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(12) **United States Patent**
Barbero Calzado et al.(10) **Patent No.:** **US 11,219,681 B2**
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(73) Assignee: **Valneva Austria GmbH**, Vienna (AT)(*) Notice: Subject to any disclaimer, the term of this
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U.S.C. 154(b) by 0 days.(21) Appl. No.: **16/813,862**

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7/00 (2013.01); **C12N 7/02** (2013.01); **C12N**
7/06 (2013.01); **A61K 2039/5252** (2013.01);
A61K 2039/5254 (2013.01); **A61K 2039/5258**
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50/30 (2018.01)

(58) **Field of Classification Search**

CPC **A61K 39/12**; **A61K 2039/53**; **C12N**
2770/24134; **C12N 7/00**; **Y02A 50/30**
See application file for complete search history.

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Primary Examiner — Barry A Chestnut

(74) Attorney, Agent, or Firm — Wolf, Greenfield &
Sacks, P.C.(57) **ABSTRACT**

Described herein are Zika virus vaccines and compositions
and methods of producing and administering said vaccines
to subjects in need thereof.

26 Claims, 23 Drawing Sheets**Specification includes a Sequence Listing.****Takeda EX1001**

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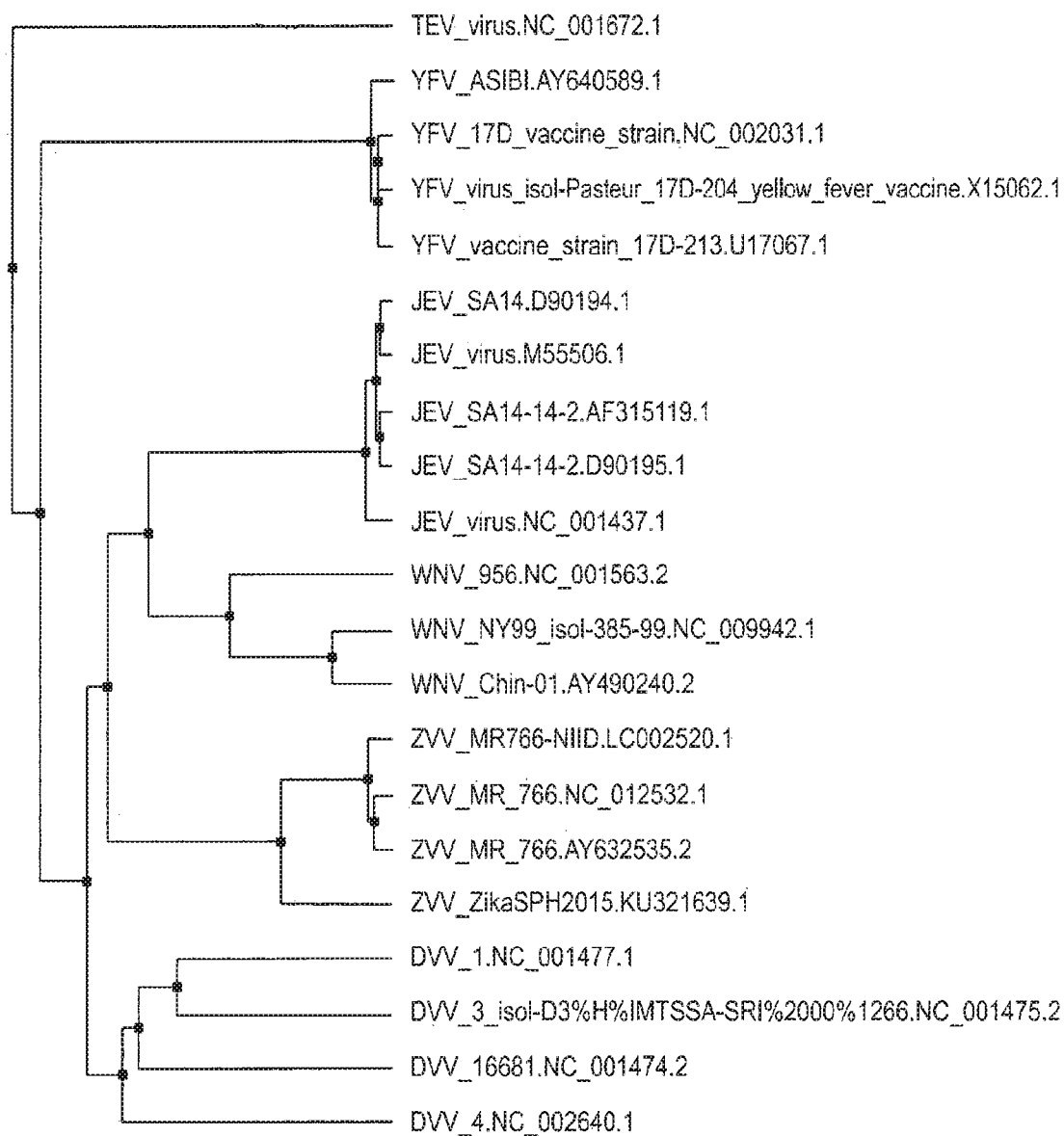


FIG. 1

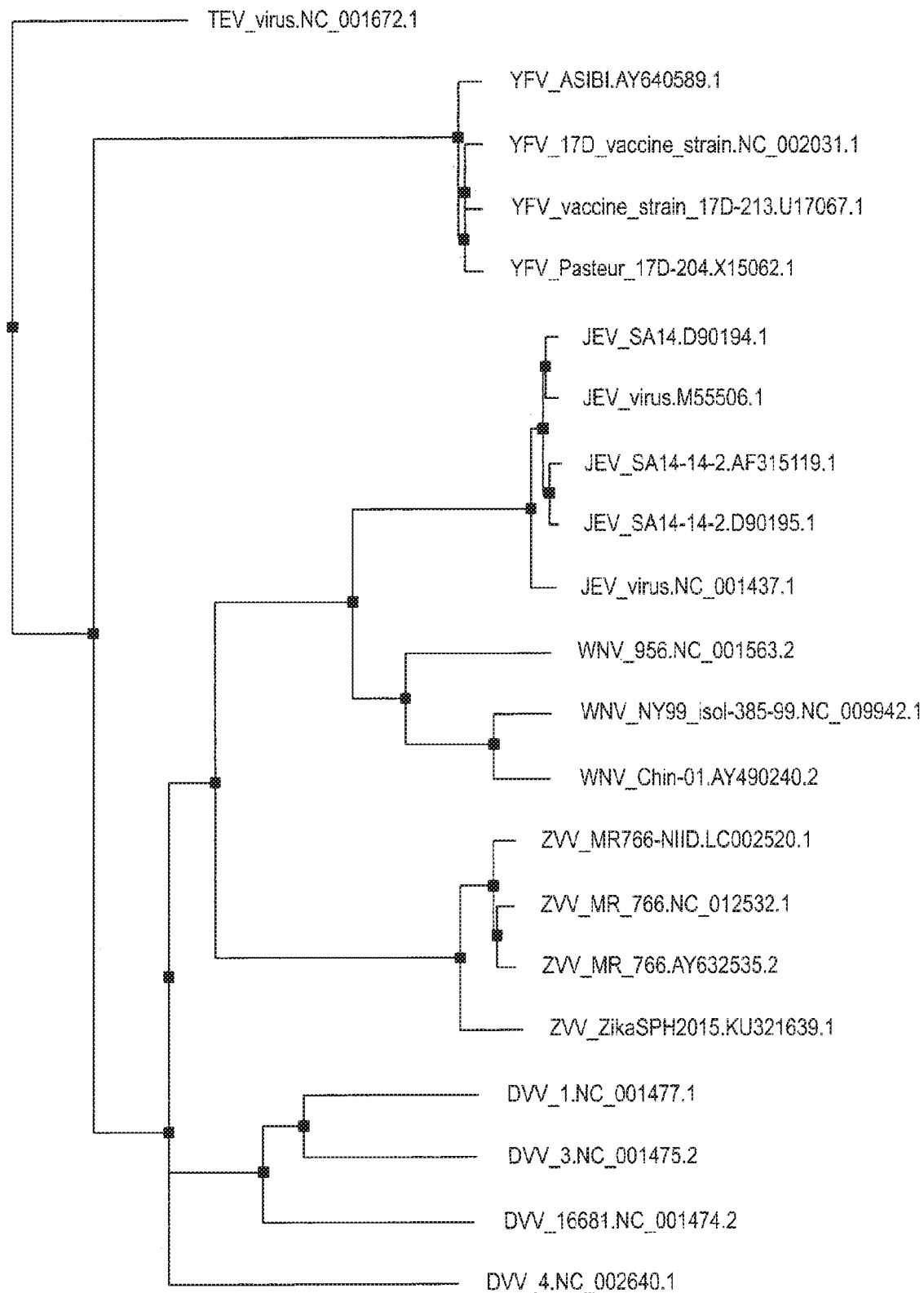


FIG. 2

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
DVV_1.NC_001477.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
DVV_16681.NC_001474.2	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
DVV_3.NC_001475.2	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
DVV_4.NC_002640.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
JEV_SA14-14-2.AF315119.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
JEV_SA14-14-2.D90195.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
JEV_SA14.D90194.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
JEV_virus.M55506.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
JEV_virus.NC_001437.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
TEV_virus.NC_001672.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
WNV_956.NC_001563.2	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
WNV_Chin-01.AY490240.2	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
WNV_NY99_isol-365-99.NC_009942.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
YFV_17D_vaccine_strain.NC_002031.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
YFV_ASIB.AY640589.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
YFV_Pasteur_17D-204.X15062.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
YFV_vaccine_strain_17D-213.U17067.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
ZVW_MR766-NIID.LC002520.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
ZVW_MR_766.AY632535.2	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
ZVW_MR_766.NC_012532.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0
ZVW_ZikaSPH2015.KU321639.1	60.0	60.1	60.2	60.3	60.4	60.5	60.6	60.7	60.8	60.9	61.0	61.1	61.2	61.3	61.4	61.5	61.6	61.7	61.8	61.9	62.0

60.0 % Identity and higher
 70.0 % Identity and higher
 80.0 % Identity and higher

FIG. 3

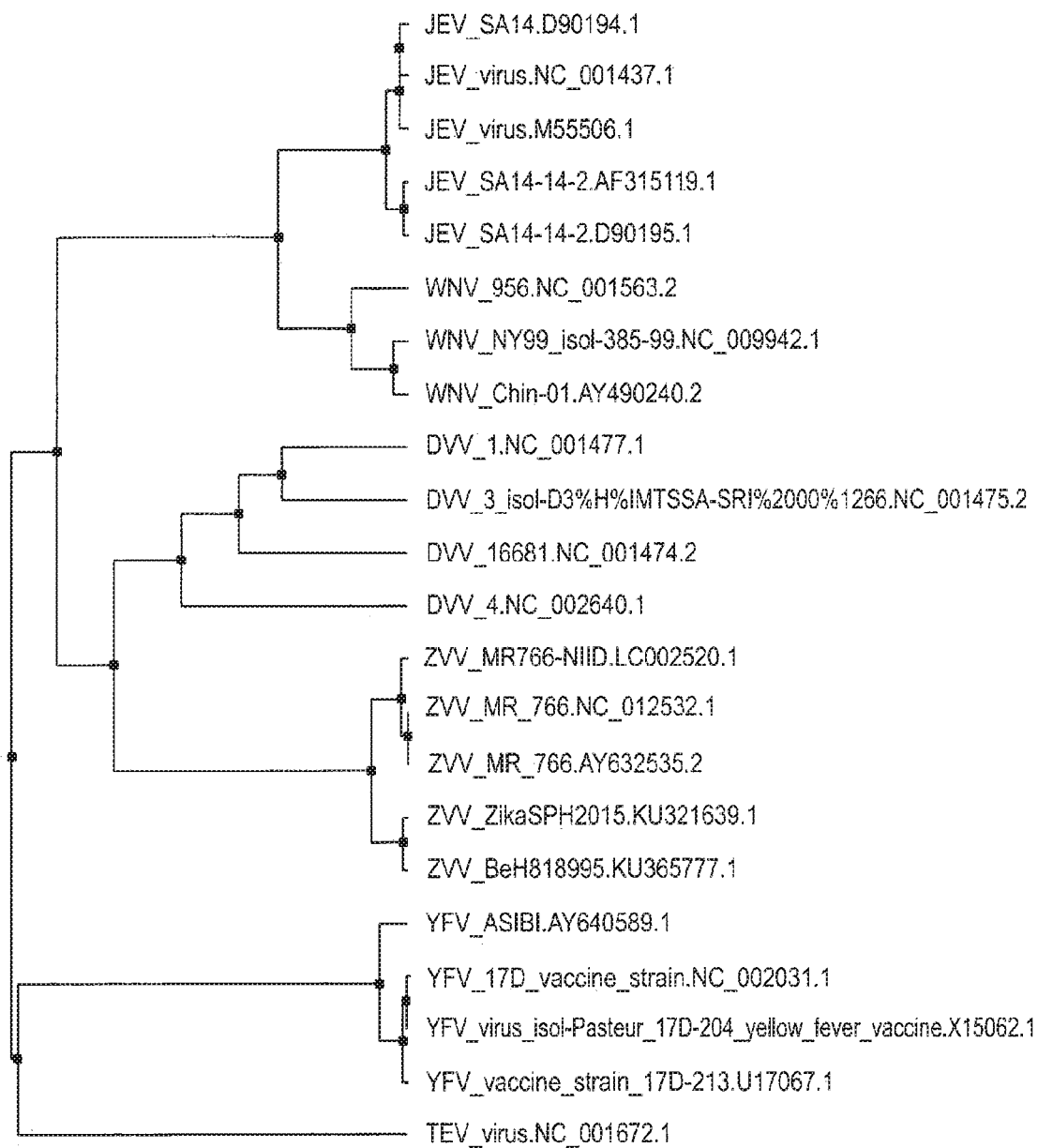


FIG. 4

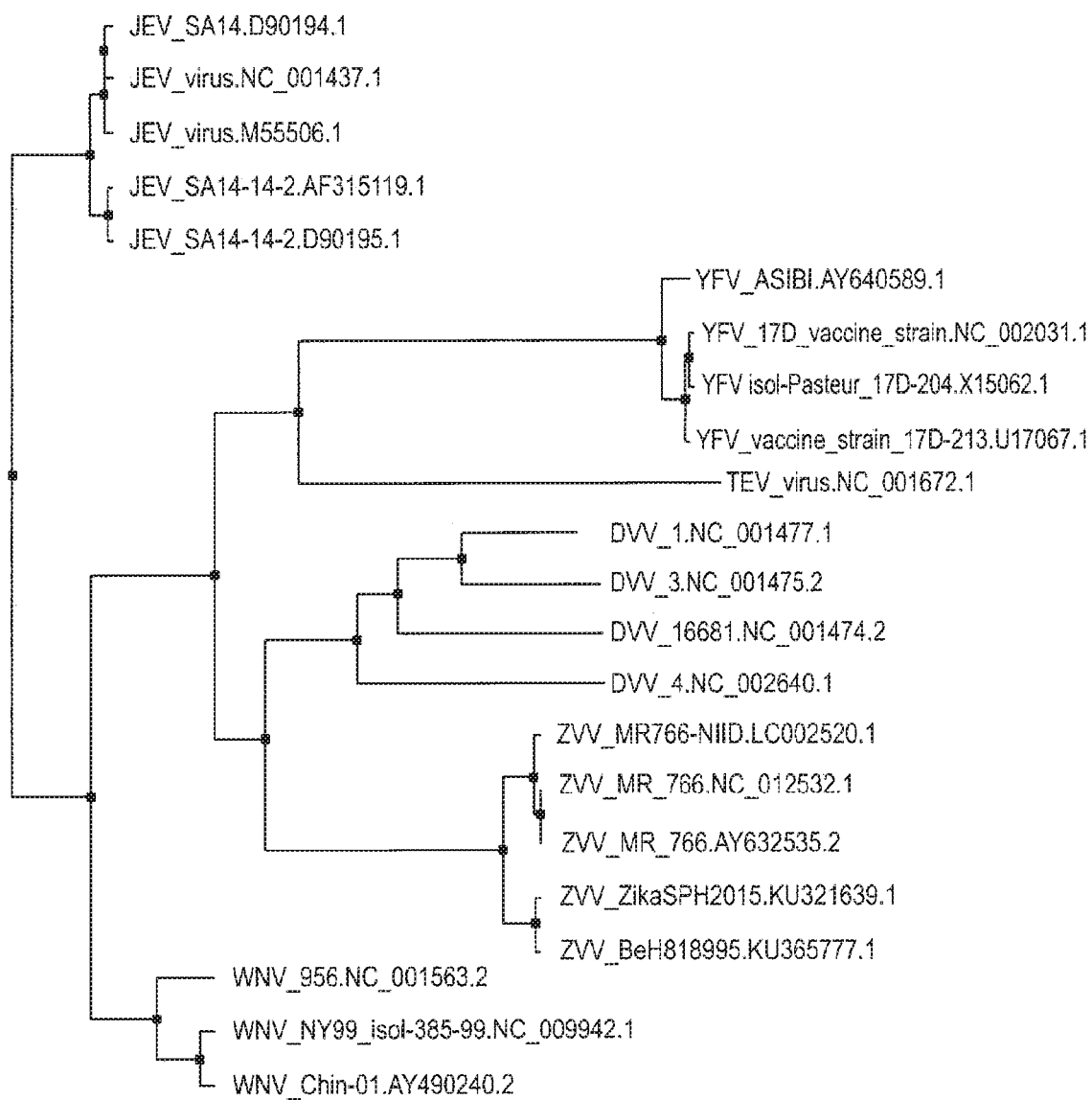


FIG. 5

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
DWV 1.NC 001477.1	0	49.7	46.7	48.0	47.5	49.7	50.1	49.9	50.5	38.3	51.5	50.5	50.9	43.0	43.8	43.0	43.2	57.8	57.9	58.4	58.4	57.1
DWV 16881.NC 001474.2	1	48.7	46.7	48.0	47.5	46.7	47.1	46.9	47.5	38.9	48.4	47.6	47.6	43.6	44.4	43.6	43.6	53.6	53.8	54.2	54.2	53.8
DWV 3.NC 001475.2	2	47.4	46.7	48.0	47.5	48.0	48.2	48.2	48.6	38.2	46.8	46.7	46.3	41.6	42.2	41.6	41.7	57.3	57.7	58.2	58.2	57.1
DWV 4.NC 002640.1	3	63.8	64.0	62.8	60.0	47.5	47.7	47.5	48.1	39.7	49.6	49.6	49.8	40.0	40.6	40.0	40.0	55.8	56.4	56.4	56.4	55.8
JEV SA14-14-2 AF315119.1	4	49.7	46.7	48.0	47.5	49.7	50.1	49.9	50.5	38.3	51.5	50.5	50.9	43.0	43.8	43.0	43.2	57.8	57.9	58.4	58.4	57.1
JEV SA14-14-2 D90195.1	5	49.7	46.7	48.0	47.5	49.7	50.1	49.9	50.5	38.3	51.5	50.5	50.9	43.0	43.8	43.0	43.2	57.8	57.9	58.4	58.4	57.1
JEV SA14 D90194.1	6	50.1	47.1	48.2	47.7	48.0	48.2	48.2	48.6	38.2	46.8	46.7	46.3	41.6	42.2	41.6	41.7	57.3	57.7	58.2	58.2	57.1
JEV virus.M55506.1	7	49.9	46.9	48.2	47.5	49.9	50.3	49.9	50.5	38.3	51.5	50.5	50.9	43.0	43.8	43.0	43.2	57.8	57.9	58.4	58.4	57.1
JEV virus.NC 001437.1	8	50.5	47.5	48.6	48.1	47.8	48.0	48.2	48.6	38.2	46.8	46.7	46.3	41.6	42.2	41.6	41.7	57.3	57.7	58.2	58.2	57.1
TEV virus.NC 001672.1	9	38.3	38.9	38.2	39.7	39.6	39.8	40.0	40.4	40.0	41.3	41.6	41.0	42.3	41.9	42.3	42.3	39.9	39.9	39.6	39.6	39.9
WNV 956.NC 001563.2	10	51.5	48.4	46.8	49.6	48.0	48.2	48.2	48.6	38.2	46.8	46.7	46.3	41.6	42.2	41.6	41.7	57.3	57.7	58.2	58.2	57.1
WNV Chin-01 AY490240.2	11	50.5	47.5	46.7	49.6	48.0	48.2	48.2	48.6	38.2	46.8	46.7	46.3	41.6	42.2	41.6	41.7	57.3	57.7	58.2	58.2	57.1
WNV NY99 isol-385-99.NC 009942.1	12	50.9	47.6	45.3	49.8	48.0	48.2	48.2	48.6	38.2	46.8	46.7	46.3	41.6	42.2	41.6	41.7	57.3	57.7	58.2	58.2	57.1
YFV 17D vaccine strain.NC 002031.1	13	43.0	43.6	41.6	40.0	43.1	43.1	43.3	43.3	43.5	42.3	43.8	43.9	43.9	43.9	43.5	43.5	42.0	43.4	43.5	43.5	42.0
YFV ASIB AY640589.1	14	43.8	44.4	42.2	40.6	42.9	42.9	43.3	43.3	43.5	41.9	43.6	43.5	43.5	43.5	43.5	42.4	43.8	43.9	43.9	42.4	
YFV isol-Pasteur 17D-204.X15062.1	15	43.0	43.6	41.6	40.0	43.1	43.1	43.3	43.3	43.5	42.3	43.8	43.9	43.9	43.9	43.5	43.5	42.0	43.4	43.5	43.5	42.0
YFV vaccine strain 17D-213.U17067.1	16	43.2	43.6	41.7	40.0	43.1	43.1	43.3	43.3	43.5	42.3	43.8	43.9	43.9	43.9	43.5	43.5	42.0	43.4	43.5	43.5	42.0
ZVBeH818995.KU365777.1	17	57.3	53.8	57.8	55.8	54.0	54.0	54.4	54.2	54.8	39.9	55.0	54.4	54.0	42.0	42.4	42.0	42.0	36.8	36.8	36.4	36.4
ZVW MR766-NIID.LC002520.1	18	57.9	53.8	57.7	56.4	54.8	54.8	55.4	55.2	55.4	39.9	55.0	54.2	53.8	43.4	43.8	43.4	43.4	36.8	36.8	36.8	36.6
ZVW MR 766 AY632535.2	19	58.4	54.2	58.2	56.4	54.8	54.8	55.2	55.0	55.2	39.6	54.8	54.0	53.8	43.5	43.9	43.5	43.5	36.4	36.4	36.4	36.2
ZVW MR 766.NC 012532.1	20	58.4	54.2	58.2	56.4	54.8	54.8	55.2	55.0	55.2	39.6	54.8	54.0	53.8	43.5	43.9	43.5	43.5	36.4	36.4	36.4	36.2
ZVW ZikaSPH2015.KU321639.1	21	57.1	53.8	57.1	55.8	54.0	54.0	54.4	54.2	54.8	39.9	55.0	54.4	54.0	42.0	42.4	42.0	42.0	36.8	36.8	36.2	36.2

FIG 6

 50 % Identity and higher
 60 % Identity and higher
 70 % Identity and higher

FIG 7A

748	M	G	A	V	L	I	M	V	G	I	T	R	N	M	T	M	S	M	I	L	V	G	V	I	M	M	F	L	S	L	G	M	G	A	
748	M	E	A	V	L	I	M	V	G	I	T	R	N	M	T	M	S	M	I	L	V	G	V	I	M	M	F	L	S	L	G	M	G	A	
748	M	E	A	V	L	I	M	V	G	I	T	R	N	M	T	M	S	M	I	L	V	G	V	I	M	M	F	L	S	L	G	M	G	A	
748	M	E	A	V	L	I	M	V	G	I	T	R	N	M	T	M	S	M	I	L	V	G	V	I	M	M	F	L	S	L	G	M	G	A	
770	M	E	A	L	L	L	M	G	V	A	R	D	R	S	I	A	L	A	F	L	A	T	G	G	V	L	V	F	L	A	T	N	H	A	
770	M	E	A	L	L	L	M	G	V	A	R	D	R	S	I	A	L	A	F	L	A	T	G	G	V	L	V	F	L	A	T	N	H	A	
770	M	E	A	L	L	L	M	G	V	A	R	D	R	S	I	A	L	A	F	L	A	T	G	G	V	L	V	F	L	A	T	N	H	A	
770	M	E	A	L	L	L	M	G	V	A	R	D	R	S	I	A	L	A	F	L	A	T	G	G	V	L	V	F	L	A	T	N	H	A	
770	M	E	A	L	L	L	M	G	V	A	R	D	R	S	I	A	L	A	F	L	A	T	G	G	V	L	V	F	L	A	T	N	H	A	
770	M	E	A	L	L	L	M	G	V	A	R	D	R	S	I	A	L	A	F	L	A	T	G	G	V	L	V	F	L	A	T	N	H	A	
752	I	K	I	L	L	T	M	L	L	S	R	S	T	S	L	S	M	T	C	I	A	V	G	M	V	T	L	Y	L	G	V	M	Q	A	
745	I	G	V	I	T	M	L	L	S	R	S	T	S	L	S	V	T	L	V	L	G	I	V	T	L	Y	L	G	V	M	Q	A	A		
771	I	G	F	L	V	L	I	S	T	S	R	N	T	S	M	A	M	T	C	I	A	V	G	I	T	L	F	L	G	F	T	Q	A	A	
750	I	E	V	L	T	M	L	L	S	K	N	T	S	M	S	F	S	C	I	A	I	S	I	I	T	L	Y	L	G	A	V	Q	A	A	
751	L	E	V	A	L	A	L	L	L	M	R	N	P	T	M	S	M	S	F	L	A	G	L	V	L	A	M	T	L	G	V	G	A	A	
766	L	G	A	L	L	L	M	G	I	A	R	D	R	S	I	A	M	T	F	L	A	V	G	V	L	L	F	L	S	V	N	H	A	A	
770	L	G	A	L	L	L	M	G	I	A	R	D	R	S	I	A	L	T	F	L	A	V	G	V	L	L	F	L	S	V	N	H	A	A	
770	L	G	A	L	L	L	M	G	I	A	R	D	R	S	I	A	L	T	F	L	A	I	G	V	L	L	F	L	S	V	N	H	A	A	
793	I	G	T	L	V	L	L	L	L	T	K	N	G	S	I	S	L	T	C	L	A	L	G	G	V	M	I	F	L	S	T	A	S	A	A
793	I	G	T	L	V	L	L	L	L	T	K	N	G	S	I	S	L	M	C	L	A	L	G	G	V	L	I	F	L	S	T	A	S	A	A
789	I	G	T	L	V	L	L	L	L	T	K	N	G	S	I	S	L	T	C	L	A	L	G	G	V	M	I	F	L	S	T	A	S	A	A
789	I	G	T	L	V	L	L	L	L	T	K	N	G	S	I	S	L	T	C	L	A	L	G	G	V	M	I	F	L	S	T	A	S	A	A
775	I	G	T	L	V	L	L	L	L	T	K	N	G	S	I	S	L	M	C	L	A	L	G	G	V	L	I	F	L	S	T	A	S	A	A

FIG. 7C

YFV_ASIA/Y640589.1/292-784
 YFV_17D_vaccine_strain_NC_002031.1/292-784
 YFV_vaccine_strain_17D-213_U17067.1/292-784
 YFV_isol-Pasteur_17D-204_X15062.1/292-784
 IEV_SAI4.D90194.1/307-806
 IEV_virus_NC_001437.1/307-806
 IEV_virus_M55506.1/307-806
 IEV_SAI4-14-2.AF315119.1/307-806
 IEV_SAI4-14-2.D90195.1/307-806
 DWV_1.NC_001477.1/294-788
 DWV_16681.NC_001474.2/287-781
 DWV_4.NC_002640.1/313-807
 DWV_3.NC_001475.2/294-786
 TEV_virus_NC_001672.1/292-787
 WNV_956.NC_001563.2/306-802
 WNV_NY99_isol-385-99.NC_009942.1/306-806
 WNV_Chin-01.AY490240.2/306-806
 ZWV_MR766-NIID.LC002520.1/326-829
 ZWV_ZikaSPH2015.KU321639.1/326-829
 ZWV_MR_766.NC_012532.1/326-825
 ZWV_MR_766.AY632535.2/326-825
 ZWV_BeH818995.KU365777.1/308-811

