MDHAR	monodehydroascorbate reductase
827891	B120	S-locus lectin protein kinase family protein

824764	SZF1	salt-inducible zinc finger 1
825397	AT3G62240	RING/U-box superfamily protein
829891	CYP81D8	cytochrome P450, family 81, subfamily D, polypeptide 8
819362	NDT1	NAD+ transporter 1
843474	NAP5	non-intrinsic ABC protein 5
826631	AT4G10390	Protein kinase superfamily protein
824257	BCS1	cytochrome BC1 synthase

Extended Data Table 2: Accession numbers of the sequences

Arachis duranensis SLC25A44 isoform 1:	LOC107483350; XP_015959458.1
Arachis duranensis SLC25A44 isoform 2:	LOC107483350, XP_020995737.1
Arachis ipaensis SLC25A44:	LOC107637593; XP_016196479.1
Arachis hypogaea SLC25A44:	LOC112796283; XP_025694448.1
Saccharomyces cerevisiae SLC25s:	ScYBL030c, ScYBR085w, ScYBR104w, ScYBR192w, ScYBR291c, ScYDL119c, ScYDL198c, ScYEL006w, ScYER053c, ScYFR045w, ScYGR096w, ScYGR257c, ScYHR002w, ScYIL006w, ScYIL134w, ScYJL133w, ScYJR095w, ScYJRO77c, ScYKL120w, ScYKR052c, ScYLR348c, ScYMR056c, ScYMR166c, ScYMR241w, ScYNL003c, ScYNL083w, ScYOR100c, ScYOR130c, ScYOR222w, ScYPL134c, ScYPR011c, ScYPR021c, ScYPR058w, ScYPR128c, ScYDR470C
Arabidopsis thaliana SLC25s:	At1g14560, At1g14140, At1g74240, At1g25380, At1g79900, At1g72820, At1g07020, At1g78180, At1g0703, At2g33820, At2g35800, At2g22500, At2g46320, At2g47490, At2g37890, At2g17270, At3g55640, At3g54110, At3g51870, At3g20240, At3g05290, At3g53940, At3g48850, At4g11440, At4g26180, At4g24570, At4g32400, At4g01100, At4g39460, At4g27940, At4g28390, At5g17400, At5g26200, At5g01500, At5g15640 (SLC25A44), At5g56450, At5g13490, At5g48970, At5g09470, At5g46800, At5g19760, At5g58970, At5g07320, At5g61810, At5g01340, At5g42130, At5g14040, At5g51050, At5g66380, At5g27520, At5g64970, At1g07025, At1g34065, At2g26360, At2g30160, At2g39970, At3g08580, At3g21390, At4g03115, At4g15010 (NP_568317.1, NP_563775.1, NP_563776.1, NP_172866.1, NP_001321154.1, NP_564233.1, NP_564436.4, NP_565048.1, NP_177564.2, NP_565171.4, NP_179319.1, NP_178108.1, NP_179836.1, NP_180204.2, NP_180577.1, NP_001324478.1, NP_001324476.1, NP_181325.2, NP_850252.1, NP_181526.1, NP_001325192.1, NP_850452.1, NP_566102.1, NP_566251.1, NP_850541.1, NP_188659.1, NP_566683.1, NP_190454.1, NP_190755.2, NP_190962.2, NP_190979.1, NP_001319759.1, NP_191123.1, NP_001190650.1, NP_680566.5, NP_001329299.1, NP_001319903.1, NP_567453.1, NP_194188.1, NP_001320068.1, NP_001329416.1, NP_567790.1, NP_194568.1, NP_194966.1, NP_001190968.1, NP_195754.1, NP_568060.1, NP_195770.1, NP_196349.1, NP_196509.1, NP_196853.1, NP_196908.1, NP_197477.1, NP_568345.1, NP_197992.1, NP_198104.1, NP_199028.1, NP_568670.1, NP_001332470.1, NP_199708.1, NP_199918.2, NP_568894.1, NP_201302.1, NP_569032.1, NP_568940.1, NP_199918.2, NP_568317.1, NP_001330083.1)
