

**TABLE S1****List of genes encoding characterized and putative yeast kinases**

No.	Standard Name	Position in KO collection	Annotation	Systematic Name
1	<i>CKA1</i>	129-B-5	Alpha' catalytic subunit of casein kinase 2, a Ser/Thr protein kinase with roles in cell growth and proliferation	<i>YIL035C</i>
2	<i>CKA2</i>	106-D-2	Alpha' catalytic subunit of casein kinase 2, a Ser/Thr protein kinase with roles in cell growth and proliferation	<i>YOR061W YOR29-12</i>
3	<i>YCK2</i>	127-E-2	Palmitoylated, plasma membrane-bound casein kinase I isoform	<i>YNL154C</i>
4	<i>ATG1</i>	148-D-7	Protein serine/threonine kinase, required for autophagy and for the cytoplasm-to-vacuole targeting (Cvt) pathway	<i>YGL180W APG1 AUT3 CVT10</i>
5	<i>YCK1</i>	114-F-11	Palmitoylated, plasma membrane-bound casein kinase I isoform	<i>YHR135C CKI2</i>
6	<i>CMKI</i>	129-H-4	Calmodulin-dependent protein kinase	<i>YFR014C</i>
7	<i>YGL059W</i>	126-G-1	Putative protein kinase of unknown cellular role	<i>YGL059W</i>
8	<i>ARK1</i>	140-G-6	Serine/threonine protein kinase involved in regulation of the cortical actin cytoskeleton	<i>YNL020C</i>
9	<i>SNF1</i>	149-D-6	AMP-activated serine/threonine protein kinase found in a complex containing Snf4p and members of the Sip1p/Sip2p/Gal83p family	<i>YDR477W CAT1 GLC2 CCR1 HAF3 PAS14</i>
10	<i>HRR25</i>	inviable	Protein kinase involved in regulating diverse events including vesicular trafficking, DNA repair, and chromosome segregation; binds the CTD of RNA pol II; homolog of mammalian casein kinase I delta (CKI delta)	<i>YPL204W</i>
11	<i>BCK1</i>	133-H-6	Mitogen-activated protein (MAP) kinase kinase kinase acting in the protein kinase C signaling pathway, which controls cell integrity	<i>YJL095W SAP3 LAS3 SSP31 SLK1</i>
12	<i>GIN4</i>	147-F-1	Protein kinase involved in bud growth and assembly of the septin ring, proposed to have kinase-dependent and kinase-independent activities	<i>YDR507C ERC47</i>
13	<i>HAL5</i>	143-D-10	Putative protein kinase	<i>YJL165C</i>
14	<i>HRK1</i>	144-H-9	Protein kinase implicated in activation of the plasma membrane H(+)-ATPase Pma1p in response to glucose metabolism	<i>YOR267C</i>
15	<i>HSL1</i>	117-B-8	Nim1p-related protein kinase that regulates the	<i>YKL101W NIK1</i>

			morphogenesis and septin checkpoints	
16	<i>NPR1</i>	127-C-12	Protein kinase that stabilizes several plasma membrane amino acid transporters by antagonizing their ubiquitin-mediated degradation	<i>YNL183C</i>
17	<i>PKH2</i>	131-B-9	Serine/threonine protein kinase involved in sphingolipid-mediated signaling pathway that controls endocytosis	<i>YOL100W</i>
18	<i>PPZ2</i>	111-G-4	Serine/Threonine protein phosphatase Z	<i>YDR436W</i>
19	<i>PRR1</i>	117-C-5	Serine/threonine protein kinase that inhibits pheromone induced signalling downstream of MAPK, possibly at the level of the Ste12p transcription factor	<i>YKL116C</i>
20	<i>PSK1</i>	101-D-2	One of two (see also <i>PSK2</i> ) PAS domain containing S/T protein kinases	<i>YAL017W FUN31</i>
21	<i>PSK2</i>	107-G-2	One of two (see also <i>PSK1</i> ) PAS domain containing S/T protein kinases	<i>YOL045W</i>
