

New Phytologist Supporting Information Figs S1–S6 and Tables S1 & S2

Article title: Multifunctional oxidosqualene cyclases and cytochrome P450 involved in the biosynthesis of apple fruit triterpenic acids

Authors: Christelle M. Andre, Sylvain Legay, Amélie Deleruelle, Niels Nieuwenhuizen, Matthew Punter, Cyril Brendolise, Janine M. Cooney, Marc Lateur, Jean-François Hausman, Yvan Larondelle and William A. Laing

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MdOSC5) by real-time qPCR on RNA extracted from apple skin tissues.

Fig. S3 Mass spectra of lupeol, germanicol, β -amyrin, and α -amyrin.

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Fig. S5 Alignment of P450 predicted amino acid sequences from apple (CYP716A175) and other species.

Fig. S6 Mass spectra comparison (MS1, MS2, and MS3) between betulinic acid, ursolic acid, oleanolic acid, and a putative morolic acid.

Table S1 Primer sequences and properties of triterpene-related and housekeeping genes

 in this study.

Table S2 Summary of the skin triterpene composition of 20 apple cultivars



Table S1 Primer sequences and properties of triterpene-related and housekeeping genes used to (a) isolate oxidosqualene cyclases and (b) used on the panel of 20 apple cultivars

(a) Prime	ers used 1	to isolate	Oxidosquale	ne Cyclases
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Primer name	Sequence
attB1 F_OSC4_MR	GGGGACAAGTTTGTACAAAAAAGCAGGCTCCATGTGGAAGCTTAAGGTCG
attB2 R_OSC4_MR	GGGGACCACTTTGTACAAGAAAGCTGGGTCTAATCACGCTTTGGAAGG
attB1 F_OSC5_RG	GGGGACAAGTTTGTACAAAAAGCAGGCTCCATGTGGAAGCTTAAGGTCG
attB2 R_OSC5_RG	GGGGACCACTTTGTACAAGAAAGCTGGGTTTAGACATCAACAAATGGAACCC

(b) Primers used to measure gene expression by PCR

Genes	Accession	Primer Sequences (5'-3')	Size	T _m (°C)	Ε	References
	Number		(bp)			
eF-1α	AJ223969.1	F: ACTGTTCCTGTTGGACGTGTTG	208	82.5	1.861	Giorno <i>et al.</i> (2012)

R: GAGTTGGAAGCAACGTACCC



IMPA-9	CN909679	F: TCGTGAACTCAGGCGCTTACTG	205	83.5	1.953	Giorno <i>et al.</i> (2012)
		R : AAGCAACGGTAAAGCGGGCAAC				
MdGAPDH	EB146750	F : TGAGGGCAAGCTGAAGGGTATCTT	185	82.5	1.874	Malladi & Hirst (2010)
		R: TCAAGTCAACCACACGGGTACTGT				
MdACTIN	EB127077	F: ACCATCTGCAACTCATCCGAACCT	185	82	1.919	Malladi & Hirst (2010)
		R: ACAATGCTAGGGAACACGGCTCTT				
MdOSC1	FJ032006.1	F	: 238	84	1.857	Brendolise et al. (2011)
		TTGTACTACTAATCCAGTGATCAAGATGTGG				
		R : CTCTCTTAGTATCTGAAAACGCCATAGGA	G			
MdOSC3	FJ032008.1	F : GCAATCGTGATCAAAGAAGATGTGGAGG	232	84	1.882	Brendolise et al. (2011)
		R : TTCTCTTAAAATCTGAAAACGCCATAGG				
MdOSC4	KT383435	F : CTCTCGAAGTAACAATGAAGCACA	124	79	1.864	



R : TAATCACCATTTGGGTCTTCAG

MdOSC5	KT383436	F : TATGCATCCAGCAAAAATGTTT	152	77.5	1.851
		R : TCCAATTAATTTCGCCATAAGGT			
CYP716A17	EB148173	F : AGGCACGTTCCTCGCTTC	70	77.5	1.974
5		R : CAAACCCTAAGAGGAGGGTCA			



Table S2 Summary of the skin triterpene composition of 20 apple cultivars separated into three russeting groups: russeted (four cultivars), semi-russeted (nine cultivars), and waxy (seven cultivars)

		Triterpene A	cids (nmol g ⁻¹]	DW)	Triterpene-caffeates	$(nmol g^{-1} DW)$	
	Total Tritamanas	Ursolic	Oleanolic	Potulinia agid	Oleanolic acid -3-	Betulinic acid -3-	Betulinic acid -3-
	Total Therpenes	acid	acid	Betuilline actu	trans-caffeate	trans-caffeate	cis-caffeate
Russeted							
Average	6899 ^a	1569 ^a	800 ^a	1628 ^b	416 ^b	2115 ^c	371 ^c
Min–Max	4971-8075	670–2802	500-1270	1094–2095	248–511	1287–3722	266–586
Semi-russeted							
Average	5567 ^a	1981 ^{ab}	1515 ^b	1028 ^{ab}	205 ^b	693 ^b	145 ^b
Min–Max	4228–7636	1464–2504	991–1974	527-1712	72–406	291–1312	68–257
Waxy							
Average	5864 ^a	2839 ^b	2045 ^b	687 ^a	90 ^a	159 ^a	45 ^a
Min	3562-7379	1680–3816	1203–2540	324-834	23–175	82–252	25–73

Data are expressed in nmol g⁻¹ DW. Data were obtained after HPLC-DAD analysis as described in the Materials and Methods section. Averages with no letter in common within a column are significantly different (P < 0.05; One-way ANOVA, Tukey's pairwise results).





