

Supplementary materials

Expression and Interaction Analysis among Saffron ALDHs and Crocetin Dialdehyde

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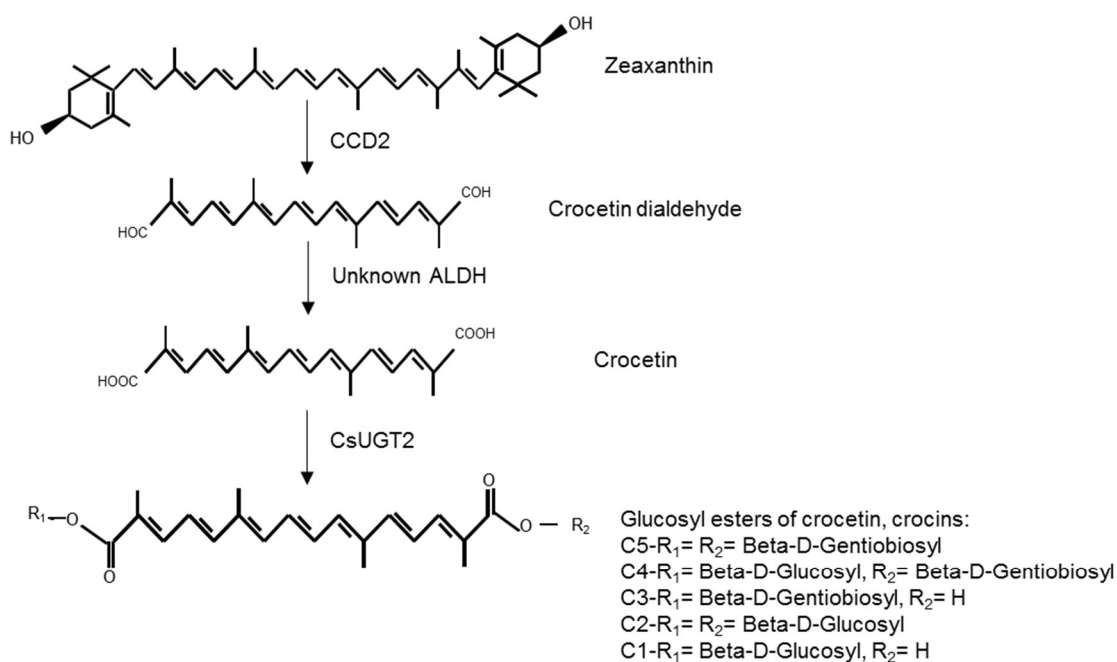


Figure S1. Crocins biosynthesis pathway from zeaxanthin. CCD2: Carotenoid cleavage dioxygenase family 2, ALDH: Aldehyde dehydrogenase and CsUGT2: UDPG-Glucosyltransferase 2

Primers used for qPCR

CsADH-3898_F: ACGTCAGGTGTGTCTGCAAG

CsADH-3898_R: TGTGGGCATAGCCAATGATA

CsADH-11367_F: CTGATGAGGGCATTGAAGGT

CsADH-11367_R: TTTCGTCGACGTCTTCTCCT

CsADH-20158_F: CCGGTCCAAATTAACCACAC

CsADH-20158_R: GCTCGAAACAGTATGCGTGA

CsADH-54788_F: CAGGGAGAGCTTCAACAAGG

CsADH-54788_R: TTGAGCTGGCACCTTTTCT

Primers used in pThio-Cloning

CsADH-3898_F CGCCCTTGGCGAATTATGCTTCAATCTCCTCTCCGACG

CsADH-3898_R TACCCTCGAGGAATTTACGACTTCTGGGATGTGGGC

CsADH-11367_F CGCCCTTGGCGAATTATGGCTGCTGCGAAGAGG

CsADH-11367_R TACCCTCGAGGAATTAGCATATCAATTTTCTCTTGCCTGC

CsADH-20158_F CGCCCTTGGCGAATTATGGCGGCTGCCAAGAAG

CsADH-20158_R TACCCTCGAGGAATTCTACAACCATGCTGGATTCTTGAGG

CsADH-54788_F CGCCCTTGGCGAATTATGGCCTTTGATGGAGAGAAAGCT

CsADH-54788_R TACCCTCGAGGAATTTCAAGATTTGGAGAAACCAATAGAGCC

Sequences used to generate the phylogenetic tree.

