Supporting Information for:

Simulation-guided rational *de novo* design of a small pore-forming antimicrobial peptide

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Figure S1

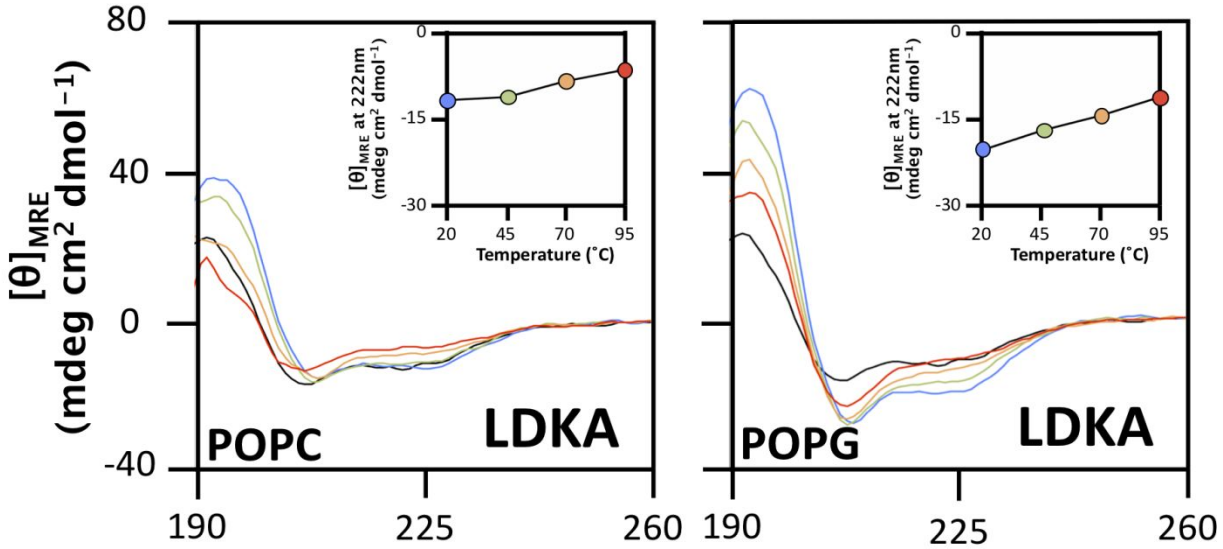

Figure S1 | Secondary structure of LDKA peptide against elevated temperature. 50 µM LDKA peptide was dissolved in 10 mM phosphate buffer (pH 7.0) at 20 ˚C (black) as the reference spectra. Thermostability of the peptide structure with 600 µM POPC vesicle (left) or POPG vesicle (right)_was measured using circular dichroism spectroscopy with elevated temperature at each 20 (blue), 45 (green), 70 (orange), and 95 ˚C (red).

Figure S2

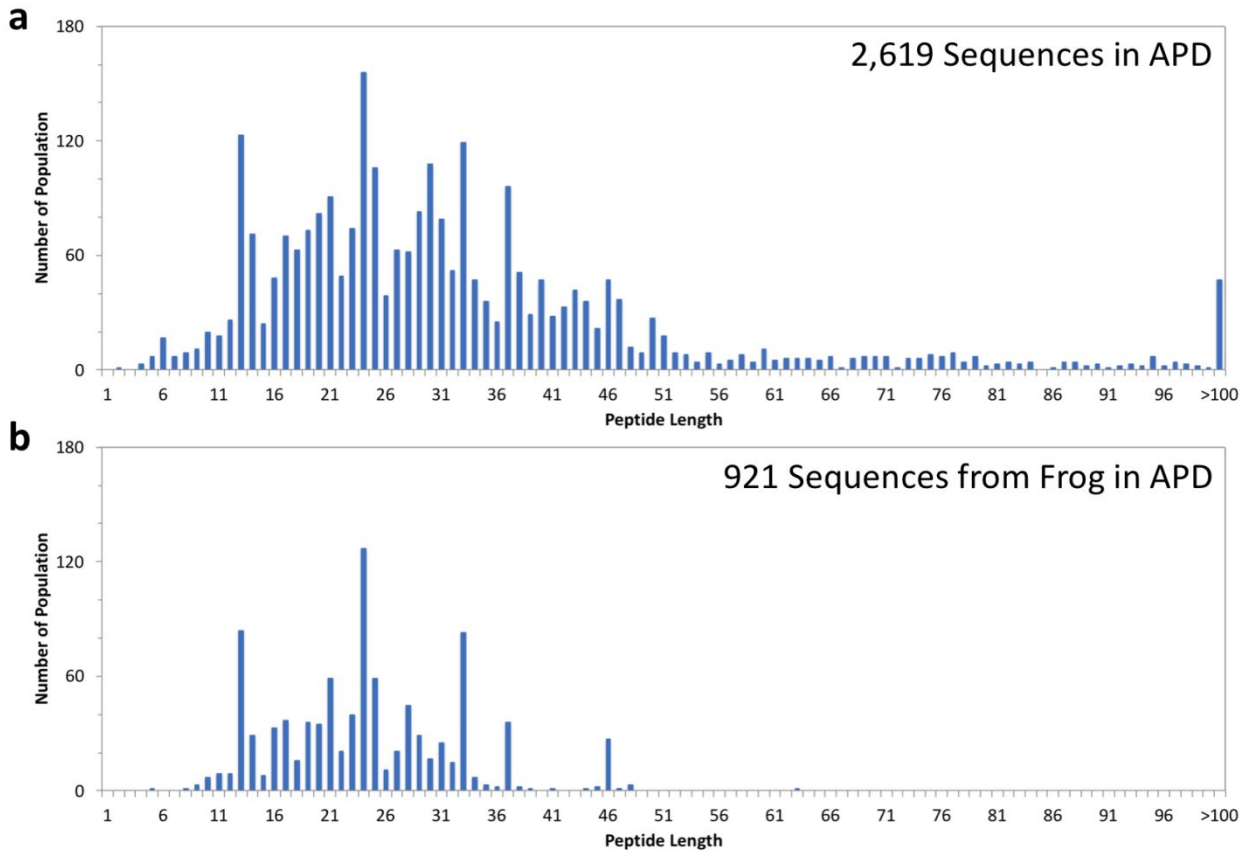

Figure S2 | Peptide length analysis of the APD. Distribution of the peptide length of **a,** 2,619 sequences and **b,** 921 sequences from frog in APD.

Figure S3

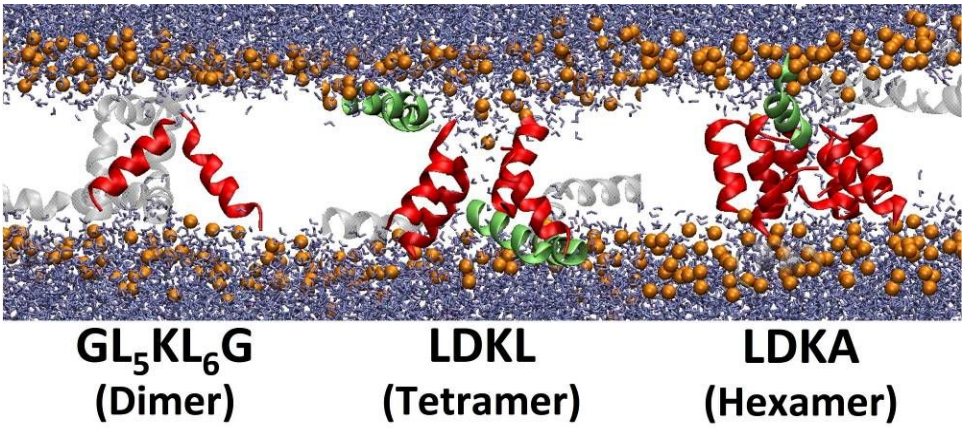

Figure S3 | Water conducting structures. Shown are snapshot of the water conducting channels of the dominant structure in the GL_5KL_6G (dimer), LDKL (tetramer), and LDKA (hexamer) simulations. Red peptides are the TM peptides that are counted in the oligomer. Green peptides are located on the membrane surface, but form part of the oligomeric membrane-spanning channel structure. Grey peptides are part of the simulation system but are do not form part of the channels.

Figure S4

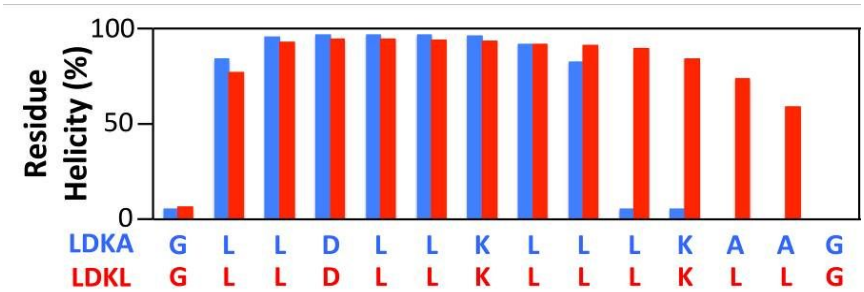

Figure S4 | Residue helicity of each LDKA and LDKL with DMPC/DMPG bilayer. Higher helicity results in stronger peptide binding to the membrane.

