

Protection and alleviated inflammation induced by virus-like particle vaccines containing *Plasmodium berghei* MSP-8, MSP-9 and RAP1

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Supplementary Tables

Supplementary Table S1. *Plasmodium berghei* rhoptry-associated protein 1 (RAP1) sequence comparison. Nucleotide sequences of codon-optimized (RAP1) were obtained from GenScript, and compared with the original non-codon optimized RAP1 (XM_034565422.1) sequence acquired from NCBI database.

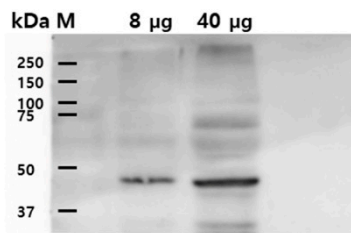
Optimized	1	ATG TT CATCAAGATCGTGTCACTGTTCAT CT GTCCAGGCTGGTG TT CCAGGACTACTCA
Original	1	ATGTTTATTAAAAATTGTAAGTTTGTTCATACTTTCCCGATTGGTGTTCAGATTATTCT
Translation	1	M F I K I V S L F I L S R L V F Q D Y S
Optimized	61	GT CGCTTTCAACATCAGAGACTCCAACATCATCTCCA AA CTACAGCCACGGTTACAACAGC
Original	61	GTGGCATTTAACATACGTGACTCTAATATTATATCAATTATTACATGGTTACAACAGC
Translation	21	V A F N I R D S N I I S N Y S H G Y N S
Optimized	121	CC CGGCATCAACAACGACAAGCTGGGAAACCTGA AA CTACTTCA CC GAGATCTTCC AA AG
Original	121	CCAGGTCTAAACAATGATAAATTAGGCAATTTGAATTATTTACGGAAATCTTCCCCAA
Translation	41	P G I N N D K L G N L N Y F T E I F P K
Optimized	181	AAG G AGCACGAAATCATCAACCTGTACGACGACGTGCAGGAGCTGCTGGGCAACGAACGC
Original	181	AAGGAACATGAAATTATTAATTTATATGATGATGTACAAGAATTGTTAGGAAATGAGCGA
Translation	61	K E H E I I N L Y D D V Q E L L G N E R
Optimized	241	ATGTCT TT CTG C AGGAA G ACGACGACGTCA ACC CAGACAAGAA CG GTACTAGCAACAAG
Original	241	ATGTCTTTTTTACAAGAAGATGATGATGTCAATCAAAATAAAAAATGGA AA CTTCTAATAAA
Translation	81	M S F L Q E D D D V N Q N K N G T S N K
Optimized	301	TACGCT CT GTTCAACGGTAA CC TGATCGCCGACCTGAAGGAGGAAGAGCCTATCGACGAA
Original	301	TACGCTTTATTTAATGGAAATTTAATAGCTGATTTAAAAGAAGAGGAACCAATTGATGAA
Translation	101	Y A L F N G N L I A D L K E E E P I D E
Optimized	361	ACC G CTGAAGAGGAA ACT ATCAACGAGAA CA T CG ACGAA AGA ACACCTCAACTATCAAG
Original	361	ACCGCCGAAGAGGAAACAATTAATGAAATATAGATGAAAAAATACATCAACTATAAAA
Translation	121	T A E E E T I N E N I D E K N T S T I K
Optimized	421	TAC ACCCCGACTAC ACT CCACGCCTGAAGAA G GCTATGCACAC CC TGGGC TAC GACAAG
Original	421	TATACACCAGATTACACACCCCGTTTAAAAAAGCTATGCATACATTAGGCTATGATAAA
Translation	141	Y T P D Y T P R L K K A M H T L G Y D K
Optimized	481	GAG TTCAAGCTGGCCGAA CT GACCACTATCCAG TC CTGCCCTAACGACA ACT TTCTGTTC
Original	481	GAATTTAAATTAGCTGAATTGACAACAATACAGTCATGTCCCAATGATAATTTTTTATTT
Translation	161	E F K L A E L T T I Q S C P N D N F L F
Optimized	541	GAC ATCTTCCCCAGGCCATCCAGAAGTTCCAG GAG AAC GAC ATGA AG TACATCCAGACC
Original	541	GATATATTTCCCCAAGCAATACAAAAATTT CAG GA AA ACGATATGAAATACATACAACT
Translation	181	D I F P Q A I Q K F Q E N D M K Y I Q T
Optimized	601	CAG GGTGACCAGTACGTG GAA TGCATCAAGAAG CACA AGCTGGT CGG CTCAGACAAC CAG
Original	601	CAAGGGGATCAATATGTAGAATGTATTAAAAAGCATAAATTAGTTGGATCAGATAATCAG
Translation	201	Q G D Q Y V E C I K K H K L V G S D N Q

