

Saccharomyces cerevisiae	-----msgelanYkrlEKvGEGTYGVVYKAlDlRpGqGqrVVALKKIRLES
Homo sapiens	-----MEDYtKIEKIGEGTYGVVYKgRhKtT-----GQVAmKKIRLES
Caenorhabditis elegans	mdpiregevahegdsYtlnDftKlEKIGEGTYGVVYKgKnRRT----namVAmKKIRLES
Schizosaccharomyces octosporus	-----MdnYvKVEKIGEGTYGVVYKAKhKss----GrIVAmKKIRLED
Candida pseudohaemulonius	-----MvelsDfgrqEKIGEGTYGVVYKAlDtRh--nnrVVALKKIRLES
Spizellomyces punctatus	-----MdkYdKIEKvGEGTYGVVYKARDRhS-----GEIVALKKIRLET
Apiotrichum porosum	-----mSlqnYtKlEKvGEGTYGVVYKAvDlQs---GnfVALKKIRLEa
Cryptococcus amyloletus	-----mSldnYhKlEKvGEGTYGVVYKAKDinT---GsIVALKKKIRLEa
Kwoniella pini	-----mSldnYtKlEKvGEGTYGVVYKARDIsT---GnfVALKKIRLEa
Malassezia pachydermatis	-----MENYqKIEKvGEGTYGVVYKARDltpGanGrLVALKKIRLEa
Pseudomicrostroma glucosiphilum	-----MENYqKlEKvGEGTYGVVYKARDltaegGGrIVALKKKIRLEa
Nematostella vectensis	-----MdDfsKIEKIGEGTYGVVYKAKhKtT---GgfaALKKKIRLEv
Trichoplax adhaerens	-----MdkYlKIEKIGEGTYGVVYKgKnRnT---qQLVALKKIRLEn
Hemicentrotus pulcherrimus	-----MEDftKIEKlGEGTYGVVYKgRhKRT---GkIVALKKKIRLES
Halocynthia roretzi	-----MEDYiKIEKIGEGTYGVVYKgRhKtT---nQyVALKKIRLES
Oryzias luzonensis	-----MEDYvKIEKIGEGTYGVVYKgRhKsT---GQVAmKKIRLES
Rana dybowskii	-----MdeYaKIEKIGEGTYGVVYKgRhKaT---GQIVAmKKIRLEn
Gallus gallus	-----MEDYtKIEKIGEGTYGVVYKgRhKtT---GQVAmKKIRLES
Drosophila melanogaster	-----MEDFeKIEKIGEGTYGVVYKgRhKlT---GQIVAmKKIRLES
Ixodes scapularis	-----MEDYtKVEKIGEGTYGVVYKgKnKs---GQIVAmKKIRLES

	L62	L84	*L86
Saccharomyces cerevisiae	EDEGVPSTAIREISLLKEL-Kdd----	NIVrLyDIvHsdaHKLYLVFEFLDlDLKRYMeg	
Homo sapiens	EeEGVPSTAIREISLLKEL-RHF----	NIVsLqDvLmQds-rLYLiFEFLsMDLKKYlDS	
Caenorhabditis elegans	EDEGVPSTAIREISLLKEL-qHP----	NvVgLeavimQEn-rLfLiFEFLsfDLKRYMDq	
Schizosaccharomyces octosporus	EsEGVPSTAIREISLLKEv-ndesnrsNcVrLlDILHaES-KLYLVFEFLDMDLKKYMDr		
Candida pseudohaemulonius	EDEGVPSTAIREISLLKELm-Rdd----	NIVrLyDIiHsdSHKLYLVFEFLDlDLKKYMeI	
Spizellomyces punctatus	EDEGVPSTAIREISLLKEL-KHP----	NIVrLlDIvHnda-KLYLiFEFLDlDLKKYMDT	
Apiotrichum porosum	EDEGVPSTsIREISLLKELSKdd----	NIVkLlDIvHQda-KLYLVFEFLDlDLKRYMDS	
Cryptococcus amyloletus	EDEGVPSTsIREISLLKELSKdd----	NIVkLlDIvHsEa-KLYLVFEFLDMDLKKYMDS	