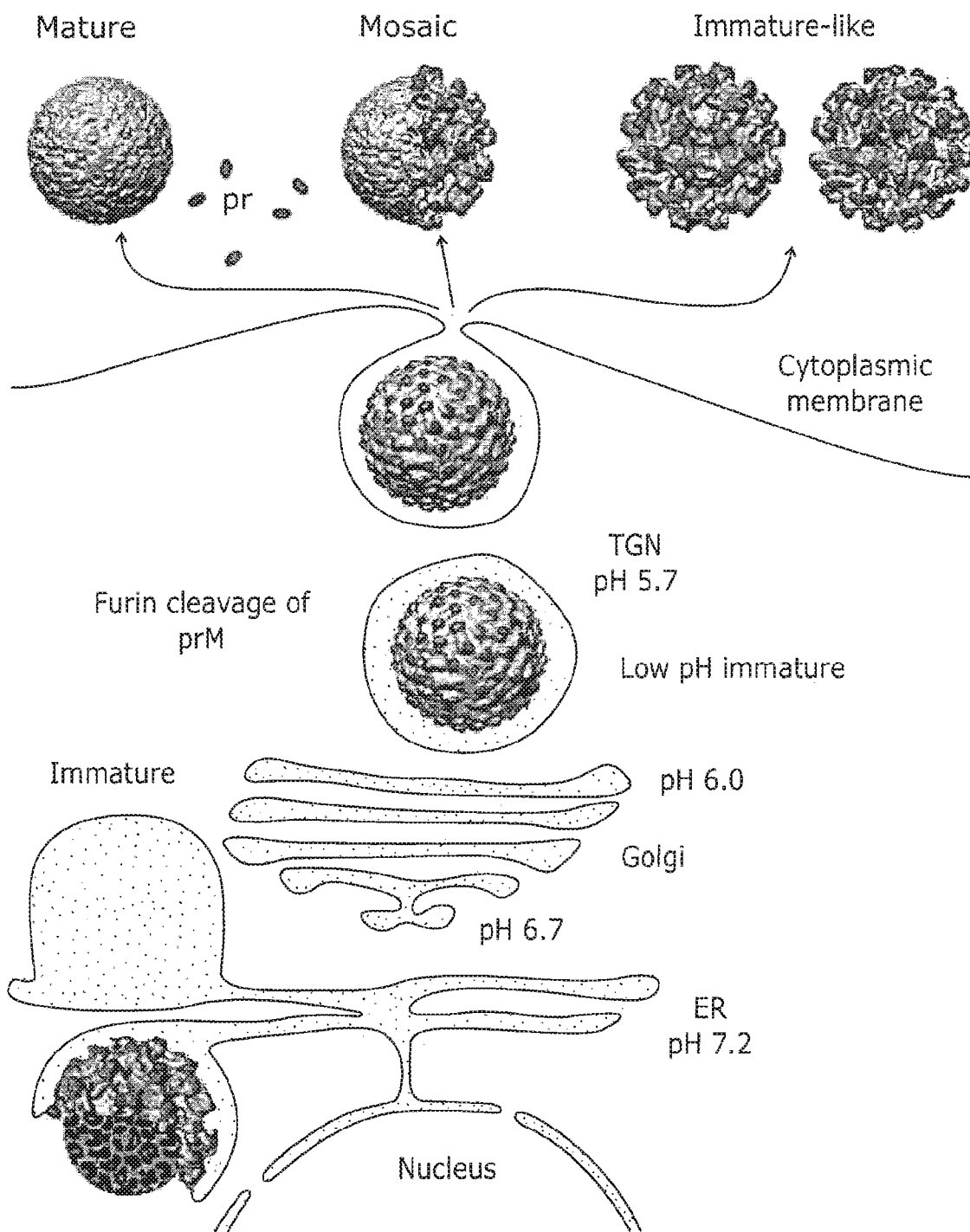
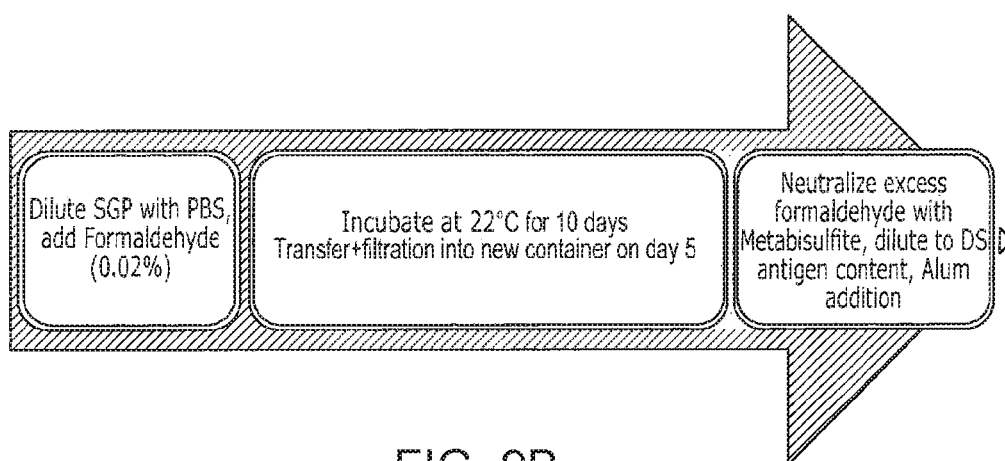
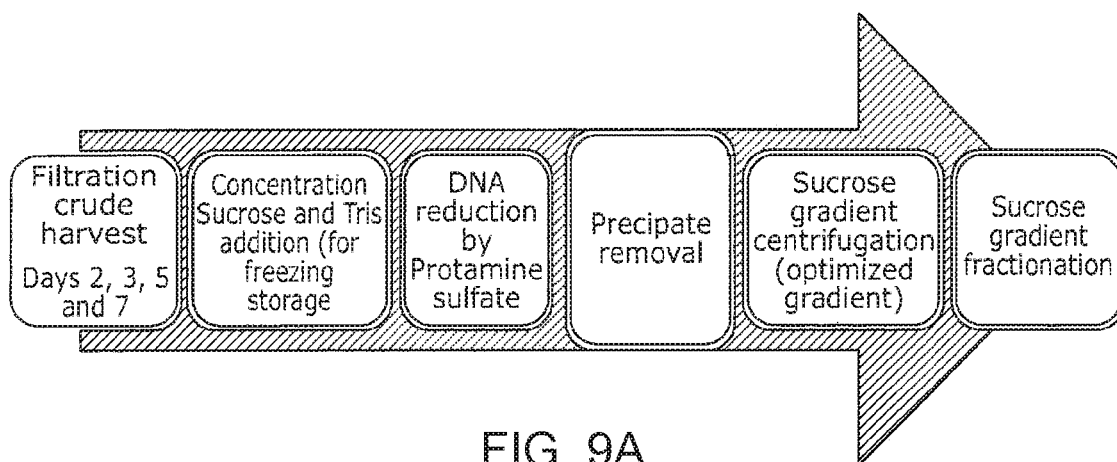


FIG. 8



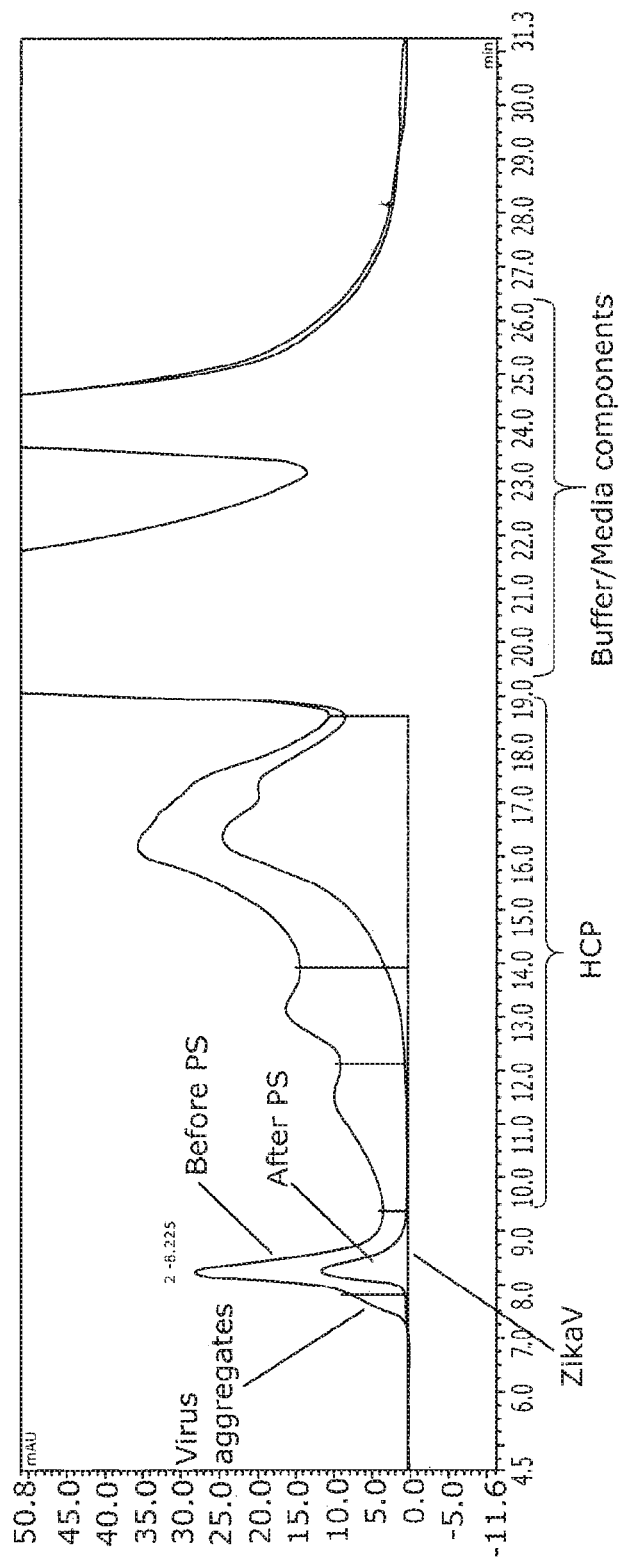
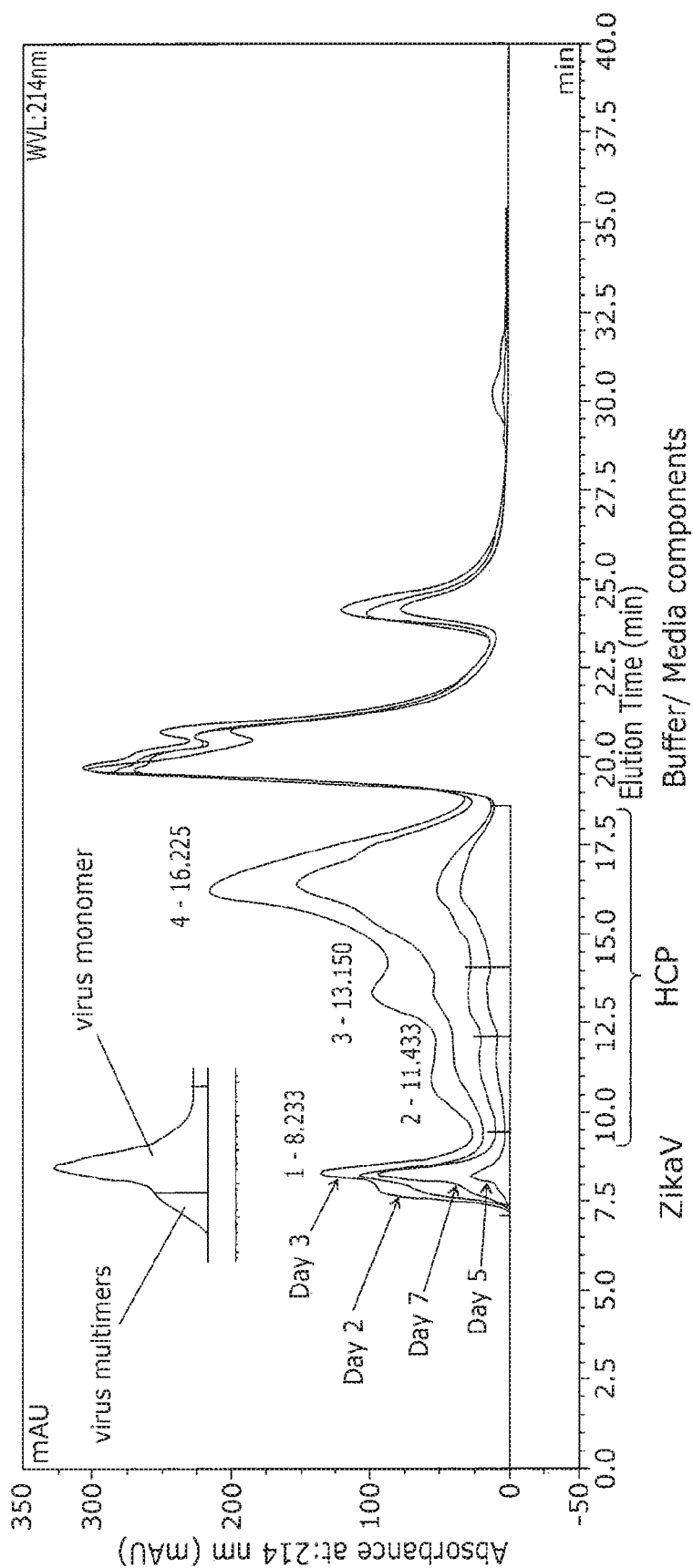
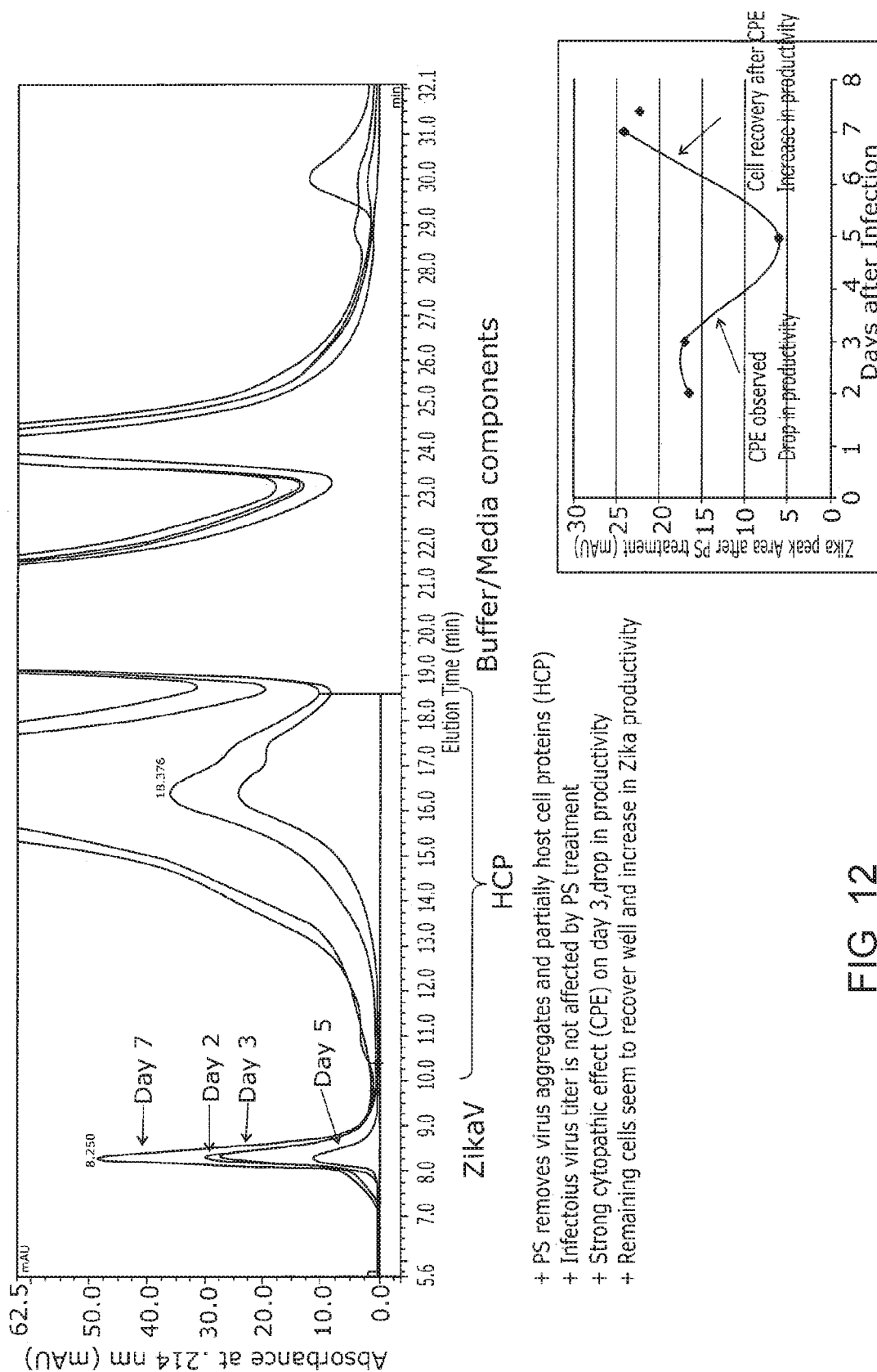


FIG. 10



- + Similar virus concentration in harvests Day 2, Day 3, Day 7; lower virus concentration in harvest Day 5
- + Day 2 and Day 3 harvests contained more HCP than Days 5/7 (correlates with observed CPE)
- + Minor amount of virus multimers observed

FIG. 11



- + PS removes virus aggregates and partially host cell proteins (HCP)
- + Infectious virus titer is not affected by PS treatment
- + Strong cytopathic effect (CPE) on day 3, drop in productivity
- + Remaining cells seem to recover well and increase in Zika productivity

FIG 12

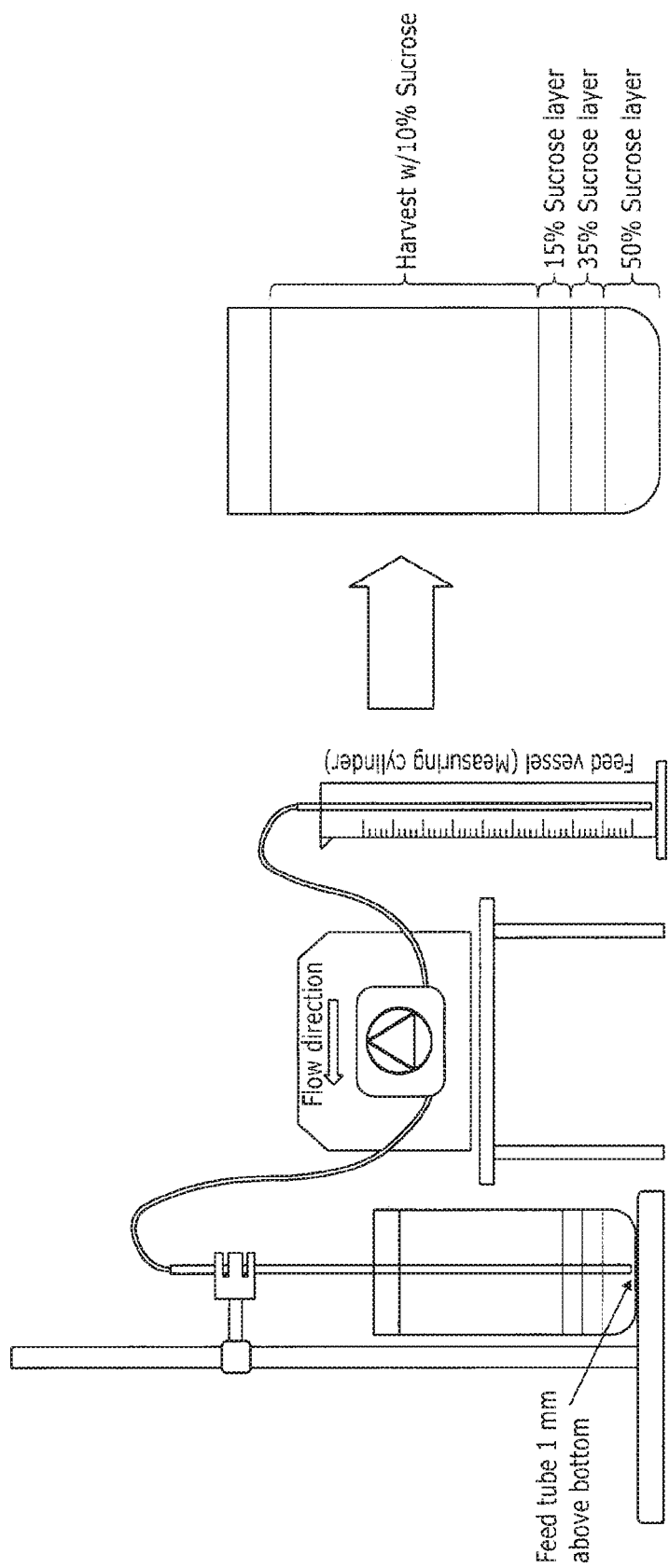
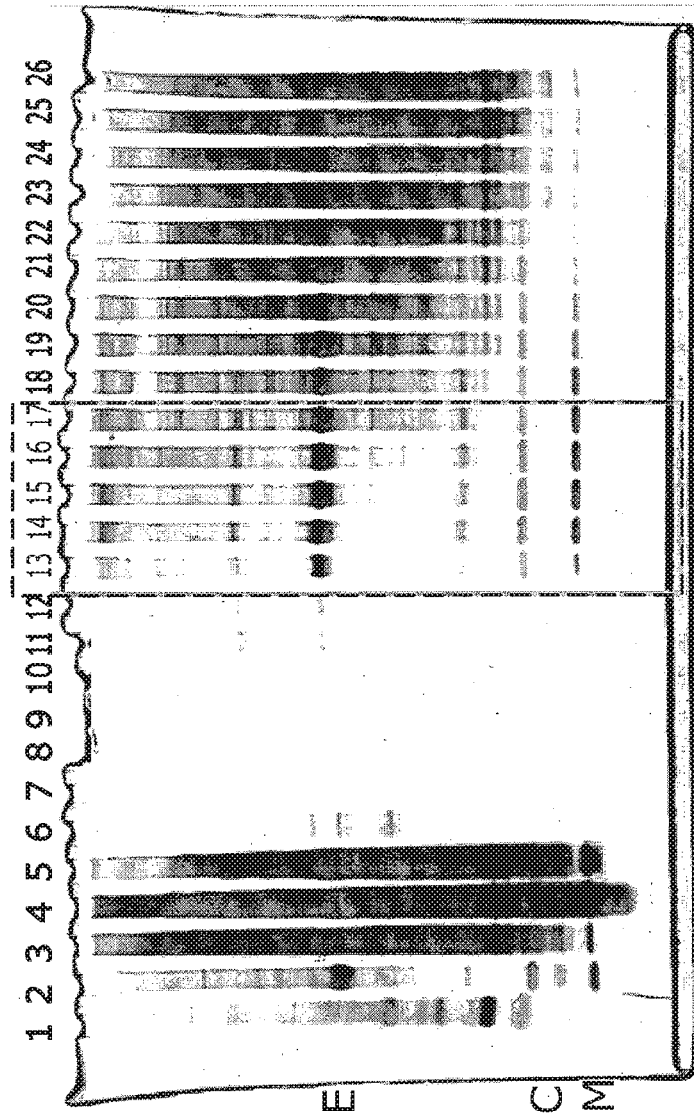


FIG. 13

Lane	Sample
1	Molecular weight Marker
2	JEV Sucrose Gradient Pool (Reference)
3	Zika Harvest pool (day 2,3,5,7)
4	Zika Harvest pool (day 2,3,5,7) concentrated 300x
5	Zika Harvest pool (day 2,3,5,7) concentrated 300x + Protamine sulfate
6	Ultrafiltration Permeate
7	SGC Bottle 1, Fraction 4
8	SGC Bottle 1, Fraction 5
9	SGC Bottle 1, Fraction 6
10	SGC Bottle 1, Fraction 7
11	SGC Bottle 1, Fraction 8
12	SGC Bottle 1, Fraction 9
13	SGC Bottle 1, Fraction 10
14	SGC Bottle 1, Fraction 11
15	SGC Bottle 1, Fraction 12
16	SGC Bottle 1, Fraction 13
17	SGC Bottle 1, Fraction 14
18	SGC Bottle 1, Fraction 15
19	SGC Bottle 1, Fraction 16
20	SGC Bottle 1, Fraction 17
21	SGC Bottle 1, Fraction 18
22	SGC Bottle 1, Fraction 19
23	SGC Bottle 1, Fraction 20
24	SGC Bottle 1, Fraction 21
25	SGC Bottle 1, Fraction 22
26	SGC Bottle 1, Fraction 23



Pooled fractions F10-F14
(10mL total volume per bottle)