Optimized	661	GACCTGAAGCTGAACTTCGGAAACTCCGTGAACACTTTCGGTCCTTACAAGATCCCCAG
Original	661	GACTTGAAATTGAATTTTGGTAATTCAGTTAATACTTTTGGCCCATATAAAATACCACAA
Translation	221	D L K L N F G N S V N T F G P Y K I P Q
Optimized	721	AAGATGATCACCTTCGACCTGATCGCCTGCCAAGCAACATCACTCCTGTCAACCTGGCT
Original	721	AAAATGATTACCTTCGATTTAATCAGATTACCTTCAAATATTACTCCTGTTAATTTAGCA
Translation	241	K M I T F D L I R L P S N I T P V N L A
Optimized	781	AACGACTACTACCTGTCCGAGAGCGAGTTCCCAACCTGCACAAGCTGAACTACTGCCTG
Original	781	AATGATTATTATTTATCCGAAAGTGAATTTCCAAATTTGCATAAACTAAATTTATGTCTA
Translation	261	N D Y Y L S E S E F P N L H K L N Y C L
Optimized	841	CTGCACCCTGCCAAGCTGGAGAAGCTGCTGAAGCGTAAGGACATCAAGTCTTACATCAAC
Original	841	TTACACCCTGCAAAATTAGAAAAATTATTAAGAAAGAAAGATATTAATCATATATAAAT
Translation	281	L H P A K L E K L L K R K D I K S Y I N
Optimized	901	AACACCGAATCTGGATCATACGACAACCTTCTCAAGAAGGCTATGAACGAGAGCATCGAA
Original	901	AATACAGAATCTGGCTCTTATGATAATTTTTTAAGAAGGCTATGAATGAATCCATTGAA
Translation	301	N T E S G S Y D N F F K K A M N E S I E
Optimized	961	TGCCACGTGGAGAACACCCCTGCACATGATCCTGTCTAAGCTGACTCTGTTCATGTTCTTC
Original	961	TGCCATGTTGAAAATACATTACATATGATATTATCAAACTCACACTTTTATGTTCTTT
Translation	321	C H V E N T L H M I L S K L T L F M F F
Optimized	1021	AACGTCAACAGCCAGACTCCAAGAACATCCTGAAGAAGCAGCTGTACATCATCAAGTCT
Original	1021	AATGTTAAACAAACCAGATTCTAAGAATATCCTTAAGAAGCAATTGTACATAATAAATCA
Translation	341	N V N K P D S K N I L K K Q L Y I I K S
Optimized	1081	GGCCTGTCATACCGCTCCCGTAAGTACGTGGACAACGCCTACAAGAAGGTCATCAACAAC
Original	1081	GGGCTAAGTTATAGAAGTAGAAAAATATGTCGATAATGCTTATAAGAAGGTTATAAACAAT
Translation	361	G L S Y R S R K Y V D N A Y K K V I N N
Optimized	1141	TTCAAGGACTACGAGAACAAGATCAAGCTGATCGACAGCAACCTGGAAAACATCACCTCT
Original	1141	TTTAAAGATTACGAAAACAAAATAAAATTGATTGATTCCAATTTGGAGAATATAACTTCG
Translation	381	F K D Y E N K I K L I D S N L E N I T S
Optimized	1201	TACTACGCTGCCACGCTTTCGGAAACCTGTGCAACACTTACATGAGAGAAGGACAACATC
Original	1201	TACTATGCCGCGCATGCTTTTGGTAATTTATGCAACACATATATGGAAAAAGATAATATA
Translation	401	Y Y A A H A F G N L C N T Y M E K D N I
Optimized	1261	TACGAAGCTAAGCCTACCTGTACGAGCACATCGCCCTAGCATCAAGATCTTCTCCAGC
Original	1261	TATGAAGCAAATGCATATTTGTATGAGCACATTGCTCCATCCATTAATAATTTCTCTTCT
Translation	421	Y E A N A Y L Y E H I A P S I K I F S S