Kwoniella pini	EDEGVPSTsIREISLLKELSKdd----	NIVkLlDIvHsda-KLYLVmEFLDMDLKKYMDN	
Malassezia pachydermatis	EDEGVPSTAIREISLLKEL-Rde----	NIVrLyeIiHQES-rLYLVFEFLDlDLKKYMDN	
Pseudomicrostroma glucosiphilum	EDEGVPSTAIREISLLKEL-Knd----	NIVrLyDIiHQES-KLYLVFEFLDlDLKKYMDN	
Nematostella vectensis	EDEGiPSTAIREISLLKELrhHP----	NvVeLqhILHQEp-KLYLVFEYlTcDLKKhldT	
Trichoplax adhaerens	EeEGVPSTAIREISLLKEL-KHP----	NIVdLievLYEES-KLYLVFEFLDMDLKKRYlDT	
Hemicentrotus pulcherrimus	EeEGVPSTAIREISLLKEL-yHP----	NIVlLeDvLmEpn-rLYLVFEYlTMDLKKYMeS	
Halocynthia roretzi	EeEGVPSTAIREISiLkEL-qHP----	NIVsLlDvLlQES-KLYLVFEFLqMDLKKYMDS	
Oryzias luzonensis	EeEGVPSTAIREISLLKEL-KHP----	NvVrLlDvLmQES-rLYLiFEFLsMDLKKYlDS	
Rana dybowskii	EeEGVPSTAIREISLLKEL-qHP----	NIVcLlDvLmQds-rLYLiFEFLsMDLKKYlDS	
Gallus gallus	EeEGVPSTAIREISLLKEL-hHP----	NIVcLqDvLmQda-rLYLiFEFLsMDLKKYlDT	
Drosophila melanogaster	dEGVPSTAIREISLLKEL-KHe----	NIVcLeDvLmEEn-riYLiFEFLsMDLKKYMDS	
Ixodes scapularis	EdDGVPSTAIREITLLKEL-nHR----	NIVrLqDvimQEn-KvYLVFEFLsMDLKKhldT	

Saccharomyces cerevisiae	IPk-d-QpLgadIVKkfMmQlCkGIayCHShRiLHRDLKPQNLLInKdGnlKLgDFGLAR
Homo sapiens	IPp-G-QymDssLVKSYLYQILQGivFCHSRRVLHRDLKPQNLLIDdKgtIKLADFGLAR
Caenorhabditis elegans	Lgk-d-EyLpletlKSYtFQILQamcFCHqRRViHRDLKPQNLLvDnnGaIKLADFGLAR
Schizosaccharomyces octosporus	IsetGAsaLDPrlVqkfaYQlvnGvnFCHSRRiHRDLKPQNLLIDKEGnlKLADFGLAR
Candida pseudohaemulonius	IPq-G-agLEPsmVKrfMhQlIKGIkhCHShRVLHRDLKPQNLLIDKdGnlKLADFGLAR
Spizellomyces punctatus	qsn----gLsapLiKSYMYQILKGIhYCHchRiLHRDLKPQNLLIDqQGmlKLADFGLAR
Apiotrichum porosum	LPd-k-BaLpPnLVKkftYQlIKGlfyCHvhRVLHRDLKPQNLLIDKEGnlKLADFGLAR
Cryptococcus amyloletus	Lge-k-dgLgPmMVKkfsYQlIKGIYFCHghRiLHRDLKPQNLLInKgGdlKiADFGLAR
Kwoniella pini	Igd-k-dgLgPnMVKkftYQlvKGlyyCHAhRiLHRDLKPQNLLInKEGnlKiADFGLAR
Malassezia pachydermatis	Vad-kpEgLGPeIVmkftYQlvRGIYFCHAhRiLHRDLKPQNLLIDKEGnlKLADFGLAR
Pseudomicrostroma glucosiphilum	Vag-tAdgLgPeIVKkftYQlLRGIYyCHAhRiLHRDLKPQNLLIDKtGnlKLADFGLAR
Nematostella vectensis	trg----mLDktLVKSYLYQITnaIyFCHARRiLHRDLKPQNLLIDSKGlIKLADFGlGr
Trichoplax adhaerens	LPk-G-ktiDamLmKSYLYQIILGvvyCHShRVLHRDLKPQNLLInSKGcIKLADFGlGr