Fig. S1 Chromatograms of typical LC-APCI-MS analysis of the products of MdOSC3 (iii) after transient expression in *Nicotiana benthamiana*, following the methodology described in the Materials and Methods section. p19 was used as a negative control (i) and mixed with authentic standards at 20 µg ml⁻¹ (1, lupeol; 2, β-amyrin; 3, α-amyrin) (ii). Compounds were identified and quantified on the basis of their mass spectral data (Fig. S3). Chromatograms are presented as selected ion plots of the m/z 409.8 [MH-H2O]+ ion.





Fig. S2 Expression analysis of triterpene biosynthetic genes (MdOSC1, MdOSC3, MdOSC4, MdOSC5) by real-time qPCR on RNA extracted from apple skin tissues. Error bars show SE (n = 3).



Fig. S3 Mass spectra comparison (MS1, MS2, and MS3) between lupeol, germanicol, β -amyrin, and α -amyrin.



Fig. S4 Chromatographic trace of extract of *Nicotiana benthamiana* leaf transiently transformed with MdOSC4 (b) and the same sample spiked with taraxerol (T) (a) showing no taraxerol in the leaf sample. Mass spectra of the taraxerol peak (MS1, MS2, and MS3) (c). Transient expression of MdOSC4 (b) led to the formation of germanicol (G), β -amyrin (β -A), and lupeol (L). The presence of taraxerol (T) could therefore be excluded.



Fig. S5 Alignment of P450 predicted amino acid sequences from apple (CYP716A175) and other species. The prefix is the cytochrome P450 designation, and the suffix identifies the species as follows: At, Arabidopsis thaliana; Aa, Artemisia annua; Mt, Medicago truncatula; Vv, Vitis vinifera; Cp, Carica papay; Pt, Populus trichocarpa; St, Solanum tuberosum; Nt, Nicotiana tobaccum. GenBank (GB) numbers (or Arabidopsis identifiers) in the order listed in the alignment are: AT5G36140 (CYP716A2-At), AT5G36110 (CYP716A1-At), (CYP716A20-Vv), XP_002280969.1 XP_002264643 (CYP716A19-Vv), XP_002309057.1 (CYP716A8-Pt), ABC94483.1 (CYP716A14-Aa), XP_002324668.2 (CYP716A3-Pt), XP_002325241 (CYP716A6-Pt), XP_006338129 (CYP716A13-St), no GB identifier (CYP716A36-Nt), CBN88268.1 (CYP716A12-Mt), BAJ84106 (CYP716A15-Vv), BAJ84106 (CYP716A17-Vv), no GB identifier (CYP716A16-Cp). The text/background colour code refers to the degree of similarity between the different sequences: red/yellow, identical; dark blue/turquoise, conservative; black/green, block of similar; black/white, nonsimilar.