FIG. 14

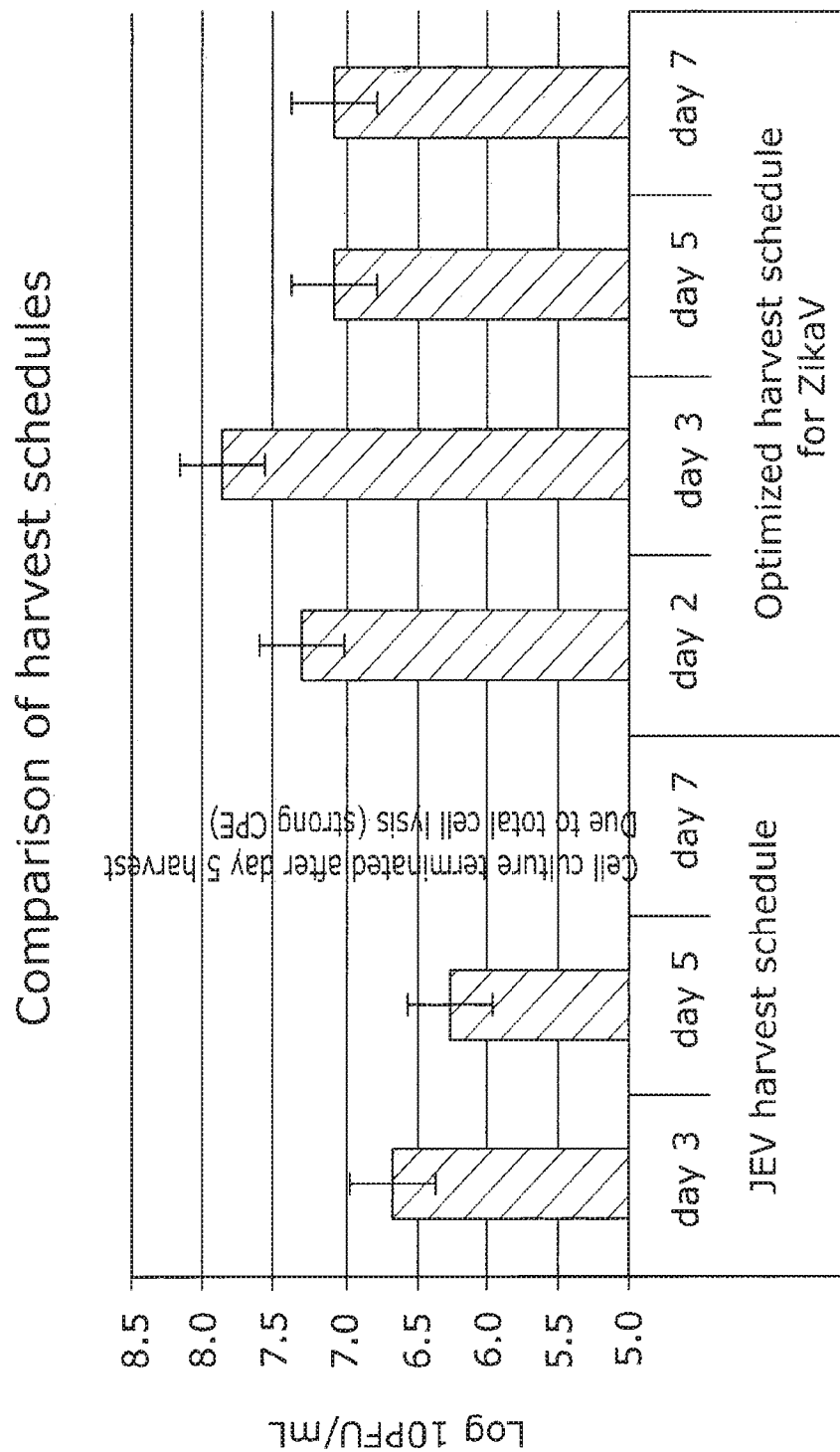


FIG 15

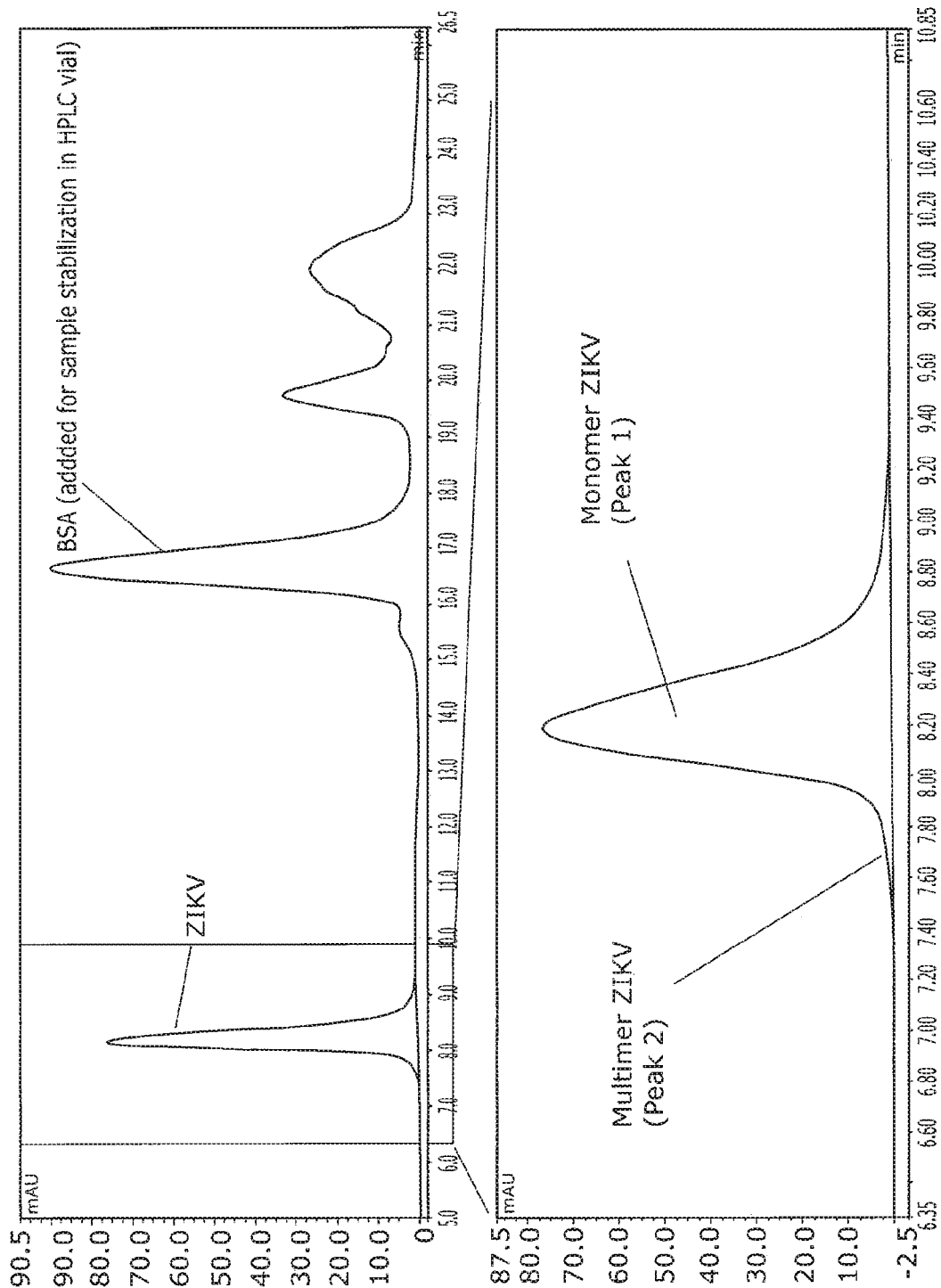


FIG. 16

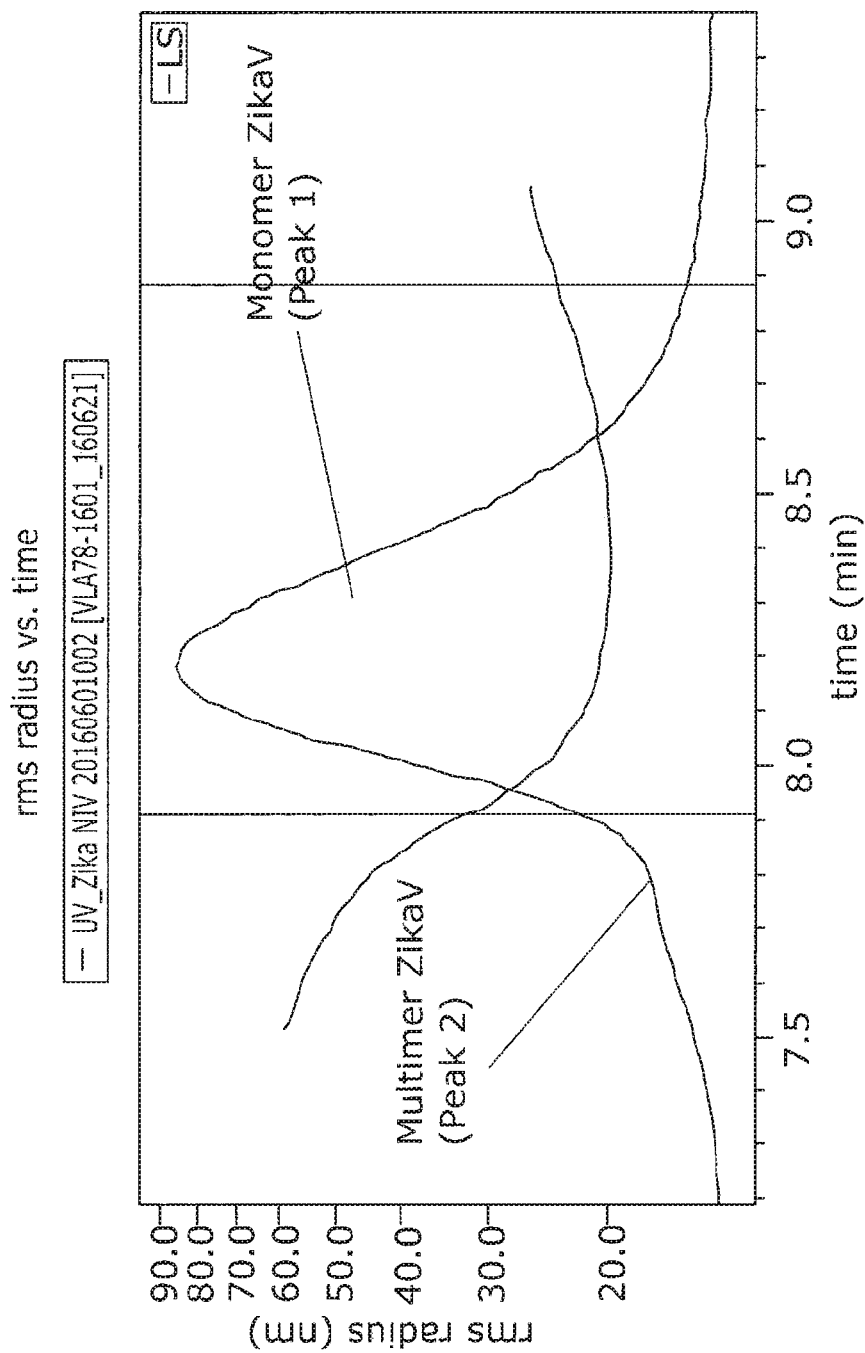


FIG. 17

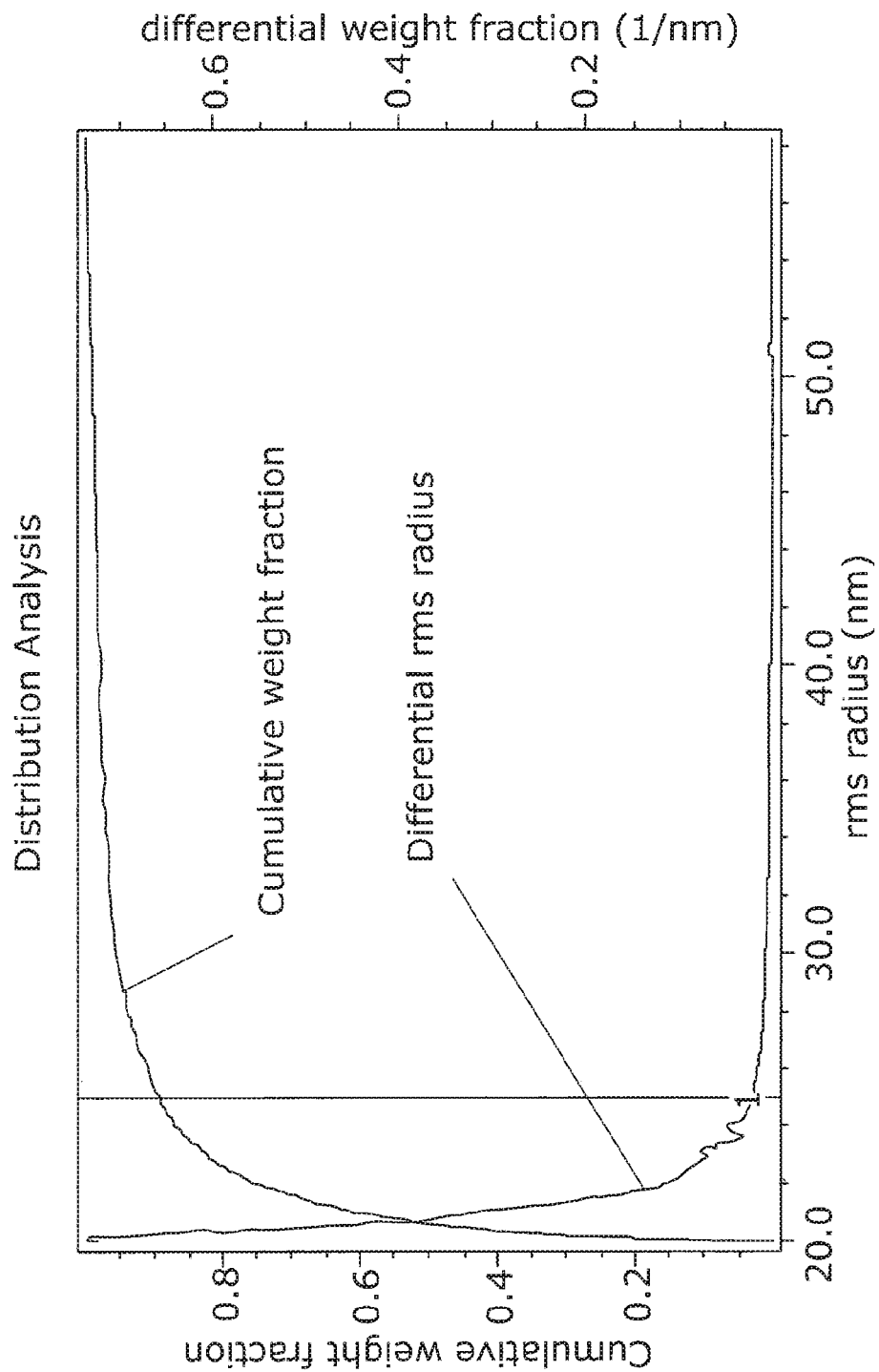


FIG 18

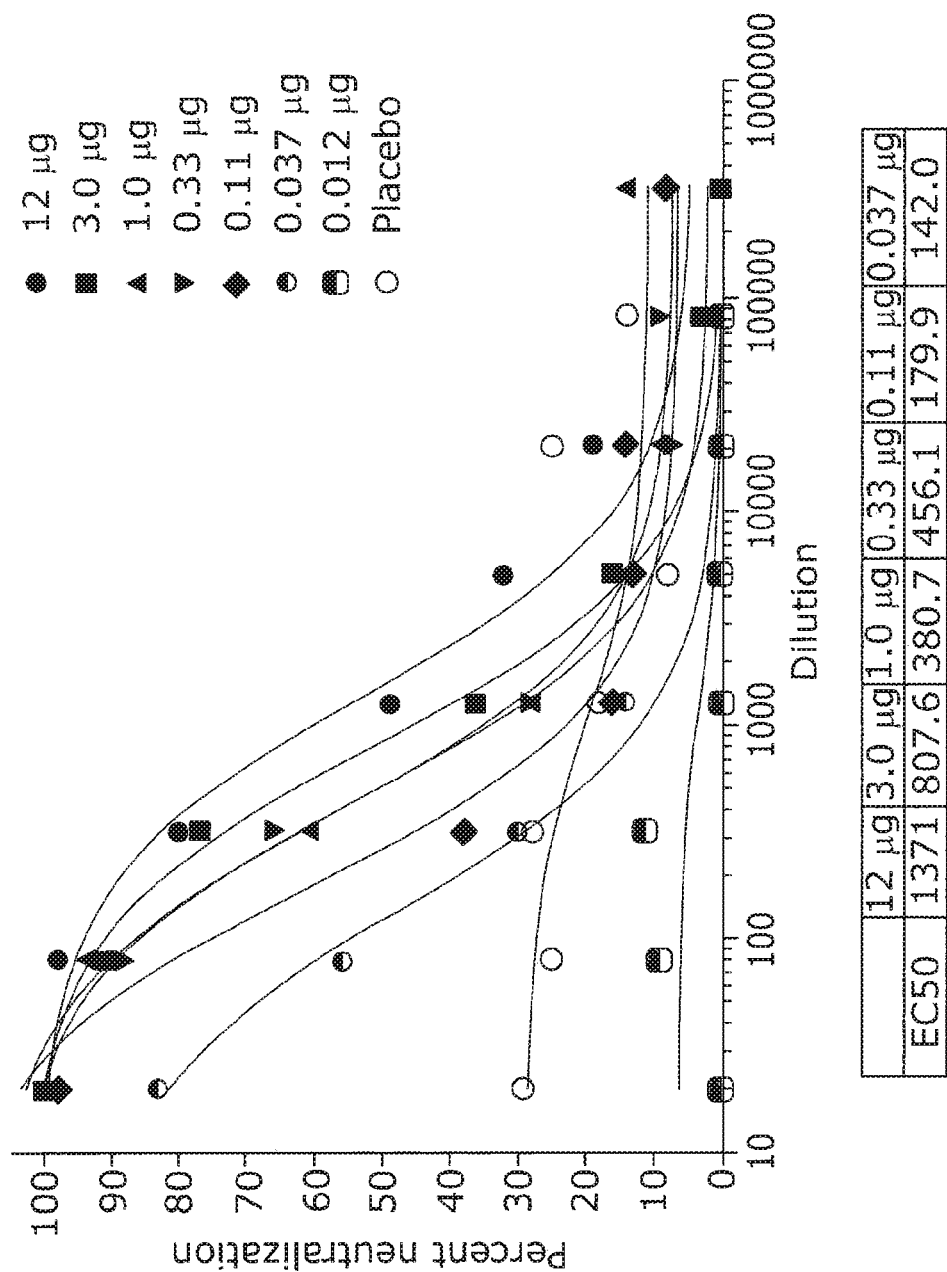


FIG. 19

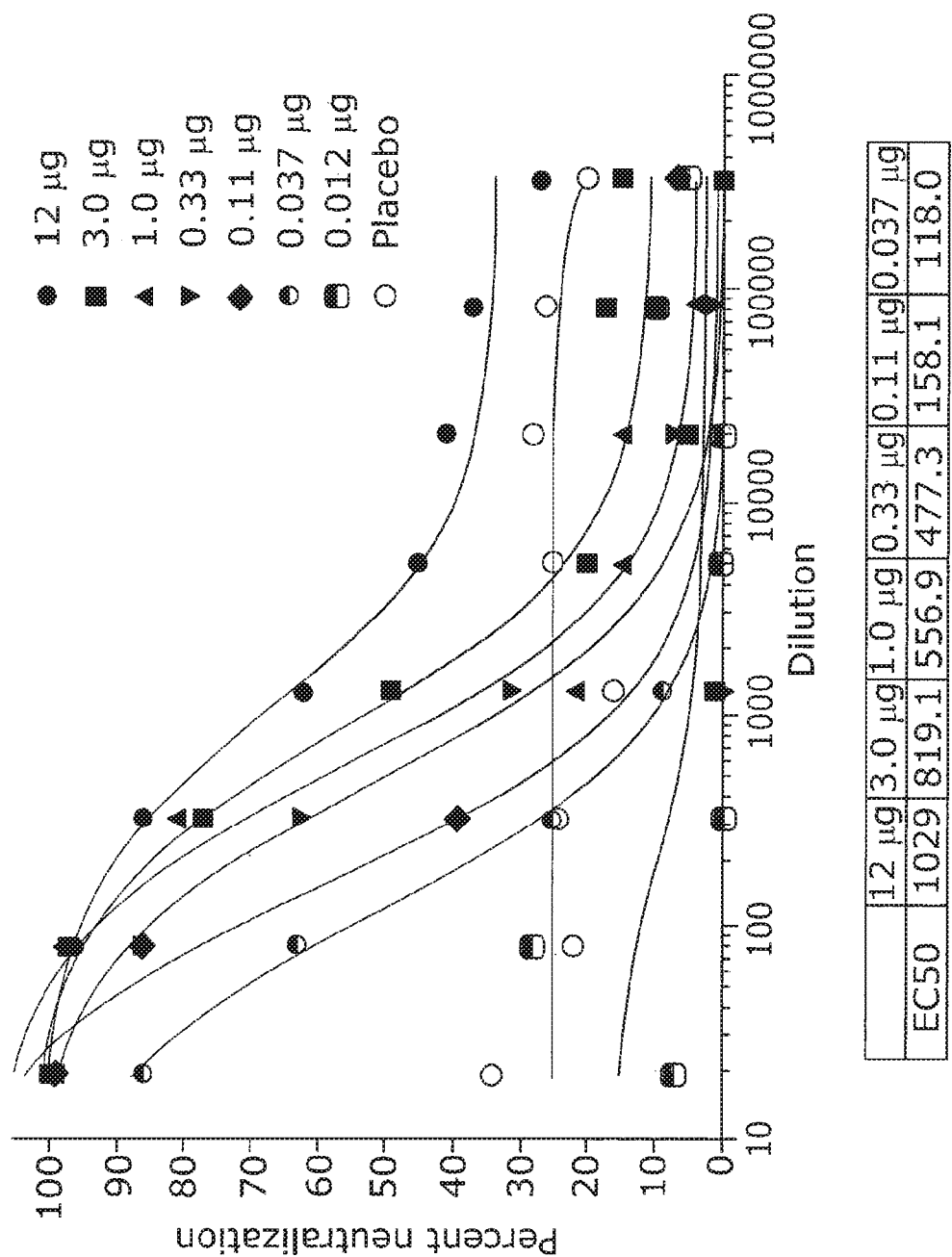


FIG. 20

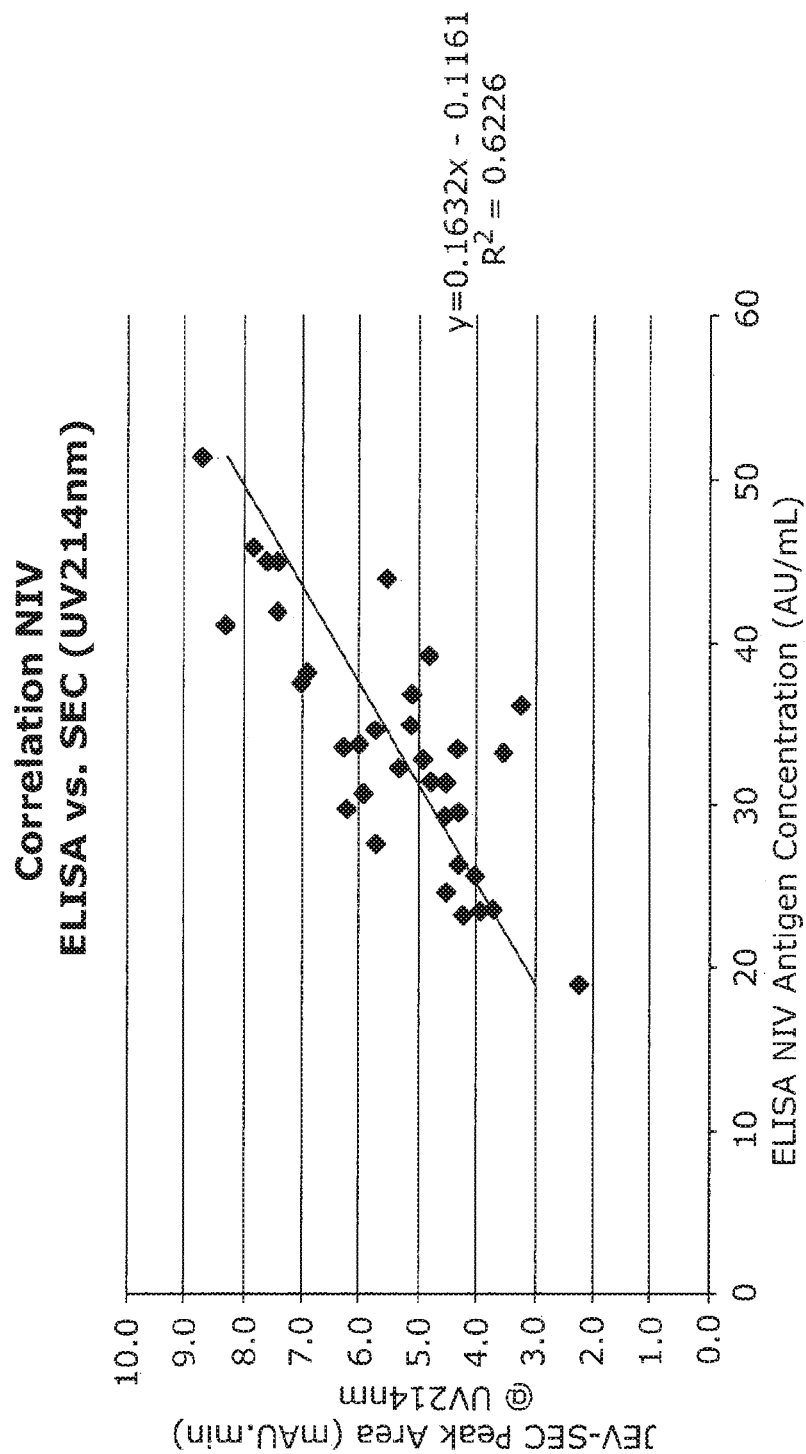


FIG. 21

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ZIKA VIRUS VACCINE**RELATED APPLICATIONS**

This application is a continuation of U.S. application Ser. No. 16/063,007, filed Jun. 15, 2018, which is a national stage filing under 35 U.S.C. § 371 of International Patent Application Serial No. PCT/EP2016/082664, filed Dec. 23, 2016, the contents of each of which is herein incorporated by reference in its entirety.

**REFERENCE TO A SEQUENCE LISTING
SUBMITTED AS A TEXT FILE VIA EFS-WEB**

The instant application contains a Sequence Listing which has been submitted in ASCII format via EFS-Web and is hereby incorporated by reference in its entirety. Said ASCII copy, created on Jul. 15, 2020, is named I042270125US01-SUBSEQ-CEW and is 455 kilobytes in size.

FIELD OF INVENTION

The disclosure relates to methods for the purification of Zika viruses for use in vaccines and in particular relates to an improved sucrose gradient process step allowing the separation of impurities such as protamine sulphate. The disclosure also relates to Zika virus vaccines and compositions and methods for producing said vaccines and administering the vaccines to subjects for the generation of an anti-Zika virus immune response.

BACKGROUND OF THE INVENTION

Adverse responses to protamine sulfate have been known for many years. Previous exposure to protamine can induce a humoral immune response and predispose susceptible individuals to the development of untoward reactions from the subsequent use of this drug. Patients exposed to protamine through the use of protamine-containing insulin or during heparin neutralization may experience life-threatening reactions and fatal anaphylaxis upon receiving large doses of protamine intravenously. Severe reactions to intravenous protamine can occur in the absence of local or systemic allergic reactions to subcutaneous injection of protamine-containing insulin. Although there is no clear evidence for hypersensitivity reactions of protamine sulphate linked to vaccination, vaccines containing protamine impurities have a precaution and contraindication warning in their labels stating that a serious allergic reaction after a previous dose of such a protamine containing vaccine (e.g. IXIARO®, see CDC site www.cdc.gov/japaneseencephalitis/vaccine/) is a contraindication to further doses. Thus elimination of said impurity is a medical request for an improved safety profile. On the other hand protamine sulphate is an excellent tool (and often better than other tools such as benzonase) to purify crude harvests of viruses grown on cell substrates.

In 2007, Zika virus was detected for the first time outside of the endemic regions of Asia and Africa since its discovery in a Rhesus monkey in Uganda in 1947. Since then, the virus has caused a large epidemic in French Polynesia, spreading through islands in the Pacific and into South and Central America by 2015 (WHO “Zika Situation Report” Feb. 5, 2016). Evidence suggests that in addition to being transmitted by *Aedes* species mosquitos, other vectors may exist, and the virus may be transmitted by blood transfusion, transplacentally, and through sexual transmission (WHO Zika Virus

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Fact Sheet, February 2016). Though the symptoms of Zika virus infection include mild fever, rash, and conjunctivitis, there is a likely correlation between infection and neurological disorders, including Guillain-Barré syndrome and microcephaly in fetuses/neonates subsequent to infection during pregnancy. There is currently no specific treatment or vaccine for Zika virus and the only preventative measures involve control of the mosquito vector. Zika virus presents a substantial public health threat due to the wide circulation of the *Aedes* mosquito, multiple routes of transmission, and potentially severe neurological effects of infection.

A preventative vaccine against Zika virus is a pressing medical need in endemic areas and in geographical areas where the vector is spreading. Furthermore, as Zika infection has dire consequences on embryonic and fetal development, a safe and effective vaccine for women of child-bearing potential or pregnant women is needed. Vaccines administered during pregnancy must be very safe for both the mother and the developing fetus. While live attenuated viral vaccines are highly effective, they are often not considered safe enough for administration to pregnant women. In this regard, inactivated viral vaccines, which lack the ability to propagate in the vaccinated subject, are considered much safer. Development of an inactivated Zika virus vaccine for administration to at-risk patients would fill this need.

SUMMARY OF THE INVENTION

During the course of virus purification, it was observed that addition of protamine sulfate to a virus harvest produced on a cell substrate removed not only contaminating DNA derived from host cells, as expected, but surprisingly also virtually eliminated immature and otherwise non-infectious virus particles from the preparation. This finding provided a streamlined, gentle, reproducible and broadly-applicable process for obtaining highly-purified infectious virus particles for applications such as vaccine preparation. In addition, it was surprisingly found that said protamine sulfate can be very efficiently separated from the virus fraction allowing for a safer vaccine produced at high yields.

Disclosed herein are virus vaccines and compositions comprising an inactivated Zika virus, and related methods of producing said vaccines and compositions. Also provided are methods of administering said Zika virus vaccines for the prevention of Zika virus infection and/or for the production of an anti-virus immune response in subjects, for example subjects at risk of being exposed to Zika virus. In particular, the invention is directed to a virus vaccine comprising an optimally inactivated Zika virus particle, wherein the Zika virus particle in an appropriate dose is able to seroconvert a subject that is administered the virus vaccine with at least a 70% probability, preferably an 80% probability. Another advantage of the invention is that related methods of producing said vaccines and compositions are very efficient and provide pure compositions largely devoid of impurities, in particular protamine sulphate, allowing for high volume production of vaccines. Detail experimental examples to the above are provided for Zika virus.

The herein disclosed *in vivo* data regarding immunogenicity of the inactivated Zika virus vaccine of the current invention indicates that the virus is surprisingly potently immunogenic and also highly cross-protective (very similar immunogenicity in African and Asian strains). Data indicate that immunogenicity was unexpectedly higher than the recently reported inactivated Zika virus vaccine candidate (Larocca, et. al, 2016, Nature doi:10.1038/nature18952).