22	<i>YPL150W</i>	109-B-1	Putative protein of unknown function	<i>YPL150W</i>
23	<i>YNR047W</i>	141-D-9	Putative protein of unknown function	<i>YNR047W</i>
24	<i>YKL171W</i>	117-F-9	Putative protein of unknown function	<i>YKL171W</i>
			LIM domain-containing protein that localizes to sites of polarized growth, required for selection and/or maintenance of polarized growth sites, may modulate signaling by the GTPases Cdc42p and Rho1p; has similarity to metazoan paxillin	
25	<i>PXL1</i>	135-A-5		<i>YKR090W</i>
26	<i>AKL1</i>	140-D-12	Ser-Thr protein kinase, member (with Ark1p and Prk1p) of the Ark kinase family	<i>YBR059C</i>
			Regulatory protein of unknown function, constitutively-expressed, involved in the regulation of mating-specific genes and the invasive growth pathway, required for MAP-kinase imposed repression, inhibits pheromone-responsive transcription	
27	<i>DIG1</i>	123-F-3		<i>YPL049C</i>
			Regulatory protein of unknown function, pheromone-inducible, involved in the regulation of mating-specific genes and the invasive growth pathway, required for MAP-kinase imposed repression, inhibits pheromone-responsive transcription	
28	<i>DIG2</i>	147-D-4		<i>YDR480W</i>
29	<i>PRK1</i>	129-D-8	Protein serine/threonine kinase	<i>YIL095W PAK1</i>
30	<i>KIN1</i>	110-G-12	Serine/threonine protein kinase involved in regulation of exocytosis	<i>YDR122W</i>
31	<i>KIN2</i>	102-F-11	Serine/threonine protein kinase involved in regulation of exocytosis	<i>YLR096W</i>

32	<i>KLN4</i>	119-D-3	Serine/threonine protein kinase that inhibits the mitotic exit network (MEN) when the spindle position checkpoint is activated	<i>YOR233W</i>   <i>KLN31</i>   <i>KLN3</i>
33	<i>KLN82</i>	124-G-6	Putative serine/threonine protein kinase, most similar to cyclic nucleotide-dependent protein kinase subfamily and the protein kinase C subfamily	<i>YCR091W</i>
34	<i>KKQ8</i>	117-F-8	Putative serine/threonine protein kinase with unknown cellular role	<i>YKL168C</i>
35	<i>KSP1</i>	114-D-1	Nonessential putative serine/threonine protein kinase of unknown cellular role	<i>YHR082C</i>
36	<i>SKM1</i>	131-C-10	Member of the PAK family of serine/threonine protein kinases with similarity to Ste20p and Cla4p	<i>YOL113W</i>
37	<i>CBK1</i>	inviable	Serine/threonine protein kinase that regulates cell morphogenesis pathways	<i>YNL161W</i>
38	<i>SMK1</i>	133-D-2	Middle sporulation-specific mitogen-activated protein kinase (MAPK) required for production of the outer spore wall layers	<i>YPR054W</i>
39	<i>RIM11</i>	144-E-9	Protein kinase required for signal transduction during entry into meiosis	<i>YMR139W</i>   <i>GSK3</i>   <i>MDS1</i>
40	<i>DUN1</i>	138-F-2	Cell-cycle checkpoint serine-threonine kinase required for DNA damage-induced transcription of certain target genes, phosphorylation of Rad55p and Sml1p, and transient G2/M arrest after DNA damage	<i>YDL101C</i>
41	<i>RIM15</i>	150-A-8 and 150-C-2	Glucose-repressible protein kinase involved in signal transduction during cell proliferation in response to nutrients, specifically the establishment of stationary phase	<i>YFL033C</i>   <i>TAK1</i>