Toxoplasma gondii ME49 SLC25s:	TgXP_002366558.1, TgXP_002370456.1, TgXP_018635179.1, TgXP_002365941.1, TgXP_002366007.1, TgXP_002366943.1, TgXP_002367179.1, TgXP_002367239.2, TgXP_002367322.1, TgXP_002369636.2, TgXP_002369649.1, TgXP_002370137.2, TgXP_002370602.1, TgXP_002370651.1, TgXP_002371759.1, TgXP_018635049.1, TgXP_018635362.1, TgXP_018635818.1, TgXP_018636111.1, TgXP_018637381.1, TgXP_018637483.1
Trypanosoma brucei TREU927/4 GUTat10.1 SLC25s:	Tba1.116.m00278 Tb08.29H22.850 Tb927.8.4440, Tba1.117.m00198 Tb08.29O4.550 Tb927.8.1310, Tba1.175.m00296 Tb07.5F10.810 Tb927.7.3940, Tba1.196.m00393 Tb08.11J15.1150 Tb927.8.5810, Tba1.210.m00039 Tb05.30H13.730 Tb927.5.1550, Tba1.26.m00116 10C8.285 Tb927.2.2970, Tba1.311.m00187 10C8.285 Tb927.2.2970, Tba1.312.m00303 Tb03.27C5.440 Tb927.3.2980, Tba1.313.m00170 Tb04.2L9.1150 Tb927.4.1660, Tba1.314.m00167 Tb05.30H13.730 Tb927.5.1550, Tba1.316.m00386 Tb07.5F10.810 Tb927.7.3940, Tba1.330.m00122 Tb08.29O4.550 Tb927.8.1310, Tba1.330.m00325 Tb08.28L1.350 Tb927.8.3330, Tba1.330.m00437 Tb08.29H22.850 Tb927.8.4440, Tba1.330.m00574 Tb08.11J15.1150 Tb927.8.5810, Tba1.339.m00858 Tb09.211.1750, Tba1.339.m00917 Tb09.211.2370, Tba1.339.m01002 Tb09.211.3200, Tba1.340.m00470 Tb10.70.2290, Tba1.340.m00997 Tb10.406.0470, Tba1.340.m01218 Tb10.389.0690, Tba1.340.m01356 Tb10.61.2510, Tba1.340.m01408 Tb10.61.1830, Tba1.340.m01409 Tb10.61.1820, Tba1.340.m01410 Tb10.61.1810, Tba1.340.m01490 Tb10.61.0610, Tba1.341.m00018 Tb11.03.0870, Tba1.341.m00506 Tb11.02.2960, Tba1.341.m01308 Tb11.01.5040, Tba1.341.m01399 Tb11.01.5950, Tba1.341.m01400 Tb11.01.5960, Tba1.341.m01400 Tb11.01.5960, Tba1.79.m00365 Tb04.2L9.1150 Tb927.4.1660, Tba1.82.m00204 Tb08.28L1.350 Tb927.8.3330, Tba1.340.m01245(SLC25A44; XP_827797.1) Tb10.389.0340
Homo sapiens SLC25s:	SLC25A44 isoform 1 E9PGQ0 ; NP_001273113.1, SLC25A44 isoform 2 Q96H78 ; NP_055470.1, SLC25-10 A0A0S22382 , SLC25-10 A0A0S223G3 , SLC25-10 A0A0S223I3 , SLC25-10 F6RGN5 , SLC25-10 Q9UBX3 , SLC25-11 I3L1P8 , SLC25-11 Q02978 , SLC25-11 Q6IBH0 , SLC25-12 B4DGK6 , SLC25-12 O75746 , SLC25-13 Q75KX8 , SLC25-13 Q9UJS0 , SLC25-14 F6SL11 , SLC25-