Figure S5

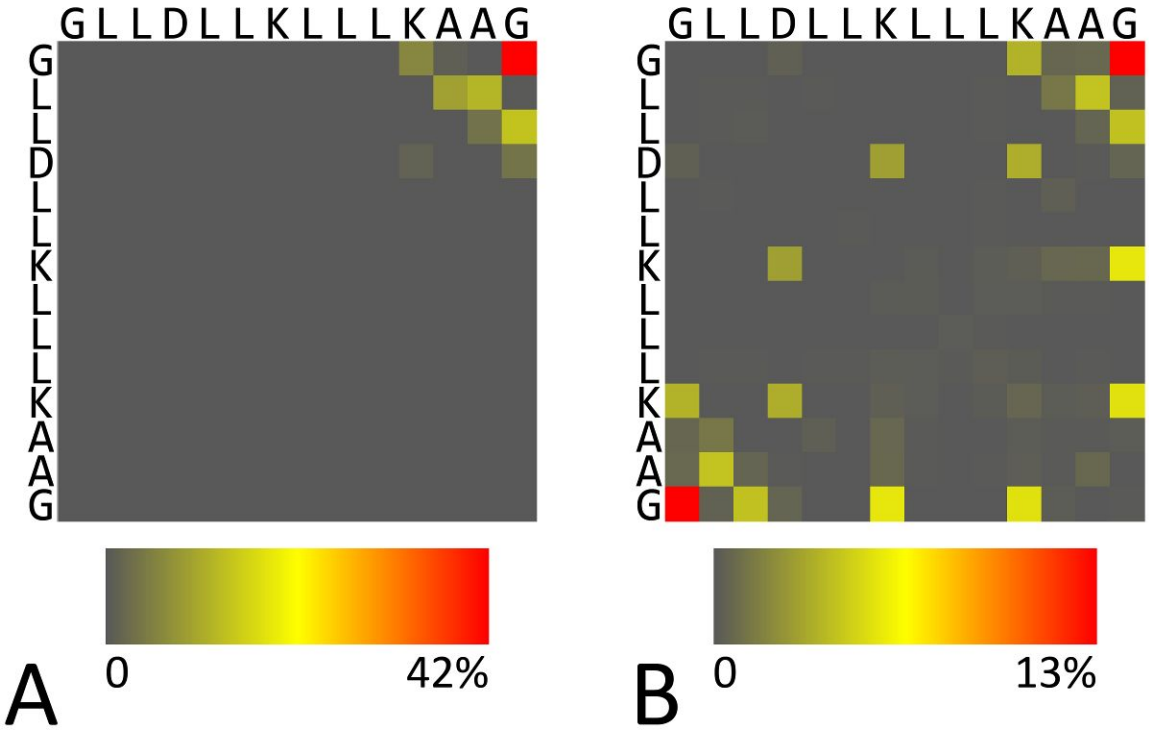

Figure S5 | Contact analysis of the LDKA channel. a, This panel shows a typical ensemble average for a pair of peptides, each being located in a different bilayer leaflet. The figures shows the head-to-tail contacts required by the peptides to span the full length of the hydrophobic membrane core. **b,** This panel shows the ensemble average of the contacts between all peptides over the course of the simulation. Head-to-tail contacts are visible in the top right and bottom left corners of the plot. These stem from the two rings of peptides in each membrane leaflet, while the contacts in the middle of the helix are between neighboring peptides in each leaflet.

Figure S6

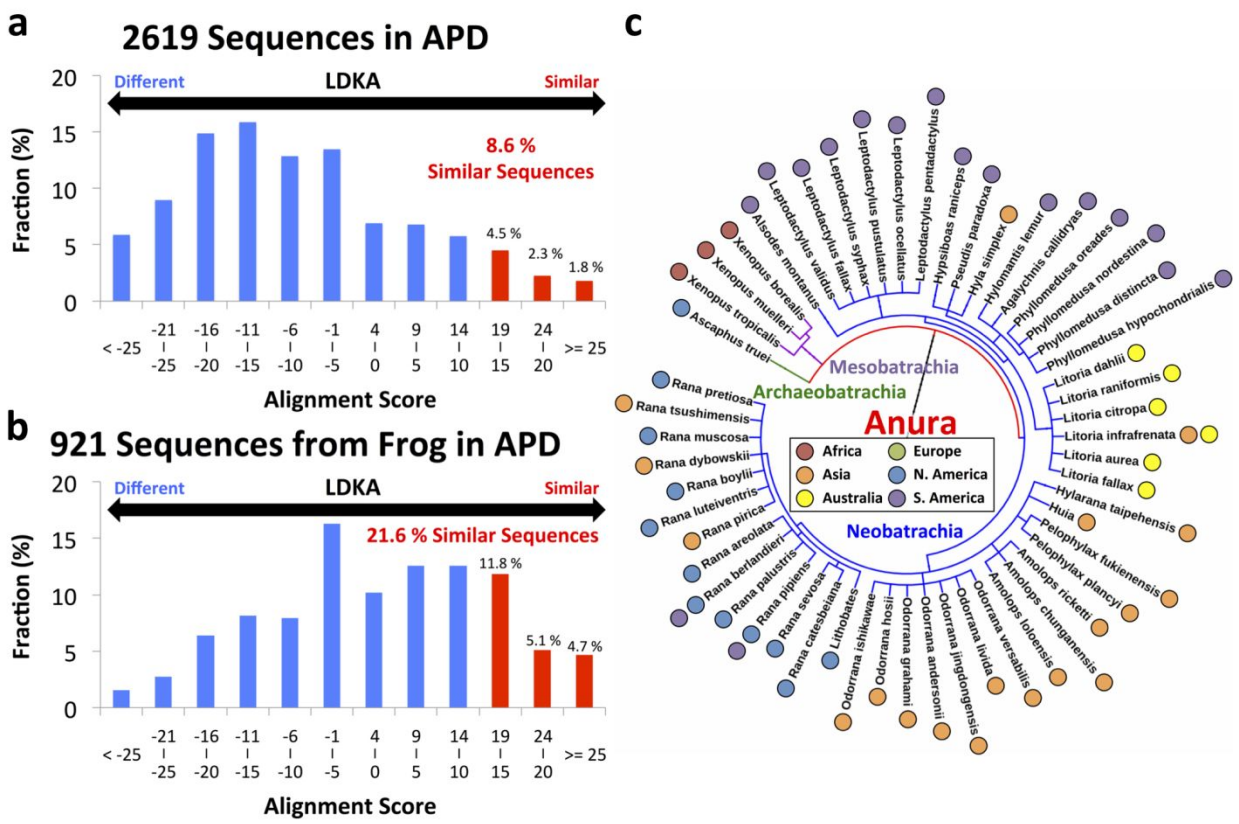

Figure S6 | Comparison of LDKA with naturally occurring AMPs. Alignment score of LDKA with AMPs in the APD. Shown is the sequence similarity of LDKA with all peptide sequences in the database (**a**), and peptide sequences from frog (**b**). An alignment score of 15 was used as a cutoff to distinguish different from similar sequences. **c,** A phylogenetic tree of frog AMPs that have LDKA-like sequences with an alignment score ≥ 15, demonstrating that a similar sequence motif occurs on all continents (the colored circles represent: red: Africa, orange: Asia, yellow: Australia, green: Europe, blue: North America, and purple: South America).

Figure S7

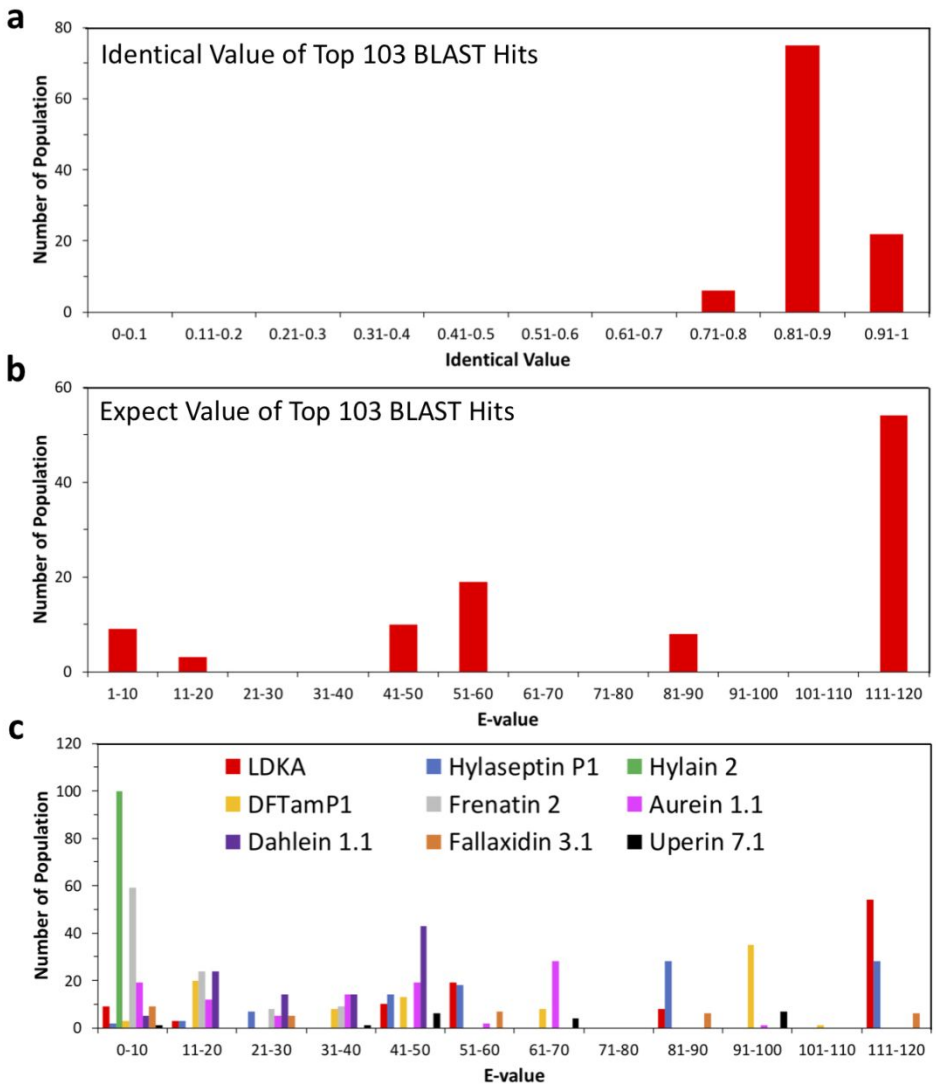

Figure S7 | Homology analysis of the LDKA sequence using BLAST. LDKA (GLLDLLKLLLKAAG) was analyzed using BLAST <https://blast.ncbi.nlm.nih.gov> and shows 103 hits on 100 subject sequences with **a,** > 0.7 identical value. **b,** The E-value (expect value) provides a measure of the probability of the high similarity score occurring by chance when searching a database of a particular size. E-values decrease exponentially as the score of the match increases; therefore, larger E-values suggests a greater chance that the similarity between the hit and the query are merely coincidence. **c,** E-values comparison of LDKA with other similar antimicrobial peptides from frogs (alignment score ≥ 23).