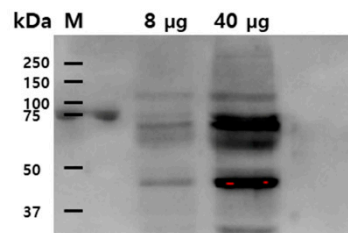
Optimized	1321	TGCATCAAGCACCTGACCATCTACAACCTACATCATCTCAAACCTGCTGGGCCAGGTGAAG
Original	1321	TGTATTAAACATTTGACAATTTATAATTATATTATATCAAATTTACTTGGTACCGTAAAA
Translation	441	C I K H L T I Y N Y I I S N L L G Q V K
Optimized	1381	CACCTGATGTCCTACACTCCTAGGAAGCCCATCCTGAAGGACATCCACTTCAAGGCTCTG
Original	1381	CATTTAATGAGTTATACCCCTAGAAAACCAATATTTAAAAGATATACATTTTAAGGCTCTT
Translation	461	H L M S Y T P R K P I L K D I H F K A L
Optimized	1441	CTGAACAAGTTCAAGAAGCCTCAGAACGTGAACGAGCTGCCATACGACCTACCGTCAAG
Original	1441	TTAAACAAATTTAAAAAACCCAAAATGTAAATGAACTTCCATATGACCCAACTGTAA
Translation	481	L N K F K K P Q N V N E L P Y D P T V K
Optimized	1501	TCATTTCGCCCTGGGCGAGCTGACTAGAGAACCCATCCACGGACTGATCCACTCCTACTTC
Original	1501	TCATTTGCACTTGGTGAATTAACGAGAGAACCTATTCATGGTTTAATTCATTCGTACTTT
Translation	501	S F A L G E L T R E P I H G L I H S Y F
Optimized	1561	GAATACAAGAAGAAGGACCTGCTGGACATCATGCAGAAGCTGAAGCTGGACATCTTCAGC
Original	1561	GAATATAAGAAAAAGACCTATTAGATATTATGCAGAAGCTCAAATTAGATATTTTTTCA
Translation	521	E Y K K K D L L D I M Q K L K L D I F S
Optimized	1621	CTGGCTAACAAGGACCTGAAGTTCCCTCTGCCGACCTGCCAGACTACAAGCTGTTCAAG
Original	1621	CTTGCTAATAAAGATTTTAAATTTCCAAGTGCCGATTGCGCAGATTATAAATTGTTTAA
Translation	541	L A N K D L K F P S A D L P D Y K L F K
Optimized	1681	GACATCGTGAACAAGTACAAGAAGGAGATCAAGATCCTGTTCCAGGAGATGAACAGCGAA
Original	1681	GATATAGTCAATAAATATAAAAAAGAAATCAAAATTTTATTCCAAGAAATGAATTCTGAA
Translation	561	D I V N K Y K K E I K I L F Q E M N S E
Optimized	1741	TACGTC AAGCTGTTCAAGATGCGCATCTCTGCTTTCCTACCAGAAGGACTTCTTCATCTAC
Original	1741	TATGTCAAACCTTTTAAATGCGTATTTTCAGCATTCTACCAAAGGACTTTTATTTAT
Translation	581	Y V K L F K M R I S A F Y Q K D F F I Y
Optimized	1801	GACCGTGTCTTCTAA
Original	1801	GATCGTGTATTCTAA
Translation	601	D R V F

Supplementary Figures

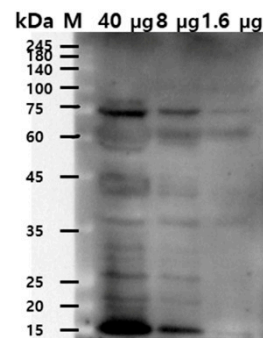
A. MSP-8 (Size: 45 kDa)



B. MSP-9 (Size: 68 kDa)



C. RAP1 (Size: 67 kDa)



Supplementary Figure S1. The original uncropped western blot images of merozoite surface protein 8 (MSP-8, **A**), merozoite surface protein 9 (MSP-9, **B**), and rhoptry-associated protein 1 (RAP1, **C**) of *Plasmodium berghei*.