14 O95258 , SLC25-15 B2R921 , SLC25-15 Q9Y619 , SLC25-16 B7Z8R5 , SLC25-16 P16260 , SLC25-17 B0QYW5 , SLC25-17 F6RTR7 , SLC25-17 F8WE74 , SLC25-17 O43808 , SLC25-18 AOA024ROWO , SLC25-18 Q9H1K4 , SLC25-19 Q5IS35 , SLC25-19 Q5IPC1 , SLC25-19 Q9HC21 , SLC25-1 B4DP62 , SLC25-1 D9HTE9 , SLC25-1 P53007 , SLC25-20 C9JPE1 , SLC25-20 O43772 , SLC25-21 Q9BQT8 , SLC25-22 AOA024RCA6 , SLC25-22 AOA0D9SFE1 , SLC25-22 E9PJH7 , SLC25-22 Q9H936 , SLC25-23 B4DSH6 , SLC25-23 MOQZJ5 , SLC25-23 MOQZT4 , SLC25-23 MOR1W8 , SLC25-23 Q9BV35 , SLC25-24 B4DI95 , SLC25-24 Q6NUK1 , SLC25-25 H7C4Z4 , SLC25-25 Q6KCM7 , SLC25-26 H7C430 , SLC25-26 Q70HW3 , SLC25-27 B4DHR4 , SLC25-27 O95847 , SLC25-28 Q96A46 , SLC25-28 X6RFA8 , SLC25-29 G3V477 , SLC25-29 Q8N8R3 , SLC25-2 Q9BXI2 , SLC25-30 B3KSR0 , SLC25-30 B3KTE8 , SLC25-30 Q5SV54 , SLC25-31 Q9H0C2 , SLC25-32 AOA024R9D0 , SLC25-32 Q9H2D1 , SLC25-33 Q9BSK2 , SLC25-34 Q6PIV7 , SLC25-35 Q3KQZ1 , SLC25-36 B4DL01 , SLC25-36 J3KQA4 , SLC25-36 Q96CQ1 , SLC25-37 Q9NY22 , SLC25-38 AOA024R2L5 , SLC25-38 AOA2R8Y553 , SLC25-38 AOA2R8Y823 , SLC25-38 , AOA2R8YE85 , SLC25-38 Q96DW6 , SLC25-39 B4DFG5 , SLC25-39 K7EMR4 , SLC25-39 K7EMW3 , SLC25-39 Q9BZJ4 , SLC25-3 AOA024RBE8 , SLC25-3 AOA024RBH9 , SLC25-3 B2RE88 , SLC25-3 F8VVM2 , SLC25-3 Q00325 , SLC25-40 Q8TBP6 , SLC25-41 Q8N5S1 , SLC25-42 Q86VD7 , SLC25-43 Q8WUT9 , SLC25-45 E9PJQ3 , SLC25-45 Q8N413 , SLC25-46 B7Z6C8 , SLC25-46 E7EVY2 , SLC25-46 Q96AG3 , SLC25-47 G3V374 , SLC25-47 Q6Q0C1 , SLC25-48 J3KQI1 , SLC25-48 Q6ZT89 , SLC25-4 AOA0S2Z3H3 , SLC25-4 P12235 , SLC25-4 V9GYG0 , SLC25-52 I3L0B8 , SLC25-52 Q3SY17 , SLC25-53 Q5H9E4 , SLC25-5 P05141 , SLC25-5 Q6NVC0 , SLC25-5 Q9H1U9 , SLC25-6 P12236 , SLC25-6 Q6I9V5 , SLC25-7 P25874 , SLC25-8 P55851 , SLC25-9 P55916 , SLC25-50 NP_055157.1 , SLC25-50 NP_001304162.1 , SLC25-50 NP_001304161.1 , SLC25-49 NP_00125857.1 , SLC25-51 NP_219480.1
Schizosaccharomyces pombe SLC25s: SpSPAC4G8.08(Q09834), SpSPAC4G9.20c(Q1024899), SpSPAC12B10.09(Q10442), SpSPAC17H9.08(O13805), SpSPBC29A3.11c(O59674), SpSPCC1442.03(Q76PC3), SpSPBC1604.04(O94370), SpSPAC8C9.12c(O14281), SpSPCC1682.09c(O74439), SpSPBC12D12.05c(O94502), SpSPBC1703.13c(Q9P7V8), SpSPAC19G12.05(O13844), SpANC1(Q09188), SpSPBP23A10.06(Q9P7X9), SpSPBC83.13(P78763), SpPi069(O13660), SpSPBC1271.11(O94344), SpSPAC227.03c(Q9UTD6), SpOAC1(Q9UTN1), SpSPAC328.09(Q9P377), SpSPAC688.09(Q9P6L7), SpSPAC823.10c(Q9P6N6)
Penicillium brasilianum SLC25s: CEJ53785, CEJ54003, CEJ54406, CEJ54698, CEJ54728, CEJ54729, CEJ56447, CEJ56561, CEJ56594, CEJ56802, CEJ57296, CEJ57592, CEJ57626, CEJ58128, CEJ58181, CEJ58192, CEJ58313, CEJ58565, CEJ58632, CEJ58953, CEJ59015, CEJ60733, CEJ60822, CEJ60848, CEJ61183, CEJ61303, CEJ61709, CEJ62024, CEJ62087, CEJ62095, CEJ62174, CEO58508, CEO59069, CEO59692, CEO59841, CEO59910, CEO60187, CEO60305, CEO60440, CEO60441, CEO60498, CEO60658, CEJ58312, CEJ60343, CEJ62127