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Inactivated viruses are among the safest vaccines and especially preferred for delivery to populations where safety is especially concerning, such as pregnant women, children and immunocompromised individuals, which makes the herein disclosed inactivated Zika virus particularly suitable. Obtaining a high titer of inactivated virus is a challenge in the field. The herein disclosed process for purifying inactivated Zika virus results in not only a high yield, but also a very pure drug substance.

Each of the limitations of the invention can encompass various embodiments of the invention. It is, therefore, anticipated that each of the limitations of the invention involving any one element or combinations of elements can be included in each aspect of the invention. This invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings are not intended to be drawn to scale. The figures are illustrative only and are not required for enablement of the disclosure. For purposes of clarity, not every component may be labeled in every drawing, alignments were performed with the multi alignment package Jalview (Waterhouse et al., 2009, *Bioinformatics* 25 (9) 1189-1191). In the drawings:

FIG. 1: Average distance tree (by % identity, nt), complete genomes.

FIG. 2: Neighbor joining tree (by % identity, nt), complete genomes.

FIG. 3: Pairwise alignment-Jalview (% identity, nt), complete genomes.

FIG. 4: Average distance tree (by % identity, aa), E-protein.

FIG. 5: Neighbor joining tree (by % identity, aa), E-protein.

FIG. 6: Pairwise alignment-Jalview (% identity, aa), E-protein.

FIGS. 7A-7C: Alignment (shading: % identity, aa), E-protein.

FIG. 8: An example of virus particle maturation in the host cell. As observed in flaviviruses, full maturation of the particles requires proteolytic cleavage of the precursor membrane glycoprotein (prM) by the host protease furin. Not all prM molecules are cleaved, resulting in the release of mature, mosaic or immature-like conformations from the cells. Mosaic and immature forms are generally not infectious-only mature virions are infective and have hemagglutinin (HA)/TCID50 activity. (Figure adapted from Plevka, et al., *Maturation of flaviviruses starts from one or more icosahedrally independent nucleation centres*, *EMBO reports* (2011) 12, 602-606).

FIGS. 9A-9B: An exemplary downstream virus purification process from the crude harvest to formulation of the drug substance (vaccine), a preferred embodiment of the process of the invention (FIG. 9A). A flow-chart of an exemplary virus inactivation process is shown in (FIG. 9B).

FIG. 10: PS treatment results in selective removal of Zika virus aggregates and Vero HCP and LMW impurities (SEC-HPLC of 30x concentrated Zika Virus harvest day 5).

FIG. 11: SEC-HPLC of individual 30x concentrated Zika harvest prior to PS treatment at different time points.

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FIG. 12: SEC-HPLC of individual 30x concentrated Zika harvest post PS treatment at different time points. The smaller graph indicates the observed cytopathic effect (CPE) over time.

FIG. 13: Preparation of the sucrose gradient.

FIG. 14: Representative SDS-PAGE from the sucrose gradient harvest of a Zika purification is shown.

FIG. 15: Comparison of JEV and ZikaV harvest schedules/yields.

FIG. 16: SEC-HPLC elution profile of ZikaV NIV. Data were processed on Dionex Ultimate 3000/Superoose 6 Increase column. Both panels are from the same chromatogram. The upper graph is the complete elution profile; the lower graph is an enlargement of the ZIKAV elution peak.

FIG. 17: SEC-MALLS analysis of inactivated ZikaV.

FIG. 18: Cumulative particle size distribution of Zika NIV.

FIG. 19: Graphical representation of the neutralization of the Zika virus H/PF/2013 with pooled mouse sera. The number of plaques without serum was set to 100%. The EC50 was calculated using the 3-parameter method.

FIG. 20: Graphical representation of the neutralization of the Zika virus MR766 with pooled mouse sera. The number of plaques without serum was set to 100%. The EC50 was calculated using the 3-parameter method.

FIG. 21: Correlation between JEV antigen content in neutralized inactivated virus (NIV) analysed by ELISA and SEC-HPLC (Dionex Ultimate 3000, Superoose 6 column).

DETAILED DESCRIPTION OF THE INVENTION

Disclosed herein are Zika virus vaccines and compositions comprising an inactivated Zika virus, and related methods of producing said vaccines and compositions. Also provided are methods of administering said virus vaccines for the prevention of virus infection and/or for the production of an anti-virus immune response in subjects, for example subjects at risk of being exposed to virus. In particular, the invention is directed to a virus vaccine comprising an optimally inactivated virus particle, wherein the virus particle in an appropriate dose is able to seroconvert a subject that is administered the virus vaccine with at least a 70% probability, preferably an 80% probability. Another advantage of the invention is that related methods of producing said vaccines and compositions are very efficient and provide pure compositions largely devoid of impurities, in particular protamine sulphate, allowing for high volume production of vaccines. Examples to the above are provided for Zika virus.

Disclosed herein are downstream processes for purifying Zika virus particles from a crude preparation. The downstream process can be applied to either a virus which has not adapted for propagation on a particular cell substrate or for a partially/fully cell substrate adapted Zika virus particle.

Aspects of the invention provide processes for the purification of infectious Zika virus particles comprising the steps of (a) providing a crude harvest (a) comprising virus particles and impurities, wherein the impurities are generated from growing said virus particles on a cell substrate; (b) reducing impurities from the crude harvest (a) by precipitation with an agent comprising a protamine salt, preferably a protamine sulphate, to obtain a virus preparation (b); and further purifying the virus preparation (b) by an optimized sucrose density gradient centrifugation to obtain a virus preparation (c) comprising the infectious virus particles.

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In some embodiments, the concentration of protamine sulphate in step (b) is about 1 to 10 mg/ml, more preferably about 1 to 5 mg/ml, more preferably about 1 to 2 mg/ml. In one embodiment, the concentration of protamine sulphate in step (b) is about 2 mg/mL. In one embodiment, the concentration of protamine sulphate is 1.2 to 1.8 mg/ml, more preferably 1.4 to 1.6 mg/ml. In a preferred embodiment, the concentration of protamine sulphate in step (b) is about 2 mg/ml.

In some embodiments, the residual host cell DNA of the virus preparation (c) is less than 1 µg/mL, especially less than 900, 800, 700, 600, 500, 400, 300 or 200 ng/mL, preferably less than 100 ng/mL.

In a preferred embodiment, the residual host cell DNA of the virus preparation (c) is less than 10 ng/mL. In some embodiments, the residual host cell protein of the final virus preparation (c) is less than 10 µg/mL, especially less than 9, 8, 7, 6, 5, 4, 3 or 2 µg/mL, preferably less than 1 µg/mL. In a preferred embodiment, the residual host cell protein of the virus preparation (c) is less than 100 ng/mL. In some embodiments, the residual non-infectious virus particles of the final virus preparation (c) is less than 10 µg/mL, especially less than 9, 8, 7, 6, 5, 4, 3 or 2 µg/mL, preferably less than 1 µg/mL. In a preferred embodiment, the content of residual non-infectious virus particles of the virus preparation (c) is less than 100 ng/mL.

In some embodiments, the residual protamine is less than 1 µg/mL, especially less than 900, 800, 700, 600, 500, 400, 300 or 200 ng/mL, preferably less than 100 ng/mL, more preferably is below the detection limit of HPLC, in particular below the detection limit in the final drug substance. In some embodiments, the PS content is tested by HPLC or size exclusion chromatography (SEC). For example, HPLC is validated for PS determination in JEV sucrose gradient pool samples as a routine release assay and is very sensitive (i.e., LOQ 3 µg/mL; LOD 1 µg/mL). In the current invention, PS content in Zika virus DS samples was <LOD. In one embodiment, the HPLC assessment of PS content can be performed on a Superdex Peptide 10/300GL column (GE: 17-5176-01) using 30% Acetonitrile, 0.1% Trifluoroacetic acid as solvent with a flow rate of 0.6 ml/min at 25° C. and detection at 214 nm. A more sensitive method of measurement for residual protamine in a purified virus preparation is mass spectrometry (MS). In some embodiments, the residual PS levels in a Zika virus preparation are tested by MS or other such highly sensitive method, e.g. nuclear magnetic resonance (NMR). With this method, residual PS, as well as fragments and/or break-down products of PS, can be detected at trace amounts, such as levels as low as, for example, 10⁶, 10⁷ or 10⁸ molecules per typical sample load. In some embodiments, the PS levels are tested in the sucrose gradient pool. In some embodiments, the PS levels are tested in the drug product. In some embodiments, the PS levels are tested in the drug substance.

In some embodiments, the crude harvest (a) comprising the virus particles and impurities is subjected to one or more pre-purification step(s) prior to step (b). In some embodiments, the one or more pre-purification step(s) comprises digesting host cell genomic DNA in the crude harvest (a) comprising the virus particles and impurities by enzymatic treatment. In some embodiments, the one or more pre-purification step(s) comprises filtration, ultrafiltration, concentration, buffer exchange and/or diafiltration. In some embodiments, the one or more pre-purification steps is filtration using a filter having a pore size equal to or less than 1 µm. In some embodiments, the filter has a pore size equal to or less than 0.2 µm. In a preferred embodiment, the filter

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has a pore size of 0.2 µm. In some embodiments, the concentration and/or ultra/diafiltration and/or buffer exchange is performed by tangential flow filtration (TFF). In some embodiments, ultra/diafiltration of the crude harvest (a) comprising the virus particles and impurities is performed using a hollow fiber membrane having a cut-off of equal to or less than 300 kDa. In a preferred embodiment, the hollow fiber membrane has a cut-off of about 100 kDa.

The process according to the current invention may also comprise the use of a sucrose gradient, preferably an optimized sucrose gradient. The sucrose gradient is preferably optimized for the removal of protamine sulfate, also for the removal of immature viral particles or other viral particles which are non-infectious or host cell proteins or nucleic acids (DNA, RNA, mRNA, etc) or other host cell debris. In the current invention the optimized sucrose gradient comprises at least two, at least three, at least four layers of sucrose solutions with different densities. In one embodiment, the virus preparation to be purified is provided in a sucrose solution which has a density of about 8%, about 9%, about 10%, about 11%, about 12% sucrose (w/w), preferably about 10%. In one embodiment, one sucrose solution in the gradient has a density of about 45%, about 46%, about 47%, about 48%, about 49%, about 50%, about 51%, about 52%, about 53%, about 54%, about 55% sucrose (w/w), preferably about 50%. In one embodiment, one sucrose solution in the gradient has a density of about 30%, about 31%, about 32%, about 33%, about 34%, about 35%, about 36%, about 37%, about 38%, about 39%, about 40% sucrose (w/w), preferably about 35%. In one embodiment, one sucrose solution in the gradient has a density of about 10%, about 11%, about 12%, about 13%, about 14%, about 15%, about 16%, about 17%, about 18%, about 19%, about 20% sucrose (w/w), preferably about 15% sucrose. In a preferred embodiment, the sucrose gradient comprises three layers of sucrose solutions of about 50%, about 35% and about 15% (w/w) sucrose and the virus composition to be purified is contained in about 10% (w/w) sucrose. Because the invention provided for means to not only test for host cell DNA but also immature viral particles, the skilled person in the art is able to more precisely optimize the sucrose gradient for most efficient purification and include additional tools such as PRNT assay to monitor purification success.

In some embodiments, the virus particle is a live virus, a chimeric virus, an attenuated live virus, a modified live virus, or a recombinant live virus. In a further step, the virus particles of the invention may be optionally inactivated. In some embodiments, the virus particle is an attenuated form of the virus particle. For example, the virus may have reduced infectivity, virulence, and/or replication in a host, as compared to a wild-type virus. In some embodiments, the virus is a mutated or modified virus, for example the nucleic acid of the virus may contain at least one mutation relative to the wild-type virus. In some embodiments, the virus is a recombinant live virus, meaning a virus that is generated recombinantly and may contain nucleic acid from different sources.

In some embodiments, the Zika virus particle is a live virus, an attenuated live virus, a modified live virus, or a recombinant live virus. In preferred embodiments, the Zika virus is a Zika virus from the Asian lineage.

In some embodiments, the relative reduction of impurity of the final virus preparation relative to the liquid medium (a) comprising the virus particles and impurities is in a range from 60 to 95%. In some embodiments, the residual impurity of the final virus preparation is less than 1%.

In some embodiments, the Zika virus is propagated in a cell line selected from the group consisting of an EB66 cell line, a Vero cell line, a Vero- α His cell line, a HeLa cell line, a HeLa-S3 cell line, a 293 cell line, a PC12 cell line, a CHO cell line, a 3T3 cell line, a PerC6 cell line, a MDSK cell line, a chicken embryonic fibroblast cell line, a duck cell line, and a diploid avian cell line. In some embodiments, said cell line is a duck cell line. In some embodiments, said cell line is a diploid avian cell line. In some embodiments, said cell line is an EB66 cell line. In a preferred embodiment, said cell line is a Vero cell line.

Aspects of the invention provide a use of any of the processes described herein for manufacturing a composition for immunization against a viral infection. In a preferred embodiment, the composition or vaccine is directed against Zika virus such as e.g. a Zika virus of the Asian lineage.

Other aspects provide compositions comprising the Zika virus particles obtainable by any of the processes described herein for treating and/or preventing (i.e. protecting from) a viral infection. In a preferred embodiment, the viral infection is caused by Zika virus such as e.g. a Zika virus of the Asian lineage.

Furthermore, disclosed herein are Zika virus vaccines and compositions comprising an inactivated Zika virus, and related methods of producing said vaccines and compositions. Also provided are methods of administering the Zika virus vaccines for the prevention of Zika virus infection and/or for the production of an anti-Zika virus immune response in subjects, for example subjects at risk of being exposed to Zika virus.

Zika virus is a flavivirus closely related to Dengue virus and is similarly transmitted by the *Aedes* species mosquito, although other arthropod vectors for Zika virus are possible. Since it was first isolated from a Rhesus monkey in the Zika forest of Uganda in 1947, there were very few reported incidents of human infection, especially outside of the endemic regions of Africa and Asia until a large outbreak in French Polynesia in 2007 (Haddow et al. *PLoS Neglected Tropical Diseases* (2012) 6(2), Malone et al. *PLoS Neglected Tropical Diseases* (2016) 10(3)). The virus has since spread through islands of the Pacific, including Oceania, and into South and Central America (WHO “Zika Situation Report” Feb. 5, 2016).

In addition to being spread by the bite of an infected mosquito, evidence also suggests transmission may occur between individuals, such as from the blood of an infected individual, in utero/transplacental transmission from an infected mother to the fetus, sexual transmission between sexual partners, and possibly by other local transmission routes. There is a possible association between Zika virus infection during pregnancy and microcephaly in the fetus/neonate. Microcephaly is a rare condition in which a baby’s head circumference is significantly less than expected based on the average for their age, sex, and ethnicity. This is a result of the brain failing to undergo proper embryonic development, and in 90% of cases is associated with mental retardation (Rocha et al. (2016) *Bull World Health Organ* 8 Feb. 2016).

There is a probable association between individuals having had a prior Zika virus infection and the incidence of Guillain-Barré syndrome, a neurological disorder in which the individual’s immune system destroys the myelin sheath surrounding axons of the peripheral nervous system (WHO “Zika Situation Report” Feb. 5, 2016).

No specific treatments or vaccines for Zika virus currently exist, and the only measures at this time to prevent infection are through vector control and avoiding travel to regions experiencing outbreaks.

Described herein are Zika virus vaccines and compositions comprising inactivated Zika virus that provide a safe method for generating an immune response to Zika virus, including virus-neutralizing antibodies, that may help prevent against Zika virus infection.

Any strain of Zika virus may be used in the methods and compositions described herein. In some embodiments, the Zika virus is an isolate from an infected subject during a Zika virus outbreak. In some embodiments, the Zika virus is a strain isolated from Africa or from the African virus lineage. In some embodiments, the Zika virus is a strain isolated from Asia or from the Asian lineage (includes also strains from French Polynesia). In some embodiments, the Zika virus is a strain isolated from the Americas (South America, Central America, or North America), such as a Suriname Zika virus strain. In some embodiments, the Zika virus has an RNA genome corresponding (but not limited) to the DNA sequence provided by GenBank Accession No. AY632535.2, KU321639.1, KU497555.1, KU501215.1, KU509998.1, KU527068.1, KU681081.3, KU681082.3, KU707826.1, KU744693.1, or LC002520.1 or RNA genome disclosed partially or fully herein (SEQ ID NO: 2 to 69).

In some embodiments, the process of the invention results in an enrichment of infectious Zika virus particles from the crude harvest comprising infectious Zika virus particles and non-infectious virus particles and other virus products such that the enrichment of the infectious virus particles is at least 50%, at least 60%, at least 70%, at least 80%, at least 90%, at least 95%, preferably at least 80%, especially at least 85% relative to the total virus particle content of the crude harvest (a) comprising the virus particles and impurities.

In some embodiments, the residual impurity of the final virus preparation with respect to all impurities in the crude harvest is less than 10%, 9%, 8%, 7%, 6%, 5%, 4%, 3%, 2%, 1%, preferably less than 5% as determined by SEC-HPLC (Size Exclusion Chromatography—HPLC).

A unique aspect of the current invention is the realization that know-how related to the vaccine design and purification approach used for the Japanese Encephalitis Vaccine (JEV) IXIARO® (see Srivastava A. K. et al., 2001, Vaccine 19, 4557-4565, WO99/11762) may be employed and improved upon in order to expedite the development of a Zika virus vaccine and provide it to the subjects in need as soon as possible. The industrial process as disclosed for IXIARO®, providing a very effective vaccine against JEV, was complemented by further significant improvements disclosed herein in order to provide a more efficient (higher yield) and safer (less or no protamine sulphate with its allergic potential) Zika vaccine compared to the available JEV vaccine. A particular innovation of the herein disclosed vaccines is their greatly reduced protamine salt (SEQ ID NO: 1) content in the final drug substance facilitated by the development of an improved sucrose gradient. Said sucrose gradient not only allowed the separation of protamine sulphate but also allowed for a very effective inactivation by formaldehyde and resulted in the case of Zika with over 90% yield with the improved process disclosed herein vs about 35% yield with the published JEV process, see experimental part for comparison).

Aspects of the disclosure relate to methods of producing a virus in Vero tissue culture cells. Vero cells are a commonly used tissue culture cell line derived from the kidney of an African green monkey. The Vero cells used in the

methods described herein are the Vero (WHO) cell line, obtained from the Health Protection Agency general cell collection under catalogue number 88020401.

Vero cells can be grown to confluent monolayers, for example in tissue culture flasks; in suspension (on micro-carriers), for example in roller bottles; or in any other cell culture system for viral production. In some embodiments, the Vero cells are grown in a bioreactor for viral production. For plaque assays or the plaque reduction neutralization test (PRNT), Vero cells are grown in monolayers in tissue culture flasks, dishes, or wells of a plate. To infect the Vero cells with the virus, the culture medium is inoculated with virus and the cells are incubated with the virus for a period of time. The cells may be washed after inoculation to remove any virus that did not adsorb to the cells in a given amount of time.

The methods provided herein involve passaging the virus in Vero cells. As used herein, the terms “passage” or “passaging” refer to infecting a population of Vero cells with virus and subsequently inoculating a second population of Vero cells with virus produced by infection of the first Vero cell population. In some embodiments, a portion of the culture medium from the infected Vero cells (containing virus that was released from the infected cells) is used to inoculate a second population of Vero cells. This is referred to as one passage or one round of passaging. The passaging may be performed serially, for example, a portion of the culture medium from the infected second population of Vero cells is used to inoculate a third population of Vero cells, and so on. In some embodiments, virus obtained from a single plaque is used to inoculate another population of cells.

In some embodiments, the virus is passaged in Vero cells several times, such as at least 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, or 40 times. In some embodiments, the virus is passaged in Vero cells at least 4 times or 5 times. In some embodiments, the virus is passaged in Vero cells at least 30 times. It is important that the virus population, i.e. the virus sequences, stays as much as possible constant over said passaging. If adaptation of the virus occurs (i.e. appearance of mutated viruses in the original virus population), it is preferred that said passages are not used in the context of manufacturing of said virus, e.g. for Zika it was found that up to passage 3 and culturing to day 7 can be used without major shifts in virus population, i.e. introduction of virus population with mutations. However this observation needs to be done for each virus strain and may be different.

In some embodiments, the Vero cells are incubated for at least 2 days after inoculation with the virus at e.g. a typical 0.01 MOI (multiplicity of infection) to allow for viral production prior to passaging. In some embodiments, the Vero cells are incubated for at least 3, 4, 5, 6, 7, 8, 9, 10 or more than 10 days e.g. at least 7 days after inoculation with the virus prior to passaging. The number of days the Vero cells are incubated after viral inoculation may depend on factors such as the multiplicity of infection used to inoculate the cells and the viral titer desired in the culture medium. Serial passaging of the virus in Vero cells may result in generation of a Vero cell adapted virus strain.

The culture medium from the infected Vero cells may be harvested (collected) to obtain the virus. In some embodiments, the culture medium is harvested from infected Vero cells and is replaced with fresh culture medium, which is then harvested after another period of time. In some embodiments, the culture medium harvested from infected Vero cells is pooled from independent Vero cell cultures and/or

from independent days. Harvesting can be repeated up to 4 times by 7 or 9 days post infection, for example, and result in a high yield of virus per unit cell culture. In order to minimize the adaptation of Zika virus strain to Vero cells, it was found that Vero cells could be incubated for at least 7 days, more preferably 5 days, prior to passaging and subsequently supernatants could be harvested at days 2, 3, 5 and 7 or 2, 3, and 5 (see also experimental part). The harvested culture medium can be stored at +4° C. prior to purification of the virus from the culture medium up to 2 weeks.

In some embodiments, debris from infected and lysed Vero cells may be removed from the harvested culture medium, referred to as a “clarification” of the culture medium. The harvested culture medium may be clarified by common methods known in the art, such as low-speed centrifugation, for example, at 1500 g for 10 min, and/or by filtration through a filter of pore size of 0.45 µm. The harvested culture medium can be stored at +4° C. prior to concentration.

To concentrate the titer of the Zika virus in the harvested culture medium, it may be subjected to concentration by any method known in the art. For example, the harvested culture medium may be concentrated by methods including, without limitation, ultrafiltration, ultracentrifugation, centrifugal concentrator, vacuum centrifugation, and lyophilization. In some embodiments, the harvested culture medium is concentrated by ultrafiltration and the retentate containing the Zika virus is collected. In some embodiments, the harvested culture medium is concentrated by precipitation in which polyethylene glycol (PEG) 8000 is dissolved in the culture medium (up to 10%) and the precipitate is dissolved in a buffer, for example phosphate-buffered saline (PBS, pH 7.0).

The harvested culture medium may be precipitated to produce a virus supernatant. In some embodiments, the harvested culture medium is precipitated to remove Vero cell DNA and other undesired material, such as Vero cell debris, from the harvested culture medium. In some embodiments, the harvested culture medium is concentrated prior to precipitation. In some embodiments, the harvested culture medium is precipitated by adding protamine sulfate (e.g. SEQ ID NO: 1) to the harvested culture medium and incubating the mixture, for example at +4° C. or on ice. In some embodiments, the harvested culture medium is treated with benzonase to remove Vero cell DNA and other undesired material, such as Vero cell debris, from the harvested culture medium. However, it was found that the treatment with protamine sulfate is preferred (see experimental part). In some embodiments, the precipitated culture medium is centrifuged to collect precipitated material and the supernatant containing the virus, referred to as a “virus supernatant”, is collected.

The virus supernatant may be further purified after precipitation, for example density gradient ultracentrifugation. In some embodiments, the virus supernatant is further purified by sucrose gradient. Fractions may be collected from the sucrose gradients and assayed for presence of the virus. Methods for assaying for virus positive fractions include plaque assay, hemagglutination assay, polyacrylamide gel electrophoresis, and antigen assays such as Western blotting and ELISA. The fractions containing virus may be pooled based on titer of the virus and level of other impurities. The level or amount of impurities present in the virus supernatant can be estimated by testing for Vero cell DNA, virus aggregates and/or Vero cell protein (see experimental part). A particular embodiment of the invention is the improved sucrose gradient that allows for an efficient protamine separation as shown in the experimental part. It was surprisingly

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found that the addition of a virus-containing fraction with 10% (w/w) sucrose to a simple three layer sucrose density gradient (e.g. a gradient comprising a 15% (w/w) sucrose solution, a 35% (w/w) sucrose solution, and a 50% (w/w) sucrose solution) resulted in efficient separation of protamine sulphate without much loss of virus. Thus a particularly preferred embodiment of the invention is the use of a sucrose density gradient that is able to efficiently separate protamine sulphate, wherein said sucrose density gradient is used in the purification of virus such as the viruses described herein, i.e. a Zika virus.

To achieve a safe vaccine or composition for the administration to subjects, the virus supernatant may be inactivated (see experimental part for Zika virus). As used herein, the terms "inactivated" and "optimally inactivated" may be used interchangeably and refer to a process (or its result) by which the virus is rendered unable to infect a host cell (non-infectious), but that does not affect or substantially affect the antigenicity of the virus, for example, the immunogenic antigens exposed on the surface of the virus are able to stimulate an immune response in a subject (e.g., antigen-specific antibodies). By "does not affect or substantially affect the antigenicity of the virus" is meant that the inactivated virus retains at least 50%, at least 55%, at least 60%, at least 65%, at least 70%, at least 75%, at least 80%, at least 85%, at least 90%, at least 95%, at least 96%, at least 97%, at least 98%, at least 99%, or even essentially 100% of the antigenicity of a virus that is not subjected to inactivation.

A variety of methods are known in the art for inactivating viruses. In some embodiments, the virus is inactivated by chemical inactivation, thermal inactivation, pH inactivation, or UV inactivation.

In some embodiments, the inactivating is by chemical inactivation and involves contacting the virus with one or more chemical inactivation agents for a period of time under conditions such that the virus is inactivated but the antigenic epitopes are substantially intact. In some embodiments, the virus is inactivated for a period of time that is longer than is required to completely inactivate the virus. In some embodiments, the virus supernatant is inactivated for the number of days required to inactivate the virus plus at least one additional day. Samples of the virus supernatant may be taken at one or more times throughout the inactivation process and assessed for viral viability (infectivity) by any method known in the art, such as by infecting a monolayer of host cells (i.e., plaque assay). Using such a procedure, the period of time that is required to completely inactivate the virus can be determined, and a longer period of time is selected to ensure complete inactivation.

In some embodiments, the virus is contacted with a chemical inactivation agent for between 1 day and 50 days, between 2 days and 40 days, between 2 days and 30 days, between 2 days and 20 days, between 2 days and 10 days, between 3 days and 9 days, between 4 days and 8 days, between 5 days and 7 days, between 2 days and 5 days, or between 5 and 10 days. In some embodiments, the virus is contacted with one or more chemical inactivation agents for at least 1 day, 2 days, 3 days, 4 days, 5 days, 6 days, 7 days, 8 days, 9 days, 10 days, 11 days, 12 days, 13 days, 14 days, 15 days, 16 days, 17 days, 18 days, 19 days, 20 days, 21 days, 22 days, 23 days, 24 days, 25 days, 26 days, 27 days, 28 days, 29 days, 30 days, 31 days, 32 days, 33 days, 34 days, 35 days, 36 days, 37 days, 38 days, 39 days, 40 days, 41 days, 42 days, 43 days, 44 days, 45 days, 46 days, 47 days, 48 days, 49 days, or at least 50 days.

In some embodiments, the chemical inactivation is performed at about +5° C., +10° C., +15° C., +20° C., +25° C.,

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+30° C., +35° C., +40° C., or about +45° C. In some embodiments, the chemical inactivation is performed at about +4° C. In some embodiments, the chemical inactivation is performed at about +22° C.

Any chemical inactivation agent known in the art may be suitable for inactivating the virus in the methods described herein. It will be appreciated by one of skill in the art that factors such as the chemical inactivation agent and the temperature at which inactivation is performed may affect the length of time (number of days) required to completely inactivate the virus. Examples of chemical inactivation agents include, without limitation, formaldehyde, enzymes, β -propiolactone, ethanol, trifluoroacetic acid, acetonitrile, bleach, urea, guanidine hydrochloride, tri-n-butyl phosphate, ethylene-imine or a derivatives thereof, and organic solvents such as Tween, Triton, sodium deoxycholate, and sulphobetaine. A preferred inactivation is inactivation with formaldehyde at 22° C. +/- 2° C. for about 10 days.