>CAD70189.1 (Bixa Orellana)

MESTGRAPLGNRIGNPGGLVVPEIKFTKLFINGRFVDNVSGQTFDTRDPRTGDVLATIAEADKDDLDLAVK
NAREAFDHGPWPRMSGYERARIMTKFADLVEAFIEELAALDTADAGKTLMSGKAVDIPA AVQIMRY YAGA
ADKLHGQPLKMNQDTQGYTLKDPIGVVGHII PWNYPTMMFFLKNAPALAAGCTMVVKPAEQTPLSALFY
AHLARMAGVPDGVVNVVPGFGPTAGAAVSSHMDVDSVSFTGSQEVGRAIMRAAAQSNLKNVSLELGGK
SPVIIFDDADVDMAVSLSQLACFTNKGEICVATSRVYVQEGYDALVKKIVEAAREWRFDTKANMGPQVDK
KQFERVLKYIDLKGKREGATLLTGKKTNGDKGYIQTIFLDVREDMNIAQDELFGPVMALMKFKTVDEAIQK
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VNTAIPNSPWY

> c74954_g1_i1 (Crocus sieberi)

MANN CNNGNSGEELKIPEIKYTKLFINGQFTDSVSGKTFETIDPRNGEVI AKLAEGDKADVDLAVKAAREAFD
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GVINVVTGFGTTAGSALSHHMDVDKISFTGSTEVGRLVMEAAARSNLKHVSLELGGKSPVIIFDDADVDMA
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EYGKAEGATLLTGKACGEKGYIEPTIFTDVKEDMKICQEEIFGPVMSLMKFKTTEEAEKANNTKYGLAAG
ILTNDLNTANRVSR SIRAGTIWNCYFSFDRDCPFGGFKMSGFGKDMGLQAIEKYLQEKCVVTP IYGSPWL

>KY631926 (Gardenia jasminoides)

MAVQSNGNGSSDSHV KVPQIKFTKLFINGEFVDSVSGKTFETIDPRNGEVI AEIAEGGKEDVDLAVKAAREA
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KVTELALQGTLFNKGEICVAGSRIFVQEGYDKFLIKLKQKVKNWVVGDPDPTSHQGPQVDKKQYDRILSYI
EHGKKEGATLFHGGKPCDGKGYIEPTIFTDVTDEMTIAKEEIFGPVMSVFKFKTVEEAIKRANATKYGLAAG
VMTNNINIAN TVARSIRAGAIWNCYFAFDRDSPYGGYKMSGFGRDMGMDGLKKYLAVKAVATPIYNSPW
L

>KY631927(Gardenia jasminoides)

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GKPYEQAAKIEVPMFVRLIRYYAGWADKIHGMTVPADGPHHVQTLHEPIGVAGQIIPWNFP LLMYAWKV
GPALACGNTIVLKTAEQTPLSALYVTKLLHEAGLPSGALNVVSGFGPTAGAAALCSHMDVDKLAFTGSTETGK
VILELSAKSNLKPVTLELGGKSPFIVCEDADVDNAVELAHFALFFNQGCCAGSRTYVHERVYDEFVEKATA
RALKRSVGD PFRQEIEQGPQVDSEQFQKILRYIRAGVDGGATLETGGDRLGEKGYIKPTVFSNVQDDMLIA
TDEIFGPVQSILKYRDLDEVIRRANSSRYGLAAGVFTQSLDTANTVMRALRVGT VWINCFDTFDA AIPFGGY
KMSGQGREGKGEYSLKNYLQVKAVVTPLKNPAWL

>KY631928 (Gardenia jasminoides)

>XP_957628 (*Neurospora crassa* OR74A)

>NP_000680 (Pan troglodytes)

>NP_000684 (Homo sapiens)

>Np033048 (Mus musculus)