Micromonas commoda SLC25s: XP_002499375.1, XP_002500000.1, XP_002500028.1, XP_002500224.1, XP_002500313.1, XP_002500487.1, XP_002501164.1, XP_002501167.1, XP_002501272.1, XP_002501280.1, XP_002501327.1, XP_002501559.1, XP_002502042.1, XP_002502429.1, XP_002502432.1, XP_002502611.1, XP_002502691.1, XP_002502963.1, XP_002502989.1, XP_002503138.1, XP_002503139.1, XP_002503204.1, XP_002503554.1, XP_002503601.1, XP_002503685.1, XP_002503900.1, XP_002504104.1, XP_002504685.1, XP_002505072.1, XP_002505284.1, XP_002505418.1, XP_002505989.1 (SLC25A44), XP_002505990.1 (SLC25A44), XP_002506016.1, XP_002506340.1, XP_002506755.1, XP_002507364.1, XP_002507469.1, XP_002508333.1, XP_002508974.1, XP_002509046.1, XP_002509174.1, XP_002509195.1, XP_002509228.1, XP_002509286.1
Dictyostelium fasciculatum SLC25s: DfXP_004350022.1, DfXP_004350212.1, DfXP_004350854.1, DfXP_004350609.1, DfXP_004351882.1, DfXP_004352164.1, DfXP_004353860.1, DfXP_004354820.1, XP_004355517.1, DfXP_004355985.1, DfXP_004356144.1, DfXP_004357211.1, DfXP_004357679.1, DfXP_004357861.1, DfXP_004358573.1, DfXP_004358716.1, DfXP_004358737.1, DfXP_004358844.1, DfXP_004358997.1, DfXP_004359404.1, DfXP_004359534.1, DfXP_004360107.1, DfXP_004360873.1, DfXP_004361047.1, DfXP_004361616.1, DfXP_004361870.1, DfXP_004362737.1, DfXP_004366438.1, DfXP_004366584.1, DfXP_004366990.1, DfXP_004367267.1, DfXP_004367315.1, DfXP_004362985.1
Caenorhabditis elegans SLC25s: Ce_B0432.4(MISC-1), Ce_C14C10.1, Ce_C16C10.1, Ce_C33F10.12, Ce_C42C1.10(HPO-12), Ce_C47E12.2, Ce_C54G10.4, Ce_D1046.3(Q18934), Ce_F01G4.6(P40614), Ce_F17E5.2(Q19529), Ce_F20D1.9(Q93540), Ce_F13G3.7-slc25A44a, Ce_F13G3.7-SLC25A44b, Ce_F25B4.7(P91270), Ce_F43G9.3(Q93717), Ce_F55A11.4(Q20799), Ce_F55G1.5(Q20847), Ce_K01C8.7(Q21084), Ce_K01H12.2(G5EFW8), Ce_K02F3.2(Q21153), Ce_K07B1.3(O01883), Ce_K11G12.5(G5EE96), Ce_K11H3.3(P34519), Ce_R07B7.10(Q21800), Ce_R07E3.4(Q21809), Ce_R11.1(O62347), Ce_T01B11.4(G5EFU2), Ce_T05F1.8(Q9XUR1), Ce_T09F3.2(G5EEG6), Ce_T10F2.2(Q10050), Ce_T20D3.5(O01256), Ce_T27E9.1(O45865), Ce_W02B12.9(Q23125), Ce_W02D3.6(O01813), Ce_Y43C5B.3(G5EDJ9)
Yarrowia lipolytica CLIB122 SLC25s: Y.lipolyticaCAG77842.1 YALIOF05500p, Y.lipolyticaCAG78212.1 YALIOF14223p, Y.lipolyticaCAG78266.1 YALIOF15433p, Y.lipolyticaCAG78270.1 YALIOF15609p, Y.lipolyticaCAG78406.1 YALIOF18854p, Y.lipolyticaCAG78442.1 YALIOF19712p, Y.lipolyticaCAG78464.1 YALIOF20262p, Y.lipolyticaCAG78496.1 YALIOF20966p, Y.lipolyticaCAG78714.1 YALIOF26323p, Y.lipolyticaCAG79061.1 YALIOE03058p, Y.lipolyticaCAG79104.1 YALIOE04048p, Y.lipolyticaCAG79229.1 YALIOE06897p, Y.lipolyticaCAG79319.1 YALIOE09284p, Y.lipolyticaCAG79387.1 