IDS1XXXEXXNX(22)P motif Thermotoga maritima ------MDARIVNALIG<mark>S</mark>VYETIRDVLGIEPKTGKPSTVS HIEIPHSLVTVIGITGGIEGSLIYSFSSETALK<mark>V</mark>VSAM<mark>M</mark>GGMEYNQLDEL AL<mark>S</mark>AIG<mark>E</mark>LG<mark>N</mark>MTA<mark>G</mark>KLAMKLEH--LGKHVD<mark>I</mark>TP<mark>P</mark>TVVSGRDLKIKSFGVI LKLPISVFSEEDFD<mark>L</mark>HLSVKSGG DLTKECANOIIGYAKNLLNDAKGDDEYKLGIPEYLGKVD-FSEIV-LD EALTYKFE-NCYFRIGYCK----Campylobacter jejuni --------MLKILEY<mark>S</mark>ITHFCEHILRLRIEAAOD---- ISGELYGASIPIMGKSEGECNFYLFFPKEFLKK<mark>I</mark>AEIL<mark>I</mark>NDEKFKEDDWC Campylobacter volucris ----MNKTLEY<mark>S</mark>IHHFCVOVLKLKIEPTST---- IKGELYGASIPIYFKDE-EYSFYLFFOKKALNE<mark>T</mark>ALVL<mark>L</mark>H-EELKEDGLA DLVKEIANOIVGYTKKLLNDTNGKDEFKLGVPEYLGHVEKLSSIK-LK EKFTYTLK-DSCFRIGYKKL---Campylobacter avium -----MISNIEKSTKHEFEDILKEKITKDDN---- ISGELYGSSIVLSSESEGDYEFYLFEPKEVFEK<mark>E</mark>ROIE<mark>L</mark>KNAVEKEDDFC DLAKECANEIIGYAKVKLNENK--KEYSLGIPEYLGRVD-FANFK-LD EEFTYSMO-GCNFRIGYKKA---DLVKEIANOIVGYAKKLLNDTNGKDEFKLGVPEYLGHVEKLSSIK-LK EKFTYNLK-NSSFR<mark>I</mark>GYKSL---Campylobacter insulaenigrae -----MNKTLEY<mark>S</mark>IHHFFVOVLKFKIESTNT---- IRGELYGASIPIYFKDK-EYSFYLFFOKEALNE<mark>I</mark>AAVL<mark>L</mark>H-DKLKEDGLA Campylobacter sp. RM8964 DLSR<mark>E</mark>VA<mark>N</mark>QIV<mark>G</mark>YAKHLLSD-NNNGVYK<mark>L</mark>GT<mark>P</mark>EFLGKVEKFPVR--LE KSQIFKIK-NKTFK<mark>I</mark>GYKKA---Campylobacter helveticus DLTK<mark>e</mark>Ca<mark>n</mark>qii<mark>G</mark>YAKNLLNDVKGEDEYK<mark>L</mark>GI<mark>P</mark>EYLGRID-FSSIK-LE ESLTYSIE-NHNFR<mark>I</mark>GFKKYER-Campylobacter subantarcticus Campylobacter sputorum DICK<mark>E</mark>VA<mark>N</mark>QII<mark>G</mark>YAKNLLVD-RGKDEYK<mark>L</mark>GT<mark>P</mark>EYLGMTKNFGLR--LN EKIIFKMN-NRTFQ<mark>I</mark>GYKKV---DLSK<mark>E</mark>IS<mark>N</mark>OII<mark>G</mark>RVKVVLNNSNDKSOYKLGTP</mark>EFLGEVKNFNIK--LD DKIIYKMK-NRTFO<mark>I</mark>GYKKV---Campylobacter pinnipediorum DLCK<mark>E</mark>IA<mark>N</mark>OII<mark>G</mark>KAKNLLNE-RENNAYKLGTPEFLGEVDVFRIK--LE EKFVYKMK-NRTFO<mark>I</mark>GYNKA---Campylobacter curvus Campylobacter lanienae LGKDLYGASIPIY-KDGEEIOFYLYFKKETLELFVDKLFNKEEGKKTDLG LSR<mark>E</mark>VA<mark>N</mark>QIV<mark>G</mark>YAKNLLND-NNNGNYK<mark>L</mark>GT<mark>P</mark>EFLGKVERFPVR--LE