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TPLSALYMGALIKEAGFPFPGVVNILPGYGPTAGAAIASHIGIDKIAFTGSTEVGKLIQEAAGRSNLKRVTLGL
GKSPNIIFADADLDYAVEQAHQGVFFNQGCCTAGSRIFVEESIYEEFVKRSVERAKRRIVGSPFDPTEQGP
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ERANNSDFGLVAAVFTNDINKALMVSSAMQAGTVWINCYNALNAQSPFGGFKMSGNGREMGEFGLREY
SEVKTVTVKIPQKNS

>NP038495 (*Mus musculus*)

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QIGSPWRTMDASERGRLLNKLADLMERDRLLLATMEALNGGKVFANAYLSDLGGCIKALKYCAGWADKIH
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NS

>fr850689 (*Fusarium fujikuroi*)

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ELNNQMRTFFPQGAKNSPDLCRIVNAGHFNRLLKMLDGTNGKIVLGGSMDESTLFMEPTAVLVDDINDS
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>WP_012263921 (*Microcystis aeruginosa*)

MLSNSEKLAKLRQYFASGATRSYQFRRQQLKQAIKYEAEIYRALYSDLKKSPEDCWVTENGFLLEINTA
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LVVKIIIEIFPEEYVLIVPGDGAEVIPNMLDSFTFDHIFTGSTRVGKIIYQLAAAKLIPVTLELGGKSPCVIEADA
NISVATRRIAVTKFSNCGQMCIADYVLVHQSQQENVIRELVNTIVNFFGKDARLSADYGKIINEKQFDRLID
FLQDGEIVFGGKTDRENLYIQPTLLTNVSLDAPIMQGEIFGPILPIIAFSTFEEALAIKPNPLAFYLFITTKAKT
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KGKLNLFKLLVR

>XP_006340688.1 (*Solanum tuberosum*)

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DTLSSSYDLQVAVKRIAGGKWGPCNGQACIGIDYVLVETQFAPVLIELLEKIIKTFYGENLKTGLNLARIVNKH
HFDRVHNLKDPKVAASVVYGGSVDEENMVIEPTILLNPPLDADIMTEEIFGPLLPIITLNNEESIQFINSRPKP
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>BAV82469.1 (*Cocos nucifera*)

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>OAY76151.1 (Ananas comosus)

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>XP_003544699.1 (Glycine max)

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>ATW64820.1 (Zea mays)

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SGNFELVTKEIFGPFQVVTEYSEDQLELVLEACERMNAHLTAIVSNDPLFLQDVLGRSVNGTTYAGIRARTT
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>XP_002441445.1 (Sorghum bicolor)

MSRLLSRRQIDAVRRSAPLACVSRWLHTPSFATVSPHEVSGSSPAEVQNFVQGSWTASANWNWIVDPLN
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GALYMGNKPVCLKVDSKVSIVMEQMIRLLHDCGLPAEDMDFINSDGVTMKNKLLLEANPKMTLFTGSSRVAE
KLAADLKGRVKLEDAGFDWKILGPDVQEVVDYVAVWCDQDAYACSGQKCSAQSVLFMHKNWSSSGLLEK
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>PKA47055.1 (*Apostasia shenzhenica*)

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>Q70SZ7 (*Crocus sativus*)

MVSTGCSGNGAKGTNGGIVVPEIKFTKLFINGEFVDSVSGSTFETRDPRNGDVIANIAEGDKEDVDLAVKAA
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VLKYIEHGKSEGATLLTGKPAADKGYIEPTIFVDVTEDMKIAQEEIFGPVMSLMKFKTVEEGIDCANNTKY
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NSPWL

>XP_009411491.1 (*Musa acuminata* subsp. *Malaccensis*)

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>XP_008598050.1 (*Beauveria bassiana* ARSEF 2860)

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ADKSPDWSRIVNMNHFNRKRLDNTKGKIVMGGNMWEDKLIIEPTAVLVDSIDDSMMVEESFGPIWSI
LPFDTLDEAIDIANKVDPTPLSLTTFGSDAENEKILLNVTSGGATINDGFWHAAMNQTPIGGVGSSGQGN
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RGSKKSSILRWAILMPVVAYLVELRRAKL

