

A

5'3' Frame 1

ITFTTSTRTGTGTANPKNFLACPSKSHINPNVANPKLVYTHQGLVMDISTNTQNLAFISDTTFFPLVLVTPNSNHIQTALICENKYGVLGTRSGGHDGACMYISQVPPYVVDLNMNKKIKIDVQ2TANVAGATGLVYYNINENKNLSFGGZCTVGVGGH
GGTGAAGGYYLGAADNIDARLVGGGVLKRRSGEDFLPARGTGGGSGNIAAKKIKLVYVPSKSTIPVYKAGMIGHLVLPKNNKATYKQVGLNDFWIPITKNTINSGKNTATVGVFPISIPGGVSDVLDNMKKFSGELGKTSCKEKFNIIDTIFGVGV
NNTANPKKKYIKIDVQKPIETAMNKKLELVYEDVAGAKYLVYFPLMISGSAIPFFIRAGDNYELATYATKQKQENKKIDWIPVYVYVITPTVSGNPLATLVNYSGLGKDTNHSAPNTDA

THCAS TK20 (Drug-type)

53' Frame 3

THCAS TK55 (Drug-type)

5' Frame 3
FFFLPFIQISIANPKNFKLCKSIKHNNVANKLYTQHQQLVNLSTIQLQAFISDTTPFLPLVITPNNHSIQATILCKSKVVLQIKTRSGKDAKQNYISQVFFVYVLHNMISIKIDVHQIATWAGATLKYETVYINMKHNSLSPGGCPTVVGSGRPS
DGTALMNTGLAANDINLHNVGQYGLQKQKGLDGLFATGSGGEMFVLIAHKELIYVSTGTFVYKNNLHGVLKPLNNQNIATIKYSDGLVLMHFTIKNTDNGKNTVYGVSSIFHGGVGGVLYLHMNFFPELGIKTKCKEFLNDDITTFISQVW
PNTANPKKILLVSGSKKATSIKLDVYKFFIPETAMKILKLYKEDGAKQNYLYPTQGLMEEISGAPFFPHNGLMELYNATAGNQGDKNNHNVNNTVTFVQGNFLAYLNTQGLKTRSGASPHYTGQ

THCAS TK137 (Drug-type)

5' Frame 1

ITVFTSTHTIGTIANPKNFLACPSKTHPNVNVKPLVTPQDQLYMTINSTIQHNLAFSTTFFPLVIVTPFNNGHQTATLCKKKYGLQIRTKGGHDAKMTISQVFPYVVDLNAISIKIDVHSGTANVVGATGLGVYVYTKKNNKLSFGQCTPTVVGGRF
GGGAGLMDVNVGLAAGNITDAGLVGGGKYLKGGGGLPAGLGGGGGGGTAANKYIKVAPSKTITVTVGGGCHGLGVVGNQGHIAKYKQGLVLYMTHTIKHLYHGGHKTATVGGFPIFGVGGVGLVGGGKSGFELGSKTKTCKQKSPKIDOTTITVGGV
NNYNNANKKILDSJAGSGSGFVLYGVKPIFETAMKYLKLVGGGVGNNVLYPFGGIMSLGGATFPFHAGIYLYLATADAGQSGHKKHNVGGVYNTTTPVVGQFLATLVGGGLGKGNHAGNNTTQ

THCAS TK1 (Intermediate-type)

[illegible]

THCAS TK97 (Intermediate-type)

53' Frame 2

FFFLFFFTQTSTANPRENFKLPCKSKH:PNVNAVPLVYTGROOL:INSTITIIONLEFISTCTTEFLVITVPHSHHITLCKLXKVVLQINTROOKDA:GMYISIVQVYVYVVLNMM:SIKINHWGATNAGATLREYVYIN:HEKKNLSFGQCYCTVYVGGHPSG
GYTALM:TLAAGN:ICAHMLVNDGYV:DR:EM:EDLFAW:GROG:FF:IAAK:IKLVA:PS:IT:FFVGGN:MLGVL:FNH:QKAT:YDCLV:LV:TR:FIN:ITN:GK:YK:YV:IS:FG:GVL:VLM:K:FF:EL:IK:IT:CK:EF:NV:IT:TF:Y:SOVN
DYNAL:KELL:LV:YV:IS:IKL:VY:YV:IT:PM:V:ML:ER:LY:K:YV:G:G:V:ML:VY:YV:G:G:EE:IS:SA:IP:YV:RAG:IK:LV:KY:TA:W:K:Q:K:IN:V:V:V:IT:VY:YV:G:G:PL:AT:IN:DL:G:K:YV:IS:V:V:YV:YV:G:G