KSQIFKMK-NKTFK<mark>I</mark>GYKRA---Campylobacter hepaticus DLIK<mark>ecan</mark>oli**g**yaknlındakedieyk<mark>i</mark>gi <mark>p</mark>eylgkid-fskiv-ld esltykfe-nsyfr<mark>i</mark>gyck-----MLKILKY<mark>S</mark>ISHFFEHILKLHIOAAOD---- ISGEFYGASIPIIGKNEGEYNFYLFFPKEFLOK<mark>I</mark>ADIL<mark>I</mark>HGEKFKEDDWC Campylobacter coli ---MLKVLEY<mark>S</mark>ITHFFEHILRLHIEKAED---- IVGELYGASIPVMEKSGREYHFYLFFPKEFLQT<mark>I</mark>ANVL<mark>V</mark>RDEKFKEDDWC LSK<mark>E</mark>CA<mark>N</mark>QII<mark>G</mark>YAKNLLNDAKGDDEYK<mark>L</mark>GI<mark>P</mark>EYLGRVD-FSSII-LD ESLTYSFE-NHYFR<mark>I</mark>GYCK----Campylobacter upsaliensis ----MLKILEYSITHFCEHILRLRIEKGEN---- IGGELYGASIPIEGTKGNEYDFYLFFPKEALKKFADVLISDYKFKEDDWC DLIK<mark>E</mark>CA<mark>N</mark>OII<mark>G</mark>YAKNLLNDAKGEDEYKLGI<mark>P</mark>EYLGRID-FSTIK-LD ESLTYSID-NYNFR<mark>I</mark>GFKKYE--DICK<mark>EVAN</mark>LAI<mark>G</mark>YAKNLLNE-REANAYKLGTPEYLGRTS-FHVK--LD DKRVYKIK-NRTFO<mark>V</mark>GYKKA---Campylobacter showae ---MDVAELGIKHICEDTIGYKVESAKS---- AEGEFYGSSLPIF-KGKEEFHFYLYFKKDTINRFASVI<mark>I</mark>GVDKLAEDEIS DLSR<mark>E</mark>VA<mark>N</mark>QII<mark>G</mark>YAKNLLND-RHDGKYK<mark>L</mark>GT<mark>P</mark>EFLGKVESFPVK--LA ESKLFKMK-NRTFK<mark>I</mark>GYKKA---Campylobacter fetus -----MMSAVCYATKHFCTDTLGFELKDGSK---- LGKDVYGASIPVY-KDNEEYOFFLYFKRDTLKY<mark>F</mark>AKVL<mark>L</mark>NVSDEKHVDLG DLVK<mark>E</mark>CA<mark>N</mark>QII<mark>G</mark>YAKNLLNDVKGDDVYK<mark>L</mark>GI<mark>P</mark>EYLGRVD-FSSIN-LD ESLTYELE-NHCFR<mark>I</mark>GYKKV---Campylobacter cuniculorum -----MLKIIEY<mark>S</mark>AIHFCEHILKLHIRKVED---- ISGELYGASIPITGQDNGEYNFYLFFSVEVLKK<mark>I</mark>VDVY<mark>V</mark>RNNKFKEDDWA Campylobacter lari ----MTKTLEYSIYHFFEHILKLKISOKSV---- IRGELYGASIPLYFKDE-EYSFYLFFOKOALNEIALFLLH-EELKEDGLA DLVK<mark>E</mark>VA<mark>N</mark>OII<mark>G</mark>YAKKLLNDTNGKDEYR<mark>L</mark>GV<mark>P</mark>EYLGRIDGFSKIK-LK EKFTYEVK-NASFR<mark>I</mark>GYKKI---Campylobacter peloridis DLVK<mark>E</mark>IA<mark>N</mark>QIV<mark>G</mark>YAKKLLNDANGKDEFK<mark>L</mark>GV<mark>P</mark>EYLGHVEKLSSIK-LK AKFTYIMK-NARFR<mark>I</mark>GYKKL---Campylobacter concisus -MRKVIDE<mark>A</mark>TSYLCKDTLGLDLEFGKS---- LGKGFYGASIPVY-KGKSEYHFYLFFKKDTLKI<mark>F</mark>MNAF<mark>F</mark>GHEDVDGGDLD