In some embodiments, the inactivating agent is neutralized after chemical inactivation of the virus. In some embodiments, the inactivating agent is formaldehyde and is neutralized after chemical inactivation using sodium thiosulphate or sodium metabisulfite.

In some embodiments, the virus is inactivated by thermal inactivation. In some embodiments, the thermal inactivation involves exposing the virus to heat, such as dry heat or vapor heat, for a period of time. In some embodiments, the thermal inactivation involves exposing the virus to temperatures of about +40° C., +45° C., +50° C., +55° C., +60° C., +65° C., +70° C., +75° C., +80° C., +85° C., +90° C., +95° C., or about +100° C. In some embodiments, the virus is exposed to heat for at least 5 hours, 6 hours, 7 hours, 8 hours, 9 hours, 10 hours, 11 hours, 12 hours, 13 hours, 14 hours, 15 hours, 16 hours, 17 hours, 18 hours, 19 hours, 20 hours, 21 hours, 22 hours, 23 hours, 24 hours, 36 hours, 48 hours, 60 hours, 72 hours, 84 hours, about 96 hours, or longer. A preferred thermal inactivation involves exposing the virus to temperatures of about +56° C. for 60 minutes.

In some embodiments, the virus is inactivated by exposing the virus to acidic or alkaline conditions for a period of time such that the virus is completely inactivated. The pH of a virus preparation may be adjusted to a desired pH, for example by the addition of an acid, a base, or a buffer with a particular pH to the virus preparation. In some embodiments, the virus is inactivated at an acidic pH of about 2, 2.5, 3, 3.5, 4, 4.5, 5 or about 5.5. In other embodiments, the virus is inactivated at an alkaline pH of about 8, 8.5, 9, 9.5, 10, or about 10.5.

In some embodiments, the virus is inactivated using UV inactivation. UV inactivation involves exposing the virus to energy-rich radiation, such as UV-A, UV-B, or UV-C light for a period of time. It will be appreciated that any two or more methods of inactivation may be combined and performed concurrently or serially.

The inactivated virus may be subsequently dialyzed to remove any undesired material, including the inactivating agent and any neutralizing agent, and/or to replace the buffer with a buffer that is pharmaceutically acceptable for administration to subjects. In some embodiments, the inactivated virus is dialyzed with PBS. In addition or alternatively, the inactivated virus may be filtered, such as sterile filtered, through a 0.22 μ m filter.

Any of the methods or uses described herein may be for the prevention of a Zika virus infection in a subject. As used herein, the terms "prevent," "preventing" and "protection from" include the administration of a virus vaccine or composition to a subject to reduce, or delay the onset of the

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manifestation of clinical or subclinical symptoms, complications, pathologies or biochemical indicia of a disease or infection, or to reduce or inhibit the spread/transmission of the Zika virus. As used herein, antigen(s), such as an inactivated Zika virus, that is administered to a subject prophylactically (e.g., prior to infection) may be referred to as a vaccine.

Zika Vaccine

As described herein Zika virus may cause any of a variety of symptoms upon infection of a subject, and is generally characterized by mild fever; rash (exanthema) on face, neck, trunk, upper arms;

headache; sensitivity to light; non-inflammatory joint pain; conjunctivitis; lack of appetite; diarrhea; abdominal pain; and/or dizziness. Zika virus infection during pregnancy is associated with microcephaly in the fetus/neonate. There is also a probable association between the onset of Guillain-Barré syndrome or symptoms thereof. Diagnosis of Zika virus infection in subjects exposed to Zika virus or suspected of being exposed to Zika virus involves detecting the presence of virus-specific antibodies and/or molecular testing, such as PCR or real-time PCR detection of Zika virus.

Provided herein are methods for administering a dose of a therapeutically effective amount of a Zika virus vaccine to a subject in need thereof. In some embodiments, the subject is a mammalian subject, such as a human, non-human primate, rodent, rabbit, sheep, dog, cat, horse, or cow. In some embodiments, the subject is a mouse. In some embodiments, the subject is a human subject, such as a child, an adult, or an elderly adult. In some embodiments, the subject is a female subject. In some embodiments, the subject is pregnant or planning on becoming pregnant. In some embodiments, the subject is at risk of being exposed to Zika virus. In some embodiments, the subject is living in or traveling to an area where Zika virus is present or is thought to be present. In some embodiments, the subject has been previously infected with or vaccinated against Dengue virus; i.e., at risk for antibody-dependent enhancement of disease. In some embodiments, the subject is living in or traveling to an area that is experiencing a Zika virus infection outbreak. In some embodiments, the subject is living in or traveling to an area where an arthropod vector capable of transmitting the Zika virus vector is present or is thought to be present.

Any of the Zika virus vaccines or compositions described herein may be administered to a subject in a therapeutically effective amount or a dose of a therapeutically effective amount. As used herein, a “therapeutically effective amount” of vaccine is any amount that results in a desired response or outcome in a subject, such as those described herein, including but not limited to prevention of infection, an immune response or an enhanced immune response to Zika virus, or prevention or reduction of symptoms associated with Zika disease.

In some embodiments, the therapeutically effective amount of a Zika virus vaccine or composition described herein is an amount sufficient to generate antigen-specific antibodies (e.g., anti-Zika virus antibodies). In some embodiments, the therapeutically effective amount is sufficient to provide seroprotection in a subject; i.e., to generate sufficient antigen-specific antibodies to prevent/protect from infection. In some embodiments, seroprotection is conferred on at least 75%, 80%, 90%, 95%, 96%, 97%, 98%, or at least 99% of vaccinated subjects. In some embodiments, seroprotection is defined by a reduction in the number of Zika virus plaques by 50% or more in a plaque reduction neutralization test (PRNT) by a 1:10 or higher dilution of sera

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from a vaccinated subject. In some embodiments, an effective amount of the Zika vaccine is sufficient to seroconvert a subject with at least 70% probability. In some embodiments, the therapeutically effective amount is sufficient to seroconvert a subject with at least 75%, 80%, 85%, 90%, 95%, 96%, 97%, 98%, or at least 99% probability. Whether a subject has been seroconverted can be assessed by any method known in the art, such as obtaining a serum sample from the subject and performing an assay to detect anti-Zika virus antibodies. In some embodiments, a subject is seroconverted if a serum sample from the subject contains an amount of anti-Zika virus antibodies that surpasses a threshold or predetermined baseline. A subject is generally considered seroconverted if there is at least a 4-fold increase in anti-Zika virus antibodies (i.e., anti-Zika E protein IgG antibodies) in a serum sample from the subject as compared to a serum sample previously taken from the same subject.

In some embodiments, seroconversion of a subject is assessed by performing a plaque reduction neutralization test (PRNT). Briefly, PRNT is used to determine the serum titer required to reduce the number of Zika virus plaques by 50% (PRNT50) as compared to a control serum/antibody. The PRNT50 may be carried out using monolayers of Vero cells or any other cell type/line that can be infected with Zika virus. Sera from subjects are diluted and incubated with live, non-inactivated Zika virus. The serum/virus mixture may be applied to the Vero cells and incubated for a period of time. Plaques formed on the Vero cell monolayers are counted and compared to the number of plaques formed by the Zika virus in the absence of serum or a control antibody. A threshold of neutralizing antibodies of 1:10 dilution of serum in a PRNT50 is generally accepted as evidence of protection (Hombach et. al. Vaccine (2005) 23:5205-5211).

In some embodiments, the Zika virus may be formulated for administration in a composition, such as a pharmaceutical composition. The term “pharmaceutical composition” as used herein means a product that results from the mixing or combining of at least one active ingredient, such as an inactivated Zika virus, and one or more inactive ingredients, which may include one or more pharmaceutically acceptable excipient.

Pharmaceutical compositions of the invention, including vaccines, can be prepared in accordance with methods well known and routinely practiced in the art (see e.g., Remington: The Science and Practice of Pharmacy, Mack Publishing Co. 20th ed. 2000; and Ingredients of Vaccines-Fact Sheet from the Centers for Disease Control and Prevention, e.g., adjuvants and enhancers such as alum to help the vaccine improve its work, preservatives and stabilizers to help the vaccine remain unchanged (e.g., albumin, phenols, glycine)). Pharmaceutical compositions are preferably manufactured under GMP conditions. Typically a therapeutically effective dose of the inactivated Zika virus preparation is employed in the pharmaceutical composition of the invention. The inactivated Zika virus is formulated into pharmaceutically acceptable dosage forms by conventional methods known to those of skill in the art. Dosage regimens are adjusted to provide the optimum desired response (e.g., the prophylactic response).

Dosages of the active ingredients in the pharmaceutical compositions of the present invention can be varied so as to obtain an amount of the active ingredient which is effective to achieve the desired pharmaceutical response for a particular subject, composition, and mode of administration, without being toxic to the subject. The selected dosage level depends upon a variety of pharmacokinetic factors including the activity of the particular compositions of the present

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invention employed, the route of administration, the time of administration, the rate of excretion of the particular compound being employed, the duration of the treatment, other drugs, compounds and/or materials used in combination with the particular compositions employed, the age, sex, weight, condition, general health and prior medical history of the subject being treated, and like factors.

A physician, veterinarian or other trained practitioner, can start doses of the inactivated Zika virus vaccine employed in the pharmaceutical composition at levels lower than that required to achieve the desired therapeutic effect and gradually increase the dosage until the desired effect (e.g., production of anti-Zika virus antibodies) is achieved. In general, effective doses of the compositions of the present invention, for the prophylactic treatment of groups of people as described herein vary depending upon many different factors, including means of administration, target site, physiological state of the patient, whether the patient is human or an animal, other medications administered, and the titer of anti-Zika virus antibodies desired. Dosages need to be titrated to optimize safety and efficacy. In some embodiments, the dosing regimen entails subcutaneous or intramuscular administration of a dose of inactivated Zika virus twice, once at day 0 and once at about day 7. In some embodiments, the dosing regimen entails subcutaneous administration of a dose of inactivated Zika virus twice, once at day 0 and once at about day 14. In some embodiments, the dosing regimen entails subcutaneous administration of a dose of inactivated Zika virus twice, once at day 0 and once at about day 28. In some embodiments, the inactivated Zika virus is administered to the subject once.

Any of the Zika virus vaccines or compositions described herein may be administered to a subject with, prior to, or after administration of one or more adjuvants. An adjuvant is a molecule that enhances a response in a subject, such as an immune response, to an antigen or other molecule. In some embodiments, an adjuvant may stabilize an antigen or other molecule. Determining whether a Zika virus vaccine or compositions thereof are administered with an adjuvant depends on various factors (e.g., type and extent of response desired) and will be evident to one of skill in the art. In some embodiments, administering any of the Zika virus vaccines or compositions described herein with, prior to, or after administration of an adjuvant may enhance the production of virus neutralizing (anti-Zika virus) antibodies. In some embodiments, a subject that is administered any of the Zika virus vaccines or compositions described herein with, prior to, or after administration of an adjuvant may only require a single administration of the Zika virus vaccine or composition to be seroconverted (produce a level of anti-Zika virus antibodies). Examples of adjuvants may include, without limitation, aluminium salt (aluminium hydroxide or aluminium phosphate), calcium phosphate hydroxide, paraffin oil, killed bacteria, bacterial toxins, toxoids, subunits of bacteria, squalene, thimerosal, detergents, IL-1, IL-2, IL-12, 2-component adjuvants, such as 2-component adjuvants containing an antibacterial peptide and a TLR9 agonist (e.g., IC31®), and combinations such as Freund's complete adjuvant and Freund's incomplete adjuvant. In some embodiments, the Zika virus vaccines or compositions is administered with aluminium hydroxide. In some embodiments, the inactivated Zika virus vaccine or composition is administered with aluminium phosphate salt. A preferred aluminium salt is the aluminium hydroxide with reduced Cu content, e.g. lower than 1.25 ppb based on the weight of the Zika composition, an adjuvant described in detail in WO 2013/083726 or Schlegel et al., Vaccine 33 (2015) 5989-5996.

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In some embodiments, the adjuvant is comprised of two components. In some embodiments, the 2-component adjuvant comprises an antibacterial peptide and a TLR9 agonist. In some embodiments, the antibacterial peptide is provided by the amino acid sequence KLKL₅KLK (SEQ ID NO: 71). In some embodiments, the TLR9 agonist is a deoxyinosine-containing immunostimulatory oligodeoxynucleic acid molecule (I-ODN). In some embodiments, the I-ODN comprises the nucleic acid sequence (dIdC)₁₃ (SEQ ID NO: 70). In some embodiments, the adjuvant is IC31®. In some embodiments, the adjuvant is in nanoparticle form (See, e.g., U.S. Pat. No. 8,765,148 B2, incorporated by reference in its entirety). In some embodiments, the adjuvant is IC31®, i.e. KLKL₅KLK (SEQ ID NO: 71) and the nucleic acid sequence (dIdC)₁₃ (SEQ ID NO: 70), in combination with an aluminium salt such as aluminium hydroxide.

The Zika virus vaccines or compositions described herein may be administered to a subject concomitantly with one or more vaccines to another infectious agent, such as another infectious agent is that present or thought to be present in the same geographic area as Zika virus. In some embodiments, the other infectious agent is one that the subject is also at risk of being in contact with. In some embodiments, the other infectious agent is transmitted by the same arthropod vector as Zika virus. In some embodiments, the other infectious agent is Japanese Encephalitis virus, Yellow Fever virus, Dengue virus and/or Chikungunya virus.

Also within the scope of the present disclosure are kits for use in prophylactically administering to a subject, for example to prevent or reduce the severity of Zika virus infection. Such kits can include one or more containers comprising a composition containing inactivated Zika virus, such as an inactivated Zika virus vaccine. In some embodiments, the kit may further include one or more additional containing comprising a second composition, such as a second vaccine. In some embodiments, the second vaccine is a vaccine for another arbovirus. In some embodiments, the second vaccine is a Dengue virus vaccine and/or a Chikungunya virus vaccine.

In some embodiments, the kit can comprise instructions for use in accordance with any of the methods described herein. The included instructions can comprise a description of administration of the composition containing inactivated Zika virus to prevent, delay the onset, or reduce the severity of Zika virus infection. The kit may further comprise a description of selecting a subject suitable for administration based on identifying whether that subject is at risk for exposure to Zika virus or contracting a Zika virus infection. In still other embodiments, the instructions comprise a description of administering a composition containing inactivated Zika virus to a subject at risk of exposure to Zika virus or contracting Zika virus infection.

The instructions relating to the use of the composition containing inactivated Zika virus generally include information as to the dosage, dosing schedule, and route of administration for the intended treatment. The containers may be unit doses, bulk packages (e.g., multi-dose packages) or sub-unit doses. Instructions supplied in the kits of the invention are typically written instructions on a label or package insert (e.g., a paper sheet included in the kit), but machine readable instructions are also acceptable.

The kits of the present disclosure are in suitable packaging. Suitable packaging includes, but is not limited to, vials, bottles, jars, flexible packaging, and the like. Also contemplated are packages for use in combination with a specific device, such as a syringe or an infusion device. The container may have a sterile access port, for example the

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container may be a vial having a stopper pierceable by a hypodermic injection needle. At least one active agent in the composition is an inactivated Zika virus, as described herein.

This invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting. The use of “including”, “comprising”, or “having”, “containing”, “involving”, and variations thereof herein, is meant to encompass the items listed thereafter and equivalents thereof as well as additional items.

Unless otherwise defined herein, scientific and technical terms used in connection with the present disclosure shall have the meanings that are commonly understood by those of ordinary skill in the art. Further, unless otherwise required by context, singular terms shall include pluralities and plural terms shall include the singular. The methods and techniques of the present disclosure are generally performed according to conventional methods well-known in the art. Generally, nomenclatures used in connection with, and techniques of biochemistry, enzymology, molecular and cellular biology, microbiology, virology, cell or tissue culture, genetics and protein and nucleic chemistry described herein are those well-known and commonly used in the art. The methods and techniques of the present disclosure are generally performed according to conventional methods well known in the art and as described in various general and more specific references that are cited and discussed throughout the present specification unless otherwise indicated.

The present invention is further illustrated by the following examples, which in no way should be construed as further limiting. The entire contents of all of the references (including literature references, issued patents, published patent applications, and co-pending patent applications) cited throughout this application are hereby expressly incorporated by reference, in particular for the teaching that is referenced hereinabove. However, the citation of any reference is not intended to be an admission that the reference is prior art.

TABLE 1

Overview of process buffers and stock solutions.			
Buffer	Composition	Final pH	Final conductivity [mS/cm]
A	0.5 M NaOH		n.a.
B	0.1 M NaOH		n.a.
C	25 mM Tris, 150 mM NaCl	7.4 ± 0.2	16.5
D	1 M Tris	7.4 ± 0.2	n.a.
E	4.5 M NaCl	n.a.	n.a.
F	1 M NaCl	n.a.	n.a.
G	1% SDS	n.a.	n.a.
H	50% (w/w) Sucrose in 25 mM Tris, 150 mM NaCl	7.4 ± 0.2	n.a.
I	35% (w/w) Sucrose in 25 mM Tris, 150 mM NaCl	7.4 ± 0.2	n.a.
J	15% (w/w) Sucrose in 25 mM Tris, 150 mM NaCl	7.4 ± 0.2	n.a.
K	10 x PBS	7.4 ± 0.2	n.a.
L	50 mg/mL Protamine sulphate	7.4 ± 0.2	n.a.

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TABLE 1-continued

Overview of process buffers and stock solutions.			
Buffer	Composition	Final pH	Final conductivity [mS/cm]
M	Drug substance formulation buffer (10 mM Tris(hydroxymethyl)-amino-methan, 5% Sucrose, 1% (10 mg/mL) rHSA)	7.4 ± 0.2	1.3

TABLE 2

Abbreviations.	
°Bx	Degrees Brix = sugar content (w/w) of an aqueous solution*
BSA	Bovine serum albumin
CC700	Capto™ Core 700
CPE	Cytopathic effect
EtOH	Ethanol
EU	Endotoxin units
DS	Drug Substance
DP	Drug Product
DSP	Downstream Process
HCP	Host cell protein
hcDNA	Host cell DNA
hpi	Hours post infection
HPLC	High Performance Liquid Chromatography
ID	Inner diameter
JEV	Japanese Encephalitis virus
LAL	Limulus amoebocyte lysate
LDS buffer	Lithium dodecyl sulfate sample loading buffer
LOD	Limit of detection
LOQ	Limit of quantitation
MALLS	Multiangle light scattering
mAU	Milli absorbance units
MS	Mass spectroscopy
NIV	Neutralized inactivated virus
PBS	Phosphate buffered saline
PD	Process development
PFU	Plaque forming units
p.i.	Post-infection
PS	Protamine sulphate or protamine sulfate
ref	Relative centrifugal force
rHSA	Recombinant human serum albumin
Rms radius	Root mean square radius
rMSB	Research master seed bank
RSD	Relative standard deviation
SEC	Size exclusion chromatography
SGC	Sucrose gradient centrifugation
SGP	Sucrose gradient purified
SDS	Sodium dodecyl sulphate
TBS	Tris buffered saline
TFF	Tangential flow filtration
TCID50	Tissue culture infectious dose 50%
UF/DF	Ultrafiltration/diafiltration
WFI	Water for injection
ZikaV	Zika virus

*Degrees Brix (°Bx) is the sugar content of an aqueous solution. One degree Brix is 1 gram of sucrose in 100 grams of solution and represents the strength of the solution as percentage by mass. °Bx corresponds to the sucrose content in percent (w/w), e.g., 45 °Bx equals 45% (w/w) sucrose.

TABLE A

Primers for Zika virus sequencing: lower case letters indicate bases not included in ZIKA but containing restriction sites for later cloning when needed (therefore, two Tms provided).					
Primer Pair	Oligoname	Primer sequence (5'-3') restriction sites (lower case)	T _m (gene-specific)	T _m (entire primer)	Amplicon size [bp]
1	9320_Zika_PF_1F	SEQ ID NO: 74 ttaggatccGTTGTTGATCTGTGTGAAT	69.9	74.6	707
	9321_Zika_PF_1R	SEQ ID NO: 75 taactcgagCGTACACAACCCAAGTT	69.3	75.6	
2	9322_Zika_PF_2F	SEQ ID NO: 76 ttaggatccTCACTAGACGTGGGAGTG	70	73.9	704
	9323_Zika_PF_2R	SEQ ID NO: 77 taactcgagAAGCCATGTCYGATATTGAT	69.8	73.7	
3	9324_Zika_PF_3F	SEQ ID NO: 78 ttaggatccGCATACAGCATCAGGTG	72.3	74.5	712
	9325_Zika_PF_3R	SEQ ID NO: 79 taactcgagTGTGGAGTTCCGGTGTCT	72	76.4	
4	9326_Zika_PF_4F	SEQ ID NO: 80 ttaggatccGAATAGAGCGAARGTTGAGATA	70.9	74	712
	9327_Zika_PF_4R	SEQ ID NO: 81 taactcgAGTGGTGGTGATCTTCTTCT	70.5	73.7	
5	9328_Zika_PF_5F	SEQ ID NO: 82 ttaggatccAGTCACAGTGGAGGTACAGTAC	70.3	75	704
	9329_Zika_PF_5R	SEQ ID NO: 83 taactcgagCRCAGATACCATCTTCCC	71.5	77.3	
6	9330_Zika_PF_6F	SEQ ID NO: 84 ttaggatCCCTTATGTGCTTGGCCTTAG	70.7	72.7	698
	9331_Zika_PF_6R	SEQ ID NO: 85 taactcgagTCTTCAGCCTCCATGTG	70.4	76.9	
7	9332_Zika_PF_7F	SEQ ID NO: 86 ttaggatccAATGCCCCACTCAACATAGA	71.9	75	716
	9333_Zika_PF_7R	SEQ ID NO: 87 taactcgagTCATTCTTCTTTCAGCCCTT	71	74	
8	9334_Zika_PF_8F	SEQ ID NO: 88 ttaggatccAAGGGTGATCGAGGAAT	70.9	75.2	703
	9335_Zika_PF_8R	SEQ ID NO: 89 taactcgagTTCCTTCAGAGAGAGGAGC	71.9	73.4	
9	9336_Zika_PF_9F	SEQ ID NO: 90 ttaggatccTCTTTTGCAAACCTGCGATC	71.9	75	699
	9337_Zika_PF_9R	SEQ ID NO: 91 taactcgagTCCAGCTGCAAGGGTAT	71	74.9	
10	9338_Zika_PF_10F	SEQ ID NO: 92 ttaggatccGTGTGGACATGTACATTGA	71.4	75.8	706
	9339_Zika_PF_10R	SEQ ID NO: 93 taactcgagCCCATTTGCCATAAAGTC	70.4	75.8	
11	9340_Zika_PF_11F	SEQ ID NO: 94 ttaggatccTCATACTGTGGTCCATGGA	71.6	78.1	692
	9341_Zika_PF_11R	SEQ ID NO: 95 taactcgagGCCCATCTCAACCCCTTG	74	78	
12	9342_Zika_PF_12F	SEQ ID NO: 96 ttaggatccTAGAGGGCTTCCAGTGC	70.9	74	707
	9343_Zika_PF_12R	SEQ ID NO: 97 taactcgAGATACTCATCTCCAGTTTGTG	70.2	72.2	
13	9344_Zika_PF_13F	SEQ ID NO: 98 ttaggatccGAAAACAAAACATCAAGAGTG	70.6	75.4	726
	9345_Zika_PF_13R	SEQ ID NO: 99 taactcgagGAATCTCTCTGTCTGTGTCT	71.9	75.6	
14	9346_Zika_PF_14F	SEQ ID NO: 100 ttaggatccTTGATGGCACGACCAAC	73.1	75.6	715
	9347_Zika_PF_14R	SEQ ID NO: 101 ttaggatccGTTGTTGATCTGTGTGAAT	70.8	77.9	

TABLE A-continued

Primers for Zika virus sequencing: lower case letters indicate bases not included in ZIKA but containing restriction sites for later cloning when needed (therefore, two Tms provided).					
Primer Pair	Oligoname	Primer sequence (5'-3') restriction sites (lower case)	T _m (gene-specific)	T _m (entire primer)	Amplicon size [bp]
15	9348_Zika_PF_15F	SEQ ID NO: 102 taactcgagCAGGTCAATGTCCATTG	71.9	75.4	719
	9349_Zika_PF_15R	SEQ ID NO: 103 ttaggatccTGTGTGTTCTATGCTGGT	73.9	77.2	
16	9350_Zika_PF_16F	SEQ ID NO: 104 taactcgagTGATCAGRGCCCCAGC	72.3	75.4	703
	9351_Zika_PF_16R	SEQ ID NO: 105 ttaggatccTGCTGCCCAGAAGAGAA	72	76.3	
17	9352_Zika_PF_17F	SEQ ID NO: 106 taactcgagCACCACACAYGGGTCTT	73.6	76	705
	9353_Zika_PF_17R	SEQ ID NO: 107 ttaggatccTCAAGGACGGTGTGGC	72	75.5	
18	9354_Zika_PF_18F	SEQ ID NO: 108 taactcgagCAATGATCTTCATGTTGGG	71.7	75.8	699
	9355_Zika_PF_18R	SEQ ID NO: 109 ttaggatccTATGGGGAGGACTGGT	71	74.1	
19	9356_Zika_PF_19F	SEQ ID NO: 110 taactcgagCCCCAGAACCTTGGATC	73.3	75.5	711
	9357_Zika_PF_19R	SEQ ID NO: 111 ttaggatccCAGACCCCCAAGAAGGC	71.3	76.9	
20	9358_Zika_PF_20F	SEQ ID NO: 112 taactcgagCCCCTTTGGTCTTGTCT	71.7	75	706
	9359_Zika_PF_20R	SEQ ID NO: 113 ttaggatccAGGAAGGATGTATGCAGATG	71.9	73.9	
21	9360_Zika_PF_21F	SEQ ID NO: 114 taactcgagACATTTGCGCATATGATTTTG	70.4	75.7	709
	9361_Zika_PF_21R	SEQ ID NO: 115 ttaggatccAGGAAGGACACACAAGAGT	71.8	75	
22	9362_Zika_PF_22F	SEQ ID NO: 116 taactcgagACAGGCTGCACAGCTTT	70	79.1	581
	9363_Zika_PF_22R	SEQ ID NO: 117 ttaggatccTCTCTCATAGGGCACAGAC	74.8	81.1	

SEQUENCES

A typical form of protamine

PRRRRSSRP VRRRRRPRVS RRRRRRGRR RR

SEQ ID NO: 1

Provided below are examples of nucleic acid sequences of the genomes of Zika viruses that may be used in the methods, compositions, and/or vaccines described herein.
KU321639.1 Zika virus strain ZikaSPH2015, Brazil, complete genome

GTGTGTTACTGTTGCTGACTCAGACTGCGACAGTTCGAGTTTGAAGCGAAAGCTAGCAACAGTATCAACAGGTTTATTGG
ATTTGGAACGAGAGTTTCTGGTCATGAAAAACCCAAAAAGAAATCCGGAGGATTCCGGATTGTCAATATGCTAAAACG
CGGAGTAGCCCGTGTGAGCCCCCTTTGGGGGCTTGAAGAGGCTGCCAGCCGGACTTCTGCTGGGTATGGGCCCATCAGG
ATGGTCTTGGCAATTCTAGCCTTTTGTAGATTACGGCAATCAAGCCATCACTGGGTCTCATCAATAGATGGGGTTCAGTG
GGGAAAAAGAGGCTATGGAATAATAAAGAAGTTCAAGAAAGATCTGGCTGCCATGCTGAGAATAATCAATGCTAGGA
AGGAGAAGAAGAGACGGGGCGCAGATACTAGTGTGGAATTGTTGGCCTCCTGCTGACCACAGCTATGGCAGCGGAGG
TCACTAGACGTGGGAGTGCATACTATATGTACTTGGACAGAAACGATGCTGGGGAGGCCATATCTTTTCCAACCACATTG
GGGATGAATAAGTGTATATACAGATCATGGATCTTGGACACATGTGTGATGCCACCATGAGCTATGAATGCCCTATGCT
GGATGAGGGGGTGAACACAGATGACGTCGATTGTTGGTGCAACACGACGTCAACTTGGGTTGTGTACGGAACCTGCCAT