YALIOE10813p, Y.lipolyticaCAG79616.1 YALIOE16478p, Y.lipolyticaCAG79657.1 YALIOE17457p, Y.lipolyticaCAG80039.1 YALIOE26785p, Y.lipolyticaCAG80102.1 YALIOE28270p, Y.lipolyticaCAG80328.1 YALIOE33341p, Y.lipolyticaCAG80521.1 YALIOD02629p, Y.lipolyticaCAG80690.1 YALIOD06798p, Y.lipolyticaCAG80752.1 YALIOD08228p, Y.lipolyticaCAG81508.1 YALIOD26147p, Y.lipolyticaCAG81658.1 YALIOC02431p, Y.lipolyticaCAG81788.1 YALIOC05753p, Y.lipolyticaCAG81805.1 YALIOC06127p, Y.lipolyticaCAG82141.2 YALIOC14498p, Y.lipolyticaCAG82322.1 YALIOC19195p, Y.lipolyticaCAG82683.1 YALIOB03344p, Y.lipolyticaCAG82778.1 YALIOB05852p, Y.lipolyticaCAG83442.1 YALIOB21604p, Y.lipolyticaCAG83882.1 YALIOA10659p, Y.lipolyticaCAG84078.1 YALIOA16863p, Y.lipolyticaCAG84248.1 YALIOA20944p, Y.lipolyticaCAG84250.1 YALIOA20988p
Trypanosoma cruzi CL Brener TC3 SLC25s: Tca1.4571.m00013 Tc00.1047053503425.5 Tc00.1047053503425.5, Tca1.4619.m00031 Tc00.1047053503521.39 Tc00.1047053503521.39, Tca1.4807.m00017 Tc00.1047053503897.170 Tc00.1047053503897.170, Tca1.4828.m00002 Tc00.1047053503939.20 Tc00.1047053503939.20, Tca1.4875.m00009 Tc00.1047053504033.90 Tc00.1047053504033.90, Tca1.4887.m00014 Tc00.1047053504057.140 Tc00.1047053504057.140, Tca1.4913.m00007 Tc00.1047053504109.70 Tc00.1047053504109.70, Tca1.4921.m00005 Tc00.1047053504125.50 Tc00.1047053504125.50, Tca1.4924.m00019 Tc00.1047053504131.190 Tc00.1047053504131.190, Tca1.4967.m00012 Tc00.1047053504217.19 Tc00.1047053504217.19, Tca1.5360.m00007 Tc00.1047053506359.70 Tc00.1047053506359.70, Tca1.5738.m00003 Tc00.1047053509551.30 Tc00.1047053509551.30, Tca1.5889.m00002 Tc00.1047053510315.20 Tc00.1047053510315.20, Tca1.5966.m00034 Tc00.1047053510663.64 Tc00.1047053510663.64, Tca1.6711.m00025 Tc00.1047053505807.250 Tc00.1047053505807.250, Tca1.6853.m00016

Tc00.1047053506211.160 Tc00.1047053506211.160, Tca1.6857.m00004 Tc00.1047053506221.40 Tc00.1047053506221.40, Tca1.6869.m00026 Tc00.1047053506247.260 Tc00.1047053506247.260, Tca1.6869.m00036 Tc00.1047053506247.360 Tc00.1047053506247.360, Tca1.6930.m00178 Tc00.1047053506401.304 Tc00.1047053506401.304, Tca1.6985.m00013 Tc00.1047053506525.130 Tc00.1047053506525.130, Tca1.7076.m00008 Tc00.1047053506739.80 Tc00.1047053506739.80, Tca1.7083.m00131 Tc00.1047053506755.74 Tc00.1047053506755.74, Tca1.7090.m00010 Tc00.1047053506771.18 Tc00.1047053506771.18, Tca1.7161.m00002 Tc00.1047053506979.20 Tc00.1047053506979.20, Tca1.7175.m00010 Tc00.1047053507017.100 Tc00.1047053507017.100, Tca1.7617.m00063 Tc00.1047053508153.630 Tc00.1047053508153.630, Tca1.7739.m00307 Tc00.1047053508461.284 Tc00.1047053508461.284, Tca1.7818.m00017 Tc00.1047053508659.18 