Table S1

Peptide	Model Membrane	System† [Peptide/Lipids/Water]	Length [µs]	T [°C]	Forcefield
GL_5KL_6G	DMPC/DMPG	16 / 192 DMPC & 64 DMPG / 10336	5	70	CHARMM36
LDKL	DMPC/DMPG	1 / 48 DMPC & 16 DMPG / 3641	5	70	CHARMM36
LDKL	DMPC/DMPG	16 / 192 DMPC & 64 DMPG / 9552	5	70	CHARMM36
LDKA	None	1 / None / 810	3	70	CHARMM36
LDKA	DMPC/CHOL/PSM	1 / 20 DMPC & 20 CHOL & 20 PSM / 2757	5	70	CHARMM36
LDKA	DMPC/DMPG	1 / 48 DMPC & 16 DMPG / 3641	5	70	CHARMM36
LDKA	DMPC/DMPG	16 / 192 DMPC & 64 DMPG / 10208	7	70	CHARMM36
LDKA*	DMPC/DMPG	16 / 192 DMPC & 64 DMPG / 10208	8	50	CHARMM36

Table S1 | Summary of the simulations. All systems contain 100 mM potassium chloride. POPC: 1-palmitoyl-2-oleoyl-sn-glycero-3-phosphocholine. POPG: 1-palmitoyl-2-oleoyl-sn-glycero-3-phospho-(1'-rac-glycerol). hRBC: human red blood cell. DMPC: 1,2-dimyristoyl-sn-glycero-3-phosphocholine. Chol: cholesterol. PSM: N-palmitoyl-D-erythro-sphingosylphosphorylcholine. DMPG: 1,2-dimyristoyl-sn-glycero-3-phospho-(1'-rac-glycerol). LDKA* at 50 ˚C is the system that continues running for another 8 µs after 7 µs of LDKA at 70 ˚C.

Table S2

System	P:L	T [˚C]	Helicity [%]	Major TM Oligomer	H-Bond of P-P [#/peptide]	$\Delta G_{S\rightarrow TM}$ [kcal/mol]	$\Delta G_{interface}$ [kcal/mol]	ΔG_{trans_TM} [kcal/mol]
GL_5KL_6G	16:256	70	86±2	Dimer (24±10 %)	10±0	0.1±0.4	-5.42	0.66
LDKL	16:256	70	90±2	Tetramer (7±7 %)	12±0	1.2±1.7	-2.08	4.50
LDKA	16:256	70	70±3	Hexamer (13±12 %)	10±0	0.6±0.6	-0.62	5.21
LDKA*	16:256	50	78±2	Hexamer (14±12 %)	11±0	0.5±0.2	-0.62	5.21

Table S2 | Summary of peptide-design simulations. All simulations are in DMPC/DMPG bilayer (DMPC:DMPG = 3:1), containing 100 mM potassium chloride. $\Delta G_{Interface}$ and ΔG_{trans_TM} represent the free energies of peptide insertion from water into membrane interfaces and into a transmembrane configuration, respectively, and were estimated using the Wimley-White hydrophobicity scale using the MPEx software. The LDKA* system was continued for 8 µs at 50 ˚C, after running for 7 µs at 70 ˚C.

Table S3

Peptide	Membrane Model	T [°C]	P:L	Helicity [%]	H-Bond of P-P [#/peptide]	Peptide Tilt Angle [°]
LDKL	DMPC/DMPG	70	1:64	80.0±7.7	8±2	95.3±15.2
LDKA	None	70	-	67.6±8.0	8±1	-
LDKA	DMPC/CHOL/PSM	70	1:60	63.7±2.1	8±1	96.9±12.7
LDKA	DMPC/DMPG	70	1:64	62.7±3.7	8±1	101.8±12.0

Table S3 | Summary of pore formation simulations. All systems contain 100 mM potassium chloride.

Table S4

Peptide	Source	Sequence	Alignment Score	Net Charge at pH 7	$\Delta G_{Interface}$ [kmol/cal]
LDKA	*Ab initio design*	GLL**D**LL**K**LLL**K**AAG	69 (Identical)	+1	-0.62
Ib-AMP2	*Impatiens balsamina*	QYG**RR**CCNWGPG**RR**YCK**R**WC	-43 (Unlike)	+6	-0.29
HSP1	*Hyla punctata South America*	GIL**D**AI**K**AIA**K**AAG	42	+1	2.32
Hylain 2	*Hyla simplex China*	GIL**D**PI**K**AFA**K**AAG	39	+1	1.78
DFTamP1	*Ab initio designed*	GLLSLLSLLG**K**LL	36	+1	-3.48
Frenatin 2	*Litoria infrafrenata Australia*	GLLGTLGNLLNGLGL	31	0	-3.16
Aurein 1.1	*Litoria aurea & Litoria raniformis Australia*	GLF**D**II**KK**IA**E**SI	28	0	2.34
Dahlein 1.1	*Litoria dahlii Australia*	GLF**D**II**K**NIVSTL	27	0	-0.46
Fallaxidin 3.1	*Litoria fallax Australia*	GLL**D**LA**K**HVIGIAS**K**L	26	+1	1.60
Uperin 7.1	*Litoria ewingi Australia*	GWF**D**VV**K**HIASAV	23	+0	0.31

Table S4 | Summary of the peptide sequences similar to LDKA found in the APD. To evaluate the similarity between two sequences an alignment score is calculated using multiple sequence alignment by CLUSTALW <http://www.genome.jp/tools/clustalw/>. The calculation is summation of (1) K-tuple size, (2) gap penalty, (3) top diagonals, and (4) window size. The alignment score of two identical sequences of LDKA is 69 and the lowest alignment score in the APD is -49. Alignment scores equal to or above 15 are classified as similar. $\Delta G_{Interface}$ shows the free energy from water to the POPC interface, and was estimated using the Wimley-White Scale in MPEx software. We assume the N- and C-termini to be charged.

Table S5

APD #	Alignment Score	Source	Sequences
-	69	LDKA	GLLDLLKLLLKAAG
914	-43	Ib-AMP2 (IBAMP2, Ib antimicrobial peptide 2; UCSS1a; 2S=S; plants, XXQ)	QYGRRCCNWGPGRRYCKRWC
1249	42	Hylaseptin P1 (HSP1, UCLL1; frog, amphibians, animals)	GILDAIKAIAKAAG
2488	39	Hylain 2 (frogs, amphibians, animals; XXA; UCLL1c)	GILDPIKAFAKAAG
77	38	Brevinin-2EB (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILDTLKNLAKTAGKGALQGLVKMASCKLSGQC
607	37	Brevinin-2DYb (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLFDVVKGVLKGAGKNVAGSLLEQLKCKLSGGC
2249	36	DFTamP1 (database filtering technology designed AMP 1; XXA; UCLL1c; synthetic)	GLLSLLSLLGKLL
2474	35	Palustrin-2GN3 (frogs, amphibians, animals; XXU; 1S=S, UCSS1a)	GILDTLKQLGKAAAQSLLSKAACKLAKTC
1256	35	Brevinin-2PRd (Brevinin 2PRd, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLMSVLKGVLKTAGKHIFKNVGGSLLDQAKCKITGQC
1253	35	Brevinin-2PRa (Brevinin 2PRa, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLMSLFKGVLKTAGKHIFKNVGGSLLDQAKCKITGEC
79	35	Brevinin-2ED (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILDSLKNLAKNAGQILLNKASCKLSGQC
1257	33	Brevinin-2PRe (Brevinin 2PRe, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLLSVLKGVLKTTGKHIFKNVGGSLLDQAKCKISGQC
1254	33	Brevinin-2PRb (Brevinin 2PRb, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLMSLFRGVLKTAGKHIFKNVGGSLLDQAKCKITGEC
566	32	Dybowskin-3; Brevinin-2DYc; Brevinin-2RNa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLFDVVKGVLKGVGKNVAGSLLEQLKCKLSGGC
587	32	Brevinin-2TSa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIMSLFKGVLKTAGKHVAGSLVDQLKCKITGGC
606	32	Brevinin-2DYa (frog, amphibians, DXWZ, animals; XXU; ; 1S=S, UCSS1a)	GLLSAVKGVLKGAGKNVAGSLMDKLKCKLFGGC
2007	31	Frenatin 2 (frog, amphibians, animals; XXA; UCLL1c)	GLLGTLGNLLNGLGL
88	30	Esculentin-2EM (Gaegurin-4, Gaegurin 4, GGN4, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILDTLKQFAKGVGKDLVKGAAQGVLSTVSCKLAKTC
1396	30	Pelophylaxin-3 (frog, amphibians, animals; DXWZ; XXU; 1S=S, UCSS1a)	GLMDSLKGLAATAGKTVLQGLLKTASCKLEKTC
2487	30	Hylain 1 (frogs, amphibians, animals; XXA; UCLL1c)	GILDAIKAFANALG
1255	29	Brevinin-2PRc (Brevinin 2PRc, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLMSVTKGVLKTAGKHIFKNVGGSLLDQAKCKISGQC
609	29	Brevinin-2DYd (frog, amphibians, animals; XXU1S=S, UCSS1a)	GIFDVVKGVLKGVGKNVAGSLLEQLKCKLSGGC
118	29	RANATUERIN-2La (Ranatuerin 2La, Also Ranatuerin-2PRa; frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILDSFKGVAKGVAKDLAGKLLDKLKCKITGC
75	29	Brevinin-2 (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLLDSLKGFAATAGKGVLQSLLSTASCKLAKTC
14	29	Aurein 2.1 (XXA, UCLL1c; frog, amphibians, animals)	GLLDIVKKVVGAFGSL
83	28	Esculentin-2A (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILSLVKGVAKLAGKGLAKEGGKFGLELIACKIAKQC
12	28	Aurein 1.1 (XXA, UCLL1c; frog, amphibians, animals)	GLFDIIKKIAESI
13	27	Aurein 1.2 (XXA, UCLL1c; frog, amphibians, animals; BBMm; ZZH)	GLFDIIKKIAESF
322	27	Uperin 2.8 (UCLL1c; toad, amphibians,animals; XXA)	GILDVAKTLVGKLRNVLGI
696	27	Dahlein 1.1 (XXA, UCLL1c; frog, amphibians, animals)	GLFDIIKNIVSTL