42	<i>PBS2</i>	145-C-9	MAP kinase kinase that plays a pivotal role in the osmosensing signal-transduction pathway, activated under severe osmotic stress	<i>YJL128C</i>   <i>SSK4</i>   <i>SFS4</i>   <i>HOG4</i>
43	<i>TFG1</i>	inviable	TFIIIF (Transcription Factor II) largest subunit	<i>YGR186W</i>   <i>RAP74</i>   <i>SSU71</i>
44	<i>PKH1</i>	147-E-1	Serine/threonine protein kinase involved in sphingolipid-mediated signaling pathway that controls endocytosis	<i>YDR490C</i>
45	<i>PKH3</i>	147-C-8	Protein kinase with similarity to mammalian phosphoinositide-dependent kinase 1 (PDK1) and yeast Pkh1p and Pkh2p, two redundant upstream activators of Pkc1p	<i>YDR466W</i>
46	<i>MCK1</i>	105-D-4	Protein serine/threonine/tyrosine (dual-specificity) kinase involved in control of chromosome segregation and in regulating entry into meiosis	<i>YNL307C</i>   <i>YPK1</i>

47	<i>CLA4</i>	105-D-11	Cdc42p activated signal transducing kinase of the PAK (p21-activated kinase) family, involved in septin ring assembly and cytokinesis	<i>YNL298W ERC10</i>
48	<i>IME2</i>	133-H-1	Serine/threonine protein kinase involved in activation of meiosis, associates with Ime1p and mediates its stability, activates Ndt80p	<i>YJL106W SME1</i>
49	<i>YMR291W</i>	105-A-2	Putative kinase of unknown function	<i>YMR291W</i>
50	<i>SAT4</i>	115-F-2	Ser/Thr protein kinase involved in salt tolerance	<i>YCR008W HAL4</i>
51	<i>YDL025C</i>	146-E-2	Putative protein kinase, potentially phosphorylated by Cdc28p	<i>YDL025C</i>
52	<i>SWE1</i>	119-G-12	Protein kinase that regulates the G2/M transition by inhibition of Cdc28p kinase activity	<i>YJL187C WEE1</i>
53	<i>PRR2</i>	136-F-12	Serine/threonine protein kinase that inhibits pheromone induced signalling downstream of MAPK, possibly at the level of the Ste12p transcription factor	<i>YDL214C</i>
54	<i>SKY1</i>	104-E-1	SR protein kinase (SRPK) involved in regulating proteins involved in mRNA metabolism and cation homeostasis	<i>YMR216C</i>
55	<i>ISR1</i>	124-A-9	Predicted protein kinase, overexpression causes sensitivity to staurosporine, which is a potent inhibitor of protein kinase C	<i>YPR106W</i>
56	<i>STE11</i>	149-G-7	Signal transducing MEK kinase involved in pheromone response and pseudohyphal/invasive growth pathways where it phosphorylates Ste7p, and the high osmolarity response pathway, via phosphorylation of Pbs2p	<i>YLR362W</i>
57	<i>DBF2</i>	143-C-1	Ser/Thr kinase involved in transcription and stress response	<i>YGR092W</i>
58	<i>CAK1</i>	inviable	Cyclin-dependent kinase-activating kinase required for passage through the cell cycle, phosphorylates and activates Cdc28p	<i>YFL029C CIV1</i>
59	<i>TOS3</i>	148-D-6	Protein kinase, related to and functionally redundant with Elm1p and Sak1p for the phosphorylation and activation of Snf1p	<i>YGL179C</i>
60	<i>MPS1</i>	inviable	Dual-specificity kinase required for spindle pole body (SPB) duplication and spindle checkpoint function	<i>YDL028C RPK1</i>