>NP_442494 (*Synechocystis* sp. PCC 6803)

MNTAKTVVAEQRDFFRQGKTKSVQDRLTALAKLKTQIQAQEEEEIKALKQDFGKPTFESYVNEILGVIREINYY
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SGVITRLIQNVFSPA WATVVEGDETISQQLQEKFDHIFFTGSPRVGR LIMAAAAEQ LTPVTLELGGKSPCVV
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QWSRLVSLSHGKVITRGDHNEDRYIAPT LIIDPD LNSPLMQEEIFGPILPILTYQSLSEAIDFINIKPKPLALYF
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RYSYGKKMNLIKKLFS

>XP_020265822.1 (*Asparagus officinalis*)

MVAPLASWPWSNLGSKYLLYGPLVAKVLYSRYNVDRGISVESSSWCLHLLALSLLRGFIHQAWFSFSSMLF
LTRRRRIKDGVD FEQIDKEWDWDNFLILQVFMGAALFYMFPSLINLP IWDFRGLIMAALLHVS VSEPLFYCA
HRLHHRGPLFEKYHSTHHSSKVLQSFTAGFGTPLEHLVMSIVMGAPVVGANLMGFGSMGLVYGYILFFDFM
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DQVPAFVFLAHVVDVAFSLHSPFILRSFSSSPFSVRLWILLWPGAFIIMLFMWAFSKTFLLSFYNIRGR LHQT
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GVVHACHAGGVVHSLEGWTHHEVG AIDVDRIDIVWRAALKHGLKPV

>MH182707 (*Buddleja davidii*)

MSSTGQTNGASILLDEYSHNIKIPKIKFTKLFINGHFLHSISGNTFETIDPRTEEVIANIAEGDKDDVDLAVNAA
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HGATLKMSRALQGYTLREPIGVVGHIPWNFSPQMFVMKVGPALAAAGCTMVVKPAEQTPLSALYYAHLAK
LAGIPDGVVNVVTGYGHAAGAAISSHMDIDMVSFTGSTEVGR LVMQAAAQSNLKPVSLELGGKSPFIVFD
DVDVDKVADLALQATLYNKGEICVAGTRV FVQEGYDKFLTKLVEKAKAWVVGDPFDPNVHQGPQVNKK
QYERILSFIELGKKEGATLLTGGKPCDRKKGYIEPTIFTD VDDDMTIAKEEIFGPVMSVMKFKTVEEVIK RAN
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>XP_020263644.1 (*Asparagus officinalis*)

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AFLANTIPKYLDPKAVKVIEGGPRIGERLLEHKWDKIFFTGSTRIGRMVMAAAAKHLTPVALELGGKCPAIVD
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RLSNLLKNPSVTSSIVHGGSVDYKNQTIEPTVVLDPPLDAEIMTEEIFGPLLPIITLKKIEDSIGFIKAKPKPLVIYA
FTNDQKLKRRIVDETSSG SVTFNDSL IQYVCDTIPFGGIGESGFGSYHGKFTFDMFSHEKPV LKRSFLTEFSFRY
PPWNEQKLQLLRRLYEFDYFGFALVWLGLKRR

>XP_020241205.1 (*Asparagus officinalis*)

MALWKLILSILMTLSIPGSAQGSKFTK FREPYLRKASSFSSELPQVRYDYIIVGGGTAGCPLAATLSQNYSVLLL
ERGGSPYGNLNISRMQNFHISLADTSPSSSPQPFISTDGVINARARVLGGGSCINAGFYTRASTSYVKNAGW
NDELVNQSYPWIEERIVHKPKLAPWQVAVKDGLLQAGISPFNGYTYDHL YGTVGGTIFDERGFRTTAANLL