697	27	Dahlein 1.2 (XXA, UCLL1c; frog, amphibians, animals)	GLFDIIKNIFSGL
822	27	Brevinin-20b (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIFNVFKGALKTAGKHVAGSLLNQLKCKVSGEC
1411	27	Ranatuerin-2Mb (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIMDSVKGVAKNLAAKLLEKLKCKITGC
15	26	Aurein 2.2 (XXA, UCLL1c; frog, amphibians, animals)	GLFDIVKKVVGALGSL
16	26	Aurein 2.3 (XXA, UCLL1c; frog, amphibians, animals)	GLFDIVKKVVGAIGSL
319	26	Uperin 2.4 (UCLL1; toad, amphibians,animals)	GILDFAKTVVGGIRNALGI
508	26	Nigrocin-1 (frog, amphibians, animals; XXU 1S=S, UCSS1a)	GLLDSIKGMAISAGKGALQNLLKVASCKLDKTC
575	26	Brevinin-2GRa (Brevinin-2JD; frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLLDTFKNLALNAAKSAGVSVLNSLSCKLSKTC
655	26	Ranatuerin-2PLd (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIMDSVKNVAKNIAGQLLDKLKCKITGC
1237	26	Fallaxidin 3.1 (XXA, UCLL1c; frog, amphibians, animals)	GLLDLAKHVIGIASKL
1410	26	Ranatuerin-2Ma (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLLSSFKGVAKGVAKDLAGKLLEKLKCKITGC
1897	26	Brevinin-2RTb (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GILDTLKEFGKTAAKGIAQSLLSTASCKLAKTC
2276	26	Esculentin-2SN1 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GIFSLFKAGAKFFGKNLLKEAGKAGAEHLACKAANQC
2302	26	Esculentin-2LTa (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GIFSLFKAGAKFFGKHLLKQAGKAGAEHLACKATNQC
2600	25	Ocellatin-PT8 (frog, amphibians, animals; UCLL1a)	GVFDIIKGAGKQLIARAMGKIAEKVGLNKDGN
2142	25	Palustrin-Ca (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GFLDIIKDTGKEFAVKILNNLKCKLAGGCPP
1716	25	Esculentin-2PRa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GVFSFLKTGAKLLGSTLLKMAGKAGAEHLACKATNQC
545	25	Ocellatin-3 (XXA; UCLL1c; frog, amphibians, animals)	GVLDILKNAAKNILAHAAEQI
18	25	Aurein 2.5 (XXA, UCLL1c; frog, amphibians, animals, BBMm)	GLFDIVKKVVGAFGSL
1843	24	Brevinin-2-OR2 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLLDTIKNMALNAAKSAGVSVLNSLSCKLSKTC
1847	24	Brevinin-2-OR6 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLLDTIKNMALNAAKSAGVSVLNSLSCKDSKTC
1848	24	Brevinin-2-OR7 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLLDTIKNMALNAAKSAGVSVLNTLSCKLSKTC
1403	24	Ocellatin-V2 (XXA; UCLL1c; frog, amphibians, animals)	GVLDILKGAGKDLLAHALSKISEKV
815	24	Caerulein precursor-related fragment Eb (CPRF-Eb, UCLL1; frog, amphibians, animals)	GLGSFLKNAIKIAGKVGSTIGKVADAIGNKE
610	24	Brevinin-2DYe (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLFSVVTGVLKAVGKNVAKNVGGSLLEQLKCKISGGC
568	24	Dybowskin-5 (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLFSVVTGVLKAVGKNVAKNVGGSLLEQLKCKKISGGC
142	24	GLK-19 (synthetic; Derivatives: GLR-19, ZZH)	GLKKLLGKLLKKLGKLLLK
76	24	Brevinin-2EA (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILDTLKNLAISAAKGAAQGLVNKASCKLSGQC
93	24	Rugosin C (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILDSFKQFAKGVGKDLIKGAAQGVLSTMSCKLAKTC
317	23	Uperin 2.2 (UCLL1; toad, amphibians,animals)	GFVDLAKKVVGGIRNALGI
318	23	Uperin 2.3 (UCLL1c; toad, amphibians,animals; XXA)	GFFDLAKKVVGGIRNALGI
327	23	Uperin 7.1 (UCLL1c; amphibians, frog, animals; XXA; ZZH)	GWFDVVKHIASAV
378	23	Ponericin G3 (antss, insects, arthropods, invertebrates, animals; ZZI)	GWKDWLNKGKEWLKKKGPGIMKAALKAATQ

576	23	Brevinin-2GRb (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GVLGTVKNLLIGAGKSAAQSVLKTLSCKLSNDC
1292	23	Odorranain-C1 (OdC1, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GVLGAVKDLLIGAGKSAAQSVLKTLSCKLSNDC
1421	23	Brevinin-2HSa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLLDSLKNLAINAAKGAGQSVLNTLSCKLSKTC
1429	23	Brevinin-2PTc (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLLDSFKNAMIGIAKSAGKTALNKIACKIDKTC
1501	23	Ranatuerin-2Wb (frog, amphibians, animals; DXWZ; XXU; 1S=S, UCSS1a)	GLFDSIKNVAKNVAAGLLDKLKCKITGC
1835	23	Brevinin-2-OA2 (Brevinin-2E-OG1; XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLLDTFKNMALNAAKSAGVSVLNALSCKLSKTC
1840	23	Brevinin-2-OA7 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GVLGTVKDLLIGAGKSAAQSTLKTLSCKISNDC
2281	23	Brevinin-2SN2 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GVLDTLKNVAIGVAKGAGTGVLKALLCQLDKSC
1956	22	Macropin 1 (Mac1, MAC-1, insects, arthropods, invertebrates, animals, XXA)	GFGMALKLLKKVL
1236	22	Fallaxidin 3.2 (XXA, UCLL1c; frog, amphibians, animals)	GLLDFAKHVIGIASKL
964	22	Dermaseptin-L1 (Dermaseptin L1, DRS-L1; UCLL1; frog, amphibians, animals)	GLWSKIKEAAKAAGKAALNAVTGLVNQGDQPS
934	22	Dermaseptin-S7 (DRS-S7; Dermaseptin S7, DRS S7; UCLL1; frog, amphibians, animals; DXWZ)	GLWKSLLKNVGKAAGKAALNAVTDMVNQ
653	22	Ranatuerin-2PLb (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIMDTVKNAAKDLAGQLLDKLKCRITGC
657	22	Ranatuerin-2PLf (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIMDTVKNAAKDLAGQLDKLKCRITGC
543	22	Ocellatin-1 (XXA, UCLL1c; frog, amphibians, animals)	GVVDILKGAGKDLLAHLVGKISEKV
352	22	Citropin 1.2 (XXA, UCLL1c; frog, amphibians, animals)	GLFDIIKKVASVVGGL
120	22	RANATUERIN 2B (Ranatuerin-2B, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLLDTIKGVAKTVAASMLDKLKCKISGC
84	22	Esculentin-2B (ES2B_RANES, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIFSLVKGAAKLAGKGLAKEGGKFGLELIACKIAKQC
1293	22	Odorranain-D1 (OdD1, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GFLDTFKNLALNAAKSAGVSVLNSLSCKLFKTC
1422	22	Brevinin-2HSb (frog, amphibians, animals; DXWZ; XXU; 1S=S, UCSS1a)	GLLDTLKNMAINAAKGAGQSVLNTLSCKLSKTC
381	21	Ponericin G6 (antss, insects, arthropods, invertebrates, animals; ZZI)	GLVDVLGKVGGLIKKLLP
353	21	Citropin 1.3 (XXA, UCLL1c; frog, amphibians, animals)	GLFDIIKKVASVIGGL
447	21	Anoplin (insects, arthropods, invertebrates, animals; XXA; SAR; derivatives)	GLLKRIKTLL
506	21	DP1 (synthetic)	KLAKLAKKLAKLAK
544	21	Ocellatin-2 (XXA, UCLL1c; frog, amphibians, animals)	GVLDIFKDAAKQILAHAAEKQI
639	21	Citropin 2.1.3 (UCLL1; frog, amphibians, animals)	GLIGSIGKALGGLLVDVLKPKLQAAS
1837	21	Brevinin-2-OA4 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLLDTFKNLAINAAESAGVSVLNSLSCKLSKTC
1844	21	Brevinin-2-OR3 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLIDTIKNMALNAAKSAGVSVLNTLSCKLSKTC
2268	21	Pleurain-M1 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLLDSVKEGLKKVAGQLLDTLKCKISGCTPA
2598	21	Ocellatin-PT4 (frog, amphibians, animals, XXA, UCLL1c)	GVFDIIKGAGKQLIAHAMGKIAEKV
2599	21	Ocellatin-PT7 (frog, amphibians, animals; UCLL1a)	GVFDIIKGAGKQLIAHAMGKIAEKVGLNKDGN
2667	21	Lys-49 phospholipase A2 (PLA2), myotoxin II (snake, reptiles; animals; S=S, UCSS1a)	SLFELGKMILQETGKNPAKSYGAYGCNCGVLGRGKPKDATDRCCYVHK CCYKKLTGCNPKKDRYSYSWKDKTIVCGENNSCLKELCECDKAVAICLR ENLNTYNKKYRYYLKPLCKKADAC