61	<i>MKK1</i>	119-D-2	Mitogen-activated kinase kinase involved in protein kinase C signaling pathway that controls cell integrity	<i>YOR231W SSP32</i>
62	<i>IKS1</i>	134-B-3	Putative serine/threonine kinase	<i>YJL057C</i>
63	<i>MKK2</i>	109-B-7	Mitogen-activated kinase kinase involved in protein kinase C signaling pathway that controls cell integrity	<i>YPL140C LPI6 SSP33</i>

64	<i>IPL1</i>	inviable	Aurora kinase involved in regulating kinetochore-microtubule attachments	<i>YPL209C PAC15</i>
65	<i>YKL161C</i>	117-F-2	Protein kinase implicated in the Slp2p mitogen-activated (MAP) kinase signaling pathway	<i>YKL161C MLP1</i>
66	<i>SGV1</i>	inviable	Cyclin (Bur2p)-dependent protein kinase that functions in transcriptional regulation	<i>YPR161C BUR11</i>
67	<i>KLN28</i>	inviable	Serine/threonine protein kinase, subunit of the transcription factor TFIIF	<i>YDL108W</i>
68	<i>ELM1</i>	116-G-3	Serine/threonine protein kinase that regulates cellular morphogenesis, septin behavior, and cytokinesis	<i>YKL048C LDB9</i>
69	<i>BUD32</i>	171-D-4	Protein kinase proposed to be involved in bud-site selection, telomere uncapping and elongation, and transcription	<i>YGR262C LDB14</i>
70	<i>FUS3</i>	125-F-7	Mitogen-activated serine/threonine protein kinase involved in mating	<i>YBL016W DAC2</i>
71	<i>RIO1</i>	inviable	Essential serine kinase involved in cell cycle progression and processing of the 20S pre-rRNA into mature 18S rRNA	<i>YOR119C RRP10</i>
72	<i>CDC5</i>	inviable	Polo-like kinase with similarity to <i>Xenopus</i> Plx1 and <i>S. pombe</i> Plo1p	<i>YMR001C PKX2 MSD2</i>
73	<i>RIO2</i>	inviable	Essential serine kinase involved in the processing of the 20S pre-rRNA into mature 18S rRNA	<i>YNL207W</i>
74	<i>STE20</i>	121-E-10	Signal transducing kinase of the PAK (p21-activated kinase) family, involved in pheromone response and pseudohyphal/invasive growth pathways, activated by Cdc42p	<i>YHL007C</i>
75	<i>SPS1</i>	147-G-3	Putative protein serine/threonine kinase expressed at the end of meiosis and localized to the prospore membrane, required for correct localization of enzymes involved in spore wall synthesis	<i>YDR523C</i>
76	<i>SSN3</i>	123-F-8	Cyclin-dependent protein kinase, component of RNA polymerase II holoenzyme	<i>YPL042C SRB10 UME5 RYE5 CDK8 GIG2 NUT7</i>
77	<i>CDC7</i>	inviable	DDK (Dbf4-dependent kinase) catalytic subunit required for firing origins and replication fork progression in mitosis through phosphorylation of Mcm2-7p complexes and Cdc45p	<i>YDL017W SAS1 LSD6</i>
78	<i>YCK3</i>	148-F-4	Palmitoylated, vacuolar membrane-localized casein kinase I isoform	<i>YER123W CKI3</i>
79	<i>KLN3</i>	101-E-6	Nonessential protein kinase with unknown cellular role	<i>YAR018C FUN52 NPK1</i>
80	<i>MEC1</i>	inviable	Genome integrity checkpoint protein and PI kinase superfamily member	<i>YBR136W ESR1 SAD3</i>

81	<i>CMK2</i>	132-C-5	Calmodulin-dependent protein kinase Serine/threonine protein kinase required for receptor-mediated endocytosis	<i>YOL016C</i>
82	<i>YPK1</i>	117-D-1	Protein kinase with similarity to serine/threonine protein kinase Ypk1p	<i>YKL126W SLI2</i>