Tc00.1047053508659.18, Tca1.7851.m00015 Tc00.1047053508737.150 Tc00.1047053508737.150, Tca1.7953.m00002 Tc00.1047053508989.20 Tc00.1047053508989.20, Tca1.8002.m00086 Tc00.1047053509109.114 Tc00.1047053509109.114, Tca1.8008.m00005 Tc00.1047053509127.50 Tc00.1047053509127.50, Tca1.8133.m00003 Tc00.1047053509561.30 Tc00.1047053509561.30, Tca1.8134.m00011 Tc00.1047053509569.110 Tc00.1047053509569.110, Tca1.8197.m00009 Tc00.1047053509769.90 Tc00.1047053509769.90, Tca1.8208.m00019 Tc00.1047053509805.190 Tc00.1047053509805.190, Tca1.8356.m00016 Tc00.1047053510291.14 Tc00.1047053510291.14, Tca1.8366.m00046 Tc00.1047053510339.74 Tc00.1047053510339.74, Tca1.8370.m00386 Tc00.1047053510359.69 Tc00.1047053510359.69, Tca1.8443.m00009 Tc00.1047053510603.90 Tc00.1047053510603.90, Tca1.8479.m00003 Tc00.1047053510737.30 Tc00.1047053510737.30, Tca1.8508.m00010 Tc00.1047053510819.100 Tc00.1047053510819.100, Tca1.8515.m00030 Tc00.1047053510835.24 Tc00.1047053510835.24, Tca1.8634.m00001 Tc00.1047053511249.10 Tc00.1047053511249.10, Tca1.8646.m00166 Tc00.1047053511283.124 Tc00.1047053511283.124, Tca1.8647.m00007 Tc00.1047053511289.70 Tc00.1047053511289.70, Tca1.8672.m00008 Tc00.1047053511365.80 Tc00.1047053511365.80, Tca1.8765.m00014 Tc00.1047053511725.140 Tc00.1047053511725.140, Tca1.8765.m00126 Tc00.1047053511725.134 Tc00.1047053511725.134
Oryza sativa SLC25A44: XP_015622257.1
Vitis vinifera SLC25A44 isoform 1: XP_010660573.1
Vitis vinifera SLC25A44 isoform 2: LOC100254860; XP_003633751.1
Vitis vinifera SLC25A44 isoform 3: XP_010660574.1
Vitis vinifera SLC25A44 isoform 4: XP_010660575.1
Chlamydomonas reinhardtii SLC25A44: XP_001701982.1
Chlamydomonas reinhardtii SLC25A44: PNW86570.1
Ostreococcus tauri SLC25A44: XP_003081262.2
Gorilla gorilla gorilla SLC25A44: XP_018879898.1
Mus musculus SLC25A44: NP_001139348.1
Bos taurus SLC25A44: NP_001071325.1
Drosophila melanogaster SLC25A44 (Dmel_CG5805): NP_001287513.1
Halyomorpha halys SLC25A44: XP_014285646.1
Rhincodon typus SLC25A44: XP_020377155.1
Cimex lectularius SLC25A44: XP_014241248.1
Pangasianodon hypophthalmus SLC25A44: XP_026793239.1
Sinocyclocheilus rhinoceros SLC25A44: XP_016396502.1
Boleophthalmus pectinirostris SLC25A44: XP_020773135.1
Saccoglossus kowalevskii SLC25A44: XP_006815419.1
Strongylocentrotus purpuratus SLC25A44: XP_782479.3
Dendronephthya gigantea SLC25A44: XP_028399431.1
Orbicella faveolata SLC25A44: XP_020616140.1
Nematostella vectensis SLC25A44: XP_001634420.1
Pocillopora damicornis SLC25A44: XP_027039995.1
Stylophora pistillata SLC25A44: XP_022800183.1
Exaiptasia pallida SLC25A44: XP_020901668.1