Hemicentrotus pulcherrimus	L-k-G-kqmdPaLVKSYLYhQmvdGIlFCHSRRiLHRDLKPQNLLIDnnGtIKLADFGLAR
Halocynthia roretzi	IPa-G-kymDkeLVKSYtYQILQGItFCHSRRVLHRDLKPQNLLIDnGtiKLADFGLAR
Oryzias luzonensis	IPs-G-QymDEmLVKSYLYQILEGIYFCHrRRVLHRDLKPQNLLIDnKvIKLADFGLAR
Rana dybowskii	IPs-G-QyLEamLVKSYLYQILQGIiFCHARRVLHRDLKPQNLLIDSKGvIKLADFGLAR
Gallus gallus	IPs-G-QyLDrSrVKSYLYQILQGIvFCHSRRVLHRDLKPQNLLIDdKGVIKLADFGLAR
Drosophila melanogaster	LPv-d-khmEseLvrSYLYQITsaIlFCHrRRVLHRDLKPQNLLIDKSGLIKvADFGlGr
Ixodes scapularis	LPk-n-QsmDtkLVKSYLYQILEGIIFCHrRRVLHRDLKPQNLLIDdKGlIKLADFGLAR

Saccharomyces cerevisiae	AFGvPLRaYTHEiVTLLWYRAPEVLLGgkqYSTgVDtWSIGCIFAEMcnrKPiFsGDSEID
Homo sapiens	AFGIPIrVYTHEVVTLLWYRsPEVLLGSaRYSTPVDiWSIGtIFAELATKKPLFHGDSEID
Caenorhabditis elegans	AiGIPIrVYTHEVVTLLWYRAPEiLmGagRYSMgVDMWSIGCIFAEMATKKPLFqGDSEID
Schizosaccharomyces octosporus	sFGvPLRnYTHEiVTLLWYRAPEVLLGSrhYSTgVDiWSVGCIFAEMirrtPLFpGDSEID
Candida pseudohaemulonius	AFGvPLRaYTHEVVTLLWYRAPEiLLGgkqYSTgVDMWSVGCIFAEMcnrKPLFpGDSEID
Spizellomyces punctatus	AFGvPLRtYTHEVVTLLWYRAPEiLLGSkhYSTaVDMWSVGCIFAEMclrhPLFpGDSEID
Apiotrichum porosum	AFGIPLRtYTHEVVTLLWYRAPEVLLGSrhYSTaIdMWSVGCIFAEMamrsPLFpGDSEID
Cryptococcus amyloletus	AFGIPLRtYTHEVVTLLWYRAPEVLLGSrhYSTaIdMWSVGCiVAEAMtrqPLFpGDSEID
Kwoniella pini	AFGIPLRtYTHEVVTLLWYRAPEVLLGSrhYSTaIdMWSVGCiYAEAMmrqPLFpGDSEID
Malassezia pachydermatis	AFGIPLRtYTHEVVTLLWYRAPEVLLGSrhYnTaIdMWSVGCIFAEMamrtPLFpGDSEID
Pseudomicrostroma glucosiphilum	AFGIPLRtYTHEVVTLLWYRAPEVLLGSrhYSTaIdMWSVGCIFAEMAmKsPLFpGDSEID
Nematostella vectensis	AFGIPLRaYTHEVVTLLWYRAPEVLLGgqRYScPiDvWSIGtIFAEMvTKRPLFHGDSEID
Trichoplax adhaerens	AFGvPvRVYTHEVVTLLWYRAPEVLLGStRYSCLDiWStGtIFAEMwlrRPLFqGDSEID
Hemicentrotus pulcherrimus	AFGIPLRtYTHEVVTLLWYRAPEVLLGStRYacPiDMWSLGCIFAEMvTKRPLFHGDSEID
Halocynthia roretzi	AFGIPLRVYTHEVVTLLWYRAPEVLLGStRYSCLDiWStGtIFAEMATKKPLFHGDSEID
Oryzias luzonensis	AFGvPvRVYTHEVVTLLWYRAPEVLLGSPrYSTPVDvWStGtIFAELATKKPLFHGDSEID
Rana dybowskii	AFGIPLRVYTHEVVTLLWYRAPEVLLGSvRYSTPVDvWSIGtIFAELASKKPLFHGDSEID
Gallus gallus	AFGIPLRVYTHEVVTLLWYRAPEVLLGSaLYSTPVDiWSIGtIFAELATKKPLFHGDSEID