DLCK<mark>E</mark>IA<mark>N</mark>OII<mark>G</mark>KAKNLLNE-KEPNAYKLGTPEFLGEVENFGIK--LK EKFIYKIK-NRTFO<mark>I</mark>GYDIO---Campylobacter iquaniorum -MMSAVCY<mark>S</mark>TKHFCTDILGEELEDGSK---- LGKDVYGASIPVF-KNKEEYHFYLYFKTDTLKY<mark>F</mark>AKVL<mark>L</mark>NN-DIKOVDLD DLCK<mark>E</mark>VA<mark>N</mark>QII<mark>G</mark>YAKNLLND-RGDGDYK**L**GT<mark>P</mark>EFLGKVDVFPVK--LE ESKLFKMK-NRTFE<mark>I</mark>GYKKA---DLCREVANQII<mark>G</mark>YAKNLLNE-QGK-KYKLGTPEFLGKVESFPVE--LI EYRLFKMK-NRTFK<mark>I</mark>GYKKA---Campylobacter hyointestinalis -MMDAVYEATKHFCSDVLGFKLENGSK---- LGDNVYGASIPVL-DGSDEYOFYLYFKKDTLNYFAEVL<mark>L</mark>NSDDSSOVDLA DMSK<mark>efanlvvg</mark>hskvlaee--ngesfh<mark>i</mark>st<mark>p</mark>tfygis--rihd--yd kaihfkfdhsrycs<mark>i</mark>fvka----Helicobacter mustelae MLNPHKIKKRYNRKILFLEFVVELLRKSFIEVLKNTAGIVPQDSLK---- PLRDGYISSVELLES---KKRVFIVANEEFLKLLSEKMILDDHPDEEVLI Helicobacter cholecystus DLSK<mark>E</mark>IANLVI<mark>G</mark>HAKVLLAQ--KGVHIQ<mark>I</mark>TT<mark>P</mark>TSLGQT--IPSH--SL KGIHFAIQEGK-CS<mark>M</mark>YKEHVC--DLSKELANLVV<mark>G</mark>HAKVLYSK--QNKHLNLGTPQFWGED--YTIQ--QN NGLHFELNGTK-CS<mark>I</mark>YME-----Helicobacter sp. MIT 01-6242 ------MNPLIS<mark>S</mark>FIETIQSSINIKPTQISE---- GVRQGFVSSIKLQN-----QEIFFCCELTFLKL<mark>L</mark>ASEM<mark>L</mark>FEDQPSQEILL Helicobacter hepaticus ----mdiihr<mark>s</mark>ffdivonsinktphdsim---- plkkgylsrismig---thnnvyllfdkaflrifcveflgeenpdeoale DMAK<mark>E</mark>LA<mark>N</mark>LTV<mark>G</mark>RAKVMTOE--LGKSFNIST<mark>P</mark>DFLGHR--LIKN--YD HGLHFRLDNGR-CS<mark>I</mark>YIRRVD--Helicobacter typhlonius ----MDIIHR<mark>S</mark>FFDIVEKSINKKPTDSIM---- PLKKGYLSRISMIG---TRNDVFLLFDKVFLRI<mark>F</mark>CRDF**L**GDHSPTEOALE DMAR<mark>E</mark>LA<mark>N</mark>LTV<mark>G</mark>RAKVMAOE--LGKSFD<mark>I</mark>ST<mark>P</mark>EFLGHR--LIKN--HD HGLHFRLDNGH-CS<mark>T</mark>YMRRIN--DMAK<mark>ELAN</mark>LVV<mark>G</mark>HAKVIAAK--KOKNFN<mark>I</mark>SV<mark>P</mark>TYVGYK--LLKD--YD SGLHFKLKRGH-CG<mark>I</mark>YMRGVK--Helicobacter himalavensis ----MDITHOS FVEVVOESISOS PKDSII.