	1					50	
CYP716A2-At	1	4YLT <mark>II</mark> FLF	ISS- <mark>I</mark> IF	PL <mark>LFF</mark> L(G <mark>K</mark> HLSNFRY:	PNLPPGKIG <mark>F</mark> P	PL.
CYP716A1-At	M	YMA <mark>IMII</mark> LF	LSS- <mark>I</mark> LL	SL <mark>L</mark> LLLI	R <mark>K</mark> HLSHFSY:	P <mark>NLPPG</mark> NT <mark>G</mark> LP	PL.
CYP716A20-Vv	-ME <mark>L</mark> LLLS	SFL <mark>LLM</mark> ALS	LSFW <mark>I</mark>	rffv <mark>hk</mark> i	LEKSSG:	INLPPGK <mark>M</mark> G <mark>F</mark> P	F
CYP716A19-Vv	-ME <mark>l</mark> SLLH	H <mark>I</mark> LPWATLF	TT <mark>L</mark> S <mark>L</mark>	SF <mark>L</mark> I <mark>YK</mark> I	LMIISHGTPI	R <mark>NLP</mark> S <mark>G</mark> NT <mark>G</mark> LP	Y
CYP716A8-Pt	-ME <mark>l</mark> pfis	S <mark>l</mark> lpyg <mark>i</mark> lf	<mark>I</mark> ISA <mark>V</mark> S <mark>L</mark>	SY <mark>L</mark> IN <mark>K</mark> H	H <mark>K</mark> YYLS-SLI	N <mark>NLPPG</mark> NT <mark>G</mark> LP	PL.
CYP716A14-Aa	MVD <mark>L</mark> ILI	<mark>Y</mark> SIF <mark>L</mark> S <mark>LIV</mark>	VLVPLSL	YF <mark>VFYK</mark> S	S <mark>k</mark> pvvd1	RK <mark>LPPG</mark> QT <mark>GW</mark> P	P <mark>V</mark>
CYP716A3-Pt							
CYP716A6-Pt	MQN	FLN <mark>LLL</mark> AV	FF <mark>IT</mark> FF <mark>I</mark>	SI <mark>I</mark> V <mark>yk</mark> i	H <mark>R</mark> SKFKHI	P <mark>NLPPG</mark> SS <mark>G</mark> L <mark>P</mark>	Y
CYP716A13-St	<mark>M</mark> efl	YVS <mark>LV</mark> CVFV	FL <mark>VSL</mark> L	LYKNKS-	-GEG	<mark>lppgk</mark> tg <mark>w</mark> p	PV
CYP716A36-Nt	<mark>M</mark> EVF	<mark>YL</mark> Y <mark>LL</mark> C <mark>L</mark> FT	LFT <mark>SL</mark> AL	HF <mark>IFYK</mark> I	RNSGSLT	GT <mark>LPPGKT</mark> G <mark>W</mark> P	F
CYP716A12-Mt	MEPNF	YLS <mark>LL</mark> LLFV	SF <mark>ISL</mark> S <mark>L</mark>	FF <mark>IFYK</mark> (2 <mark>k</mark> sp:	LNLPPGK <mark>M</mark> G <mark>Y</mark> P	Γ
CYP716A15-Vv	<mark>M</mark> EVF	FLS <mark>LL</mark> LIFV	LS <mark>VSI</mark> GL	HL <mark>LFYK</mark> H	H <mark>R</mark> SHFTGI	PNLPPGKIG <mark>W</mark> P	PM
CYP716A17-Vv	<mark>M</mark> evf	FLS <mark>LL</mark> LIFV	LS <mark>VSI</mark> GL	HL <mark>LFYK</mark> H	H <mark>R</mark> SHFTGI	PNLPPGKIG <mark>W</mark> P	PM
CYP716A16-Cp	<mark>M</mark> EHL	YLT <mark>LLL</mark> AF <mark>V</mark>	SF <mark>VSL</mark> S <mark>L</mark>	FI <mark>IFYK</mark> H	H <mark>r</mark> spyay:	P <mark>NLPPGK</mark> IGL <mark>P</mark>	F
CYP716A175	<mark>M</mark> EHF	YLT <mark>LLL</mark> GF <mark>V</mark>	SF <mark>ITL</mark> S <mark>L</mark>	SV <mark>lfyr</mark> i	H <mark>R</mark> AQFV—GT	NLPPGK <mark>VG</mark> YPV	7
	51					10	0 (
CYP716A2-At	51 <mark>IGE<mark>T</mark>LS<mark>FI</mark></mark>	LS <mark>A</mark> GRQ <mark>GHP</mark>	ekf <mark>v</mark> tdr	VRH <mark>FSS</mark> (G <mark>IFKT</mark> H	10 Lf <mark>g</mark> s <mark>pfav</mark> vt <mark>g</mark>) () <mark>3</mark> A
CYP716A2-At CYP716A1-At	51 <mark>IGET</mark> LSFI IGESFSFI	LSAGRQ <mark>GHP</mark> LS <mark>AG</mark> RQ <mark>GHP</mark>	EKF <mark>V</mark> TDR EKFITDR	VRH <mark>FSS</mark> VR <mark>RFSS</mark>	G <mark>IFKT</mark> H SSSC <mark>VFKT</mark> H	10 LF <mark>GSPFAV</mark> VT <mark>G</mark> LF <mark>GSPTAV</mark> VT <mark>G</mark>	00 BA BA
CYP716A2-At CYP716A1-At CYP716A20-Vv	51 IGE <mark>T</mark> LSFI IGESFSFI IGESLEFI	LSAGRQ <mark>GHP</mark> LSAGRQ <mark>GHP</mark> LRM <mark>GRKGT</mark> P	EKF <mark>V</mark> TDR EKFITDR E <mark>R</mark> FIQDR	VRH <mark>FSS</mark> VR <mark>RFSS</mark> MA <mark>KYS</mark> T(G <mark>IFKT</mark> H SSSC <mark>VFKT</mark> H Q <mark>IFKT</mark> C	10 LF <mark>G</mark> S <mark>PFAV</mark> VT <mark>G</mark> LFGSPTAVVTG L <mark>IGEPTAVVC</mark> G	00 CA CA CA
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CYP716A2-At	SGNKFLFTNENKLVI SWWPDSVNKIFPSSTQTSSK-EEAIKTRMLLMPSM
CYP716A1-At	SGNKFLFTNENKLVVSWWPDSVNKIFPSSMQTSSK-EEARKLRMLLSQFM