2668	21	Bthtx-I (Bothropstoxin-I, PLA2, snake, reptiles; animals; S=S, UCSS1a)	SLFELGKMILQETGKNPAKSYGAYGCNCGVLGRGKPKDATDRCCYVHK CCYKKLTGCDPKKDRYSYSWKDKTIVCGENNPCLKELCECDKAVAICLR ENLGTYNKKYRYHLKPFCKKADPC
2669	21	BnuTX-I (PLA2, snake, reptiles; animals; S=S, UCSS1a; BWQ)	SLFELGKMILQETGKNPAKSYGAYGCNCGVLGRGKPKDATDRCCYVHK CCYKAAAAAAAAADRYSYSWKDKTIVCGENNPCLKELCECDKAVAICL RENLGTYNKKYRYHLKPFCKKAAAA
2011	20	Citropin 1.1.3 (frog, amphibians, animals; XXA; UCLL1c)	GLFDVIKKVASVIGLASP
1841	20	Brevinin-2-OA8 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GVLATVKNLLNGTGDGAAQSVLKTLSCKLSNDC
1834	20	Brevinin-2-OA1 (XXU; 1S=S, UCSS1a frog, amphibians, animals)	GILDTFKNMALNAAKSAGVSVLNALSCKLSKTC
1622	20	CPF-B1 (caerulein precursor fragment-B1; UCLL1; frog, amphibians, animals)	GLGSLLGKAFKIGLKTVGKMMGGAPREQ
1402	20	Ocellatin-V1 (XXA; UCLL1c; frog, amphibians, animals)	GVVDILKGAGKDLLAHALSKLSEKV
881	20	Brevinin-2HS2 (Brevinin 2HS2, UCLL1; frog, amphibians, animals)	SLLGTVKDLLIGAGKSAAQSVLKGLSGKLSKDC
814	20	Caerulein precursor-related fragment Ea (CPRF-Ea, UCLL1; frog, amphibians, animals)	GLGSILGKILNVAGKVGKTIGKVADAVGNKE
816	20	Caerulein precursor-related fragment Ec (CPRF-Ec, UCLL1; frog, amphibians, animals)	GLGSFFKNAIKIAGKVGSTIGKVADAIGNKE
351	20	Citropin 1.1 (UCLL1c; XXA, frog, amphibians, animals)	GLFDVIKKVASVIGGL
316	20	Uperin 2.1 (UCLL1c; toad, amphibians,animals; XXA)	GIVDFAKKVVGGIRNALGI
19	20	Aurein 2.6 (XXA, UCLL1c; frog, amphibians, animals)	GLFDIAKKVIGVIGSL
91	19	Rugosin A (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLLNTFKDWAISIAKGAGKGVLTTLSCKLDKSC
121	19	RANATUERIN 2P (Ranatuerin-2P, frog, amphibians, animals; ZZHa_t; XXU; 1S=S, UCSS1a)	GLMDTVKNVAKNLAGHMLDKLKCKITGC
382	19	Ponericin G7 (antss, insects, arthropods, invertebrates, animals)	GLVDVLGKVGGLIKKLLPG
380	19	Ponericin G5 (antss, insects, arthropods, invertebrates, animals)	GLKDWVKIAGGWLKKKGPGILKAAMAAATQ
533	19	Ocellatin-F1 (Fallaxin, XXA; UCLL1c; frog, amphibians, animals; Derivatives: FA12)	GVVDILKGAAKDIAGHLASKVMNKL
540	19	Ocellatin-P1 (Pentadactylin, XXA; UCLL1c; frog, amphibians, animals)	GLLDTLKGAAKNVVGSLASKVMEKL
577	19	Brevinin-2GRc (Esculentin-2-OA3; Esculentin-2JDa; frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLFTLIKGAAKLIGKTVAKEAGKTGLELMACKITNQC
642	19	Pardaxin 2 (Pardaxin P-2, Pardaxin P2,Pa2, flat fish, animals)	GFFALIPKIISSPIFKTLLSAVGSALSSSGGQE
880	19	Brevinin-2HS1 (Brevinin 2HS1, UCLL1; frog, amphibians, animals; DXWZ)	GLWDTIKQAGKKIFLSVLDKIRCKVAGGG
951	19	Dermaseptin-H10 (Dermaseptin H10, DRS-H10, Drs H10; UCLL1; frog, amphibians, animals)	GLWSTIKNVAAAAGKAALGAL
1258	19	Ranatuerin-2PRa (Ranatuerin 2PRa, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLMDVFKGAAKNLLASALDKIRCKVTKC
1273	19	Esculentin-1ARb (frog, amphibians, animals: ZZHa_t; XXU; 1S=S, UCSS1a)	GLFPKFNKKKVKTGIFDIIKTVGKEAGMDVLRTGIDVIGCKIKGEC
1299	19	Odorranain-K1 (OdK1, UCLL1; frog, amphibians, animals)	GLFTLIKGAAKLIGKTVPKKQARLGMNLWLVKLPTNVKT
1401	19	Ocellatin-S1 (Syphaxin, SPX, XXA, frog, amphibians, animals)	GVLDILKGAAKDLAGHVATKVINKI
1409	19	Laticeptin (XXA; UCLL1c; frog, amphibians, animals)	GVVDILKGAAKDLAGHLATKVMNKL
1418	19	Ranatuerin-2Ya (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLMDTIKGVAKTVAASWLDKLKCKITGC
1867	19	Esculentin-2-OA2 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLFTLIKGAAKLIGKTTAKEAGKTGKLEMACKITNQC

1930	19	Esculentin-2-ALb (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GIFSLIKTAAKFVGKNLLKQAGKAGVEHLACKANNQC
2103	19	Palustrin-OG1 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLWDTIKQAGKKFFLNVLDKIRCKVAGGCRT
2113	19	Ranatuerin-2CHb (frog, amphibians, animals; XXU; more AMPs?: Ranatuerin-2CHc; 1S=S, UCSS1a)	GLMDTIKGVAKNVAASLLEKLKCKVTGC
2300	19	Brevinin-2LTc (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GVLDTFKDVAIGVAKGAGTGVLKALLCKLDKSC
2475	19	Esculentin-2LF1 (frogs, amphibians, animals; XXU; 1S=S, UCSS1a)	GIFSLIKTAAKFVGKNLLKQAGKAGLEHLACKANNQC
2482	19	CPF-M1 (frogs, amphibians, animals; UCLL1a)	GLGSLLGKAFKFGLKTVGKMMAGAPREQ
2485	19	CPF-MW1 (frogs, amphibians, animals; UCLL1a)	GLGSLLGKAFKFGLKTVGKMMGGAPREQ
2486	19	CPF-MW2 (frogs, amphibians, animals; UCLL1a)	GLGSLLGKAFKFGLKTVGKMMGGAPREE
371	18	PMAP-37 (PMAP37, cathelicidin, pigs, mammals; animals)	GLLSRLRDFLSDRGRRLGEKIERIGQKIKDLSEFFQS
654	18	Ranatuerin-2PLc (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLLDTIKNTAKNLAVGLLDKIKCKMTGC
888	18	Brevinin-2BYb (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIMDSVKGLAKNLAGKLLDSLKCKITGC
1223	18	Ascaphin-8 (XXA, UCLL1c; frog, amphibians, animals; BBMm; SeqAR; ZZH)	GFKDLLKGAAKALVKTVLF
1404	18	Ocellatin-V3 (XXA; UCLL1c; frog, amphibians, animals)	GVLDILTGAGKDLLAHALSKLSEKV
1430	18	Brevinin-2PTd (frog, amphibians, animals; DXWZ; XXU; 1S=S, UCSS1a)	GFLDSFKNAMIGVAKSAGKTALNTLACKIDKTC
1719	18	Ranatuerin-2PRb (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILDTFKGVAKGVAKDLAVHMLENLKCKMTGC
1836	18	Brevinin-2-OA3 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLLDTFKNMAINAAHGAGVSVLNALSCKLKKTC
1855	18	Esculentin-1-OA1 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLFSKFVGKGIKNFLIKGVKHIGKEVGMDVIRVGIDVAGCKIKGVC
1857	18	Esculentin-1-OA3 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLFSKFAGKGIKDLIFKGVKHIGKEVGMDVIRVGIDVAGCKIKGVC
1858	18	Esculentin-1-OA4 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLFTKFAGKGIKDLIFKGVKHIGKEVGMDVIRVGIDVAGCKIKGVC
1859	18	Esculentin-1-OA5 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLFSKFAGKGIKNFLIKGVKHIGKEVGMDVIRVGIDVAGCKIKGVC
1871	18	Esculentin-2-OR3 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GVFTLLKGATQLIGKTLGKELGKTGLELMACKITNQC
1896	18	Brevinin-2RTa (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLMSTLKDFGKTAAKEIAQSLLSTASCKLAKTC
2006	18	Frenatin 1 (frog, amphibians, animals; XXA; UCLL1c)	GLLDALSGILGL
2384	18	Raniseptin 1 (Rsp-1, frogs, amphibians, animals; UCLL1; More AMPs? Rsp-2, Rsp-3, Rsp-4, Rsp-5, Rsp-6, Rsp-7, Rsp-8, Rsp-9)	AWLDKLKSLGKVVGKVALGVAQNYLNPQQ
638	17	Citropin 2.1 (UCLL1; frog, amphibians, animals)	GLIGSIGKALGGLLVDVLKPKL
821	17	Brevinin-20a (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLFNVFKGLKTAGKHVAGSLLNQLKCKVSGGC
882	17	Brevinin-2HS3 (Brevinin 2HS3, frog, amphibians, animals; DXWZ; XXU; 1S=S, UCSS1a)	SILGTVKDLLIGAGKSAALSVLKGLSCKLSKDC
940	17	Dermaseptin-S12 (DRS-S12; Dermaseptin S12, DRS S12; UCLL1c; frog, amphibians, animals; probably XXA; DXWZ;)	GLWSKIKEAAKTAGKMAMGFVNDMV
941	17	Dermaseptin-S13 (DRS-S13; Dermaseptin S13, DRS S13; UCLL1c; frog, amphibians, animals; probably XXA; DXWZ;)	GLRSKIKEAAKTAGKMALGFVNDMA
948	17	Dermaseptin-H7 (Dermaseptin H7, DRS-H7, Drs H7, DSHYPO05; XXA; UCLL1c; frog, amphibians, animals; DXWZ)	GLWSKIKDVAAAAGKAALGAVNEAL