---- PLKKGYITKISMLENGKVSR DVFLLFDKA FLRIFCAOL<mark>T</mark>DELNESKDALE Helicobacter pullorum DLSQ<mark>E</mark>LANLTI<mark>G</mark>LAKVLAVT--ENIKFN<mark>I</mark>ST<mark>P</mark>RVYGFG--EFQDT-HS SSFNFSLGRGAKCS<mark>L</mark>FMHNKSL------MEKIIINAFROVLKDTLGETPKRVTR---- KLTKGFLSSIDIFLENEEKDTITFVSSKDFLAKLGNGLFGEEELDEIALK DLANELSNLVVGVAKVIASD--EGKDFT<mark>I</mark>STPQFLKIG--KFEPK-SE ASLHFKTSY-SFCS<mark>L</mark>YIGAVRG-Wolinella succinogenes ----MIEVLEK<mark>a</mark>fiksioemleetpkkakr---- MMKNGFISSIEILSSGE-RIPVFLIIRPLLLOA<mark>L</mark>ANRL<mark>I</mark>GEKEPDEATLI Helicobacter cinaedi --MDIIHN<mark>S</mark>FFDVVOKSISKTPHDSIM---- PLKRGYLSRISMVG---AHNDVFLLFNKAFLRI<mark>F</mark>CVDF<mark>L</mark>GEENPSEOALE DMAK<mark>E</mark>LA<mark>N</mark>LVV<mark>G</mark>RAKVMTOE--LGKHFNIST<mark>P</mark>EYLGHR--LIKN--YD HGLHFRLKOGR-CS<mark>I</mark>YMRRVH--Sulfurospirillum barnesii DLLK<mark>E</mark>IA<mark>N</mark>QII<mark>G</mark>SAKVLLEEKYPENTYH<mark>L</mark>SV<mark>P</mark>EFMGNVCAPFPIP-LS DRHHFQVK-DSTFI<mark>I</mark>AR-----DLLK<mark>E</mark>IA<mark>N</mark>OII<mark>G</mark>SAKVILEEKYPHNDYH<mark>L</mark>SV<mark>P</mark>EFMGNVATPFPIA-LO ETOHYOIK-NSTFV<mark>I</mark>AK-----Sulfurospirillum halorespirans -MKEAVIO<mark>A</mark>TENFCSTILCEVPOKASE---- LGSYFYGSAIALI-ENEMEHTWYLFFEKKVLDE<mark>I</mark>ALNL<mark>L</mark>FEENLCEEDLI --MREAVIEATHAFFETILCEVPOKIES---- LGEYFYGSAISLL-ENEAEHTWYLFFEKKVLDG<mark>I</mark>ALNI<mark>L</mark>FEENLCEDDLU DLLK<mark>e</mark>ia<mark>n</mark>oii<mark>g</mark>sakvlleekyphnnyh<mark>l</mark>sv<mark>p</mark>efmgnvcapfpip-ls dahhfoio-nstfv<mark>i</mark>ar-----Sulfurospirillum deleyianum DLLK<mark>E</mark>IA<mark>N</mark>QII<mark>G</mark>SAKVILEERYPHNDYH<mark>L</mark>SV<mark>P</mark>EFMGNVATPFPIA-LQ VAQHYQIK-NSTFV<mark>I</mark>AK-----Sulfurospirillum multivorans --MKEAVIOATENFCSTILCEVPOKASE---- LGSYFYGSAIALI-ENEMEHTWYLFFEKKVLDE<mark>I</mark>ALNL<mark>L</mark>FEENLCENDLD Sulfurospirillum cavolei ----mkqavls<mark>a</mark>aenfcstilstslrqgrl---- etdnfygaavsly-eneaehiwyllfqretlnq<mark>i</mark>aqnl<mark>l</mark>fedslceddld DLIKEVSNQIIGGAKVILQQKYPNHTYQLSVPEFMGHISHPFPFT-TQ ETLCYSLN-DFSFV<mark>I</mark>ARQ-----Sulfurospirillum sp. SL2-1 DLLK<mark>E</mark>IA<mark>N</mark>QII<mark>G</mark>SAKVILQGQNPNSDYQ<mark>L</mark>NM<mark>P</mark>EFLGNVSAPLPIK-LE ESLLYTIN-NSTFV<mark>I</mark>GR-----------MKOAVIEATENFCSTILCEIPRMVEN---- LGGOFYGSAIALI-ENECEHIWYLFFEKETLNEIAKNLLFEDNLCEDDLD <mark>DMLLE</mark>TT<mark>N</mark>MIV<mark>G</mark>SAKVLAGELY-ETSLS<mark>I</mark>ATP-FLLSDEEVSAVQ-LD