Neorickettsia sennetsu strMiyayama SLC25: Nse_0925 YP_506789.1
Neorickettsia sennetsu strMiyayama SLC25: Nse_0926 YP_003082092.1
Butyrivibrio proteoclasticus B316 SLC25: Bpr_1014 YP_003213425.1
Neorickettsia risticii strIllinois SLC25: Nri_0889 YP_506790.1
Cardinium endosymbiont cEper1 of Encarsia pergandiella SLC25: Cahe_0788 YP_506789.1
Acidaminococcus intestini RyCMR95 SLC25: Acin_0746 YP_001086859.1

Extended Data Table 3: Polymorphism of the rice and mouse *Slc25A44* genes

	Total variations	Variations in coding regions	Missense variations
Rice <i>Slc25A44</i>¹	75	8	3 missenses: _Ser211Ala _Met198Ile (<i>Arabidopsis</i> , <i>Arachis</i> , and grape SLC25A44s have Val or Ala at this position) _Leu187Ile (Grape has also Ile at this position in all the four isoforms)
Mouse <i>Slc25A44</i>²	61 (With unknown zygosity)	8	1 missense: _Val259Ile (This change can also be found among the human <i>Slc25A44</i> transcript isoforms) 1 stop-loss: _* /RRQELHRPDLQAADGRGGALGPHEGPLGKNHL GYTLHRRHRGGLREPQEAQPAT*

¹Data was extracted from the RiceVarMap v2.0 at <http://ricevarmap.ncpgr.cn/v2/>. ²Data was extracted from the Mouse Genome Database at <http://www.informatics.jax.org/>.

Extended Data Table 4: *S. cerevisiae* strains and plasmids

Strain	Genotype	Plasmid	Parent strain	Reference
ST691	<i>MATa,aro10Δ,cdc5Δ</i>	-	-	Li et al., 2016
ST7515(A)	<i>pTEF1->AtPAL2, pPGK1->AtC4H</i>	pcfB1018 (pXI-5-LoxP-SpHIS5)	ST691	This study
ST7516(B)	<i>pPGK1->ScCYB5, pTEF1->AtATR2</i>	pcfB0848 (pXI-2-LoxP-URA3)	ST7515	This study
ST2645	<i>pTEF1->ARO7, pPGK1->ARO4, pTEF1->FjTAL</i>	-	ST691	Rodriguez et al., 2015
ST9535	<i>pTEF1->AdSLC25A44</i>	pcfB9228 (XII-2-loxP-KanMX)	ST7516	This study
ST9351	<i>pTEF1->HsSLC25A44</i>	pcfB9056 (XII-2-loxP-KanMX)	ST7516	This study
ST9536	<i>pTEF1->AdSLC25A44</i>	pcfB9228 (XII-2-loxP-KanMX)	ST2645	This study
ST9352	<i>pTEF1->HsSLC25A44</i>	pcfB9056 (XII-2-loxP-KanMX)	ST2645	This study
ST9534	<i>pTEF1->AdSLC25A44_GFP</i>	pcfB9227 (XII-2-loxP-KanMX)	ST691	This study
ST9587	<i>pTEF1->AdSLC25A44ΔLWW/IQF</i>	pcfB9263 (XII-2-loxP-KanMX)	ST7516	This study
ST9591	<i>pTEF1->AdSLC25A44ΔLWW/IQF</i>	pcfB9263 (XII-2-loxP-KanMX)	ST2645	This study

Extended Data Table 5: Primers and templates used for cloning of the gene fragments

1. Construction of the plasmid pcfB6108 (T7->AdSlc25A44) using the parental plasmid pcfB1146 and the AdSlc25A44 BioBrick (BB4532)		
Amplification of the BioBrick BB4532		
Primer ID	primer sequence	Template
PR23786 (F-SLC25A44)	GGCTTAAUATGGCAATGGAAGCTGCTGAGGCTTCA	pcfB6095
PR23787 (R-SLC25A44)	GGTTTAAUTTAAGCCACAGACCTCAAACCTGGCTGAACTGACAA	