THCAS TK127 (Intermediate-type)

5' Frame 3

FTQTSTANPREPLKCFKSHINQVANKLVYTCDDQLVSLINSTIQLNPLISDTTFEPFLVYTFPHHIGLITGLIKKVGGLGIRTRGGHGEAGMISLISQVPPYDGLRMSIKIDVNSQTAKYAGATGLGATVYNNMEKNNLSFTFGQCTPVGGGFGGGGTGA
NNNGLAAGLIDAILWVDSKVGKRRMSGLNPLAFKGGGSGGPIIAAEIKLVAYSTSTPVYKRNMEGLGVVLPNFKNIGLITKRYGLVLTFTFTKNTTGGKNNKTTHVGTSTSPHGGVGLVGLVNNKSFPELIGLTKCKEFPVDTTIPSTGVYNTNAN
PKKELITTHAGAGQATSLGLTVKPPIPSTAMPIIAKLYIEEYSGAGTLLVYFGGIMESISAPITPPHAGIMELMTATNKKRQDQKIMINVSYNPTTPTTTPPPLAYLATGLSGLKATNSHPYTGQ

THCAS TK61F1-CO-2G (Intermediate-type)

5' Frame 1

TGTAATPNTPLACFSKILPNVAAPKLVYTGQDCLV**AG**LTSLTSLTQSAFISDTPHPLVIVPNNKHIGATILCCRRVQLQITRGGSDHAG**ME**ITLQVPPVYVGLAH**MS**IKIDVHSQTAFACATIGEVYTNINAKNLSLFPQGTCTPVVGGHFGGGTGAL**MS**
VLAADAIITDARLVVGGYGLAK**MS**GGVLAIRGGSGGSGITAAKIKLVAVPSSKSTIPFYVGG**MS**IRGLFLNPKQNTATKYRGLVGLDGLFLTNTLTGNNHKKSTVYVPS**SI**PIGVGGVLYLMS**MS**FFGPGVGLKTKTCKCKHNTDTYLVYVGGVNNVANK**MS**
SLYSDYSGVSSYSIKLIDYVYVYFET**AP**AKVILKLTREDVAGVAVPLTPYD**IG**IKLIDEGALTPYVHAGINLYLAKTATWKGQGNKHINWYDCCSGRGTNQAQGLAKLKTATKKTGSIPQVYF**YS**

THCAS TK61F1-CO-5P (Intermediate-type)

5' Frame 1

PHIVANIKLVTYQDQLYELILNETIQNLRFIDSTTFKPLVIVPNNHIGATILCEKRYVLGIRTRGGGSDGMYISQVIVPYVVLNMSIKIPIVNSQWYAGATILGYYIWNKNNLSIPGGYCTPVYGGHFGGGTGALMNYGLAANIIDALVYVGG
VKKKSDKIDKGGGGGGGTPIAANKIKLVAPSSGTFIPVKNMILGVLKPHNQIAKTKSGVLAETSIITNLTGNNGTIVGPTSSIPGGVGLVGLNMSFPLGIGKTKCKEFSWDTTFSDVNVNTANFKKILLYSTGTWTFASIKLQ
YKKEPIETAMKILKASIGYDGAQMYLVLSYTGMLGILSDAPVIFURAGILMLYLTAGDSQKQKSLNMYVSYNTPIYTSQVPLATYALDGLGTGNAHPSNTR

THCAS TK60 (Fiber-type)

53' Frame 1

TTFTTFFNTQTSIAMPENCLFQSEYIPNNPNKFIYTTQDQLYMDYLNSTQNLNLTSTQTFKFLKLVTPNNVSH--ASILCKKKVQLQITKPSGQDAEGLSYIGQVPAIVDLAA--MUTKYDINISQATKAYAGATLGRTYTKINMMHNFETFFQDQCTPVVDGSHF
GGTALNCTNGLAANITDAILVYQYKGLKLNDEGFLPILKGGGNGFIIAAKKFLVYVVYKATITFVSKNMGILGLPNNQKVAITKQKDCMCTFTNNTTNGKNGNITVTGTSIFLQGVDSLVQNNKSFELGKIGKNGNINLITETTFISQV
NNTANPKKILISLQASGKTATFSKLDYVQLPETAAMKILKELKYEKSGNGVLYLFGGKINLESTFPLDLA--DEYLYATVYKQKQKNGKDAWGLVFTFTPVVQSPRLATYNLSTGLSKGTNPSFNQTV

THCAS TK61 (Fiber-type)