955	17	Dermaseptin-H15 (Dermaseptin H15, DRS-H15, Drs H15; UCLL1; frog, amphibians, animals; DXWZ)	GLWSKIKDVAAAAGKAALGAVNEAL
969	17	Dermaseptin-DI5 (DRS-DI5, dermadistinctin Q2, DDQ2; DD Q2; UCLL1c; frog, amphibians, animals)	GLWSKIKEAAKTAGLMAMGFVNDMV
1272	17	Esculentin-1ARa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIFSKINKKKAKTGLFNIIKTVGKEAGMDVIRAGIDTISCKIKGEC
1274	17	Ranatuerin-2ARa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLMDTVKNAAKNLAGQLLDTIKCKMTGC
1275	17	Ranatuerin-2ARb (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILDTIKNAAKTVAVGLLEKIKCKMTGC
1387	17	Plasticin-C1 (PTC-C1, DRP-AC-1, XXA, UCLL1c; frog, amphibians, animals; DXWZ)	GLLSGILNTAGGLLGNLIGSLSN
1388	17	Plasticin-C2 (PTC-C2, DRP-AC-2, XXA, UCLL1c; frog, amphibians, animals; DXWZ)	GLLSGILNSAGGLLGNLIGSLSN
1420	17	Esculentin-2HSa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIFSLIKGAAQLIGKTVAKEAGKTGLELMACKVTKQC
1500	17	Ranatuerin-2Wa (frog, amphibians, animals; DXWZ; XXU; 1S=S, UCSS1a)	GIMDSIKGLGKNLAGQLLDKLKCKITGC
1507	17	Ranatuerin-2CPc (frog, amphibians, animals; DXWZ; XXU; 1S=S, UCSS1a)	GLMDTVKNAAKNLAGQLLDTIKCKITGC
1705	17	Esculentin-2ISa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIFSLIKGAAKLITKTVAKEAGKTGLELMACKVTNQC
1727	17	Temporin-PRc (UCLL1c; frog, amphibians, animals; XXA)	NFLDTLINLAKKFI
1839	17	Brevinin-2-OA6 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GVLATVKNLLIGTGDGAAQSVLKTLSCKLSNDC
1929	17	Esculentin-2-ALa (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GIFALIKTAAKFVGKNLLKQAGKAGLEHLACKANNQC
2064	17	Brevinin-2CG1 (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILDKLKEFGISAARGVAQSLLNTTASCKLAKTC
2112	17	Ranatuerin-2CHa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLMDTVKNAAKNLAGQLLDRLKCKITGC
2470	17	Brevinin-2LF1 (frogs, amphibians, animals; XXU; 1S=S, UCSS1a)	GFMDTAKNVAKNVAKNVAVTLLDKLRCKVTGGC
20	16	Aurein 3.1 (XXA, UCLL1c; frog, amphibians, animals)	GLFDIVKKIAGHIAGSI
87	16	Gaegurin-3 (Gaegurin 3, GGN3, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIMSIVKDVAKTAAKEAAKGALSTLSCKLAKTC
116	16	RANATUERIN 3 (Ranatuerin-3, UCSS1a; frog, amphibians, animals)	GFLDIINKLGKTFAGHMLDKIKCTIGTCPPSP
301	16	Hadrurin (scorpions, arachnids, Chelicerata, arthropods, invertebrates, animals; UCLL1a)	GILDTIKSIASKVWNSKTVQDLKRKGINWVANKLGVSPQAA
427	16	CPF-ST3 (XT-7; XXA, UCLL1c; frog, amphibians, animals, SeqAR)	GLLGPLLKIAAKVGSNLL
478	16	Pseudin-4 (Pseudin 4; UCLL1; frog, amphibians, animals)	GINTLKKVIQGLHEVIKLVSNHA
574	16	Esculentin-IGRa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLFSKFAGKGIKNLIFKGVKHIGKEVGMDVIRTGIDVAGCKIKGEC
603	16	Brevinin-1DYc (frog, amphibians, animals; XXU; 1S=S, UCSS1a. More AMPs? Brevinin-1DYd)	FLPLLLAGLPKLLCLFFKKC
651	16	Esculentin-2PLa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLFSILKGVGKIALKGLAKNMGKMGLDLVSCKISKEC
662	16	Esculentin-2B (ESC2B-RANBE, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLFSILRGAAKFASKGLGKDLTKLGVDLVACKISKQC
698	16	Dahlein 4.1 (XXA, UCLL1c; frog, amphibians, animals)	GLWQLIKDKIKDAATGFVTGIQS
887	16	Brevinin-2BYa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GILSTFKGLAKGVAKDLAGNLLDKFKCKITGC
1405	16	Leptoglycin (UCLL1; frog, amphibians, animals; Gly-rich, Leu-rich)	GLLGGLLGPLLGGGGGGGGGLL
965	16	Dermaseptin-C3 (Dermaseptin C3, Drs C3, DRS-C3, DRP-AC-3; UCLL1; frog, amphibians, animals)	SVLSTITDMAKAAGRAALNAITGLVNQ