SSGNPKNLNVLLYATVHKILFNQPKGRRPKAIGVIFKDENGQEHRAFLRRGRRSEVIVSSGTLGSPQLMLLSGI
GPKKDLKRLNIPVLIHNMHVKGGLSDNPMNSIFIPTKKPVESLIQTVGITKIGTFIEASSGFGQSSDSIQCHH
GIMSAEIGQLSTLPPKERTLAAAKEYARAKKDLPREAFQGGFILEKIDGPLSKGHLTLIDSDVNTTPNVTFNYF
KHPYDLERCYVGIRTIERVVRTKHIADLTNDYAYSNEVLLNMSVKANVNLI PKHTNDTVSLEQFCRDTVITIW
HYHGGCHTGKVVDRDYRVIGVNGLRVIDSSTYVNSPGTNPQATVMMMGRYMGVKMLRKRLGREAGV

>XP_010917487.1 (*Elaeis guineensis*)

MGALMKKEYQFLSELGLPRNPGCYVNGSWKSGPVVASHRPANNQVIAEVVEASMQEYEEGMQACM
DAAKIWMQIPAPKRGEIVRQIGELRAKLQLLGRVLSLEMKGILPEGIGEVQEIIDMCDYAVGLSRQLNGSIIP
SERPNHMMMEVWNPLGIVGVITAFNFPACAVLGWNACIALVCGNCVWVGAPTTPITIAMTEIVAGVLEK
NNLPGAIFTAFCGGAEIGQAIACDTRIPLVSFTGSTKVGLMVQQKVNRFKGKCLELSGNNAIIVMDDADIQL
AVRSVLFAAVGTAGQRCTTCRRLLHESIYQSVLDQLIKVYNQVKIGNPLEKGTLLGPLHTPASKENFVKGIEV
IKAQGGKILTGGSVIESEGNFVQPTIVEISPSAPVVKQELFGPVLYVMKFQTLKEAIEINNSVPQGLSSSIFTRRP
EVIFKWIGPHGSDCGIVNVNIPTNGAEIGGAFGGEKATGGGREAGSDSWKQYMRRATCTINYGSELPLAQ
GINFG

>XP_008809896.1 (*Phoenix dactylifera*)

MHRVALVARHVLTPSLFFRRQMSMEPGAAINRVRESGLLKTQGLIGGKWIDAYDGKTIEVQNPATGDIVTS
VAYMGKKETDAISSAYNTFNSWSKHTASERSKCLRKYDLMISHKEELALLMTLEQ GKPLKEALGEVAYG
AGFIEFFAEAKRIYGDII PATLADRRLFVLKQPVGVGAI TPWNFPLAMITRKVGPALACGCTVVVKPSEYTP
LTALAAEELSQA GIPPGVLNVVVGNASDIGDTLLQSTKVRKITFTGSTAVGKKLLAGSANTVKRISLELGGNA
PCIVFDDADLDVA VKGALAAKFRNSGQTCVCANRILVQEGIYEKFANAFKAVQNLQVGNGLVEGIAQG PL
INEAAVEKVEKFIKDATSKGANVILGRRHSLGMTFYEPTVLGNVNDEM LVSREEVFGPVAPLLRFKTEEDAI
HIANDTNAGLAAYIFTTSIPRSWRVTEALEYGLVG VNEGLISTEVAPFGGFKQSGLGREGSKYGIDEYELKYV
CLGNMKEAYTK

>XP_020098233.1 (*Ananas comosus*)

MNRFISYRELGAGARRAAWSWFSPSISLASRSVHSPSFATVDVEDLSSSHPAEVKNLVQGNWKTSANWSSI
LDPLNGDRFIKVAEVQET EIKPLVKSLSKCPKYGLHNPLRAQDRYVMYGDISAKAANMLAQPEVSHFFTRLIQ
RVSPKSYKQALAEVNV SQKFLENFSGDQVRFLARSFAVPGNHLGQHSHGYRWPYGPVAITPFNFPLEIPL
QVMGALYMGNKPV LKVD SKVSIVMEQMLRLLHDCGLPMEDVD FINS DGITMKNLLIEAKPQMTLFTGSSH
VAEKLASDLNGRIKLEDAGFDWKILGPDVQEV DYVAWVCDQDAYACSGQKCSAQ SILFVHENWASTGLID
KLQCLAGKRKLEDLTIGPVLTVTTASMLEHIHKLKIPGSKILFGGEPLENHSIPEVYGALKPTALFVPLGEMLKT
DNFELVTREIFGPFQIITEYRHDQLELVLDACERMHAHLTA AVVSNDPLFLQDVIGRSVNGTTYAGIRARTTG
APQNHWFPGPAGDPRGAGIGTPEAIKLVWSCHREVIYDIGPLPKDWEVPAAT