Amplification of the AdSlc25A44 cassette to be used for in-vitro transcription		
Primer ID	primer sequence	Template
PR23809 (F.cassette)	GTGCTGCAAGGCGATTAAGTTGGGTAACGC	pcfB6108
PR23810 (R.cassette)	CCTCGAGGCGGCCGCTGCAG	
2. Construction of the yeast integrative plasmid pcfB9228 (TEF->AdSlc25A44) using the parental plasmid pcfB2225 and the AdSlc25A44 BioBrick (BB4533)		
Amplification of the BioBrick BB4533		
Primer ID	primer sequence	Template
PR21569 (F-SLC25A44)	ATCTGTCAUAAAACAATGGCAATGGAAGCTGCTGAGGCTTCA	pcfB6108
PR21570 (R-SLC25A44)	ATGATGTTUAGCCACAGACCTCAAACCTGGCTGAACTGACA	
3. Construction of the yeast integrative plasmid pcfB9056 (TEF->HsSlc25A44) using the parental plasmid pcfB2225 and the HsSlc25A44 BioBrick (BB4534)		
Amplification of the BioBrick BB4534		
Primer ID	primer sequence	Template
PR24665 (F-SLC25A44)	ATCTGTCAUAAAACAATGGAAGACAAAAGAAACATCCAGATCATCGAGTGGGAA	pcfB9038
PR24666 (R-SLC25A44)	ACGCGATUTACCAATGTCTGGAGTCCACCAGCTCAGGTCGA	
Amplification of the pcfB2225		
Primer ID	primer sequence	Template
PR24663 (P2225-Tef.R)	ATGACAGAUTTGTAATTAACCTAGATTAGATTGCTATGCTTTCTTCTAATGAGCAA	pcfB2225
PR24664 (P2225.R)	AATCGCGUGCATTCTCCGCTCTAACCGAAA	
4. Construction of the plasmid pcfB9227 (TEF->AdSlc25A44-Gfp) using the parental plasmid pcfB9228 and the Gfp BioBrick (BB4535)		
Amplification of the BioBrick BB4535		
Primer ID	primer sequence	Template
PR24222	AATATGTCUAAAGGTGAAGAATTATTCACTGGTGTGTCCCAAT	pcfB5286
PR24223	ATGATGTTUTTTGTACAATTCATCCATACCATGGGTAATACCAGCAGCAGTA	
Amplification of the pcfB9228		
Primer ID	primer sequence	Template
PR25396	AAACATCAUTAAATCGCGTGCATTCTCCGCTCTAACCGAAAAGGA	pcfB9228
PR24225	AGACATATUAGCCACAGACCTCAAACCTGGCTGAACTGACAATCTCTTAATCA	
5. Construction of the plasmid pcfB9263 (TEF->AdSlc25A44ΔLWW/IQF) using the parental plasmid pcfB9228		
Amplification of the pcfB9228		
Primer ID	primer sequence	Template
PR25078	AATTCGGTUCATATGGCGCCGCTCAGCACATCATTTGGA	pcfB9228
PR25079	AACCGAATUGAATTGCAGATGCAGGTGACTGAGTAATGGCTGTCTAGTCCAAA	

Extended Data Table 6: Primers used for the screening of gene-integration into the genomes of yeast strains

Site	Primer ID	Sequence of the primer 5'-3'	Description	Fragment size (bp)
XII-2	2220	CCTGCAGGACTAGTGCTGAG	XII-2 DOWN	666
	894	GGCCCTGATAAGGTTGTTG		
	2221	GTTGACACTTCTAAATAAGCGAATTTTC	XII-2 UP	795
	893	CGAAGAAGGCCTGCAATTC		
XI-2	2220	CCTGCAGGACTAGTGCTGAG	XI-2 DOWN	818
	910	GAGACAAGATGGGGCAAGAC		
	2221	GTTGACACTTCTAAATAAGCGAATTTTC	XI-2 UP	963
	909	GTTTGTAGTTGGCGGTGGAG		
XI-5	2220	CCTGCAGGACTAGTGCTGAG	XI-5 DOWN	701
	8419	GCATGGTCACCGCTATCAGC		
	2221	GTTGACACTTCTAAATAAGCGAATTTTC	XI-5 UP	1050
	8418	CTCAATGATCAAAATCCTGAATGCA		