NSKCIGIN-GGEMT<mark>I</mark>ALQRL---Sulfuricurvum kujiense -----MLPTIVE<mark>A</mark>ATNEELHOIRLPYDEIDS---- TKKRTLEAYIDIETTNGEIHRAYIGCDPMLIOT<mark>I</mark>AEIE<mark>L</mark>GEDESDEOTLI Sulfuricurvum sp. IAE1 -----MLPIIVE<mark>A</mark>AANFCLHOIRLPYEITELP--- PKKRTLFAFIDIES-NGSTHRAYIGCDPTLIOA<mark>I</mark>AEIF<mark>L</mark>GEDESDEOTLT DMLL<mark>e</mark>ta<mark>n</mark>miv<mark>g</mark>sakvlaaeay-dtsmmiat<mark>p</mark>-ffvs-eelsoir-pd elocigin-dgelt<mark>i</mark>alkrl---Sulfurimonas gotlandica -----MLKTIIQ<mark>A</mark>SENFCIHQIREPHVISDGI--- NKKRTLIAYIDIEAKNGKKHRVYIASDEKFMQR<mark>I</mark>SKLF<mark>L</mark>EEDESDEETLI DMTLETTNMIVGSAKVIAEEAD-ENPYTINTP-HFEKIDHF-DFE-YD EAKILKIE-NDEMIIAIKEL--------mtdllki<mark>s</mark>maevfeonfgmrllpcknl--- pnrdgyraripflcesgersiatlwlorptlkl<mark>v</mark>skil<mark>l</mark>feddpdeeslk DLTS<mark>E</mark>LA<mark>N</mark>FIV<mark>G</mark>HAKMLASD--RNIPCR<mark>I</mark>ET<mark>P</mark>EFAGVG---PLQN-GE ETILFKTG-NRCIA<mark>L</mark>QVKG----Hydrogenimonas sp. MAG Caminibacter mediatlanticus ------MNNILYO<mark>S</mark>CENFAKSLGIDIIKCNDD---- ---DIKGFVSEVDVRGDLNYKVYVVLPKEKLDM<mark>V</mark>SEIF<mark>F</mark>GDTSYDIE-DLSK<mark>e</mark>la<mark>n</mark>liv<mark>g</mark>nanvvase--kninfd<mark>i</mark>sv<mark>e</mark>kflgey---knle-fd dkiclksn-gikff<mark>v</mark>lykee---Cetia pacifica -----MEDVINE<mark>S</mark>AKEFASSI.GAOLTECNEK---- ---NLRGYVSKISISGDENYDIYLVLPKDKI.DL<mark>V</mark>SELF<mark>F</mark>GDTEYDVD-DLSNEIANLIIGASKVKALD--KNIKFDISVPEFLGEY---KSID-YD NMYCFKLN-GRDFY<mark>I</mark>LLKER---Nautilia profundicola -----MENTIKEAVKNEMDSIEAKADECNEE---- ---LGNGFVSKIATTGDENYDIYIIVPHEKLSY<mark>T</mark>ANYY<mark>F</mark>GDDDYDTE---DLTKEIANQIIGNAKIIAAE--KNINFD<mark>I</mark>SV<mark>P</mark>EFLGEFD--KNIE-YD DMLSFKFNGDKCFY<mark>I</mark>LFKGK----<mark>DLTKE</mark>IA<mark>NQIIG</mark>NAKIVAQK--RNVSFD<mark>I</mark>GV<mark>P</mark>EYLGEFD--KNIE-YD DILSFKFNGDKCFY<mark>I</mark>LFKGK---Nautilia sp. PV-1 Lebetimonas sp. JS138 -<mark>DLTNEIAN</mark>LIV<mark>G</mark>NAKIIAOK--KKINFN<mark>I</mark>ST<mark>P</mark>EFLGKFN--KNIE-YD DVLAFKYK-TVCFY<mark>I</mark>LFKEK---

S2 Fig. Sequence alignment of potential CheX homologs in *Campylobacterota* species with experimentally confirmed CheX from *Thermotoga maritima* shown on the top.