Drosophila melanogaster	sFGIPvRIYTHEiVTLLWYRAPEVLLGSPrYScPVDiWSIGCIFAEMATrKPLFqGDSEID
Ixodes scapularis	AFGIPIrVYTHEiVTLLWYRAPEVLLGSPrYSTPiDiWSIaCiFvEMinKRPLFHGDSEID

	*I239
Saccharomyces cerevisiae	qiFkIFRvLGTpNEaIWfdivyLPdfKpsFFqWRrkdLsqvVps-----LDprGIDLl
Homo sapiens	qLFRIFRaLGTpNNEVWPeVeSLqDYKNTFFPKWKpgsLashVKN-----LDENGLDlL
Caenorhabditis elegans	ELFRIFRvLGTpTEleWnGveSLPDYKaTFPKWrenfLrdkfydkktgkhlLDDtafsLL
Schizosaccharomyces octosporus	EiFkIFqzLGTpNEEVWPGVTiLlqDYKSTFFPKWRvdlhrvTpn-----geEaaTeLL
Candida pseudohaemulonius	EiFRIFRiLGTpNEEVWPDvTyLPdfKtTwPKWersdLgphIps-----LDrdGvDlL
Spizellomyces punctatus	EiFRIFRTLGTpNEEiWPNvTtLPDYKenFPiWtaqnLakvlpN-----LeseGvDlL
Apiotrichum porosum	EiFRIFRiLGTpDEESWPGirSLPDYKSsFPqWhqaeLggaVsg-----LDaNGlDlL
Cryptococcus amyloletus	EiFRIFRvLGTpDEdVWPGVrSLPDYKpTFPqWspinLgdvVKg-----LDadGMDlV
Kwoniella pini	EiFRIFRvLGTpDEdVWPGVraLPDYKpTFPqWnaveLksaVKg-----LDENGsDlL
Malassezia pachydermatis	EiFRIFRTLGTpNdeVWPGVqSLPDYKtTFPKWngvpLksaVsg-----LDDtGLDlL
Pseudomicrostroma glucosiphilum	EiFRIFRTLGTpTdaVWPGVktLPDYKasFPqWsgmpLakaVpN-----LDaNGIDlL
Nematostella vectensis	qLFRIFRiLGTpTEEtWkGVtSLPDYKpTFPKWagdgLkkaVpq-----LDsdGLDlL
Trichoplax adhaerens	ELFRIFRiLGTpdddIWPGVSSLPefKKSsFPKWSkqsydtfVpN-----msEsGIDlL
Hemicentrotus pulcherrimus	qLFRIFRtLGTpTdeIWPGVTqLqDYKSTFFPmWtkpnikgaVKg-----mDeeGLDlL
Halocynthia roretzi	qLFRIFRvLGTatEddWPGVTSLkDYKrTFPKWKkgmvvesVKN-----LnEeGIDlL
Oryzias luzonensis	qLFRIFRtLGTpNndVWPDVeSLPDYKNTFFPKWKggsLssmVKN-----LDKNGlDlL
Rana dybowskii	qLFRIIselwGTPNnEVWPeVeSLqDYKNTFFPKWKggsLaanVKN-----iDKeGLDlL
Gallus gallus	qLFRIFRaLGTpNndVWPDVeSLqDYKNTFFPKWKpgsLgthVqN-----LDeDGLDlL
Drosophila melanogaster	qLFRmFRiLkTpTEdIWPGVTSLPDYKNTFFCWstnqLtnqLKN-----LDaNGIDLi
Ixodes scapularis	qLFRIFRtLGTpTEdtWPGVTkLPDYKSsFPnWseniLrsllKN-----mDDdGIDlL

Saccharomyces cerevisiae	dKlLaYDPinRISArRAaiHPYFqEs-----
Homo sapiens	SKMLIYDPAkRISgKmaLnHPYFNdlDnqikm-----
Caenorhabditis elegans	egLliYDPSlRlnAKKALvHPYFDnmDtS---kLPagnyrGeIelf
Schizosaccharomyces octosporus	saMLVYDPAhRISAKRALqgPYlrEygeTfv-----
Candida pseudohaemulonius	eqMLnYDPSnRISAKRALvHPYFqEdNdeaydsyPrsvnmG----