SEQ ID NO: 2

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CACAAAAAGGTGAAGCACGGAGATCTAGAAGAGCTGTGACGCTCCCTCCCATTCCTAGGAAGCTGCAAAACGCGGT
 CGCAAACTGGTTGGAATCAAGAGAATACACAAAGCACTTGATTAGAGTCGAAAATTGGATATTCAGGAACCTGGCTTC
 GCGTTAGCAGCAGCTGCCATCGCTTGGCTTTTGGGAAGCTCAACGAGCCAAAAAGTCATATACTTGGTCATGATACTGCT
 GATTGCCCCGGCATACAGCATCAGGTGCATAGGAGTCAGCAATAGGGACTTTGTGGAAGGTATGTCAGGTGGGACTTGG
 GTTGATATTGCTTGAACATGGAGGTTGTGTACCGTAATGGCACAGGACAAACCGACTGTCGACATAGAGCTGGTTAC
 AACAAAGTCAGCAACATGGCGGAGGTAAAGATCCTACTGCTATGAGGCATCAATATCAGACATGGCTTCGGACAGCCGCT
 GCCCAACACAAGGTGAAGCCTACCTTGACAAGCAATCAGACACTCAATATGTCGAAAAGAACGTTAGTGGACAGAGGC
 TGGGGAATGGATGTGACTTTTTTGGCAAAGGAGTCTGGTGACATGCGCTAAGTTTGCATGCTCCAAGAAAATGACCG
 GGAAGAGCATCCAGCCAGAGAATCTGGAGTACCGGATAATGCTGTCAAGTTCATGGCTCCAGCACAGTGGGATGATCGT
 TAATGACACAGGACATGAACTGATGAGAATAGAGCGAAGGTTGAGATAACGCCCAATTCACCAAGAGCCGAAGCCACC
 CTGGGGGTTTTTGAAGCCTAGGACTTGATTGTGAACCGAGGACAGGCCTTGACTTTTCAGATTGTATTACTTGACTATG
 AATAACAAGCACTGGTTGGTTTCAAGAGAGTGGTTCCACGACATTCCATTACCTTGGCACGCTGGGGCAGACACCGGAAC
 TCCCACTGGAACAACAAAGAGCACTGGTAGAGTTCAAGGACGCACATGCCAAAAGGCAAACTGTCGTGGTTCTAGGG
 AGTCAAGAAGGAGCAGTTACACGCGCCCTTGTGGAGCTCTGGAGGCTGAGATGGATGGTGCAAGGGAAGGCTGTCCT
 CTGGCCACTTGAAATGTGCGCTGAAAAATGGATAAACTTAGATTGAAGGCGTGTCTACTCCTTGTGTACCGCAGCGTTCA
 CATTACCAAGATCCCGGCTGAAACACTGCACGGGACAGTCACAGTGGAGGTACAGTACGCAGGGACAGATGGACCTTG
 CAAGGTTCCAGCTCAGATGGCGGTGGACATGCAAACTCTGACCCAGTTGGGAGGTTGATAACCGCTAACCCCGTAATCA
 CTGAAAGCACTGAGAACTCTAAGATGATGCTGGAACCTTGATCCACCATTGGGGACTCTTACATTGTCTATAGGAGTCGGG
 GAGAAGAAGATCACCCACCACTGGCACAGGAGTGGCAGCACCATTGGAAAAGCATTGTAAGCCACTGTGAGAGGTGCCA
 AGAGAATGGCAGTCTTGGGAGACACAGCCTGGGACTTTGGATCAGTTGGAGGCGCTCTCAACTCATTGGGCAAGGCAT
 CCATCAAATTTTTGGAGCAGCTTCAAATCATTGTTTGGAGGAATGTCTGGTTCTCACAATTTCTCATTGGAACGTTGCTG
 ATGTGGTTGGGTCTGAACACAAAGAATGGATCTATTTCCCTTATGTGCTTGGCCTTAGGGGGAGTGTTGATCTTCTTATCC
 ACAGCCGTCTCTGTGATGTGGGTGCTCGGTGACTTCTCAAGAAGGAGACGAGATGCGGTACAGGGGTGTTCTGTCT
 ATAACGACGTTGAAGCCTGGAGGGACAGGTACAAGTACCATCCTGACTCCCCCGTAGATTGGCAGCAGCAGTCAAGCA
 AGCCTGGGAAGATGGTATCTGCGGGATCTCCTCTGTTTCAAGAATGGAACATCATGTGGAGATCAGTAGAAGGGGAG
 CTCAACGCAATCTGGAAGAGAATGGAGTTCAACTGACGGTCGTTGTGGGATCTGTAAAAAACCCATGTGGAGAGGTC
 CACAGAGATTGCCCGTCTGTGAACGAGCTGCCACGGCTGGAAGGCTTGGGGGAAATCGCACTTCGTGAGAGCAGC
 AAAGACAAATAACAGCTTTGTCTGGATGGTGACACACTGAAGGAATGCCCACTCAACATAGAGCATGGAACAGCTTTCT
 TTGTGGAGGATCATGGGTTTCGGGTATTTACACATAGTGTCTGGCTCAAGGTTAGAGAAGATTATTATTAGAGTGTGAT
 CCAGCCGTTATTGGAACAGCTGTTAAGGGAAGGAGGCTGTACACAGTGATCTAGGCTACTGGATTGAGAGTGAGAAGA
 ATGACACATGGAGGCTGAAGAGGGCCATCTGATCGAGATGAAAAATGTGAATGGCCAAAGTCCACACATTGTGGAC
 AGATGGAATAGAAGAGAGTGATCTGATCATACCAAGTCTTTAGCTGGGCCACTCAGCCATCACAATACCAGAGAGGGCT
 ACAGGACCCAAATGAAGGGCCATGGCAGTGAAGAGCTTGAAATTCGGTTTGAGGAATGCCAGGCACTAAGGTCCA
 CGTGGAGGAACATGTGGAACAAGAGGACCATCTCTGAGATCAACCACTGCAAGCGGAAGGGTGATCGAGGAATGGTG
 CTGCAAGGAGTGACAAATGCCCCACTGTCTTCGGGCTAAAGATGGCTGTTGGTATGGAATGGAGATAAGGCCAGG
 AAAGAACCAGAAAGCACTTAGTAAGGTCAATGGTGACTGCAGGATCAACTGATCACATGGATCACTTCTCCCTTGGAGT
 GCTTGTGATTCTGCTCATGGTGCAGGAAGGGCTGAAGAAGAGAATGACCACAAAGATCATATAAGCACATCAATGGCA
 GTGCTGGTAGCTATGATCCTGGGAGGATTTTCAATGAGTGACCTGGCTAAGCTTGCAATTTTGATGGGTGCCACCTTCGC
 GGAATGAACACTGGAGGAGATGTAGCTCATCTGCGCTGATAGCGGATTCAAAGTCAGACCAGCGTTGCTGGTATCTT
 TCATCTTCAGAGCTAATTGGACACCCCGTGAAAGCATGCTGCTGGCCTTGGCCTCGTGTCTTTTGCAAACTGCGATCTCCG
 CCTTGAAGGCGACCTGATGTTTCTCATCAATGGTTTGTCTTGGCCTGGTTGGCAATACGAGCGATGGTTGTTCCACGCA

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CTGATAACATCACCTTGGCAATCTGGCTGCTCTGACACCACTGGCCCGGGGCACACTGCTTGTGGCGTGGAGAGCAGGC
CTTGCTACTTGC GG GGGTTTATGCTCCTCTCTCTGAAGGGAAAAGGCAGTGTGAAGAAGAACTTACCATTGTTCATGGC
CCTGGGACTAACCGCTGTGAGGCTGGTCGACCCCATCAACGTGGTGGGCTGCTGTTGCTCACAAGGAGTGGGAAGCGG
AGCTGGCCCCCTAGCGAAGTACTCACAGCTGTTGGCCTGATATGCGCATTTGGCTGGAGGGTTGCGCAAGGCAGATATAGA
GATGGCTGGGCCCATGGCCGCGGTCTGGTCTGCTAATTGTCTAGTTACGTGGTCTCAGGAAAGAGTGTGGACATGTACATTG
AAAGAGCAGGTGACATCACATGGGAAAAGATGCCGAAGTCACTGGAACAGTCCCCGGCTCGATGTGGCGCTAGATG
AGAGTGGTGATTTCTCCCTGGTGGAGGATGACGGTCCCCCATGAGAGAGATCATACTCAAGGTGGTCTGATGACCATC
TGTGGCATGAACCAATAGCCATACCCCTTTCAGCTGGAGCGTGGTACGTATACGTGAAGACTGGAAAAAGGAGTGGTG
CTCTATGGGATGTGCTCTGCCAAGGAAGTAAAAAGGGGAGACCACAGATGGAGTGTACAGAGTAATGACTCGTAG
ACTGTAGGTTCAACACAAGTTGGAGTGGGAGTTATGCAAGAGGGGGTCTTTCACATATGTGGCACGTCAAAAAGGA
TCCGCGCTGAGAAGCGGTGAAGGGAGACTTGATCCATACTGGGGAGATGTCAAGCAGGATCTGGTGTCTACTGTGGTC
CATGGAAGCTAGATGCCGCTGGGACGGGCACAGCGAGGTGCAGCTCTTGGCCGTGCCCCCGGAGAGAGCGAGGA
ACATCCAGACTCTGCCCGAATATTTAAGACAAAGGATGGGGACATTGGAGCGGTTGCGCTGGATTACCCAGCAGGAAC
TTCAGGATCTCCAATCCTAGACAAGTGTGGGAGAGTGATAGGACTTTATGGCAATGGGGTCGTGATCAAAAATGGGAGT
TATGTTAGTGCCATCACCAAGGGAGGAGGAGGAAGAGACTCCTGTTGAGTGCTTCGAGCCTTCGATGCTGAAGAAGA
AGCAGCTAACTGTCTTAGACTTGACCTCTGGAGCTGGGAAAACCAGGAGAGTTCTTCTGAAATAGTCCGTGAAGCCATA
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KU501215.1 Zika virus strain PRVABC59, Puerto Rico, complete genome

SEQ ID NO: 4

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KU509998.1 Zika virus strain Haiti/1225/2014, Haiti, complete genome

SEQ ID NO: 5

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LC002520.1 Zika virus genomic RNA, strain: MR766-NIID, Uganda, complete genome
SEQ ID NO: 11

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SEQ ID NO: 12

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KJ776791.1, Zika virus strain H/PF/2013 polyprotein gene, complete cds

SEQ ID NO: 13

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CATGACAGAGAGATTCCAGGAAGCCATTGACAACCTCGCTGTGCTCATGCGGGCAGAGACTGGAAGCAGGCCTTACAAA
GCCGCGCGGCCCAATTGCCGAGACCCCTAGAGACCATTATGCTTTTGGGGTGTCTGGGAACAGTCTCGCTGGGAATCTT
TTTCGTCTTGATGAGGAACAAGGGCATAGGGAAGATGGGCTTTGGAATGGTGACTCTTGGGGCCAGCGCATGGCTCATG
TGGCTCTCGGAAATTGAGCCAGCCAGAATTGCATGTGTCTCATTGTTGTGTTCTATTGCTGGTGGTGTCTCATACCTGAG
CCAGAAAAGCAAAGATCTCCCAGGACAACCAATGGCAATCATCATATGGTAGCAGTAGGTCTTCTGGGCTTGATTAC

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CGCCAATGAACTCGGATGGTTGGAGAGAAACAAAGAGTGACCTAAGCCATCTAATGGGAAGGAGAGAGAGGGGGCAAC
CATAGGATTCTCAATGGACATTGACCTGCGGCCAGCCTCAGCTTGGGCCATCTATGCTGCCTTGACAACCTTCATTACCCCA
GCGGTCCAACATGCAGTGACCACTTCATACAACAACACTACTCCTTAATGGCGATGGCCACGCAAGCTGGAGTGTGTTTGGT
ATGGGCAAAGGGATGCCATTCTACGCATGGGACTTTGGAGTCCCGCTGCTAATGATAGGTTGCTACTCACAATTAACACC
CCTGACCCCTAATAGTGGCCATCATTTTGTCTGCTGGCGCACTACATGTACTTGATCCCAGGGCTGCAGGCAGCAGCTGCGC
GTGCTGCCCAGAAGAGAACGCGCAGCTGGCATCATGAAGAACCCTGTTGTGGATGGAATAGTGGTGACTGACATTGACAC
AATGACAATTGACCCCAAGTGGAGAAAAAGATGGGACAGGTGCTACTCATAGCAGTAGCCGTCTCCAGCGCCATACTGT
CGCGGACCGCTGGGGTGGGGGGAGGCTGGGGCCCTGATCACAGCGCAACTTCCACTTTGTGGGAAGGCTCTCCGA
ACAAGTACTGGAACCTCTACAGCCACTTCACTGTGTAAACATTTTAGGGGAAGTTACTTGGCTGGAGCTTCTCTAATCTA
CACAGTAACAAGAAACGCTGGCTTGGTCAAGAGACGTGGGGTGGAAACAGGAGAGACCCTGGGAGAGAAATGGAAGG
CCCGCTTGAACCATGCTGCGCCCTGGAGTCTACTCCTACAAAAGTCAGGCATCACCGAGGTGTGCAGAGAAGAGGCC
CGCCGCGCCCTCAAGGACGGTGTGGCAACGGGAGGCCATGCTGTGTCCTCGAGGAAGTGCAAAGCTGAGATGGTTGGTG
GAGCGGGGATACCTGCAGCCCTATGGAAGGTCTTGATCTTGGATGTGGCAGAGGGGGCTGGAGTTACTACGCCGCCA
CCATCCGCAAAGTTCAAGAAGTGAAAGGATACACAAAAGGAGGCCCTGGTCATGAAGAACCCTGTTGGTGCAAAGCTA
TGGGTGGAACATAGTCCGTCTTAAGAGTGGGGTGGACGTCTTTCATATGGCGGCTGAGCCGTGTACACGTTGCTGTGTG
ACATAGGTGAGTCATCATCTAGTCTGAAGTGAAGAAGCACGGACGCTCAGAGTCTCTCCATGGTGGGGGATTGGCTT
GAAAAAGACCAGGAGCCTTTTGTATAAAAGTGTGTGCCCATACACCAGCACTATGATGGAACCCCTGGAGCGACTGCA
GCGTAGGTATGGGGGAGGACTGGTCAGAGTGCCACTCTCCGCAACTCTACACATGAGATGTACTGGGTCTCTGGAGCG
AAAAGCAACACCATAAAAGTGTGTCCACCACGAGCCAGCTCCTCTTGGGGCGCATGGACGGGCCAGGAGGCCAGTGA
AATATGAGGAGGATGTGAATCTCGGCTCTGGCACGCGGGCTGTGGTAAGCTGCGCTGAAGCTCCCAACATGAAGATCAT
TGGTAACCGCATTTGAAGGATCCGAGTGAGCACGCGAAACGTGGTTCTTTGACGAGAACCACCCATATAGGACATGG
GCTTACCATGGAAGCTATGAGGCCCCACACAAGGGTCAGCGTCTCTCTAATAAACGGGGTGTGTCAGGCTCCTGTCAA
ACCCCTGGGATGTGGTGACTGGAGTCACAGGAATAGCCATGACCGACACCACCCGTATGGTCAGCAAAGAGTTTCAAG
GAAAAAGTGGACACTAGGGTCCAGACCCCCAAGAAGCACTCGTCAGGTTATGAGCATGGTCTCTCTCTGGTTGTGGA
AAGAGCTAGGCAACACAAACGGCCACGAGTCTGTACCAAGAAGAGTTCATCAACAAGGTTCTGTAGCAATGCAGCATT
AGGGGCAATATTTGAAGAGGAAAAAGAGTGAAGACTGCAGTGAAGCTGTGAACGATCCAGGTTCTGGGCTCTAGT
GGACAAAGGAAAGAGACACCCTGAGAGGAGAGTGCCAGAGTTGTGTGTACAACATGATGGGAAAAAGAGAAAAGA
AACAAGGGGAATTTGGAAGGCCAAGGGCAGCCGCGCCATCTGGTATATGTGGCTAGGGGCTAGATTTCTAGAGTTCGA
AGCCCTTGGATTCTTGAACGAGGATCACTGGATGGGGAGAGAGAACTCAGGAGGTGGTGTGAAGGGCTGGGATTACA
AAGACTCGGATATGTCCTAGAAGAGATGAGTCGCATACCAGGAGGAAGGATGTATGCAGATGACACTGCTGGCTGGGAC
ACCCGCATCAGCAGGTTTGATCTGGAGAATGAAGCTCTAATCACCACCAAAATGGAGAAAGGGCACAGGGCCTTGGCAT
TGGCCATAATCAAGTACACATACCAAAACAAAGTGGTAAAGTCTTAGACCAGCTGAAAAGGGAAGACAGTTATGGA
CATTATTTTCGAGACAAGACCAAAGGGGAGCGGACAAGTTGTCACTTACGCTCTTAACACATTTACCAACCTAGTGGTG
AACTCATTCGGAATATGGAGGCTGAGGAAGTTCTAGAGATGCAAGACTTGTGGCTGCTGCGGAGGTGAGAGAAAGTGAC
CAACTGGTTGCAGAGCAACGGATGGGATAGGCTCAAACGAATGGCAGTCAGTGGAGATGATTGCGTTGTGAAGCCAATT
GATGATAGGTTTGACATGCGCTCAGGTTCTTGAATGATATGGGAAAAGTTAGGAAGGACACACAAGAGTGGAAACCT
CAACTGGATGGGACAACCTGGGAAGAAGTTCCGTTTGTCTCCACCACCTTCAACAAGCTCCATCTCAAGGACGGGAGGTCC
ATTGTGGTTCCCTGCGCCACCAAGATGAACGTGATTGGCCGGGCCCGCTCTCTCCAGGGGCGGATGGAGCATCCGGG
AGACTGCTTGCTAGCAAAATCATATGCGCAAATGTGCAGCTCCTTTATTTCCACAGAAGGACCTCCGACTGATGGCCA
ATGCCATTTGTTTCATCTGTGCCAGTTGACTGGGTTCCAACCTGGGAGAACTACCTGGTCAATCCATGGAAAGGGAGAATGG
ATGACCACCTGAAGACATGCTTGTGGTGTGGAACAGAGTGTGGATTGAGGAGAACGACCACATGGAAGACAAGACCCCA

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GTTACGAAATGGACAGACATTCCCTATTGGGAAAAAGGGAAGACTTGTGGTGTGGATCTCTCATAGGGCACAGACCGC
 GCACCACCTGGGCTGAGAACATTAAAAACACAGTCAACATGGTGCAGGATCATAGGTGATGAAGAAAAGTACATGGA
 CTACCTATCCACCAAGTTCGCTACTTGGGTGAAGAAGGCTACACCTGGAGTCTGTAAGCACCAATCTTAGTGTGTGTC
 AGGCCTGCTAGTCAGCCACAGCTTGGGGAAGCTGTGCAGCCTGTGACCCCCCAGGAGAAGCTGGGAAACCAAGCCTA
 TAGTCAGGCCGAGAACGCCATGGCAGGAAAGCCATGCTGCCTGTGAGCCCCCTCAGAGGACACTGAGTCAAAAAACC
 CCACGCGCTTGGAGGCGCAGGATGGGAAAGAAGGTGGCGACCTTCCCCACCTTCAATCTGGGGCCTGAAGTGGAGAT
 CAGCTGTGGATCTCCAGAAGAGGACTAGTGGTTAGAGGAG

In some embodiments, the Zika virus has a RNA genome corresponding to the DNA sequence provided by the nucleic acid sequence of any one of SEQ ID NOs: 2-13 or 72. In some embodiments, the Zika virus has a variant genome that is at least 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%,

98%, 99%, 99.5%, 99.6%, 99.7%, 99.8% or 99.9% identical to any one of SEQ ID NOs: 2-13 or 72.

Provided below are amino acid sequences of the E-proteins of Zika strains that may be used in the methods, compositions, and/or vaccines described herein.

SEQ ID NO: 14

isol-ARB15076.AHF49784.1.Central African Republic/291-788 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVVLHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDNRGWNGCGLPFGKSLVTCAKFTCSKKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDENRAKVEVT
 PNSPRAEATLGGFGSLGLDCEPRTGLDFSDLYLTMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEFKDAHAK
 RQTVVVLGSQEGAVHTALAGALEAEMDGAAGRLFSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKVPAAETLHGTVTVEVQYAG
 TDGPCKVPAQMAVDMQTLTPVGRILITANPVI TESTENSKMMELEDPFGDSYIVIGVGDKKITHHWRSGSTIGKAFEATVRG
 AKRMAVLGDTAWDFGSGVGFNSLKGKIHQIFGAAPKSLFGGMSWFSQILIGTLLVWLGLNTKNGSISLTCLALGGVMIFLSTA
 VSA

SEQ ID NO: 15

isol-lbH_30656.AEN75265.1.Nigeria/291-788 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVVLHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDNRGWNGCGLPFGKSLVTCAKFTCSKKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDENRAKVEVT
 PNSPRAEATLGGFGSLGLDCEPRTGLDFSDLYLTMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEFKDAHAK
 RQTVVVLGSQEGAVHTALAGALEAEMDGAAGRLFSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKVPAAETLHGTVTVEVQYAG
 RDGPCKVPAQMAVDMQTLTPVGRILITANPVI TESTENSKMMELEDPFGDSYIVIGVGDKKITHHWRSGSTIGKAFEATVRG
 AKRMAVLGDTAWDFGSGVGFNSLKGKIHQIFGAAPKSLFGGMSWFSQILIGTLLVWLGLNTKNGSISLTCLALGGVMIFLSTA
 VSA

SEQ ID NO: 16

ArB1362.AHL43500.1.-/1291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVVLHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDNRGWNGCGLPFGKSLVTCAKFTCSKKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDXXXXXXNR
 AEVEVTPNSPRAEATLGGFGSLGLDCEPRTGLDFSDLYLTMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGRLFSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKVPAAETLHGTVT
 EVQYAGTDGPCKVPAQMAVDMQTLTPVGRILITANPVI TESTENSKMMELEDPFGDSYIVIGVGDKKITHHWRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGFNSLKGKIHQIFGAAPKSLFGGMSWFSQILIGTLLVWLGLNTKNGSISLTCLALGGV
 MIFLSTAVSA

SEQ ID NO: 17

ArD128000.AHL43502.1.-/291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVVLHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDNRGWNGCGLPFGKSLVTCAKFTCSKKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDXXXXGHETDEN
 RAKVEVTPNSPRAEATLGGFGSLGLDCEPRTGLDFSDLYLTMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGRLFSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKVPAAETLHGTVT
 EVQYAGTDGPCKVPAQMAVDMQTLTPVGRILITANPVI TESTENSKMMELEDPFGDSYIVIGVGDKKITHHWRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGFNSLKGKIHQIFGAAPKSLFGGMSWFSQILIGTLLVWLGLNTKNGSISLTCLALGGV
 VMIFLSTAVSA

SEQ ID NO: 18

ArD158095.AHL43505.1.-/291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVVLHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDNRGWNGCGLPFGKSLVTCAKFTCSKKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDIGHETDENR
 AKVEVTPNSPRAEATLGGFGSLGLDCEPRTGLDFSDLYLTMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGRLFSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKVPAAETLHGTVT
 EVQYAGTDGPCKVPAQMAVDMQTLTPVGRILITANPVI TESTENSKMMELEDPFGDSYIVIGVGDKKITHHWRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGFNSLKGKIHQIFGAAPKSLFGGMSWFSQILIGTLLVWLGLNTKNGSISLTCLALGGV
 MIFLSTAVSA

SEQ ID NO: 19

ArD158084.AHL43504.1.-/291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVVLHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDNRGWNGCGLPFGKSLVTCAKFTCSKKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDIGHETDENR
 AKVEVTPNSPRAEATLGGFGSLGLDCEPRTGLDFSDLYLTMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF

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KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGKRLFSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKVP AETLHGT VTV
EVQYAGTDGPKVPAQMAVDMQTLTPVGR LITANPVITESTENSKMMLELDPFPGDSYIVIGVGDKKITHHWRSGSTIGKAF
EATVRGA KRMAVLGDTAWDFSGVGVFNSLGKGIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTC LALGGV
MIFLSTAVSA

SEQ ID NO: 20

isol-ARB13565.AHF49783.1.Central_African_Republic/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVD R G W G N G C G L F G K G S L V T C A K F T C S K I M T G K S I Q P E N L E Y R I M L S V H G S Q H S G M I V N D I G H E T D E N R
AKVEVTPNSPRAEATLGGFGLGLDCEPRTGLDFSDLYYLT MN NKH W L V H K E W F H D I P L P W H A G A D T G T P H W N N K E A L V E F
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGKRLFSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKVP AETLHGT VTV
EVQYAGTDGPKVPAQMAVDMQTLTPVGR LITANPVITESTENSKMMLELDPFPGDSYIVIGVGDKKITHHWRSGSTIGKAF
EATVRGA KRMAVLGDTAWDFSGVGVFNSLGKGIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTC LALGGV
VMIFLSTAVSA

SEQ ID NO: 21

isol-ARB7701.AHF49785.1.Central_African_Republic/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVD R G W G N G C G L F G K G S L V T C A K F T C S K I M T G K S I Q P E N L E Y R I M L S V H G S Q H S G M I V N D I G H E T D E N R
AKVEVTPNSPRAEATLGGFGLGLDCEPRTGLDFSDLYYLT MN NKH W L V H K E W F H D I P L P W H A G A D T G T P H W N N K E A L V E F
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGKRLFSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKVP AETLHGT VTV
EVQYAGTDGPKVPAQMAVDMQTLTPVGR LITANPVITESTENSKMMLELDPFPGDSYIVIGVGDKKITHHWRSGSTIGKAF
EATVRGA KRMAVLGDTAWDFSGVGVFNSLGKGIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTC LALGGV
VMIFLSTAVSA

SEQ ID NO: 22

isol-ArD_41519.AEN75266.1.Senegal/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVD R G W G N G C G L F G K G S L V T C A K F T C S K I M T G K S I Q P E N L E Y R I M L S V H G S Q H S G M I V N D I G H E T D E N R
RAKVEVTPNSPRAEATLGGFGLGLDCEPRTGLDFSDLYYLT MN NKH W L V H K E W F H D I P L P W H A G A D T G T P H W N N K E A L V E F
FKDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGKRLFSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKVP AETLHGT VTV
VEVQYAGTDGPKVPAQMAVDMQTLTPVGR LITANPVITESTENSKMMLELDPFPGDSYIVIGVGDKKITHHWRSGSTIGKA
FEATVRGA KRMAVLGDTAWDFSGVGVFNSLGKGIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTC LALGGV
VMIFLSTAVSA

SEQ ID NO: 23

MR766-NIID.BAP47441.1.Uganda/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVD R G W G N G C G L F G K G S L V T C A K F T C S K I M T G K S I Q P E N L E Y R I M L S V H G S Q H S G M T V N D I G Y E T D E N R
AKVEVTPNSPRAEATLGGFGLGLDCEPRTGLDFSDLYYLT MN NKH W L V H K E W F H D I P L P W H A G A D T G T P H W N N K E A L V E F
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGKRLFSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKVP AETLHGT VTV
EVQYAGTDGPKVPAQMAVDMQTLTPVGR LITANPVITESTENSKMMLELDPFPGDSYIVIGVGDKKITHHWRSGSTIGKAF
EATVRGA KRMAVLGDTAWDFSGVGVFNSLGKGIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTC LALGGV
MIFLSTAVSA

SEQ ID NO: 24

LC002520.1/326-829 Zika virus genomic RNA, strain: MR766-NIID, Uganda, Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVD R G W G N G C G L F G K G S L V T C A K F T C S K I M T G K S I Q P E N L E Y R I M L S V H G S Q H S G M T V N D I G Y E T D E N R
AKVEVTPNSPRAEATLGGFGLGLDCEPRTGLDFSDLYYLT MN NKH W L V H K E W F H D I P L P W H A G A D T G T P H W N N K E A L V E F
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGKRLFSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKVP AETLHGT VTV
EVQYAGTDGPKVPAQMAVDMQTLTPVGR LITANPVITESTENSKMMLELDPFPGDSYIVIGVGDKKITHHWRSGSTIGKAF
EATVRGA KRMAVLGDTAWDFSGVGVFNSLGKGIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTC LALGGV
MIFLSTAVSA