5' Frame 2

ITSLINHTGISIANPQENLKCFSEYINNNPANPKFITTCQDQLVNVLTSTIQLAFTSTITTFPLVITVFENNVHIGAILCKKKVQLQINTRGGCGAGLSYISQVFAIVLNNMTKYVIGISQTAVLAGATIGATVYVYHNNNNFSTFGGCTCTFYGVGGHFS
GGTGLANFTDVAANDINLVYVQGVLOKNGDGLNATRGGGGNGIIAARVITLCTVYVSKATITVFVNNKIHGLVLPKNSQIAATKCKDMLCTHTFTNTITONGGKNTVHGTSTFPPKGGSLVLMKRTFLNGGKLIARIELD-TT1870G-NSTL
LILKGLLKKPQWKTLS

THCAS TK139 (Fiber-type)

5' Frame 3

CTPTT-ARIKTIITIANPQENFLCYSEYSPNPNANPFIYTHQDQLYNYLADTIQNLAFPTDTEPEFLVPLNPNVSHVQASLCKKKVQIQTRSSGGHAGSLYSIQVFWFVGLANMVKVYIRSQTAWAGATGLGVYTKINDMKNFSPGSCPTVYGGH
 GGGGTAAGTNSGLAADNIDAGRLVGGYGVKLVGGEDLFWAAGGGGGGFIIAAKIKELVVVVQATFVFWQNMISGLVFKPWQNIATYDQGLMCTPFTNNTIUNGSGNITVYGTFFSLFGVGGSLVGMKGFPELGIKRTCKGLKMDITFYGGV
 NYNTANPKKIKLLDRAAGGATFAGIKLVYKELFETAMVYIKLGLYKGVVGVYLVYFGGDKGISASAPFPHRAGIMVLYLATNTAKNQENDDHIMVRSYNTFTTYPVQNFRLATYLDLQKTKNFPESFNPTQA

B *CBDAS* TK2 (Drug-type)

5' Frame 1
LNAKRKIPFPPQ-QI-NLRKQPIVYACPKFQNTQS-IRL-IRPPTTCYRHSFTCLPYPRRYT-**KKKIQIQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
PKKLDIVKKFIPESVYVQILKKLYEEDIGAGMYALFFYGGMDEISESAIPFFHAGILYELNYICDWEKQENKHLNIRNINMTFVYKKNPLATLYNRDLGIDGNPKPNNTQARINWERTYGNFDRLYVKYTLVDS

CBDAS TK20 (Drug-type)

5' Frame 1
LNAKPTLIPFPPQ-QI-NLRKQPIVYACPKFQNTQS-IRL-IRPPTTCYRHSFTCLPYPRRYT-**KKKIQIQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
LDRSARHNAELKI-**PDVYKPKLPESASVLEKLEKYEEDVYVYTLPLAGIMDEISEPALFFB-AG-VTEPWYICDWEKREDTEKASKLDKCLFIAPYVS-NPRLAYLNVALDTGINDPKSPNNTQARINWERTYGNFDRLYVKYTLVDS**

CBDAS TK55 (Drug-type)

5' Frame 2
-MLATYSHQCKRSTYTNQNLMPQNSTIHNLAFTSDTFFKLVITPFSVSHIQITLCRRKVGILQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
LLYRFRFTIC-**HYHSLRMDQYONINIR-ERMDVHGALSRISL-VLRKRIFFFSNGYKVFAGVLSGAR-KKPDNLVMS-YLAP-VYKPKMATSQ--AY-YANK-SQESK-LPQTRIMWEIFPKNDRLYVKYTLVDS**

CBDAS TK137 (Drug-type)

5' Frame 1
LNAKRKIPFPPQ-QI-NLRKQPIVYACPKFQNTQS-IRPPTTCYRHSFTCLPYPRRYT-**KKKIQIQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
PESAPVILEKLYEEDGAG-**MYALFFYGGMDEISESAIPF-AG-VTEPWYICDWEKREDTEKASKLDKCLFIAPYVS-LATSLCVLKSIGISQL-RP-YMK-SQESK-LATSKYLO-EVPM-KT-QQSKSDNP-SQ-**

CBDAS TK1 (Intermediate-type)

5' Frame 3
KCFQYIPNATNLKLVTTQNNPL-**MYLNTIHNLAFTSDTFFKLVITPFSVSHIQITLCRRKVGILQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
PKKLDIVKKFIPESVYVQILKKLYEEDIGAGMYALFFYGGMDEISESAIPFFHAGILYELNYICDWEKQENKHLNIRNINMTFVYKKNPLATLYNRDLGIDGNPKPNNTQARINWERTYGNFDRLYVKYTLVDS

CBDAS TK97 (Intermediate-type)