1242	16	Fallaxidin 4.1 (UCLL1; frog, amphibians, animals)	GLLSFLPKVIGVIGHLIHPPS
1335	16	Ascaphin-3M (UCLL1; N Am inland frog, amphibians, animals; DXWZ)	GFREVLKGAAKAFVKTVAGHIANI
1391	16	Lividin-2 (Brevinin-2-OR8; frog, amphibians, animals; XXU; 1S=S, UCSS1a)	SFLDTLKNLAISAAKGAGQSVLSTLSCKLSKTC
1392	16	Lividin-3 (Brevinin-2-OR1; frog, amphibians, animals; XXU; 1S=S, UCSS1a)	SVLGTVKDLLIGAGKSAAQSVLTALSCKLSNSC
1648	16	Pelteobagrin (fish, animals; BBMm)	GKLNLFLSRLEILKLFVGAL
1709	16	Brevinin-2ISc (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	SVLGTVKDLLIGAGKSAAQSVLTTLSCKLSNSC
1838	16	Brevinin-2-OA5 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLLDGILNANFNAAKSAGTSVLNALSCKLSKTC
1845	16	Brevinin-2-OR4 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	SVLGTVKDLLIGAGKSAAQSVLTANSCKLSNSC
1846	16	Brevinin-2-OR5 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	SFLDTLKNLAISAAKGAGQSVLSTLSCKLSETC
1856	16	Esculentin-1-OA2 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLFSKFSGKGIKNFLIKGVKHIGKEVGMDVIRTGIDVAGCKIKGEC
1866	16	Esculentin-2-OA1 (Esculentin-2JDb; XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GIFTLIKGAAKLIGKTVAKEAGKTGLELMACKITNQC
2270	16	Pleurain-N1 (frog, amphibians, animals; UCLL1)	GFFDRIKALTKNVTLELLNTITCKLPVTPP
2275	16	Temporin-SN4 (frog, amphibians, animals; XXA; UCLL1c)	FITGLISGLMKAL
2284	16	CPF-St5 (frog, amphibians, animals; UCLL1)	GVFGLLAKAALKGASKLIPHLLPSRQQ
86	15	Gaegurin-2 (Gaegurin 2, GGN2, frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIMSIVKDVAKNAAKEAAKGALSTLSCKLAKTC
263	15	Maculatin 3.1 (XXA, UCLL1c; frog, amphibians, animals)	GLLQTIKEKLESLESLAKGIVSGIQA
486	15	Cupiennin 1b (spiders, arachnids, Chelicerata, arthropods, invertebrates, animals; UCLL1a)	GFGSLFKFLAKKVAKTVAKQAAKQGAKYIANKQME
487	15	Cupiennin 1c (spiders, arachnids, Chelicerata, arthropods, invertebrates, animals; UCLL1a)	GFGSLFKFLAKKVAKTVAKQAAKQGAKYIANKQTE
488	15	Cupiennin 1d (spiders, arachnids, Chelicerata, arthropods, invertebrates, animals; ZZI; UCLL1a)	GFGSLFKFLAKKVAKTVAKQAAKQGAKYVANKHME
679	15	Esculentin 2VEb (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GLFSILKGVGKIAIKGLGKNLGKMGLDLVSCKISKEC
685	15	Ranatuerin 2VEb (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GIMDTVKGVAKTVAASLLDKLKCKITGC
699	15	Dahlein 4.2 (UCLL1; frog, amphibians, animals)	GLWQFIKDKLKDAATGLVTGIQS
942	15	Dermaseptin-H1 (DRS-H1; Dermaseptin H1; UCLL1; frog, amphibians, animals; DXWZ;)	GLWKSLLKNVGVAAGKAALNAVTDMVNQ
945	15	Dermaseptin-H4 (Dermaseptin H4, DRS-H4, Drs H4, DSHYPO02; UCLL1; frog, amphibians, animals; DXWZ;)	GLWKSLLKNVGVAAGKAALNAVTDMVNQ
947	15	Dermaseptin-H6 (Dermaseptin H6, DRS-H6, Drs H6, DSHYPO04; UCLL1c; frog, amphibians, animals; XXA, DXWZ)	GLWSTIKQKGKEAAIAAAKAAGKAVLNAASEAL
949	15	Dermaseptin-H8 (Dermaseptin H8, DRS-H8, Drs H8, DSHYPO06; UCLL1c; frog, amphibians, animals; XXA; DXWZ)	GLWSTIKQKGKEAAIAAAKAAGQAVLNSASEAL
950	15	Dermaseptin-H9 (Dermaseptin H9, DRS-H9,Drs H9, DSHYPO07; UCLL1c; frog, amphibians, animals; XXA; DXWZ	GLWSTIKQKGKEAAIAAAKAAGQAALNAASEAL
1389	15	Dermaseptin 01 (DRS-01, DRS 01; DS-01; DS 01; DShypo 05; XXA; UCLL1c; frog, amphibians, animals; ZZP)	GLWSTIKQKGKEAAIAAAKAAGQAALGAL
1393	15	Lividin-4 (Esculentin-2-OR1; frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GVFTLIKGATQLIGKTLGKELGKTGLELMACKITNQC
1504	15	Esculentin-2SE (Esculentin-2CPa; frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GFFSLIKGVAKIATKGLAKNLGKMGLDLVGCKISKEC

1706	15	Palustrin-2ISa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	GFMDTAKNVAKNVAVTLLDKLKCKITGGC
1707	15	Brevinin-2ISa (frog, amphibians, animals; XXU; 1S=S, UCSS1a)	SLLDTFKNLAVNAAKSAGVSVLNALSCKISRTC
1781	15	Palustrin-2ISc (Odorranain-F-OR1; UCLL1; frog, amphibians, animals; Inactive: Palustrin-2ISd)	GFMDTAKNVAKNVAATLLDKLKCKITGGC
1870	15	Esculentin-2-OR2 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GVFTLIKGATQLIGKTLGKEVGKTGLELMACKITKQC
1872	15	Esculentin-2-OR4 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GVFTLIKGATQLIGKTLGKELGKTGLELMACKITEQC
1873	15	Esculentin-2-OR5 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GVFTLIKGATQLIGKTLGKELGKTGLEIMACKITKQC
1874	15	Andersonin-X1 (UCLL1; frog, amphibians, animals)	GLFSKFAGKGIVNFLIEGVE
2266	15	Pleurain-G1 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GFWDSVKEGLKNAAVTILNKIKCKISECPPA
2273	15	Temporin-SN2 (frog, amphibians, animals; XXA; UCLL1c)	FITGLIGGLMKAL
2280	15	Brevinin-2SN1 (XXU; 1S=S, UCSS1a; frog, amphibians, animals)	GLRDKIKNVAIDVAKGAGTGVLKALLCQLDKSC

Table S5 | Alignment score of LDKA with 921 frog AMPs. The highest alignment score is LDKA with itself (highlighted in yellow) and the lowest is APD entry 914, highlighted in red.

Table S6

Sequence ID	Description [Organism]	Source	Start	Aligned Sequence	End	E-value	Ident
lcl|Query_52628	-	-	1	GLL-DLLK-LLLKAAG-	14	-	-
ref|XP_026192391.1	uncharacterized protein LOC113147138 [Cyclospora cayetanensis]	parasite (alveolata)	1746	-LL-DLLR-LLLKA---	1756	5	0.91
ref|XP_026192391.1	uncharacterized protein LOC113147138 [Cyclospora cayetanensis]	parasite (alveolata)	198	-LL-ELLD-LLL-----	206	5	0.91
ref|WP_108947702.1	GGDEF domain-containing protein [Azoarcus communis]	bacterium	279	GLL-DLLK-LLL-----	288	5	1
gb|PLX67755.1	GGDEF domain-containing protein [Azoarcus sp.]	bacterium	279	GLL-DLLK-LLL-----	288	5	1
ref|WP_108973867.1	GGDEF domain-containing protein [Azoarcus communis]	bacterium	274	GLL-DLLK-LLL-----	283	5	1
gb|PKO81456.1	GGDEF domain-containing protein [Betaproteobacteria bacterium HGW-Betaproteobacteria-13]	bacterium	274	GLL-DLLK-LLL-----	283	5	1
gb|PKO51326.1	GGDEF domain-containing protein [Betaproteobacteria bacterium HGW-Betaproteobacteria-21]	bacterium	56	GLL-DLLK-LLL-----	65	5	1
ref|XP_024663475.1	Cohesin subunit psc3 [Wickerhamiella sorbophila]	fungus	83	GLL-DLLN-LVVKAAG-	96	7.1	0.79
ref|WP_028895778.1	preprotein translocase subunit TatC [Syntrophorhabdus aromaticivorans]	bacterium	37	----DLLR-LLLKAAG-	47	10	0.91
ref|XP_026193552.1	uncharacterized protein LOC34620019 [Cyclospora cayetanensis]	parasite (alveolata)	1411	-LL-PLLK-LLLKAA--	1422	14	0.92
gb|OEH79675.1	zinc finger (c3hc4 ring finger) protein [Cyclospora cayetanensis]	parasite (alveolata)	164	-LL-PLLK-LLLKAA--	175	14	0.92
dbj|GBE44617.1	ribonuclease D [bacterium BMS3Bbin10]	bacterium	306	-LL-DLLR-VLLKAA--	317	14	0.83
ref|WP_081955817.1	RnfABCDGE type electron transport complex subunit C [Methanococcoides methylutens]	archaea	156	-ML-DALK-LLMKAAG-	168	41	0.77
gb|KGK98175.1	NADH:ubiquinone oxidoreductase [Methanococcoides methylutens]	archaea	150	-ML-DALK-LLMKAAG-	162	41	0.77
gb|PYN71781.1	group II intron reverse transcriptase/maturase [Candidatus Rokubacteria bacterium]	bacterium	193	--L-HLLK-LMLKAAG-	204	41	0.83

ref|XP_011555508.1	PREDICTED: LOW QUALITY PROTEIN: fatty-acid amide hydrolase 2-A-like [Plutella xylostella]	moth	392	GLL-ELLK-LLL-----	401	41	0.9
gb|KUM47998.1	hypothetical protein ABT39_MTgene4993 [Picea glauca]	tree	29	-LL-DLLK-LLL----P	53	41	1
gb|KUM47998.1	hypothetical protein ABT39_MTgene4993 [Picea glauca]	tree	47	-LL-QLLK-LLLK----	57	41	1
dbj|GAV07189.1	hypothetical protein RvY_17060 [Ramazzottius varieornatus]	eutardigrade	802	-LL-DLLK-LLL-----	810	41	1
ref|WP_126629059.1	hypothetical protein [Ktedonobacterales bacterium Uno16]	bacterium	833	-LL-DLLK-LLL-----	841	41	1
ref|WP_084630427.1	IS4 family transposase [Methanosarcina lacustris]	archaea	377	--L-DLLK-LLLK----	385	41	1
gb|AKB74567.1	Mobile element protein [Methanosarcina lacustris Z-7289]	archaea	298	--L-DLLK-LLLK----	306	41	1
ref|WP_079978064.1	30S ribosomal protein S12 methylthiotransferase RimO [Criblamydia sequanensis]	bacterium	247	GLL-DLLK-ELLKEEG-	260	58	0.79
ref|NP_001164542.1	cytochrome P450ka1 [Oryctolagus cuniculus]	rabbit (mammalia)	23	GLL-GLLL-LLLKAA--	35	58	0.85
ref|NP_001164599.1	cytochrome P450 4A6 [Oryctolagus cuniculus]	rabbit (mammalia)	23	GLL-GLLL-LLLKAA--	35	58	0.85
ref|XP_008262273.1	PREDICTED: cytochrome P450 4A6 isoform X1 [Oryctolagus cuniculus]	rabbit (mammalia)	23	GLL-GLLL-LLLKAA--	35	58	0.85
ref|WP_091688268.1	4Fe-4S dicluster domain-containing protein [Methanococcoides vulcani]	archaea	157	--L-DALK-LLMKAAG-	168	58	0.83
ref|XP_009314111.1	hypothetical protein DQ04_09161040 [Trypanosoma grayi]	parasite (excavata)	242	-LL-DMLK-LILKA---	252	58	0.82
ref|XP_001009156.2	ABC transporter C family protein [Tetrahymena thermophila SB210]	ciliate (alveolata)	88	----DMLK-LLLKAA--	97	58	0.9
ref|XP_001615248.1	hypothetical protein, conserved [Plasmodium vivax]	parasite (alveolata)	1026	-LL-DLLK-ILLK----	1035	58	0.9
emb|SCO67227.1	conserved Plasmodium protein, unknown function [Plasmodium vivax]	parasite (alveolata)	1020	-LL-DLLK-ILLK----	1029	58	0.9
gb|KMZ93172.1	hypothetical protein PVMG_04918 [Plasmodium vivax Mauritania I]	parasite (alveolata)	1020	-LL-DLLK-ILLK----	1029	58	0.9
gb|KMZ80580.1	hypothetical protein PVIIG_04365 [Plasmodium vivax India VII]	parasite (alveolata)	1006	-LL-DLLK-ILLK----	1015	58	0.9
emb|SGX77459.1	conserved Plasmodium protein, unknown	parasite (alveolata)	996	-LL-DLLK-ILLK----	1005	58	0.9