SEQ ID NO: 25

isol-MR_766.AEN75263.1.Uganda/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVD R G W G N G C G L F G K G S L V T C A K F T C S K I M T G K S I Q P E N L E Y R I M L S V H G S Q H S G M I V N D T G Y E T D E N R
AKVEVTPNSPRAEATLGGFGLGLDCEPRTGLDFSDLYYLT MN NKH W L V H K E W F H D I P L P W H A G A D T G T P H W N N K E A L V E F
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGKRLFSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKVP AETLHGT VTV
EVQYAGTDGPKVPAQMAVDMQTLTPVGR LITANPVITESTENSKMMLELDPFPGDSYIVIGVGDKKITHHWRSGSTIGKAF
EATVRGA KRMAVLGDTAWDFSGVGVFNSLGKGIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTC LALGGV
MIFLSTAVSA

SEQ ID NO: 26

ArD7117.AHL43501.1.-/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVD R G W G N G C G L F G K G S L V T C A K F T C S K I M T G K S I Q P E N L E Y R I M L S V H G S Q H S G M I V N D I G H E T D E N R
AKVEVTPNSPRAEATLGGFGLGLDCEPRTGLDFSDLYYLT MN NKH W L V H K E W F H D I P L P W H A G A D T G T P H W N N K E A L V E F
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAAGKRLFSGHLKCRCLKMDKRLKGVSYSLCTAVCTAAKVPAETLHGT VTV
VEVQYAGTDGPKVPAQMAVDMQTLTPVGR LITANPVITESTENSKMMLELDPFPGDSYIVIGVGDKKITHHWRSGSTIGKA
FEATVRGA KRMAVLGDTAWDFSGVGVFNSLGKGIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTC LALGGV
VMIFLSTAVSA

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SEQ ID NO: 27
 AY632535.2/326-825 NC_012532.1 Zika virus strain MR 766, Uganda, Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGGLFGKGSVLTCAKFTCSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIGYETDEDRAKVE
 VTPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEFKDAH
 AKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKGRLLSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKVPATLHGTVTVEVQY
 AGTDGPCKIPVQMAVDMQTLTPVGRLLITANPVITESTENSKMMELEDPFPGDSYIVIGVGDKKITHHWHRSGSTIGKAFEATV
 RGAKRMAVLGDTAWDFGSGVFNLSLKGKIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTCLALGGVMIFL
 STAVSA

SEQ ID NO: 28
 MR_766.AAV34151.1.Uganda/291-790 Flavivirus envelope glycoprotein E. |Q32ZE1|Q32ZE1_9FL
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGGLFGKGSVLTCAKFTCSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIGYETDEDRAKVE
 VTPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEFKDAH
 AKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKGRLLSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKVPATLHGTVTVEVQY
 AGTDGPCKIPVQMAVDMQTLTPVGRLLITANPVITESTENSKMMELEDPFPGDSYIVIGVGDKKITHHWHRSGSTIGKAFEATV
 RGAKRMAVLGDTAWDFGSGVFNLSLKGKIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTCLALGGVMIFL
 STAVSA

SEQ ID NO: 29
 MR_766.YP_009227198.1.Uganda/1-500 envelope protein E [Zika virus]
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGGLFGKGSVLTCAKFTCSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIGYETDEDRAKVE
 VTPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEFKDAH
 AKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKGRLLSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKVPATLHGTVTVEVQY
 AGTDGPCKIPVQMAVDMQTLTPVGRLLITANPVITESTENSKMMELEDPFPGDSYIVIGVGDKKITHHWHRSGSTIGKAFEATV
 RGAKRMAVLGDTAWDFGSGVFNLSLKGKIHQIFGAAPKSLFPGMSWFSQILIGTLLVWLGLNTKNGSISLTCLALGGVMIFL
 STAVSA

SEQ ID NO: 30
 KU681081.3/308-811 Zika virus isolate Zika virus/H.sapiens-tc/THA/2014/SV0127-14, Thailand, Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGGLFGKGSVLTCAKFTCSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHEDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKGRLLSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKIPATLHGTVTV
 EVQYAGTDGPCKVPAQMAVDMQTLTPVGRLLITANPVITEGTENSKMMELEDPFPGDSYIVIGVGDKKITHHWHRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVFNLSLKGKIHQIFGAAPKSLFPGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 31
 isol-Zika_virus%*H.sapiens-tc*%THA%2014%SV0127-14.AMD61710.1.Thailand/291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGGLFGKGSVLTCAKFTCSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHEDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKGRLLSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKIPATLHGTVTV
 EVQYAGTDGPCKVPAQMAVDMQTLTPVGRLLITANPVITEGTENSKMMELEDPFPGDSYIVIGVGDKKITHHWHRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVFNLSLKGKIHQIFGAAPKSLFPGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 32
 CK-ISL_2014.AIC06934.1.Cook_Islands/1-504 Flavivirus envelope glycoprotein E. (Fragment) OS = Zika virus GN = E PE = 4 SV = 1
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGGLFGKGSVLTCAKFTCSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHEDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKGRLLSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKIPATLHGTVTV
 EVQYAGTDGPCKVPAQMAVDMQTLTPVGRLLITANPVITEGTENSKMMELEDPFPGDSYIVIGVGDKKITHHWHRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVFNLSLKGKIHQIFGAAPKSLFPGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 33
 Natal_RGN.AMB18850.1.Brazil: Rio_Grande_do_Norte, Natal/291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGGLFGKGSVLTCAKFTCSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHEDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKGRLLSGHLKCRLLKMDKRLKGVSYSLCTAAFTFTKIPATLHGTVTV
 EVQYAGTDGPCKVPAQMAVDMQTLTPVGRLLITANPVITEGTENSKMMELEDPFPGDSYIVIGVGDKKITHHWHRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVFNLSLKGKIHQIFGAAPKSLFPGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 34
 isol-Si323.AMC37200.1.Colombia/1-504 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTTSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGGLFGKGSVLTCAKFTCSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHEDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF

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KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRLLITANPVITESTENSKMMLDPPFGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 35

KU707826.1/317-820 Zika virus isolate SSABR1, Brazil, Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDVDRGWNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHEDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRLLITANPVITESTENSKMMLDPPFGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 36

KU509998.1/326-829 Zika virus strain Haiti/1225/2014, Haiti, Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDVDRGWNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHEDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRLLITANPVITESTENSKMMLDPPFGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 37

isol-GDZ16001.AML82110.1.China/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDVDRGWNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHEDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRLLITANPVITESTENSKMMLDPPFGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 38

BeH819015.AMA12085.1.Brazil/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDVDRGWNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHEDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRLLITANPVITESTENSKMMLDPPFGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 39

MRS_OPY_Martinique_PaRi_2015.AMC33116.1.Martinique/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDVDRGWNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHEDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRLLITANPVITESTENSKMMLDPPFGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 40

KU501215.1/308-811 Zika virus strain PRVABC59, Puerto Rico, Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDVDRGWNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHEDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRLLITANPVITESTENSKMMLDPPFGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 41

Haiti%1225%2014.AMB37295.1.Haiti/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDVDRGWNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHEDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRLLITANPVITESTENSKMMLDPPFGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

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SEQ ID NO: 42
 KU527068.1/308-811 Zika virus strain Natal RGN, Brazil: Rio Grande do Norte, Natal, Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDVDRGWGNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHETDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAE TLHGTVTV
 EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLELDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 43
 isol-Z1106027.ALX35662.1.Suriname/5-508 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDVDRGWGNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHETDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAE TLHGTVTV
 EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLELDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 44
 isol-FLR.AMM39804.1.Colombia: Barranquilla/291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDVDRGWGNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHETDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAE TLHGTVTV
 EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLELDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 45
 PLCal_ZV_isol-From_Vero_E6_cells.AHL37808.1.Canada/254-757 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDVDRGWGNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHETDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAE TLHGTVTV
 EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLELDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 46
 BeH818995.AMA12084.1.Brazil/291-794 Flavivirus envelope glycoprotein E. [Zika virus].
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDVDRGWGNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHETDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAE TLHGTVTV
 EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLELDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 47
 H/PP/2013.AHZ13508.1.French_Polynesia/291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDVDRGWGNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHETDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAE TLHGTVTV
 EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLELDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 48
 PRVABC59.AMC13911.1.Puerto_Rico/291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDVDRGWGNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHETDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAE TLHGTVTV
 EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLELDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
 VLIFLSTAVSA

SEQ ID NO: 49
 KU321639.1/326-829 Zika virus strain ZikaSPH2015, Brazil, Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDVDRGWGNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHETDEN
 RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHWLVHKEWFHDIPLPWHAGADTGTPHWNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAE TLHGTVTV

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EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWHRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 50

ZikaSPH2015.AL033341.1.Brazil/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGCLFGKGSVLTCAKACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHLVHKWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWHRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 51

103344.AMC13912.1.Guatemala/291-794 polyprotein [Zika virus]. 103344.AMC13912.1.Guatemala
Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGCLFGKGSVLTCAKACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHLVHKWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWHRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 52

isol-Brazil-ZKV2015.AMD16557.1.Brazil/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGCLFGKGSVLTCAKACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHLVHKWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWHRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 53

KU497555.1/308-811 Zika virus isolate Brazil-ZKV2015, Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGCLFGKGSVLTCAKACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHLVHKWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWHRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 54

isol-ZJ03.AMM39806.1.China/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGCLFGKGSVLTCAKACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHLVHKWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWHRSGSTIGKAF
EATVRGARRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 55

isol-FSS13025.AFD30972.1.Cambodia/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGCLFGKGSVLTCAKACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHLVHKWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWHRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 56

isol-Z1106032.ALX35660.1.Suriname/291-794 Flavivirus envelope glycoprotein E. [Zika virus]
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGCLFGKGSVLTCAKACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNNKHLVHKWFHDIPLPWHAGADTGTPHWNKEALVEF
KDAHAKRQTVVVLGSGQEGAVHTALAGALEAEMDGAKRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWHRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNTKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 57

isol-Z1106033.ALX35659.1.Suriname/291-794 Flavivirus envelope glycoprotein E. [Zika virus]
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGCLFGKGSVLTCAKACSKKMTGKSIQPENLEYRIMLSVHGSQHSGMIVNDTGHEHDEN

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RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNKNKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 58

isol-BeH828305.AMK49165.1.Brazil/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFAKSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
ATVRGAKRMAVLGDTAWDFGSGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNKNKNGSISLMCLALGGV
LIFLSTAVSA

SEQ ID NO: 59

isol-GD01.AMK79468.1.China/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFAKSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNKNKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 60

isol-Z1106031.ALX35661.1.Suriname/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFAKSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNKNKNGSISLMCLALGG
VLIFLSTAVSA

SEQ ID NO: 61

ACD75819.1.Micronesia/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPAVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFAKSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLVWLGLNKNKNGSISLTCLALGGV
LIFLSTAVSA

SEQ ID NO: 62

KU681082.3/308-811 Zika virus isolate Zika virus/*H.sapiens*-tc/PHL/2012/CPC-0740, Philippines,
Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFAKSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLVWLGLNKNKNGSISLTCLALGGV
LIFLSTAVSA

SEQ ID NO: 63

isol-Zika_virus%*H.sapiens*-tc%PHL%2012%*CPC*-0740.AMD61711.1.Philippines/291-794 Flavivirus envelope
glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFAKSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHDEN
RAKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNNKEALVEF
KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTV
EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
EATVRGAKRMAVLGDTAWDFGSGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLVWLGLNKNKNGSISLTCLALGGV
LIFLSTAVSA

SEQ ID NO: 64

isol-BeH823339.AMK49164.2.Brazil/291-794 Flavivirus envelope glycoprotein E.
IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEATISDIASDSRCPTQGEAYLD
KQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFAKSKMTGKSIQPENLEYRIMLSVHGSQHSQSMIVNDTGHEHDENR
AKVEITPNSPRAEATLGGFGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPWHAGADTGTPHWNNKEALVEFK
DAHAKRQTAUVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEHLHGTVTVE
VQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMELEDPFPGDSYIVIGVGEKKITHHWRSGSTIGKAF
ATVRGAKRMAVLGDTAWDFGSGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLMWLGLNKNKNGSISLMCLALGGV
LIFLSTAVSA

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SEQ ID NO: 65

isol-P6-740.AEN75264.1.Malaysia/291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGLMIVNDXGHETDEN
 RAKVEITPNSPRAEATLGGFSGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPHWAGADTGTPHWNNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEITLHGTVTV
 EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLDPPFGDSYIVIGVGDKKITHHWXRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIFGAAPKSLFGGMSWFSQILIGTLLVWLGLNLTNGKSI SLTCLALGGV
 LIIFLSTAVSA

SEQ ID NO: 66

KU744693.1/326-829 Zika virus isolate VE Ganxian, China, Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGLMIVNDTGHETDEN
 RAKVEITPNSPRAEATLGGFSGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPHWAGAAATGTPHWNNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEITVDGTVTV
 EGQYGGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLDPPFGDSYIVIGVGDKKITHHWXRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIIGAAPKSLFGGMSWFSQILIGTLLMWLGLNLTNGKSI SLMCLALGG
 VLIFLSTAVSG

SEQ ID NO: 67

isol-VE Ganxian.AMK79469.1.China/291-794 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFACSKKMTGKSIQPENLEYRIMLSVHGSQHSGLMIVNDTGHETDEN
 RAKVEITPNSPRAEATLGGFSGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPHWAGAAATGTPHWNNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEITVDGTVTV
 EGQYGGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLDPPFGDSYIVIGVGDKKITHHWXRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGGALNSLGKGIHQIIGAAPKSLFGGMSWFSQILIGTLLMWLGLNLTNGKSI SLMCLALGG
 VLIFLSTAVSG

SEQ ID NO: 68

ArD157995.AHL43503.1.-/291-794 Flavivirus envelope glycoprotein E.
 ISCIGVSNRDLVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTMTVSNMAEVRSYCYEASISDMASASRCPTQGEPSL
 DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCSKFTCCCKMPGKSIQPENLEYRIMLPVHGSQHSGLMIVNDIGHETDENR
 AKVEVTPNSPRAEATLGGFSGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPHWAGADTGTPHWNNKEALVEF
 KDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEITLHGTVTV
 EVQYAGTDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLDPPFGDSYIVIGVGDKKITHHWXRSGSTIGKAF
 EATVRGAKRMAVLGDTAWDFGSGVGVFNSLGKGIHQIIGAAPKSLFGGMSWFSQILIGTLLVWLGLNLTNGKSI SLTCLALGGV
 MIFLSTAVSA

SEQ ID NO: 69

MR 766.ABI54475.1.Uganda/291-788 Flavivirus envelope glycoprotein E.
 IRCIGVSNRDFVEGMSGGTWVDVLEHGGCVTVMAQDKPTVDIELVTTTVSNMAEVRSYCYEASISDMASDSRCPTQGEAYL
 DKQSDTQYVCKRTLVDGRWNGCGLFGKGSVLTCAKFTCSKKMTGKSIQPENLEYRIMLSVHGSQHSGLMIVNDENRAKVEVT
 PNSPRAEATLGGFSGSLGLDCEPRTGLDPSDLYYLTMMNKHVLVHKEWFHDIPLPHWAGADTGTPHWNNKEALVEFKDAHAK
 RQTVVVLGSQEGAVHTALAGALEAEMDGAKGRLSSGHLKCRCLKMDKRLKGVSYSLCTAAFTFTKIPAEITLHGTVTVEVQYAG
 TDGPKCKVPAQMAVDMQTLTPVGRRLITANPVITESTENSKMMLDPPFGDSYIVIGVGDKKITHHWXRSGSTIGKAF EATVRG
 AKRMAVLGDTAWDFSGVGVFNSLGKGIHQIIGAAPKSLFGGMSWFSQILIGTLLVWLGLNLTNGKSI SLTCLALGGVMI FLSTA
 VSA

SEQ ID NO: 70

5'-(dIdC)₁₃-3'
 didc didc didc didc didc didc didc didc didc didc didc didc didc

SEQ ID NO: 71

KLK peptide
 KLKLLLLLKLK

SEQ ID NO: 72

ZIKV Sequence H/PP/2013 as sequenced
 CAGACTGCGACAGTTCGAGTTTGAAGCGAAAGCTAGCAACAGTATCAACAGGTTTTATTTTGGATTGGAAACGAGAGTT
 TCTGGTCATGAAAAACCCAAAAAGAAATCCGAGGATTCCGATTGTCAATATGCTAAAACGCGAGTAGCCCGTGTG
 AGCCCTTTGGGGGCTTGAAGAGGCTGCCAGCCGACTTCTGCTGGGTCATGGGCCCCATCAGGATGGTCTTGGCGATTCT
 AGCCTTTTGGAGATTACCGGCAATCAAGCCATCACTGGGTCTCATCAATAGATGGGGTTCAGTGGGGAAAAAGAGGCTA
 TGGAAATAATAAAGAGTTCAAGAAAGATCTGGCTGCCATGCTGAGAATAATCAATGCTAGGAAGGAGAAGAAGAGAC
 GAGGCGCAGATACTAGTGTCCGAATTGTTGGCCTCCTGCTGACCACAGCTATGGCAGCGGAGGTCACTAGACGTGGGAG
 TGCATACTATATGTACTTGGACAGAAACGACGCTGGGAGGCCATATCTTTCCCAACCATTGGGGATGAATAAGTGT
 ATATACAGATCATGGATCTTGGACACATGTGTGATGCCACCATGAGCTATGAATGCCCTATGCTGGATGAGGGGGTGGAA
 CCAGATGACGTCGATTGTTGTGTGCAACACGACGCTCAACTGGGTTGTGTACGGAACCTGCCATCACAAAAAGGTGAAGC
 ACGGAGATCTAGAAGAGCTGTGACGCTCCCCCTCCATTCCACTAGGAAGCTGCAACACGCGGTGCGAAACCTGGTTGGAAT
 CAAGAGAATACACAAAGCACTTGATTAGAGTCGAAATGGATATTCAGGAACCTGGCTTCGCGTTAGCAGCAGCTGCC
 ATCGCTTGGCTTTTGGGAAGCTCAACGAGCCAAAAGTCATATACTTGGTCATGATACTGCTGATGCCCCGGCATAACAGC
 ATCAGGTGCTAGGAGTCAAGCAATAGGACTTTGTGGAAGGTATGTCAGGTGGGACTTGGGTGATGTTGTCTTGGAAAC
 ATGGAGGTTGTCACCTGATGTCACAGCAGGACAAACCGACTGTGACACATAGAGCTGGTTACAACACAGCTAGCAACAT
 GCGGAGGTAAGATCCTACTGCTATGAGGCATCAATATCGGACATGGCTTCGGACAGCCGCTGCCAACACAGGTGAA
 GCCTACCTTGACAAAGCAATCAGACACTCAATATGCTGCAAAAGAACGTAGTGACAGAGGCTGGGAAATGGATGTG
 GACTTTTGGCAAGGGAGCCTGGTGACATGCGCTAAGTTTGCATGCTCCAAAGAAATGACCGGAAGAGCATCCAGCC
 AGAGAACTGGAGTACCGGATAATCTGTGAGTCCAGCACAGTGGGATGATCGTTAATGACACAGGACATG
 AAACGTGATGAGAATAGAGCGAAGGTTGAGATAACGCCCAATTCACCAAGAGCCGAGCCACCTGGGGGTTTTGGAAG

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GCTGTGTCCTCCGAGGAAGTGCAAAGCTGAGATGGTTGGTGGAGCGGGGATACCTGCAGCCCTATGGAAAGGTCATTGATC
 TTGGATGTGGCAGAGGGGGCTGGAGTTACTACGCCGCCACCATCCGCAAGGTTCAAGAAGTGAAAGGATACACAAAAGG
 AGGCCCTTGGTCATGAAGAACCCATGTTGGTGCAAAGCTATGGGTGGAACATAGTCCGCTCTTAAGAGTGGGGTGGACGTC
 TTTCATATGGCGGCTGAGCCGTGTGCACAGCTTGCTGTGTGACATAGGTGAGTCATCATCTAGTCCCTGAAGTGGAAGAAGC
 ACGGACGCTCAGAGTCCCTCCATGGTGGGGGATTGGCTTGAAAAAGACAGGAGCCTTTTGTATAAAAGTGTGTGCC
 CATAACACGACACTATGATGAAACCCCTGGAGCGACTGCAGCGTAGGTATGGGGGAGGACTGGTCAGAGTGCCACTCTC
 CCGCAACTCTACACATGAGATGACTGGGTCTCTGGAGCGAAAAGCAACACCATAAAAAGTGTGTCCACACGAGCCAGC
 TCCTCTTGGGGCGCATGGACGGGCCAGGAGGCCAGTGAAATATGAGGAGGATGTGAATCTCGGCTCTGGCACGCGGG
 CTGTGGTAAGCTGCGCTGAAGCTCCCAACATGAAGATCATTGGTAACCGCATTGAAAGGATCCGAGTGAGCACGCGGA
 AACGTGGTCTTTTGACGAGAACCCTATATAGGACATGGGCTTACCATGGAAGCTATGAGGCCCCACACAAGGTCAG
 CGTCTCTCTAATAAACGGGGTTGTGAGGCTCTCTGTCAAAACCCCTGGGATGTGGTACTGGAGTCACAGGAATAGCCATG
 ACCGACACACACCGTATGGTCAGCAAAGAGTTTTCAGGAAAAAGTGGACACTAGGGTGCCAGACCCCAAGAGGCA
 CTCTGTCAGGTTATGACACATGGTCTCTCTCTGGTTGTGAAAGAGCTAGGCAACACAACCGGCCACGAGTCTGTACCAA
 GAAGAGTTCATCAACAAGGTTCTGATGACATGACGATAGGGGCAATATTTGAAGAGGAAAAAGAGTGAAGACTGCAG
 TGAAGAGCTGTGAACGATCCAAGGTTCTGGGCTCTAGTGGACAAGGAAAGAGAGCACACCTGAGAGGAGAGTGCAG
 GTTGTGTGTACAACATGATGGGAAAAAGAGAAAAACAAGGGGAATTTGGAAAGGCCAAGGGCAGCCGCGCATCT
 GGTATATGTGGCTAGGGGCTAGATTCTAGAGTTCGAAGCCTTGGATTCTTGAACGAGGATCACTGGATGGGGAGAGA
 GAACCTCAGGAGGTGGTGTGTAAGGCTGGGATTACAAAGACTCGGATATGTCTAGAAGAGATGAGTCGCATACCAGGA
 GAAGAGGTATGATGCAAGGACTCTGGCTGGGACACCCGATCAGCAGGTTTGTATCTGAGAGATGAAGCTCTAATCA
 CCAACCAATGGAGAAAGGGCACAGGGCCTTGGCATTGGCCATAATCAAGTACACATACCAAAAACAAAGTGGTAAAGGT
 CCTTAGACACAGCTGAAAAGGGAAGACAGTTATGACATATTTTCGAGACAAGACCAAGGGGGAGCGGACAAGTTGTCT
 ACTTACGCTCTTAAACACATTTACCAACTAGTGGTCAACTCATTGGAATATGGAGGCTGAGGAAGTCTAGAGATGCAA
 GACTTGTGGCTGCTGCGGAGGTGAGAGAAAGTGACCAACTGGTTGCAGAGCAACGGATGGGATAGGCTCAAACGAATG
 GCAGTCAGTGAGATGATTGCGTGTGTAAGCCAATTGATGATAGGTTTGCACATGCCCTCAGGTTCTTGAATGATATGGG
 AAAAGTTAGGAAGGACACACAGAGTGGAAACCCCTCAACTGGATGGGACAACTGGGAAGAAGTTCGTTTTCCTCCAC
 CACTTCAACAAGCTCCATCTCAAGGACGGGAGGTCCATTGTGGTTCCCTGCCGCCACCAAGATGAAGTGAAGTGGCCGGGC
 CCGGCTCTCTCAGGGGGGGGATGGAGCATCCGGGAGACTGCTTGCCTAGCAAAATCATATGCGCAAAATGTGGCAGCTC
 CTTTATTTCCACAGAAAGGACCTCCGACTGATGGCAATGCCATTGTTCATCTGTGCCAGTTGACTGGGTTCCAACTGGG
 AGAATACCTGGTCAATCCATGGAAGGGAGAATGGATGACCACTGAAGACATGCTTGTGGTGTGGAACAGAGTGTGGA
 TTGAGGAGAACGACACATGGAAGACAAGACCCAGTTACGAAATGGACAGACATTCCCTATTTGGGAAAAAGGGAAGA
 CTTGTGGTGTGGATCTCTCATATAGGACACAGACCGCGCACCTGGGCTGAGAACATTAAAAACACAGTCAACATGGTGC
 GCAGGATCATAGGTGATGAGAAAAAGTACATGGACTACCTATCCACCAAGTTCGCTACTTGGGTGAAGAAGGGTCTACA
 CCTGGAGTGTGTAAGACCAATCTTAGTGTGTGAGGCTGCTAGTCAAGCACAGCTTGGGGAAGGCTGTGACGCTGTG
 GACCCCGGAGGAGAGTGGGAAACCAAGCCTATAGTCAGGCGGAGAACGCCATGGCACGGAAGAAGCCATGCTGCT
 GTGAGCCCTCAGAGGACACTGAGTCAAAAAACCCACGCGCTTGGAGGCGCAGGATGGGAAAAAGGTTGGCGACCT
 TCCCACCTCTCAATCTGGGCGCTGAATGGAGATCAGCTGTGGATCTCCAGAAGAGGAGTGTGGTGTAGAGGAGACCC
 CCGGAAACGCAAAACAGCATATTGACGCTGGGAAAGACAGAGACTCCATGAGTTTCCACACGCTGGCCGCGCAGGC
 ACAGATCGCGCAATAGCGGCGGCGGTGTGGGG