CYP716A20-Vv	AG <mark>NKLLFSNENKLVT<mark>SW</mark>WPRSVEKIFPSSLQTS<mark>T</mark>K-EE<mark>S</mark>MKTRKLLPAFL</mark>
CYP716A19-Vv	AG <mark>NKFLFSNENKLVTAWWP</mark> SS <mark>VNKIFP</mark> SSLQTSSQ-EE <mark>SK</mark> KM <mark>R</mark> KLLPGF <mark>L</mark>
CYP716A8-Pt	AGNKFLFSNENKLVTAWWPDSVNKIFPSSOOTSSO-EESKKMRKLFPLFF
CYP716A14-Aa	AGNKELESNENKLVKAWWPASVEKTLPSAKETTNORKMLSRSE
CVD71673-D+	
CIF/IOAS FC	AGUNDE BOMMANT WANNED FUCKTER OF A DEALER THE FIT
CIP/IGA6-PL	AGNRELESNANAVIKAWIPDFVCAIFPSSVQRPLI-EQVDRIRTLIPELI
CYP/16A13-St	SGNKFLFSNENKLVQAWWPNSVNKVFPSSTQTSSK-EEAIKMRKMLPNFF
CYP/16A36-Nt	TC <mark>NKFLFSNENKLVQAWWP</mark> DS <mark>VNKVFPSS</mark> TQTSSK-EEAIKMRKMLPNFF
CYP716A12-Mt	ASNKFLFSNENKLVTAWWPDSVNKIFPTTSLDSNLKEESIKMRKLLPQF
CYP716A15-Vv	AG <mark>NKFLFSNEN</mark> KLVHA <mark>WW</mark> PSSVDK <mark>V</mark> FPSSTQTSSK-EEA <mark>K</mark> KM <mark>R</mark> KLLP Q FF
CYP716A17-Vv	AG <mark>NKFLFSNENKLVHAWWP</mark> SS <mark>V</mark> D <mark>KVF</mark> PSSTQTSSK-EEA <mark>K</mark> KM <mark>R</mark> KLLP <mark>Q</mark> FF
CYP716A16-Cp	ACNKFLFSNENKLVTAWWPNSVNKIFPTSLQTSSI-EESKKMRKLLPQFL
CYP716A175	ACNKELESNENKLVTAWWPSSVNKVEPSSLETSAK-EEAKKMRKMLPNEM
	151 200
CVD71(2) 2+	
CIP/IGAZ-AL	
CYP/16A1-At	KPEALRRYVGVMDEIAQRHFETEWANQDQVIVFPLTKKFTFSIACRSFLS
CYP/16A20-Vv	KPEALQ <mark>KYVGIMD</mark> SIAKWHLDNHWDLNETVTVFPLAKQYTFMVACRLFLS
CYP716A19-Vv	KPEALQRYISIMDVIAQRHFESSWNNKEEVTVFPLAKMFTFWLACRLFLS
CYP716A8-Pt	KPE <mark>SL</mark> QR <mark>YI</mark> S V MDVIAQRHLA <mark>S</mark> DWEGKQEVSVFPLAKTYTFWLACRLFLS
CYP716A14-Aa	RPESLRQYVPVMDMAQRHFKTEWDGMDQIVTHEVTQNFTFSLACKIFVS
CYP716A3-Pt	KPEALRRYIGTMDMVTKRHFALEWGNKAEVVVFPLAKSYTFELACRLFLS
CYP716A6-Pt	RPDALKRYVGIFDKAAGRHFASEWENKKVVVVFPLAKRFTFGLACSLFLS
CYP716A13-St	KPEALORYVGIMDHITORHFASGWENKEOVVVFPLTKRYTFWLACRLFLS
CYP716A36-Nt	KPEALORYVGIMDHIAORHFASSWENKNOTEVEPLAKRYTEWLACRIEVS
CYP716A12-M+	KPEALORYVCWDVIAORHEVTHWDNKNETTWWPLAKRYTELIACELEWS
$CVP716\lambda 15 - VV$	
CYD716A17 VV	KEGALONYI CIMPULAODU EADOUDNDDEUTVEDIAKREIEWIACKIEMS
CIF/IGAL/-VV	KPEALORITGINDCIAORUPECKURVERUKUERUACKURVE
CIP/IGAIG-CP	RPEALQRIIGIMUGIAQRHFESGWENKEEVKVFPLARSIIFWIACRLFMS
CYP/16A1/5	KPEALQRYIGIMDTWARRHFAEGWENKKEVEVFPLAKNYTFWLAARLFWS
	0.01
	201 250
CYP716A2-At	201 250 MDDLERVRKLEBPFTTVMTGVF <mark>SIPIDLPGT</mark> R <mark>ENRAIKAS</mark> RL <mark>LSKEV</mark> STI
CYP716A2-At CYP716A1-At	201 MDDLERVRKLEEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLLSKEVSTI MEDPARVRQLEEQFNTVAVGIFSIPIDLPGTRFNRAIKASRLLRKEVSAI
CYP716A2-At CYP716A1-At CYP716A20-Vv	201 MDDLERVRKLEEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLLSKEVSTI MEDPARVRQLEEOFNTVAVGIFSIPIDLPGTRFNRAIKASRLLRKEVSAI IDDPKHIAKFANPFHILAAGVMSIPINFPGTPFNRAIKAAOSVRKELRAI
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv	201 201 200 200 200 200 200 200
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt	201 MDDLERVRKLEBPFTTVMTGVFSIPIDLPGTRFNRAIKASRLLSKEV MEDPARVRQLEBOFNTVAVGIFSIPIDLPGTRFNRAIKASRLLRKEV IDDPKHTAKFANPFHTLAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPDHVEKLABPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKPFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELLKKI
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa	201 DLERVRKLEBPFTTVMTGVFSIPIDLPGTRFNRAIKASRLLSKEV MEDPARVRQLEBOFNTVAVGIFSIPIDLPGTRFNRAIKASRLLKKEV SAI IDDPKHTAKFANPFHTLAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPDHVEKLABPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKPFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELLKI IEDPEEVKHLSGPFEKFAPGIFSIPIDLPWTPLRRAIHAGNFIRKETIAI
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt	201 DDLERVRKLEEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLISKEVSTI MEDPARVRQLEEQFNTVAVGIFSIPIDLPGTRFNRAIKASRLIKKEVSAI IDDPKHTAKFANPFHTLAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPDHVEKLAEPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKPFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELLKI IEDPEEVKHLSGPFEKFAPGIFSIPIDLPWTPLRRAIHAGNFIRKETIAI IEDPSHTARFSHPFNHTSGIFTIPIAFPGTPFNRAIKATKLIRIELAI