83	<i>YPK2</i>	145-D-12	Mitogen-activated protein kinase (MAPK) involved in signal transduction pathways that control filamentous growth and pheromone response	<i>YMR104C YKR2</i>
84	<i>KSS1</i>	143-B-7	Protein kinase involved in transcriptional activation of osmostress-responsive genes	<i>YGR040W</i>
85	<i>SCH9</i>	175-F-9	Protein kinase of the PAK/Ste20 kinase family, required for cell integrity possibly through regulating 1,6-beta-glucan levels in the wall	<i>YHR205W KOM1</i>
86	<i>KIC1</i>	inviable	Myristoylated serine/threonine protein kinase involved in vacuolar protein sorting	<i>YHR102W NRK1</i>
87	<i>VPS15</i>	171-C-10	Protein kinase of the Mitotic Exit Network that is localized to the spindle pole bodies at late anaphase	<i>YBR097W GRD8 VAC4 VPL19</i>
88	<i>CDC15</i>	inviable	Protein kinase involved in regulating diverse events including vesicular trafficking, DNA repair, and chromosome segregation	<i>YAR019C LYT1</i>
89	<i>HRR25</i>	inviable	Protein kinase related to mammalian glycogen synthase kinases of the GSK-3 family	<i>TPL204W</i>
90	<i>YGK3</i>	131-D-9	Ser/Thr kinase involved in late nuclear division, one of the mitotic exit network (MEN) proteins	<i>YOL128C</i>
91	<i>DBF20</i>	124-A-11	Putative protein kinase, possible substrate of cAMP-dependent protein kinase (PKA)	<i>YPR111W</i>
92	<i>YBR028C</i>	140-B-9	MAP kinase kinase kinase of the HOG1 mitogen-activated signaling pathway	<i>YBR028C</i>
93	<i>SSK22</i>	144-B-6	Putative serine/threonine protein kinase	<i>YCR073C</i>
94	<i>SKS1</i>	123-G-8	Protein kinase primarily involved in telomere length regulation	<i>YPL026C SHA3</i>
95	<i>TEL1</i>	126-C-5	Meiosis-specific serine/threonine protein kinase, functions in meiotic checkpoint, promotes recombination between homologous chromosomes by suppressing double strand break repair between sister chromatids	<i>YBL088C</i>
96	<i>MEK1</i>	107-B-4	Serine/threonine MAP kinase involved in regulating the maintenance of cell wall integrity and progression through the cell cycle	<i>YOR351C MRE4</i>
97	<i>SLT2</i>	114-A-8	Serine/threonine kinase and DNA damage checkpoint effector, mediates cell cycle arrest via phosphorylation	<i>YHR030C SLK2 BYC2 MPK1</i>
98	<i>CHK1</i>	137-D-4		<i>YBR274W</i>

			of Pds1p	
99	<i>HOG1</i>	102-G-10	Mitogen-activated protein kinase involved in osmoregulation via three independent osmosensors	<i>YLR113W SSK3</i>
100	<i>KNS1</i>	101-G-7	Nonessential putative protein kinase of unknown cellular role	<i>YLL019C L124</i>
101	<i>SSK2</i>	141-C-8	MAP kinase kinase kinase of the HOG1 mitogen-activated signaling pathway	<i>YNR031C</i>
102	<i>ALK1</i>	126-D-11	Protein kinase	<i>YGL021W</i>
103	<i>ALK2</i>	125-F-1	Protein kinase	<i>YBL009W</i>
104	<i>MRK1</i>	146-H-9	Glycogen synthase kinase 3 (GSK-3) homolog	<i>YDL079C</i>
105	<i>GCN2</i>	128-E-5	Protein kinase, phosphorylates the alpha-subunit of translation initiation factor eIF2 (Sui2p) in response to starvation	<i>YDR283C AAS1</i>
106	<i>YPL141C</i>	109-B-6	Putative protein kinase	<i>YPL141C</i>
107	<i>SAK1</i>	148-F-7	Upstream serine/threonine kinase for the SNF1 complex	<i>YER129W PAK1</i>