Spizellomyces punctatus	SRLLVYDPAqRISAKRALsHPYFadvDtSkSl-----
Apiotrichum porosum	AqtLIYDPAqRISAKRALqHPYFatsvaAaangta-----
Cryptococcus amyloletus	AqtLVfDPAhRISAKRALrHPYFDtvNlAaa-----
Kwoniella pini	AqtLIIfDPAhRISAKRALqHPYFtstypA-----
Malassezia pachydermatis	hhMLIYDPAiRISAKRALqHPYFasvsaa-----
Pseudomicrostroma glucosiphilum	kgMLVYDPAgRvSAKRgLnHaYFqslpgSamas-----
Nematostella vectensis	kKMLIYDPAIRISAKTsLkHPYFlnDpkfdinsLPktpevdsVm--
Trichoplax adhaerens	SKMLIYDPAAnRISgKRALsHPYFDDlDkS---tLPtdrws-----
Hemicentrotus pulcherrimus	eKMLIYDPAkRItAKasmrHPYFDnipdlsdrlqPirs-----
Halocynthia roretzi	qKcLVYDPAkRISAKALmHPYFNnlDkklclvLtsalfhe-----
Oryzias luzonensis	AKMLIYnFpkRISAreAmtHPYFDDlDkS---tLPaacingv----
Rana dybowskii	AKMLVYDPAkRISArKALLHPYFDDlDkS---sLPanqirn-----
Gallus gallus	SKMLIYDPAkRISgKmaLnHPYFDDlDkS---tLPanlikkf----
Drosophila melanogaster	qKMLIYDFvhRISAKdiLeHPYFNqfgsglvrn-----
Ixodes scapularis	ekMLVYDFvrrISAKdcLdHPYlND-----

Supplementary Figure 11. Multiple alignment of CMGC/CDK/CDC2 protein kinase orthologs. Blue capital letters stand for highly conserved positions, as suggested by the EBI web server (<https://www.ebi.ac.uk/Tools/msa/muscle/>). Asterisks show positions of amino acid changed in *cdc28* mutants found in our work (labeled either on the right of left to the asterisk). Protein identifiers: NP_001307847.1 (*Homo sapiens*), NP_009718.3 (*Saccharomyces cerevisiae*),

XP_016605543.1 (*Spizellomyces punctatus*), XP_017992564.1 (*Malassezia pachydermatis*), XP_028477809.1 (*Apiotrichum porosum*), XP_025347166.1 (*Pseudomicrostroma glucosiphilum*), XP_019012246.1 (*Kwoniella pini*), XP_018995495.1 (*Cryptococcus amylo lentus*), XP_024712237.1 (*Candida pseudohaemulon is*), XP_013017915.1 (*Schizosaccharomyces octosporus*), P13863 (*Gallus gallus*), P34556 (*Caenorhabditis elegans*), P23572 (*Drosophila melanogaster*), BAC98412.1 (*Halocynthia roretzi*), Q9DG98 (*Oryzias luzonensis*), Q9W739 (*Rana dybowskii*), BAA23218.1 (*Hemicentrotus pulcherrimus*), XP_001635734.1 (*Nematostella vectensis*), XP_002111844.1 (*Trichoplax adhaerens*), XP_002415172.1 (*Ixodes scapularis*).