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A6-Pt	201 DDLERVRKLEEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLISKEVSTI MEDPARVRQLEEQFNTVAVGIFSIPIDLPGTRFNRAIKASRLIKKEVSAI IDDPKHTAKFANPFHTLAAGVMSIPINFPGTPFNRAIKASRLIKKEVSAI VEDPDHVEKLAEPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKPFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELLKI IEDPEEVKHLSGPEEKFAPGIFSIPIDLPWTPLRRAIHAGNFIRKETIAI IEDPSHTAKLASPFNNTVSGIFTIPIAFPGTPFNRAIKATKLIRIELLAI IEDPCHTAKLASPFNNVVSGIFSIPIDLPGTPLSRAIKASTITTELFAT
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A13-St	201 MDDLERVRKLEEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLISKEVSTI MEDPARVRQLEEQFNTVAVGIFSIPIDLPGTRFNRAIKASRLIKKEVSAI IDDPKHIAKFANPFHILAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPHVEKLAEPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKPFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELLKI IEDPEEVKHLSGPFEKFAPGIFSIPIDLPWTPLRRAIHAGNFIRKEIIAI IEDPSHIARFSHPFNHITSGIFTIPIAFPGTPFNRAIKATKLIRIELLAI IEDPHIAKLASPFNLVSGIFSIPIDLPGTPLSRAIKASTIIRTELFAI
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A6-Pt CYP716A13-St	201 250 MDDLERVRKLEEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLISKEVSTI MEDPARVRQLEEQFNTVAVGIFSIPIDLPGTRFNRAIKASRLIRKEVSAI IDDPKHIAKFANPFHILAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPHVEKLAEPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKFFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELLKI IEDPEEVKHLSGPFEKFAPGIFSIPIDLPWTPLRRAIHAGNFIRKEIIAI IEDPSHIARFSHFFNHITSGIFTIPIAFFGTPFNRAIKATKLIRIELLAI IEDPHIAKLASPFNLVVSGIFSIPIDLPGTPLSRAIKASTIIRIELFAI VEDPNHVAKFADPFDVLASGLISIPIDLPGTPFNRAIKASNITRELVRI
CYP716A2-At CYP716A1-At CYP716A19-Vv CYP716A19-Vv CYP716A14-Aa CYP716A14-Aa CYP716A3-Pt CYP716A6-Pt CYP716A13-St CYP716A13-St	201 MDDLERVRKLEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLSKEVSTI MEDPARVRQLEPGFNTVAVGIFSIPIDLPGTRFNRAIKASRLIKKEVSAI IDDPKHIAKFANPFHILAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPHVEKLAFPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKPFNDLAAGIISIPIDLPWTPFNRGVKASNLVRKELHAI IEDPEVKHLSGPFEKFAPGIFSIPIDLPWTPFNRGVKASNLVHKELLKI IEDPSHIARFSHPFNHITSGIFTIPIAFFGTPFNRAIKATKLIRIELLAI IEDPCHIAKLASPFNLVVSGIFSIPIDLPGTPLRRAIKASTIIRTELFAI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNFIRKELVRI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNFIRKELVRI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNFIRKELVRI
CYP716A2-At CYP716A1-At CYP716A19-Vv CYP716A19-Vv CYP716A14-Aa CYP716A14-Aa CYP716A3-Pt CYP716A6-Pt CYP716A13-St CYP716A13-St CYP716A12-Mt	201 MDDLERVRKLEEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLSKEVSTI MEDPARVRQLEEQFNTVAVGIFSIPIDLPGTRFNRAIKASRLIKKEVSAI IDDPKHIAKFANPFHILAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPHVEKLAEPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKPFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELLKI IEDPEEVKHLSGPFEKFAPGIFSIPIDLPWTPFNRGVKASNVVHKELLKI IEDPSHIARFSHPFNHITSGIFTIPIAFFGTPFNRAIKATKLIRIELLAI IEDPCHIAKLASPFNLVSGIFSIPIDLPGTPFNRAIKASTIIRTELFAI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNFIRKELVRI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNFIRKELLLI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNLIKKELLLI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNFIRKELLI
CYP716A2-At CYP716A1-At CYP716A19-Vv CYP716A19-Vv CYP716A14-Aa CYP716A3-Pt CYP716A3-Pt CYP716A6-Pt CYP716A13-St CYP716A36-Nt CYP716A12-Mt CYP716A12-Vv	201 250 MDDLERVRKLEEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLSKEVSTI MEDPARVRQLEEQFNTVAVGIFSIPIDLPGTRFNRAIKASRLIKKEVSAI IDDPKHIAKFANPFHILAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPHVEKLAEPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKPFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELLKI IEDPEEVKHLSGPFEKFAPGIFSIPIDLPWTPLRRAIHAGNFIRKEIIAI IEDPSHIARFSHPFNHITSGIFTIPIAFPGTPFNRAIKATKLIRIELLAI IEDPCHIAKLASPFNLVVSGIFSIPIDLPGTPLRRAIKASNIRKELVRI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNIRKELVRI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNIRKELLLI VEDPNHVAKFSDFFQLIAAGIISLPIDLPGTPFNRAIKASNFIRKELKI IEDPAHVAKFSDFFQLIAAGIISLPIDLPGTPFNRAIKASNFIRKELKI IEDPAHVAKFEKFFHVLASGLITVPIDLPGTPFNRAIKASNFIRKELRAI
CYP716A2-At CYP716A1-At CYP716A19-Vv CYP716A19-Vv CYP716A14-Aa CYP716A3-Pt CYP716A3-Pt CYP716A6-Pt CYP716A6-Pt CYP716A36-Nt CYP716A36-Nt CYP716A12-Mt CYP716A15-Vv CYP716A17-Vv	201 250 MDDLERVRKLEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLSKEVSTI MEDPARVRQLEQFNTVAVGIFSIPIDLPGTRFNRAIKASRLIKKEVSAI IDDPKHIAKFANPFHILAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPHVEKLAFPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKPFNDLAAGIISIPIDLPWTPFNRGVKASNLVRKELHAI IEDPEEVKHLSGPFEKFAPGIFSIPIDLPWTPLRRAIHAGNFIRKETIAI IEDPSHIARFSHPFNHITSGIFTIPIAFPGTPFNRAIKATKLIRIELLAI IEDPCHIAKLASPFNLVVSGIFSIPIDLPGTPLRRAIKASNIRKELVRI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNIRKELVRI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNIRKELLLI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNIRKELLLI VEDPNHVAKFADFFVLASGLISIPIDLPGTPFNRAIKASNFIRKELKI IEDPAHVAKFEKFFHVLASGLITVFIDLPGTPFNRAIKASNFIRKELRAI
CYP716A2-At CYP716A1-At CYP716A19-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A3-Pt CYP716A13-St CYP716A13-St CYP716A13-Nt CYP716A12-Mt CYP716A15-Vv CYP716A17-Vv	201 250 MDDLERVRKLEEPFTTVMTGVFSIPIDLPGTRFNRAIKASRLSKEVSTI MEDPARVRQLEEQFNTVAVGIFSIPIDLPGTRFNRAIKASRLEKKEVSAI IDDPKHIAKFANPFHILAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPDHVEKLAEPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKFFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELLKI IEDPEEVKHLSGFFEKFAPGIFSIPIDLPWTPLRRAIHAGNFIRKEIIAI IEDPSHIARFSHFFNHITSGIFTIPIAFFGTPFNRAIKATKLIRIELLAI IEDPHVAKFADFFDVLASGISIPIDLFGTPLSRAIKASTIIRTELFAI VEDPNHVAKFADFFDVLASGLISIPIDLFGTPFNRAIKASNFIRKELVRI VEDPNHVAKFADFFDVLASGLISIPIDLFGTPFNRAIKASNFIRKELVRI IEDPAHVAKFEKFFHVLASGLISIPIDLFGTPFNRAIKASNFIRKELKI IEDPAHVAKFEKFFHVLASGLITVPIDLFGTPFNRAIKASNFIRKELRAI IEDPAHVAKFEKFFHVLASGLITVPIDLFGTPFNRAIKASNFIRKELRAI IEDPAHVAKFEKFFHVLASGLITVPIDLFGTPFNRAIKASNFIRKELRAI
CYP716A2-At CYP716A1-At CYP716A19-Vv CYP716A19-Vv CYP716A8-Pt CYP716A3-Pt CYP716A3-Pt CYP716A3-Pt CYP716A13-St CYP716A13-St CYP716A12-Mt CYP716A15-Vv CYP716A17-Vv CYP716A16-Cp <u>CYP716A175</u>	201 250 MDDLERVRKLEBPFTTVMTGVFSIPIDLPGTRFNRAIKASRLSKEVSTI MEDPARVRQLEOFNTVAVGIFSIPIDLPGTRFNRAIKASRLERKEVSAI IDDPKHIAKFANPFHILAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPDHVEKLABPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKFFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELKKI IEDPEEVKHLSGPFEKFAPGIFSIPIDLPWTPFNRGVKASNVVHKELKI IEDPSHIARFSHFFNHITSGIFTIPIAFPGTPFNRAIKATKLIRIELLAI IEDPSHIARFSHFFNHITSGIFTIPIAFPGTPFNRAIKATKLIRIELLAI IEDPSHIARFSHFFNHITSGIFTIPIAFPGTPFNRAIKASTIIRTELFAI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNFIRKELVRI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNFIRKELKI IEDPAHVAKFSDFFQLIAAGIISLPIDLFGTPFNRAIKASNFIRKELKI IEDPAHVAKFEKFFHVLASGLITVPIDLFGTPFHRAIKASNFIRKELRAI IEDPAHVAKFEKFFHVLASGLITVPIDLFGTPFHRAIKASNFIRKELRAI IEDPAHVAKFEKFFHVLASGLITVPIDLFGTPFHRAIKASNFIRKELRAI IEDPAHVAKFEKFFHVLASGLITVPIDLFGTPFHRAIKASNFIRKELRAI IEDPAHVAKFEKFFHVLASGLITVPIDLFGTPFHRAIKASNFIRKELRAI