5' Frame 3
KCFQYIPNATNLKLVTTQNNPL-**MYLNTIHNLAFTSDTFFKLVITPFSVSHIQITLCRRKVGILQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
PKKLDIVKKFIPESVYVQILKKLYEEDIGAGMYALFFYGGMDEISESAIPFFHAGILYELNYICDWEKQENKHLNIRNINMTFVYKKNPLATLYNRDLGIDGNPKPNNTQARINWERTYGNFDRLYVKYTLVDS

CBDAS TK127 (Intermediate-type)

5' Frame 3
KCFQYIPNATNLKLVTTQNNPL-**MYLNTIHNLAFTSDTFFKLVITPFSVSHIQITLCRRKVGILQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
PKKLDIVKKFIPESVYVQILKKLYEEDIGAGMYALFFYGGMDEISESAIPFFHAGILYELNYICDWEKQENKHLNIRNINMTFVYKKNPLATLYNRDLGIDGNPKPNNTQARINWERTYGNFDRLYVKYTLVDS

CBDAS TK61F1-CO-2G (Intermediate-type)

5' Frame 3
KCFQYIPNATNLKLVTTQNNPL-**MYLNTIHNLAFTSDTFFKLVITPFSVSHIQITLCRRKVGILQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
PKKLDIVKKFIPESVYVQILKKLYEEDIGAGMYALFFYGGMDEISESAIPFFHAGILYELNYICDWEKQENKHLNIRNINMTFVYKKNPLATLYNRDLGIDGNPKPNNTQARINWERTYGNFDRLYVKYTLVDS

CBDAS TK61F1-CO-5P (Intermediate-type)

5' Frame 1
FSTKRKIPFPPQ-QI-NLRKQPIVYACPKFQNTQS-IRL-IRPPTTCYRHSFTCLPYPRRYT-**KKKIQIQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
AKKILAYKKFIPESVYVQILKKLYEEDIGAGMYALFFYGGMDEISESAIPFFHAGILYELNYICDWEKQENKHLNIRNINMTFVYKKNPLATLYNRDLGIDGNPKPNNTQARINWERTYGNFDRLYVKYTLVDS

CBDAS TK60 (Fiber-type)

5' Frame 3
KCFQYIPNATNLKLVTTQNNPL-**MYLNTIHNLAFTSDTFFKLVITPFSVSHIQITLCRRKVGILQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
PKKLDIVKKFIPESVYVQILKKLYEEDIGAGMYALFFYGGMDEISESAIPFFHAGILYELNYICDWEKQENKHLNIRNINMTFVYKKNPLATLYNRDLGIDGNPKPNNTQARINWERTYGNFDRLYVKYTLVDS

CBDAS TK61 (Fiber-type)

5' Frame 3
KCFQYIPNATNLKLVTTQNNPL-**MYLNTIHNLAFTSDTFFKLVITPFSVSHIQITLCRRKVGILQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
PKKLDIVKKFIPESVYVQILKKLYEEDIGAGMYALFFYGGMDEISESAIPFFHAGILYELNYICDWEKQENKHLNIRNINMTFVYKKNPLATLYNRDLGIDGNPKPNNTQARINWERTYGNFDRLYVKYTLVDS

CBDAS TK139 (Fiber-type)

5' Frame 3
KCFQYIPNATNLKLVTTQNNPL-**MYLNTIHNLAFTSDTFFKLVITPFSVSHIQITLCRRKVGILQIRTRGGHGGDECMHISQVFFVIVDLNMSIKIDVRSQTAWEAGATLGEVYTWKKNKNSLAAGCTPTVCAAGHFGGGGTFPLMNYGLAANDIVDA**
LVNVDKIVLDRK-**KKDLAKLGGGGSGIIVAMKIRLVAVPKTMYVYKKIKRISLVLNVMQNIATKYDILLMTHTFTRNITDQGNKTAIRTYFSVFLGGVDSLVLMKKSPFELGDKTCKQLSWIDTIIFYSGVNYDTGNFKELLDRAGQNGA**
PKKLDIVKKFIPESVYVQILKKLYEEDIGAGMYALFFYGGMDEISESAIPFFHAGILYELNYICDWEKQENKHLNIRNINMTFVYKKNPLATLYNRDLGIDGNPKPNNTQARINWERTYGNFDRLYVKYTLVDS

Figure S2: Amino acid sequence of (A) *THCAS* and (B) *CBDAS* including TK2, TK20, TK55, and TK137 (Drug-type), TK1, TK97, TK127, TK61F1-CO-2G and TK61F1-CO-5P (Intermediate-type), TK60, TK61, and TK139 (Fiber-type).