	function [Plasmodium vivax]						
ref|WP_065340875.1	GGDEF domain-containing protein [Azoarcus olearius]	bacterium	276	GLL-DLLR-LLL-----	285	58	0.9
ref|WP_011766418.1	GGDEF domain-containing protein [Azoarcus sp. BH72]	bacterium	276	GLL-DLLR-LLL-----	285	58	0.9
gb|OJV48048.1	ribonuclease D [Alphaproteobacteria bacterium 43-37]	bacterium	312	-LI-DLLK-LLLK----	321	58	0.9
ref|WP_007745204.1	capsular polysaccharide biosynthesis protein [Oenococcus kitaharae]	bacterium	6	-LL-DLLK-LLIK----	15	58	0.9
ref|XP_023125193.1	type I inositol 3,4-bisphosphate 4-phosphatase isoform X1 [Amphiprion ocellaris]	fish	841	GLL-DLLK-LL------	849	58	1
ref|XP_023125194.1	type I inositol 3,4-bisphosphate 4-phosphatase isoform X2 [Amphiprion ocellaris]	fish	835	GLL-DLLK-LL------	843	58	1
ref|WP_111488791.1	oxidoreductase [Paraburkholderia sp. PDC91]	bacterium	179	GLL-DLLK-LL------	187	58	1
gb|PNW85664.1	hypothetical protein CHLRE_03g197150v5 [Chlamydomonas reinhardtii]	algae	525	--L-DLLK-VLLEAAG-	536	82	0.83
gb|EMD37617.1	hypothetical protein CERSUDRAFT_114269 [Gelatoporia subvermispora B]	fungus	336	-LL-ELLR-LLLNAA--	347	82	0.75
ref|XP_001693141.1	predicted protein [Chlamydomonas reinhardtii]	algae	136	--L-DLLK-VLLEAAG-	147	82	0.83
ref|XP_016645416.1	hypothetical protein SAPIO_CDS1972 [Scedosporium apiospermum]	fungus	359	----DLLK-MLLKTAG-	369	82	0.82
emb|SDF82202.1	ribonuclease D [Limimonas halophila]	bacterium	312	-LL-ELLK-VLLKA---	322	82	0.82
ref|WP_090019146.1	ribonuclease D [Limimonas halophila]	bacterium	309	-LL-ELLK-VLLKA---	319	82	0.82
ref|WP_097929107.1	ribonuclease D [Monaibacterium marinum]	bacterium	311	-LM-DLLK-VLLKA---	321	82	0.82
ref|XP_004533357.1	mucin-5AC [Ceratitis capitata]	insect	406	--L-DLLK-LILKA---	415	82	0.9
ref|WP_066524308.1	TIGR03013 family PEP-CTERM/XrtA system glycosyltransferase [Sphingobium sp. EP60837]	bacterium	15	-LL-GLLD-LLL-----	23	116	0.85
ref|WP_066524308.1	TIGR03013 family PEP-CTERM/XrtA system glycosyltransferase [Sphingobium sp. EP60837]	bacterium	17	GLL-DLL--LLLSAA--	28	116	0.85
ref|WP_004167432.1	hypothetical protein [Ruminococcus albus]	bacterium	686	GIL-DLIK-MLLKA---	697	116	0.75
gb|AGK59220.1	ribonuclease D [Hyphomicrobium denitrificans 1NES1]	bacterium	365	--L-ELLK-VLLKAA--	375	116	0.82

ref|WP_013949711.1	MULTISPECIES: ribonuclease D [Hyphomicrobium]	bacterium	344	--L-ELLK-VLLKAA--	354	116	0.82
ref|WP_082072788.1	ribonuclease D [Hyphomicrobium sp. 99]	bacterium	307	--L-ELLK-VLLKAA--	317	116	0.82
ref|WP_092868378.1	ribonuclease D [Hyphomicrobium facile]	bacterium	307	--L-ELLK-VLLKAA--	317	116	0.82
ref|WP_046848427.1	ribonuclease D [Hyphomicrobium sp. GJ21]	bacterium	307	--L-ELLK-VLLKAA--	317	116	0.82
ref|WP_041321366.1	ribonuclease D [Hyphomicrobium denitrificans]	bacterium	307	--L-ELLK-VLLKAA--	317	116	0.82
gb|RUP07634.1	ribonuclease D [Hyphomicrobium sp.]	bacterium	307	--L-ELLK-VLLKAA--	317	116	0.82
gb|RUO97259.1	ribonuclease D [Hyphomicrobium sp.]	bacterium	307	--L-ELLK-VLLKAA--	317	116	0.82
ref|WP_013216794.1	ribonuclease D [Hyphomicrobium denitrificans]	bacterium	307	--L-ELLK-VLLKAA--	317	116	0.82
gb|KUO57349.1	ribonuclease D [Alphaproteobacteria bacterium BRH_c36]	bacterium	307	--L-ELLK-VLLKAA--	317	116	0.82
emb|SGZ39487.1	uncharacterized protein HGUI_01687 [Hanseniaspora guilliermondii]	yeast	413	-LL-DLLKFLLLK----	423	116	0.91
emb|SSD60340.1	uncharacterized protein SCODWIG_02101 [Saccharomycodes ludwigii]	yeast	436	-LL-DLLKPLLLK----	446	116	0.91
ref|WP_114831261.1	MULTISPECIES: ribonuclease D [Bosea]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_113517969.1	ribonuclease D [Rhizobiales bacterium]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_112765287.1	ribonuclease D [Rhizobiales bacterium]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_112580704.1	ribonuclease D [Rhizobiales bacterium]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
gb|PZU92484.1	ribonuclease D [Chelatococcus sp.]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
gb|PZR93332.1	ribonuclease D [Pseudomonas stutzeri]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
gb|PZO00180.1	ribonuclease D [Rhizobiales bacterium]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_110492453.1	ribonuclease D [Bosea sp. CF476]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_108049604.1	ribonuclease D [Bosea sp. 124]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_103720567.1	ribonuclease D [Bosea sp. 1131]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
gb|OYW66824.1	ribonuclease D [Bosea sp. 12-68-7]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_076436993.1	ribonuclease D [Bosea sp. TND4EK4]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
gb|OJV05400.1	ribonuclease D [Bosea sp. 67-29]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_092165084.1	ribonuclease D [Bosea sp. OK403]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_092161841.1	ribonuclease D [Bosea sp. DSM 18164]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9

ref|WP_091829650.1	MULTISPECIES: ribonuclease D [Bosea]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_103875062.1	ribonuclease D [Bosea lathyri]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_091856533.1	ribonuclease D [Bosea robiniae]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_069691328.1	ribonuclease D [Bosea vaviloviae]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
gb|ODT45384.1	ribonuclease D [Methylobacterium sp. SCN 67-24]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_069880604.1	ribonuclease D [Bosea sp. BIWAKO-01]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_069055263.1	ribonuclease D [Bosea sp. RAC05]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_066735095.1	ribonuclease D [Bradyrhizobium sp. CCH5-A9]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_068177094.1	ribonuclease D [Rhizobiales bacterium CCH3-A5]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_067997338.1	ribonuclease D [Rhizobiales bacterium CCH10-E5]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_066611406.1	ribonuclease D [Bosea sp. PAMC 26642]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_066475456.1	ribonuclease D [Bosea sp. WAO]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_056799530.1	ribonuclease D [Bosea sp. Root381]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_057192447.1	ribonuclease D [Bosea sp. Root483D1]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_061966896.1	ribonuclease D [Bosea sp. Root670]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_056714325.1	ribonuclease D [Bosea sp. Leaf344]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_055728008.1	ribonuclease D [Bosea thiooxidans]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_054210635.1	ribonuclease D [Bosea vaviloviae]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_054141693.1	ribonuclease D [Bosea sp. AAP35]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_047576183.1	ribonuclease D [Methylobacterium sp. ZNC0032]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_038358639.1	ribonuclease D [Bosea sp. UNC402CLCol]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_043242724.1	ribonuclease D [Bosea sp. LC85]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
ref|WP_126112109.1	ribonuclease D [Bosea sp. Tri-49]	bacterium	306	--L-DLLK-VLLKA---	315	116	0.9
gb|RME62143.1	ribonuclease D [Alphaproteobacteria bacterium]	bacterium	326	-LLTDLLK-LLLK----	336	116	0.91

Table S6 | Homology of the LDKA sequence analysed using BLAST.