>XP_020265044.1 (*Asparagus officinalis*)

MAFWWPLL VAGIAFAICKLLFMLIPP NVPSIEVDASDVLEDGSQTKENSYIYIPRKGKSAQTDKVQCYEPAT
MKYLGYPALTPDEVKEHVAQARKAQKTWAKSSFRQRRQFLRILLKYIIEHQELICEISSRDTGKTMVDASLG
EIMTTCEKITWLLDEGEKWLKPEYRCSGRSMLHKRAKVEFYPLGVIGAIVSWNYPFH NIFNPMLAAVFSGN
AAVIKVSEHASWSGCFYLRIIQAALAAVGAPDNLVHVITGFAETGQALVSSVDKIIFVGSPGVGKMIMRKASE
TLIPVTLELGGKDAFIVCEDVDVPHVVQIATRAALQSSGQNCAGAERFYVHKDVYSTFVAQIVKLVL MVHG
PPSAGKYDMGAICMQEHADKLQNLVNDALEKGAEIAGRGSFGHLGEDAVDQFFPPTVLNVNHTMKLM
QE EAFGPIIPIMKFSDD EVIKLANDS NYGLGCAVFSGSQKRAIAIASQLHCGVAAINDFASTYMCQSLPFGG

VKHS GFGRFAGVEGLRSCCLVKS VVEDRFPYIKTVIPKPIQYPIAENGFEFQESLVELLYGMNVWDR LRAV
VNV LKIITEKNGTPITEKKRRN

>AIX10972.1 (Ornithogalum longibracteatum)

MAFSTALRSAAPLVDGSRDLFPFSDSTIRASDSFKV SCHSTKSSLR SASVSSSIVGASISPLEVVPSQISSGRVIQ
PVKATATEAPPAVARSSSGGKTKIGINGFGRIGRLVLR IATSRDDVEVVAVNDPFI DAKY MAYMLKYDSTHG
LFDGTIKVVDQSALEINGKNVVVTSKRDP AEIPWGD FGAEYVVESSGVFTTVDKASSHLKGGAKKVVISAPS
ADAPMFVVG VNEKKYEPNMNVVSNASCTTNCLAPLAKVVHEEF GIVEGLMTTVHATTATQKTVDGPSMK
DWRGGRGAGQNIIPSSTGA AKAVGKVLPELNGKLTGMAFRVPTPNVSVVDLTCRLEKSASYDDV KAAIKFA
SDGPLRGILGYTDEDVVSNDFIGDSRSSIFDAKAGIGLSASF MKLVSWYDNEWGYSNRVLDLIEH MALVSAT
R

>CsADH54788 (Crocus sativus)

MAFDGEKAMEMVKELRESFNKGTTRGYEW RVKQLKAMEKMIEEKEKDIMDALES DLSKPQLESFLHEVS
MAKSACQFAAKNLKRWMKPEKVPAQITTFPSVGNIVAEPFGVVL IISAWNYPFLSLDPVIGAIASGNTVVL
KPSEIAPATSALFARILPDYVDTS CVRVVEGAVPETTALLEQKWDKIFYTGNGKVGRVVM AAAAKHLTPVVL
ELGGKSPVVVDSNIDLKVATKRIVVGKWGCNNGQACIAPDYIVTTKSFAPKLVESLKITLERFYGKDPLETADL
SRIVNSNHVARLTRLLDDDMVSGTIVYGGQRDEKRLKIAPTLLLDVPEDSLIMKEEIFGPLLPIITVDKIEDSFAY
INSKPKPLAAYLFTKNKNLERMFVETVSSGGM LINDTALHLANPYLPFGGVGESGTGSYHGKFSFDAFSHKK
AVLSRGFGGELGARYPPYTNNKKQKILRALLAGNIIALVWALLGFSKS