CYP716A2-At CYP716A1-At CYP716A19-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A3-Pt CYP716A13-St CYP716A13-St CYP716A12-Mt CYP716A15-Vv CYP716A17-Vv CYP716A16-Cp <u>CYP716A175</u>	201 250 MDDLERVRKLEBPFTTVMTGVFSIPIDLPGTRFNRAIKASRLSKEVSTI MEDPARVRQLEOFNTVAVGIFSIPIDLPGTRFNRAIKASRLEKKEVSAI IDDPKHIAKFANPFHLAAGVMSIPINFPGTPFNRAIKAADSVRKELRAI VEDPDHVEKLABPFNELAAGIIALPIDLPGTSFNKGIKASNLVRKELHAI MEDPEEVQKFAKFFNDLAAGIISIPIDLPWTPFNRGVKASNVVHKELLKI IEDPEVKHLSGPFEKFAPGIFSIPIDLPWTPFNRGVKASNVVHKELLKI IEDPSHIARFSHPFNHITSGIFTIPIAFPGTPFNRAIKATKLIRIELLAI IEDPHIAKLASFFNLVVSGIFSIPIDLPGTPLSRAIKASTIIRTELFAI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNFIRKELVRI VEDPNHVAKFADFFDVLASGLISIPIDLPGTPFNRAIKASNFIRKELVRI IEDPAHVAKFEKFFNVLASGLISIPIDLPGTPFNRAIKASNFIRKELKI IEDPAHVAKFEKFFNVLASGLISIPIDLFGTPFNRAIKASNFIRKELKI IEDPAHVAKFEKFFNVLASGLITVPIDLFGTPFNRAIKASNFIRKELRAI IEDPAHVAKFEKFFNVLASGLITVPIDLFGTPFNRAIKASNFIRKELRAI IEDPAHVAKFEKFFNVLASGLITVPIDLFGTPFNRAIKASNFIRKELRAI IEDPAHVAKFEKFFNLASGLITVPIDLFGTPFNRAIKASNFIRKELRAI
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CYP71622-2+	
UII I I UNA AL	GHDTTSIVCTF <mark>V</mark> VNYLAEFPHIYQ <mark>R</mark> VLEEQKEILNNKDVN-EKLTWEDIE
CYP716A1-At	GHDTASTVCTEWVNYLAEFPHWYORVLOEOKETLKEKKEK-EGLRWEDTE
CVP716320 - Vrr	
CII/10A20 VV	
CIP/IGAL9=VV	GRUIASAIIIFIVAELAELPHVIDEVEREQMEIAASAAPG-ELLINWEDIP
CYP/16A8-Pt	G <mark>H</mark> DTASAAIT <mark>F</mark> IVKYLAELPH <mark>V</mark> YNKLLEEQREIAK <mark>TK</mark> TPG-EL <mark>LNWED</mark> IQ
CYP716A14-Aa	GHDNAS <mark>STCAFIVKFLADLPEIYE</mark> GVLK <mark>EQL</mark> EIAKF <mark>KAPG-ELL</mark> NWEDLS
CYP716A3-Pt	AHDSTGTACTETVKYLAEMPHTYEAVYKEOAETIKSKAPG-ELLNWVDIO
CYP716A6-Pt	AHESTSAACAETVKYLAELPLTYNAVYKEOMKTSETKAPCDDLLNWNDTO
CVD71(312 Ch	
CIP/IGAIS-SU	GHDIASSACAFIVAILAEHPHIIQRVIIEQMEIAASAGPG-ELLKWEDIQ
CYP/16A36-Nt	GHDTAS <mark>S</mark> ACTFILKYLAEFPEIYEGVYKEQMEIAMS <mark>KS</mark> PG-ELLNWDDIQ
CYP716A12-Mt	G <mark>H</mark> DTASVACT <mark>FL</mark> VKYL <mark>G</mark> ELPHIYDKVYQEQMEIAKSKPAG-ELLNWDDLK
CYP716A15-Vv	GHDTASAAIT <mark>FLI</mark> KY <mark>M</mark> AELPHI <mark>YEK</mark> VYEEQMEIANS <mark>K</mark> APG-EL <mark>LNWDDV</mark> Q
CYP716A17-Vv	GHDTASAATTELTKYMAELPHTYEKVYEEOMETANSKAPG-ELLNWDDVO
CVP716716-Cp	
CIF/IOAIO CP	
CIP/IGAL/S	GUDIASAICI <mark>LIAUIAETLUID</mark> EAIVEÕMEATSAVALG-DITUMADDIÖ
	351 400
CYP716A2-At	KM <mark>R</mark> YSWNVACEVMR <mark>I</mark> VPPLAGTFREAIDH <mark>F</mark> SFK <mark>G</mark> FYIPKGWK-LYWSAT <mark>A</mark>
CYP716A1-At	KMRYSWNVACEVMRTVPPLSGTFREAIDHFSFKGFYIPKGWK-LYWSATA
CYP716A20-Vv	KMKYSWNVANEVMRLAPPLOGSEREATTDETYAGESTPKGWKELYWSTNA
CVD716710-V-V	
CIE/IUALY-VV	NEW YOUNWAGE VINDARE WOORF REAMINDEMEDICAL STERGWA-LIWSTHS
CIP/10A8-Pt	KMRISWNVACEVMKVAPPLQGAFKLAMTEFNYAGFTIPKGWK-LYWSANT
CYP716A14-Aa	KMKYSWNVACEVLRLAPPLQG <mark>S</mark> FREAMTDFVYNGYSIPKGWK-LYWSALS
CYP716A3-Pt	KMKYSWNVACET <mark>LRLS</mark> PPFI <mark>GNFKEAI</mark> KDFTFNGFAIPKGWKASHFLTLY
CYP716A6-Pt	N <mark>MTYSWNV</mark> IR <mark>EVIR</mark> ICPTFP-NV <mark>REAI</mark> HDFD <mark>FNGFSIPKGWK</mark> AK <mark>YF</mark> P
CYP716A13-St	KMKYSWNVACEVIRLAPPLOGAFREALSDFIFNGFSIPKGWK-IYWSANS
CYP716A36-Nt	KMKYSWNVACEVIRLASPLOGAFREATNDFIFNGFYIPKGWK-LYWSANS
CVD716112_M+	
CIF/IOAIZ-MU	
CYP/16A15-VV	NMRISWNVACEVMRLAPPLQGAFREAITDFVFNGFSIPKGWK-LIWSANS
CYP/16A1/-Vv	KM <mark>R</mark> YSWNVACEVMRLAPPLQGAFRE <mark>AIT</mark> DFVFNGFSIPKGWK-LYWSANS
CYP716A16-Cp	K <mark>MKYSWNV</mark> AC <mark>E</mark> V <mark>L</mark> RLAPPLQGAFRQ <mark>AL</mark> YD <mark>FT</mark> FD <mark>GFSIPKGWK</mark> -LYWSANS
CYP716A175	K <mark>MKYSWNV</mark> AQ <mark>EV<mark>L</mark>RLAPPLQGAFRE<mark>ALS</mark>D<mark>FV</mark>FN<mark>GFTIPKGWK</mark>-LYWSANS</mark>
	401 450
	401 450
CYP716A2-At	401 450 THKNPEYFPEPEKFEPSREEGSGPKPYTYVPFGGGSRTCPGREYA
CYP716A2-At	401 450 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA
CYP716A2-At CYP716A1-At	401 450 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA
CYP716A2-At CYP716A1-At CYP716A20-Vv	401 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPDYFPDPEKFDPSRFEGNGPIPYTYVPFGGGPRMCPGKEYA
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv	401 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPDYFPDPEKFDPSRFEGNGPIPYTYVPFGGGPRMCPGKEYA THRNPEFFPKPEKFDPSRFDGKGPAPYTYVPFGGGPRMCPGKEYA
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt	401 THKNPEYFPEPEKFERSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPDYFPDPEKFDPSRFEGNGPIPYTYVPFGGGPRMCPGKEYA THRNPEFFPKPEKFDPSRFDGKGPAPYTYVPFGGGPRMCPGKEYA THKNPECFPEPENFDPSRFEGNGPAPYTFVPFGGGPRMCPGKEYA
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa	401 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPEYFPDPEKFDPSRFEGNGPIPYTYVPFGGGPRMCPGKEYA THRNPEFFPKPEKFDPSRFDGKGPAPYTYVPFGGGPRMCPGKEYA THKNPEVFTEPQKLDPSRFDGKGPAPYTFVPFGGGPHMCPGREYA
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt	401 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPEYFPEKFDPSRFEGNGPIPYTYVPFGGGPRMCPGKEYA THRNPECFPEPENFDPSRFEGNGPAPYTYVPFGGGPRMCPGKEYA THKNPEVFTEPQKLDPSRFEGNGPAPYTFVPFGGGPHMCPGREYA WSASSTHKNPEYFSEPEKFDPSRFEGKGPAPYTFIPFGGGPRMCPGNEYA
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A3-Pt	401 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPEYFPEPEKFDPSRFEGNGPIPYTYVPFGGGPRMCPGKEYA THKNPECFPEPENFDPSRFEGNGPAPYTYVPFGGGPRMCPGKEYA THKNPEVFTEPQKLDPSRFEGNGPAPYTFVPFGGGPRMCPGKEYA WSASSTHKNPEYFSEPEKFDPSRFEGKGPAPYTFVPFGGGPRMCPGNEYA
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CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A3-Pt CYP716A6-Pt CYP716A2-Vt	401 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPEFFPKPEKFDPSRFEGNGPIPYTYVPFGGGPRMCPGKEYA THKNPEFFPKPEKFDPSRFEGNGPAPYTYVPFGGGPRMCPGKEYA THKNPEVFTEPQKLDPSRFEGNGPAPYTFVPFGGGPRMCPGKEYA WSASSTHKNPEYFSEPEKFDPSRFEGKGPAPYTFIPFGGGPRMCPGREYA EPERFDPSRFEGTGPAPYTFIPFGGGPRMCPGQEFA THKSGEFFPDPEKFDPSRFEGSGPAPYTFVPFGGGPRMCPGQEFA
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A3-Pt CYP716A13-St CYP716A13-St	401 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPEFFPKPEKFDPSRFEGNGPIPYTYVPFGGGPRMCPGKEYA THKNPECFPEPENFDPSRFEGNGPAPYTYVPFGGGPRMCPGKEYA THKNPEVFTEPQKLDPSRFEGNGPAPYTFVPFGGGPRMCPGREYA WSASSTHKNPEYFSEPEKFDPSRFEGKGPAPYTFVPFGGGPRMCPGNEYA
CYP716A2-At CYP716A1-At CYP716A20-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A3-Pt CYP716A13-St CYP716A36-Nt CYP716A12-Mt	401 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPEFFPKPEKFDFSRFEGNGPIPYTYVPFGGGPRMCPGKEYA THKNPECFPEPENFDFSRFEGNGPAPYTYVPFGGGPRMCPGKEYA THKNPEVFTEPQKLDFSRFEGNGPAPYTFVPFGGGPRMCPGKEYA WSASSTHKNPEYFSEPEKFDFSRFEGKGPAPYTFVPFGGGPRMCPGREYA
CYP716A2-At CYP716A1-At CYP716A19-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A3-Pt CYP716A13-St CYP716A13-St CYP716A36-Nt CYP716A12-Mt CYP716A15-Vv	401 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPNRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPEFFPKPEKFDPSRFEGNGPIPYTYVPFGGGPRMCPGKEYA THKNPEFFPKPEKFDPSRFEGNGPAPYTYVPFGGGPRMCPGKEYA THKNPEVFTEPQKLDPSRFEGNGPAPYTFVPFGGGPRMCPGKEYA WSASSTHKNPEYFSEPEKFDPSRFEGKGPAPYTFTPFGGGPRMCPGREYA
CYP716A2-At CYP716A1-At CYP716A19-Vv CYP716A19-Vv CYP716A8-Pt CYP716A14-Aa CYP716A3-Pt CYP716A3-Pt CYP716A13-St CYP716A36-Nt CYP716A12-Mt CYP716A15-Vv CYP716A17-Vv	401 THKNPEYFPEPEKFEPSRFEGSGPKPYTYVPFGGGSRICPGREYA THMNPDYFPEPERFEPSRFEGSGPKPYTYVPFGGGPRMCPGKEYA THKNPEFFPKPEKFDPSRFEGSGPAPYTYVPFGGGPRMCPGKEYA THKNPECFPEPENFDPSRFEGSGPAPYTFVPFGGGPRMCPGKEYA THKNPEVFTEPQKLDPSRFEGSGPAPYTFVPFGGGPRMCPGKEYA WSASSTHKNPEYFSEPEKFDPSRFEGTGPAPYTFVPFGGGPRMCPGREYA
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Fig. S6 Mass spectra comparison (MS1, MS2, and MS3) between betulinic acid, ursolic acid, oleanolic acid, and a putative morolic acid.



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