108	<i>RCK1</i>	148-C-1	Protein kinase involved in the response to oxidative stress	<i>YGL158W</i>
109	<i>PKC1</i>	inviable	Protein serine/threonine kinase essential for cell wall remodeling during growth	<i>YBL105C HPO2 STT1 CLY15</i>
110	<i>RCK2</i>	121-H-5	Protein kinase involved in the response to oxidative and osmotic stress	<i>YLR248W CMK3 CLK1</i>
111	<i>BUB1</i>	134-F-4	Protein kinase that forms a complex with Mad1p and Bub3p that is crucial in the checkpoint mechanism required to prevent cell cycle progression into anaphase in the presence of spindle damage, associates with centromere DNA via Skp1p	<i>YGR188C</i>
112	<i>YPL236C</i>	108-D-7	Putative protein kinase that exhibits Akr1p-dependent palmitoylation	<i>YPL236C</i>
113	<i>FMP48</i>	117-H-12	Putative protein of unknown function	<i>YGR052W</i>
114	<i>PHO85</i>	123-G-5	Cyclin-dependent kinase, with ten cyclin partners	<i>YPL031C LDB15</i>
115	<i>PTK1</i>	127-E-6	Putative serine/threonine protein kinase that regulates spermine uptake	<i>YKL198C STK1 KKT8 YKL199C YKT9 POT1</i>
116	<i>CDC28</i>	inviable	Catalytic subunit of the main cell cycle cyclin-dependent kinase (CDK)	<i>YBR160W SRM5 HSL5 CDK1</i>
117	<i>PTK2</i>	138-E-6	Putative serine/threonine protein kinase involved in regulation of ion transport across plasma membrane	<i>YJR059W STK2</i>
118	<i>VHS1</i>	128-B-8	Cytoplasmic serine/threonine protein kinase	<i>YDR247W</i>
119	<i>TPK1</i>	120-A-3	cAMP-dependent protein kinase catalytic subunit	<i>YJL164C PKA1 SRA3</i>
120	<i>RAD53</i>	inviable	Protein kinase, required for cell-cycle arrest in response to DNA damage	<i>YPL153C LSD1 MEC2 SPK1</i>

121	<i>TPK2</i>	108-F-4	cAMP-dependent protein kinase catalytic subunit	<i>YPL203W YKR1 PKA2 PKA3</i>
122	<i>TPK3</i>	117-F-6	cAMP-dependent protein kinase catalytic subunit	<i>YKL166C</i>
123	<i>STE7</i>	139-A-8	Signal transducing MAP kinase kinase involved in pheromone response, where it phosphorylates Fus3p, and in the pseudohyphal/invasive growth pathway, through phosphorylation of Kss1p	<i>YDL159W</i>
124	<i>YAK1</i>	143-D-4	Serine-threonine protein kinase that is part of a glucose-sensing system involved in growth control in response to glucose availability	<i>YJL141C</i>
125	<i>CTK1</i>	143-E-10	Catalytic (alpha) subunit of C-terminal domain kinase I (CTDK-I), which phosphorylates the C-terminal repeated domain of the RNA polymerase II large subunit (Rpo21p) to affect both transcription and pre-mRNA 3' end processing	<i>YKL139W</i>
126	<i>KCC4</i>	115-C-3	Protein kinase of the bud neck involved in the septin checkpoint, associates with septin proteins, negatively regulates Swe1p by phosphorylation, shows structural homology to bud neck kinases Gin4p and Hsl1p	<i>YCL024W</i>
127	<i>TOR1</i>	149-C-4	PIK-related protein kinase and rapamycin target	<i>YJR066W DRR1</i>
128	<i>TOR2</i>	inviable	PIK-related protein kinase and rapamycin target	<i>YKL203C DRR2</i>
129	<i>IRE1</i>	114-C-10	Serine-threonine kinase and endoribonuclease	<i>YHR079C ERN1</i>

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