>CsADH3898 (Crocus sativus)

MLQSPLRRASTLRTWRYPASLHRLSCFSASPQASPLHGNPTS RVPNFIGGQFLESRSSESSINVINPATQEIVSR
VPLTTNEEFKAAVGA AKCAF PKWRNTPITARQRVMFKLQELIRRDMDKLALNITTEQGKTLKDAQGDVFRG
LEVVEHACGMGTLMGEYVSNVSHGIDTYSIREPLGVCAGICPFNFPAMIPLWMFPVAVTCGNTFVLKPSE
KDPGASMLLAELAMEAGLPDGV LNIVHGANDTVNNICDDEDIRAVSFVGSNTAGMHIYSRAAAKGKRVQS
NMGAKNHAIIMPDASPDATINALVAAGFGAAGQRCMALSTAVFVGGSKSWEDEI IKHASALKVNAGVEPE
TDLGPVISRQAKDRICRLVQSGIDSGARVVDGRNIVVPGYKDGNFVGPTLLADVSSDMECYKEEIFGPVLLC
MQADSLEDAIDIVNRNKYGN GASIFTTSGVSARKFQSEIEAGQVGINVPIPVPLPFFSFTGSKASFAGDLNFY
GKAGIQFFTQIKTVTQQWKDLPSQGVSLAMPTSQKS

>CsADH-20158 (Crocus sativus)

MAAAKKIASILLSRSSSASRSFHLRRGAASGIQRFATAAVVEE EPITPPVQINHTQH LINGK FVDSASGKTFTPTF
DPRTGEVITHVSQGEVEDVNRAVAAAARKAFDEGPWP KMTAYERSRILFRAADLIEKHND EIAALESWDSGK
TYEQSSLVEIPMVIRYMRY YAGWADKIHGLVVPADGPHHVQVLYEPIGVAGQIIPWNFPLVMFAWKV GPA
LACGNTVIIKTAQQTPLSALYVAKLFHEAGLPDGV LNIVVSGYGPTAGAA LASHMDVDKLAFTGSTPTGKVV
MELAAKSNLKS VILELGGKSPMIVLEDGDVDQAVELAHSA LFFNQGCCAGSRTFVHERVYDEFVEKSKA
RALKR VVGDPFRKGVEQGPQIDGDQFNRI LHYIKSGIDGGASLVTGGDRLGSKGFYIQPTIFSDVKDDMIIAK
EEIFGPVQSIFKFSDLDEVIRRSNASPFGLAAGVFTNNMDNANTLMRALRVGT VWINCYGVFDAALPFGGY
KMSGQGREKGIDSLKAYLEVKS VVTTLKNPAWL

>CsADH-11367 (Crocus sativus)

MAAAKRIASSLIARSLSTSSRSFLLRRGDAALGIQRFGTAAAFEEQPIKPSVQINHTQLLINGNFVDSASGKTFP
TLDPRTGEVIAHVAEGDAEDVNRAVAAARKAFDEGPWPRMTAYERSRILLRAADLIEKHND EISALESWDS
GKPYESALAEIPLVVRLMRYYAGWADKIHGLVVPADGPHHVQVLHEPIGVAGQIIPWNFPLVMFAWKV
GPALACGNAIVIKTAEQTPLSALYVARLFHEAGLPDGVNLNVISGFGPTAGAALASHMDVDKLAFTGSTATGK
VVLELAARSNLKPVTLELGGKSPMIILEDADIDNAVELAHFALFFNQGCCAGSRTFVHERIYDEFVEKSKA
RALRRVVGD PFRKGVEQGPQIDNEQFNKILRYIKLGKDSGASLVTGGDRLGSKGFYIQPTIFSDVQDDMVIA
QDEIFGPVQTILKFNNLDEVIRANASRYGLAAGLFTNNMDHANTLMRALKVGTIWINCDFVFDAALPFGG
FKMSGQGREKGIDSLKAYLQVKS VVTALKNPAWL