SEQ ID NO: 73

AH213508.1, Zika virus polyprotein from Polynesian outbreak (H/PF/2013)
 MNPKKSGGFRIVNMLKRGVAVSPFGLKRLPAGLLLGHGPIRMVLAIAFLRFTAIPKSLGLINRWGVSVGKEAMEIICKFKK
 DLAAMLRIINARKEKKRKGADTSVGIIVGLLLTAMAAEVTTRSGSAYMYLDRNDAGEAISPTTLGMNKKYIQLIMDLGHMCD
 TMSYECPLMDGEVPEDDVDCWNTTSTWVVYGTCHHKKEARRSRRAVTLPSHSTRKLQTRSQTWLESREYTKHLIRVENWI
 FRNPFALAAAAIAWLLGSSTSQKVIYLVMLILLIAPAYSIRICIGVSNRDFVEGMSGGTTWVDVLEHGGCVTVMAQDKPTVDIEL
 VTTTYSNNMAEVRSPCYEASIDMSASDRCPQTQGEAYLDKQSDTQYVCKRTLVDRGWNGCGLFGKGLSVTCAKFACSKKMTG
 KSIQENLEIRIMLSVHGSQHSGLMIVNDTGHTDENRAKVEITPNSPRAEATLGGFGLGLDCEPRTGLDFSDLYLTMNNKH
 WLHKWFHDIPLPHAGADTPTPHNNKEALVEFKDAHAKRQTVVVLGSQEGAVHTALAGALEAEMDGAKRLSSGHLK
 CRLKMLKRLKGVSYSLCTAFTFTFKI PAETLHGTVTVVEVQYAGTDGPKVPAQMAVDMQTLTPVGRILTANPVI TESTENSKM
 MLELDPFPFGDSYIVIGVEKKITHHWHRSSTIGKAFEAETVRGAKRMAVLGDTAWDFGSVGGALNSLGKGIHQIFGAAFKSLF
 GGMWSFQILIGTLMLLGLLTKNGSISLMCLALGGVLIPLSTAVSADVGCSDVFSKKECTRCGTGVFYNDVEAWDRDYKYHP
 DSPRLAAVQKAWEDGTCGSISSVSRMENIMWRSVEGELNAILLENGVQLTVVVGSVKPNMWRGPQLRPVVPVNLPHGWK
 AWGKSYFVRAAKTNNFSVVDGDTLKECPLKHAWSFLVEDHGFVFTSVLKVREDYSLECDPAVIGTAVKGKEAVHSDL
 GYWI ESEKNDTWRLKRAHLIEMKTEWPKSHTLWTDGIEESDLII PKSLAGPLSHNNTREGYRTQMKGPWHSSELEIRFEECPG
 TKVHVEETCGTRGPRSLRSTTAGGWSVLEEWCRECTMPPLSLFRAKDGWCYGMERIPRKEPENLVRSMVTAGSTDHMDHFSLG
 VLVILLMVQEGLKRMRTKIIISTSMVLVAMILGGFSMSDLAKLAILMGATFAEMNTGGDVAHLALIAAFKVRPALVLSFI FRA
 NWTTPRESMLLALASCLLQTAISALEGLDMVLINGFALAWLAIRAMVVPRTDNI TLAILAALTPLARGTLVLAWRAGLATCGGFM
 LLSLKGKGSVKNLPLFPVMAAGLTAIVRLVDPINNVGLLLLTRSGKRSWPPSEVLTAVGLICALAGGFAKADIEMAGPMAAVGLLIV
 SYVVSIGKSVDMYIERAGDI TWKDAEVTGNSPRLDVALDESGDFSLVEDDGPPMREIILKVVLMTICGMNP IAPFAAGAWYVY
 VKTGKRSALWDVPAPEVKVKGGETDGVYRVMTRRLLGSTQVGVGMQEGVFHTMWHVTGKSALRSBEGRLDPYWGDK
 QDLVSYCGPWKLDAAWDGHESEVQLLAVPPGERARNI QTLPGIFKTKDGDIGAVALDYPAGTSGSPILDKCGRVIGLYNGVVIK
 NGSYSVAITQGRREETPVECFEPMMLKKQLTVLDLHPGAGKTRRVLPEIVREAIKTRLRVTILAPTRVVAEMEELRGLPVRY
 MTTAVNVTHSGTEIVDLMCHATFTSRLQLIRVPNYNLYIMDEANFTDPSSIAARGYISRTRVEMGEAAAI FMTATPPGTRDAPP
 DSNRAIMDTVEVEVPERAWSGDFWTDHSGKTWVFPVPSVRNGNEIAACLTAKAGKRVILQSLRKTFTETEFQKTKHQEWDFFVVT
 DISEMGANFKADRVIDSRRCLKPVILDERVILAGPMPVTHASAAQRGRIRGNPNKPGDEYLYGGCAETDEDHAHWLEAR
 MLLDNI YLQDGLIASLYRPEADKVAIIEGEPKLRTEQRKT FVELMKRGDLPVWLAQVASAGITYTDRRCFDGTNTNIMEDS
 VPAEWWTRHKEGRVLPFRWMDARVCSHAALKSKFEAGKRGAAFGVMEALGTLPGHMTERFQEAIDNLAVLMRAETGS
 RPYKAAAALQLEPETLBTIMLGLLGLTVSLGIFPVLMRNKGIKMGFGMVTLGASAWLMLNLSIEPARIACVLIVVPLLVLLVLIPEPE
 KQRSQDNQMAIIIMVAVGLLGLITANELGWLETKSLSLHLMGRREEGATIGFSMDIDLRPASAWAIYAALTFTIPAVQHAV
 TTSYNNYSMLMATQAGVLFGMGKMPFYAWDFGVPLLMIGCYSQTLPLTLIVAIILLVAHYMYLIPGLQAAAAAAQKRTAA
 GIMKNPVVDGIVVTDIDMTIDPQVEKKMGQVLLIAVAVSAI LSRATANGWEAGALITAASTLWEGSPNKYWNSSSTATSLC
 NIFRGSYLAGASLIYVTRNAGLVKRRGGGTGETLGEKWKARLNQMSALEFYSYKSGITEVCREEARRALKDG VATGGHAVSR
 GSAKRLLVVERGYLQPYGKVIDLGCGRGGWSYAAATIRKVEVKGYTGGPGHEEPMPLVQSYGWNIVRLKSGVDVFHMAAE
 PCDTLTLCMIGESSSEPEVEEARTLDSMVGDWLEKRPAGFCIKVLCPTSTMMETLERLQRRYGGGLVVRPLSRNSTHEMYVW
 SGAKSNTIKSVSTTSQLLLGRMDGPRRPVKEYEEDVNLGSGTRAVVSCAEPNMKIIIGNRIERIRSEHAETVVFDDENHPYRTWAY
 HGSYEAPTQGSASSLINGVVRLLSKPVDVVTGVTGIAMTDTTPYQQQVFKKEKVDTRVPDQEGTRQVMSMVSWLWKELG
 KHKRPVCTKEEFINKVRSNAALGAIFEEKEWKTAVEAVNDPRFWALVDKEREHLRGECQSCVYNNMMGKREKKQGEFGKA
 KGSRAIYMWLGLARFLEPAGLGFLEHWMGRENSGGGVEGLGLQRLGYVLEEMSRIPGGRMYADDTAGWDTRISRPDLE
 NEALITNQMEKGHRALALAIKYTYQNKVVKVLRPAEKGTVMDISRQDQRSGQVVTYALNTFTNLVVQLIRNMEABEVL

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QDLWLLRRSEKVTINWLQSNQWDLKRMVSGDDCVVKPIDDRFAHALRFLNDMGKVRKDTQEWKPSTGWDNWEEVPFC
SHHPNKLHLKDGSRIVVPCRHQDELIGRARVSPGAGWSIRETACLAKSYAQMWQLLYFHRRDLRLMANAICSSVPVDWVPTG
RTTWSIHGKGWMTTEDMLVVWNRVWIEENDHMEKTPVTKWTDIPYLGKREDLWCGSLIGHRPRTWAENIKNTVNMV
RRIIGDEEKYMDYLSTQVRYLGEEGSTPGVL

SEQ ID NO: 74
9320_Zika_PF_1F
ttaggatccGTTGTTGATCTGTGTGAAT

SEQ ID NO: 75
9321_Zika_PF_1R
taactcgagCGTACACAACCCAGTT

SEQ ID NO: 76
9322_Zika_PF_2F
ttaggatccTCACTAGACGTGGGAGTG

SEQ ID NO: 77
9323_Zika_PF_2R
taactcgagAAGCCATGTCYGATATTGAT

SEQ ID NO: 78
9324_Zika_PF_3F
ttaggatccGCATACAGCATCAGGTG

SEQ ID NO: 79
9325_Zika_PF_3R
taactcgagTGTGGAGTTCCGGTGTCT

SEQ ID NO: 80
9326_Zika_PF_4F
ttaggatccGAATAGAGCGAARGTTGAGATA

SEQ ID NO: 81
9327_Zika_PF_4R
taactcgAGTGGTGGGTGATCTTCTTCT

SEQ ID NO: 82
9328_Zika_PF_5F
ttaggatccCAGTCAGTGGAGGTACAGTAC

SEQ ID NO: 83
9329_Zika_PF_5R
taactcgagCRCAGATACCATCTTCCC

SEQ ID NO: 84
9330_Zika_PF_6F
ttaggatCCCTTATGTGCTTGGCCTTAG

SEQ ID NO: 85
9331_Zika_PF_6R
taactcgagTCTTCAGCCTCCATGTG

SEQ ID NO: 86
9332_Zika_PF_7F
ttaggatccAATGCCCACTCAAACATAGA

SEQ ID NO: 87
9333_Zika_PF_7R
taactcgagTCATTCTCTTCTTACGCCCTT

SEQ ID NO: 88
9334_Zika_PF_8F
ttaggatccAAGGGTGATCGAGGAAT

SEQ ID NO: 89
9335_Zika_PF_8R
taactcgagTTCCCTTCAGAGAGAGGAGC

SEQ ID NO: 90
9336_Zika_PF_9F
ttaggatccTCTTTGCAAACCTGCGATC

SEQ ID NO: 91
9337_Zika_PF_9R
taactcgagTCCAGCTGCAAAGGTAT

-continued

SEQ ID NO: 92
9338_Zika_PF_10F
ttaggatccGTGTGGACATGTACATTGA

SEQ ID NO: 93
9339_Zika_PF_10R
taactcgagCCCATTGCCATAAAGTC

SEQ ID NO: 94
9340_Zika_PF_11F
ttaggatccTCATACTGTGGTCCATGGA

SEQ ID NO: 95
9341_Zika_PF_11R
taactcgagGCCCATCTCAACCCTTG

SEQ ID NO: 96
9342_Zika_PF_12F
ttaggatccTAGAGGGCTTCCAGTGC

SEQ ID NO: 97
9343_Zika_PF_12R
taactcgAGATACTCATCTCCAGGTTTGTG

SEQ ID NO: 98
9344_Zika_PF_13F
ttaggatccGAAACAAAACATCAAGAGTG

SEQ ID NO: 99
9345_Zika_PF_13R
taactcgagGAATCTCTGTCTATGTGTCCT

SEQ ID NO: 100
9346_Zika_PF_14F
ttaggatccTTGATGGCAGACCAAC

SEQ ID NO: 101
9347_Zika_PF_14R
ttaggatccGTTGTTGATCTGTGTGAAT

SEQ ID NO: 102
9348_Zika_PF_15F
taactcgagCAGGTCAATGTCCATTG

SEQ ID NO: 103
9349_Zika_PF_15R
ttaggatccTGTGTGTTCTATTGCTGGT

SEQ ID NO: 104
9350_Zika_PF_16F
taactcgaGTGATCAGRGCCCAGC

SEQ ID NO: 105
9351_Zika_PF_16R
ttaggatccTGCTGCCCAGAAGAGAA

SEQ ID NO: 106
9352_Zika_PF_17F
taactcgaGCACCAACAYGGTTCTT

SEQ ID NO: 107
9353_Zika_PF_17R
ttaggatccTCAAGACGGTGTGGC

SEQ ID NO: 108
9354_Zika_PF_18F
taactcgagCAATGATCTTCATGTTGGG

SEQ ID NO: 109
9355_Zika_PF_18R
ttaggatccTATGGGGGAGGACTGGT

SEQ ID NO: 110
9356_Zika_PF_19F
taactcGAGCCCAGAACCTTGATC

SEQ ID NO: 111
9357_Zika_PF_19R
ttaggatccCAGACCCCCAAGAAGGC

-continued

SEQ ID NO: 112
 9358_Zika_PF_20F
 taactcgagCCCTTTGGTCTTGCTCT

SEQ ID NO: 113
 9359_Zika_PF_208
 ttaggatccAGGAAGGATGTATGCAGATG

SEQ ID NO: 114
 9360_Zika_PF_21F
 taactcgagACATTTGCGCATATGATTTTG

SEQ ID NO: 115
 9361_Zika_PF_218
 ttaggatccAGGAAGGACACACAAGAGT

SEQ ID NO: 116
 9362_Zika_PF_22F
 taactcgagACAGGCTGCACAGCTTT

SEQ ID NO: 117
 9363_Zika_PF_228
 ttaggatccTCTCTCATAGGGCACAGAC

In some embodiments, the Zika virus has polyprotein, including an envelope (E) protein, with an amino acid sequence provided by any one of SEQ ID NOs: 14-69 or 72. In some embodiments, the polyprotein or E protein sequence is at least 80%, 81%, 82%, 83%, 84%, 85%, 86%, 87%, 88%, 89%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99%, 99.5%, 99.6%, 99.7%, 99.8% or 99.9% identical to any one of SEQ ID NOs: 2-69 or 72.

The terms “identical” or percent “identity” in the context of two or more nucleic acids or amino acid sequences refer to two or more sequences or subsequences that are the same. Two sequences are “substantially identical” if two sequences have a specified percentage of amino acid residues or nucleotides that are the same (e.g., at least 80%, 85%, 90%, 95%, 96%, 97%, 98%, or 99% identity) over a specified region or over the entire sequence, when compared and aligned for maximum correspondence over a comparison window, or designated region as measured using one of the following sequence comparison algorithms or by manual alignment and visual inspection. Optionally, the identity exists over a region that is at least about 50 nucleotides (or 10 amino acids) in length, or more preferably over a region that is 100 to 500 or 1000 or more nucleotides (or 20, 50, 200 or more amino acids) in length. In some embodiments, the identity exists over the length of a protein, such as the E protein.

For sequence comparison, typically one sequence acts as a reference sequence, to which test sequences are compared. Methods of alignment of sequences for comparison are well known in the art. See, e.g., by the local homology algorithm of Smith and Waterman (1970) Adv. Appl. Math. 2:482c, by the homology alignment algorithm of Needleman and Wunsch, J. Mol. Biol. 48:443, 1970, by the search for similarity method of Pearson and Lipman. Proc. Natl. Acad. Sci. USA 85:2444, 1988, by computerized implementations of these algorithms (GAP, BESTFIT, FASTA, Jalview and TFASTA in the Wisconsin Genetics Software Package, Genetics Computer Group, 575 Science Dr., Madison, Wis.), by multi sequence alignment implementation using e.g. CLUSTALW (Larkin et al., (2007). *Bioinformatics*, 23, 2947-2948.) or MAFFT (Katoh & Toh 2008 *Briefings in Bioinformatics* 9:286-298), or by manual alignment and visual inspection (see, e.g., Brent et al., Current Protocols in Molecular

Biology, John Wiley & Sons, Inc. (Ringbou ed., 2003)). Two examples of algorithms that are suitable for determining percent sequence identity and sequence similarity are the BLAST and BLAST 2.0 algorithms, which are described in Altschul et al., Nuc. Acids Res. 25:3389-3402, 1977 and Altschul et al., J. Mol. Biol. 215:403-410, 1990, respectively.

EXAMPLES

Example 1: Production of a Zika Drug Substance Suitable for Application as a Vaccine in Humans and Animals

Materials and Methods:

For the production of ZikaV the JEV process platform (Srivastava et al., Vaccine 19 (2001) 4557-4565; U.S. Pat. No. 6,309,650B1) was used as a basis. Small changes of certain process steps were adapted to ZikaV properties and to improve purity. A short summary of the process steps is outlined below (see also FIGS. 9A and B). Briefly, the unexpected and novel purification properties of protamine sulphate (PS) were evaluated in purification processes for Zika Virus. As shown in FIG. 10, non-infectious virus particle aggregates, HCP and other LMW impurities were removed by PS precipitation as shown by removal of aggregate shoulder in SEC-HPLC and no loss of infectious virus titer by PS treatment. Further optimization of the Zika purification protocol is provided below.

Upstream:

Roller Bottle based Vero cell expansion (25×850 cm2 CellBind):
 5% CO₂, 35° C., MEM+2 mM L-Glutamine+10% FBS
 Infection with ZikaV research Master Seed Bank (rMSB) at MOI 0.01

Virus Production without serum
 5% CO₂, 35° C., MEM+2 mM L-Glutamine
 Multiple harvests (days 2, 3, 5 and 7) with re-feed
 Sterile filtration of harvests and storage at 2-8° C. until further processing

Downstream:

Pooling of harvests and concentration by ultrafiltration (100 kDa)

Stabilization of concentrated harvest (Tris/10% sucrose) for storage if required (-80°C .)

Removal of hcDNA by Protamine Sulphate (2 mg/mL)

Sucrose Gradient Purification (optimized three layered gradient)

Formaldehyde Inactivation (0.02%, 22°C ., 10 days), neutralization with Na-metabisulfite

Dilution to DS antigen target content and formulation with Aluminium hydroxide (0.5 mg Al/mL)

Zika Virus Strain H/PF/2013 was originally isolated from a 51-year-old woman (accession number KJ776791.1, also SEQ ID NO: 13 herein) from French Polynesia. A sample was obtained from the European Virus Archive (EVA; Ref-SKU: 001v-EVA1545). Based on this material, a research master seed bank (rMSB) was prepared on Vero cells as the cell substrate and the genomic sequence was checked by sequencing. Because the genomic sequence at the 5' and 3' flanking sequences of Zika virus strain H/PF/2013 was unknown, primers for sequencing were designed in those regions based on other Zika virus strains whereas the internal primers were designed from the published sequence (SEQ ID NOs: 74 to 117, see also Table A). The sequence obtained from the rMSB by use of these primers is provided by SEQ ID NO: 72. There was 100% overlap of the sequence with the published sequence of Zika Virus Strain H/PF/2013 (SEQ ID NO: 13). However, we sequenced additional regions 5' (an additional 40 bp) and 3' (an additional 160 bp) represented in SEQ ID NO: 72. In a preferred embodiment, the Zika virus of the invention comprises SEQ ID NO: 72. The genomic RNA is somewhat longer than the sequence according to SEQ ID NO: 72 (perhaps an additional 200 bp). Additionally, a Zika virus adapted to a host cell such as e.g. Vero cells may be expected to contain one or more mutations. For these reasons, the Zika virus of the current invention comprises the sequence of SEQ ID NO: 72 or, preferably, a sequence with at least 95%, 96%, 97%, 98%, or at least 99% sequence identity to the sequence provided by SEQ ID NO: 72. Furthermore, because the viral genome is likely to contain even further flanking regions to SEQ ID NO: 72; in one embodiment, the Zika virus of the invention contains the sequence of SEQ ID NO: 72 and optionally further comprises extensions at the 5' and/or 3' ends of at least 10, at least 20, at least 30, at least 40, at least 50, at least 60, at least 70, at least 80, at least 90, at least 100, at least 110, at least 120 or at least 130 nucleotides. In a preferred embodiment, the Zika virus comprises at least the coding sequence for the entire polyprotein of Zika Virus Strain H/PF/2013 of the invention i.e. the amino acid sequence of SEQ ID NO: 73 or a polypeptide with at least 95%, 96%, 97%, 98%, or at least 99% sequence identity to the sequence provided by SEQ ID NO: 73. Furthermore, the Zika virus comprises at least the coding sequence for the E-protein of Zika Virus Strain H/PF/2013 of the invention SEQ ID NO: 47 or an E-protein thereof with at least 95%, 96%, 97%, 98%, or at least 99% sequence identity to the sequence provided by SEQ ID NO: 47.

Virus Growth on Vero Cells

Vero cells were grown in Eagle's minimal essential medium (EMEM) containing 10% fetal bovine serum (FBS). Roller bottle cultures of Vero cell monolayers were infected with Zika Virus Strain H/PF/2013 at a multiplicity of infection (moi) of 0.01 plaque forming units (pfu) per cell. After 2 hours of virus adsorption, the cultures were washed 3 times with PBS and fed with EMEM without FBS and incubated at $+35^{\circ}\text{C}$. with 5% CO_2 . Infected Vero cell cultures were incubated until the virus titer reaches a desired level.

The culture medium was harvested at days 2, 3, 5 and 7 and were pooled from those harvest days and then centrifuged in a standard centrifuge. The supernatants were then filtered. Virus culture supernatants were concentrated by TFF ultrafiltration to remove cell culture media components and to reduce batch volume.

Evaluation of Harvest Procedure

The current JEV harvest process has scheduled harvests on days 3, 5, 7 and 9 post infection. To mimic the JEV process roller bottles were infected with ZIKV bank P4-FBS at an MOI of 0.01 in infection medium (MEM with 2% FBS+2 mM L-glutamine) for 2 hours. After removing the inoculum the cells were washed twice with PBS and 200 mL production medium (MEM+2 mM L-glutamine) was added.

After taking a sample on day 2 the first virus harvest was conducted on day 3 after infection. At this point significantly higher CPE could be observed compared to cells where virus was removed on day 2. Plaque assay analysis showed that the viral titers on day 2 were in the same range as for the standard harvesting schedule. However, starting with the day 3 harvest, the observed titers were significantly lower correlating with the increased CPE observed compared to the standard harvest schedule. On day 5 post infection no more living cells could be observed at all and the experiment was terminated with a final day 5 harvest.

TABLE 3

The calculated titers per plaque assay are summarized in the list below.	
	Log 10 PFU/mL
sample day 2	7.02
harvest day 3	6.66
harvest day 5	6.26

This finding led to an optimized harvest schedule to better control of CPE and allow additional harvest day 5 and 7, see FIG. 15. For both harvest days the optimized ZikaV protocol yield significant higher virus titers compared to the modified protocol showing that the time of the first harvest is crucial for production yields. Additionally first harvesting at day 3 results in maximum 2 harvest points whereas first harvesting at day 2 allows for 4 harvest points further increasing the yield gain.

Downstream Purification of Zika Virus

The purification process was carried out at room temperature ($18-22^{\circ}\text{C}$.) unless stated otherwise. Virus purification started with concentration of filtered combined harvest using 100 kDa cut-off TFF ultrafiltration modules to remove cell culture media components and reduce batch volume. After concentration, the pooled filtered harvest material was adjusted to a final concentration of 25 mM Tris pH 7.5 and 10% sucrose (w/w) using stock solution of both components (see FIG. 11 for SEC-HPLC of different harvests prior to PS treatment). This allowed for freezing the concentrated harvest at $<-65^{\circ}\text{C}$. if required.

Host cell DNA and protein reduction as well reduction of non-infectious virus aggregates in the concentrated material was achieved by precipitation with protamine sulphate (2 mg/mL) followed by sucrose density centrifugation ($2-8^{\circ}\text{C}$.) as final polishing step (see FIG. 20 for SEC-HPLC of different harvests post PS treatment). The purification process was designed to be completed within 2 working days with SGC starting on end of day 1 followed by fractionation and SDS-PAGE analysis on day 2. The sucrose gradient fractions were stored at $2-8^{\circ}\text{C}$. during the SDS-PAGE

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analysis (Silver staining) to identify the pure fractions containing ZikaV (see FIG. 21). After pooling the relevant fractions, the pool was diluted and inactivated by Formalin. After pooling the relevant fractions of sucrose gradient centrifugation, the pool was diluted 1:3 in PBS and inactivated by Formalin (0.02% v/v, 200 ppm). Fractions were subjected to analysis by SDS-PAGE.

Effect of PS treatment on virus recovery Samples of individual 30× concentrated harvests days 2, 3, 5 and 7 were analysed before (FIG. 11) and after PS (FIG. 12) treatment by SEC-HPLC and plaque assay. SEC-HPLC was used for determination of relative total ZikaV content (active+inactive) expressed as peak area, whereas the rel. ZikaV peak purity is given as relative content of virus monomer population to total virus peak. Plaque assay states the content of total active virus particles in each sample. Experimental results are summarized in Table 4. The virus peak recovery by SEC-HPLC was only between 12 to 36% with peak purity after PS treatment in the range of >90% (no virus aggregates detected). The recovery of active virus particles by plaque assay was all >100% (130-700%, range within the variability of the assay) showing that no active virus particles were lost during PS treatment. These results show that during PS treatment only non-infective (immature and/or aggregated virus) particles were removed.

TABLE 4

ZikaV recovery by SEC-HPLC and plaque assay before and after PS treatment.				
SEC-HPLC				
Harvest day	Peak area mAU*min			rel. virus monomer content after PS (%)
	30x conc	30x + PS	SEC Recovery (%)	
Day 2	101.36	18.63	18	89%
Day 3	144.51	17.48	12	90%
Day 5	19.97	5.92	30	96%
Day 7	68.80	24.43	36	99%
Plaque Assay				
Harvest day	PFU/mL		Plaque Recovery (%)	
	30x conc	30x + PS		
Day 2	3E+08	5E+08	179	
Day 3	2E+08	4E+08	193	
Day 5	1E+08	9E+08	700	
Day 7	3E+08	4E+08	132	

Sucrose Gradient Centrifugation

The PS treated harvest was split in two parts and loaded on two centrifuge bottles. Sucrose density gradient centrifugation (SGC) was used for final concentration and polishing of the ZikaV material. The ZikaV PS treated concentrated harvest was loaded on top of a solution consisting of three layers of sucrose with different densities. The three sucrose layers were selected based on a preliminary study which showed the formation of a linear sucrose gradient and complete separation of the virus particles from residual contaminants as demonstrated for ChikV (FIG. 15D). The optimal volumes of the sucrose solutions were determined empirically. The volumes of individual layers for a centrifugation in 100 mL bottle scale are shown in Table 5.

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TABLE 5

Individual layers/volumes for a centrifugation in bottle.	
Solution	Volume (mL)
PS treated harvest in 10% sucrose (L)	40
15% sucrose (J)	15
35% sucrose (I)	15
50% sucrose (H)	20
Total volume	90

The sucrose gradient bottles were prepared by stratifying the individual sucrose layers. A plastic tube was attached to peristaltic pump tubing. The plastic tube was mounted on a laboratory stand using a clamp and placed into the centrifuge bottle. The nozzle of the plastic tube was touching the bottom of the bottle. Using a peristaltic pump the ZikaV material and the sucrose solutions were pumped into the cylinder. A measuring cylinder was used as feed vessel. The first solution pumped was the ZikaV material as it represented the solution of lowest density (10% sucrose (w/w)). After the ZikaV material the sucrose solutions were pumped in ascending order starting with the 15% (w/w) solution J, followed by 35% sucrose solution I and finishing with the highest density sucrose solution H (50% (w/w)). The described setup is shown in FIG. 14. After all sucrose solutions were transferred the plastic tubing was carefully removed in order not to disturb the layers.

Prior to centrifugation the centrifuge was pre-cooled to 4° C. The prepared SG bottles were carefully transferred into the pre-cooled rotor. (Note: Sudden movement of the bottles during transfer to the rotor must be avoided in order not to disturb the sucrose layers.) The bottles were centrifuged at ~11,000 RCF max at 4° C. for at least 20 hours, no brake/deceleration activated. In case a different centrifuge system with a different rotor is used the necessary speed and centrifugation times need to be calculated based on the k-factor in order to achieve comparable centrifugation efficiency.

Harvesting of the sucrose gradient was done manually using a peristaltic pump. A plastic tube attached to peristaltic pump tubing was used for harvesting the sucrose gradient. The bottle containing the gradient was mounted onto a laboratory stand in a tilted position (~12°) using a clamp. The plastic tubing was then placed into the bottle touching the bottom edge of the bottle and was fastened in position using a clamp. This resulted in a small gap of 1-2 mm between the tubing inlet and the bottom of the bottle (see FIG. 14).

Using a peristaltic pump set to a flow rate of 30 mL per minute the gradient was harvested and manually split into 2 mL fractions. A total number of 32 fractions per bottle were harvested (~64 mL) and the remaining volume was discarded. The fractions were immediately tested by SDS-PAGE/silver stain to identify the virus containing fractions with sufficient high purity. Representative SDS-PAGE is shown in FIG. 14. Fraction 10-14 were pooled and further processed.

The purified viral solution was inactivated by incubation with 0.02% formaldehyde over a period of ten days in a 22° C. controlled-temperature incubator. The formaldehyde is neutralized by addition of sodium metabisulphite on the tenth day.

The sucrose gradient pool (~17 mL after sampling) was further diluted 3-fold with PBS to a final volume of 51 mL.

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in a PETG container. A volume of 1% formaldehyde (10,000 ppm) solution equivalent to 1/50 of the final volume of the pre-formaldehyde pool was added to this pool resulting in an effective concentration of 200 ppm. The formaldehyde-treated solution was mixed on a magnetic stirrer for 10 minutes. After sampling, the formaldehyde-treated viral solution was placed within a cooled incubator at 22° C.±2° C. On Day 5 post addition of formaldehyde, the formaldehyde-treated viral solution was filtered through a 0.2 µm filter and then placed in the incubator at 22° C.±2° C. again. On Day 10, after removing the 10-Day inactivation final sample, a volume of 1% (of the weight of the final formaldehyde-treated viral solution) of 200 mM-sodium metabisulphite solution (2 mM final concentration) was aseptically transferred into the PETG container containing the formaldehyde-treated viral solution. After mixing for 5 minutes on a magnetic stirrer, the neutralized inactivated viral solution is held at room temperature (20 to 25° C.) for a minimum of 30 minutes. After sampling, the neutralized inactivated viral solution is stored at 5° C.±3° C. until further processing.

Inactivation by Formaldehyde

Critical parameters for this step are final formalin concentration, temperature, mixing and transfer into a new container. A preliminary acceptance criterion for maximum pfu/mL (determined by plaque assay) has been set on the diluted pool pre formaldehyde treatment.

The quality of the neutralized inactivated viral solution was monitored by the following parameters: Plaque assay on Day 10, SEC-HPLC, SDS-PAGE/Western Blot.

Interestingly, SEC-HPLC analysis of samples taken during the inactivation period followed by neutralization with bisulfite showed more or less constant peak area throughout the inactivation period. This is in contrast to JEV where losses of viral particles up to 60% are observed using the process disclosed by Srivastava et al. Vaccine 19 (2001) 4557-4565. In a scale-down model the viral losses were even much higher due to surface/area ratio at smaller scale and high losses due to unspecific adsorption. Differences of the ZikaV inactivation experiment and JEV inactivation were noticed as follows:

A) Much higher purity of ZikaV SGP pool with regard to residual PS (<2 µg/mL) compared to JEV. The 3-fold ZikaV inactivated sample contained therefore <<1 µg/mL of residual PS. Commercial JEV SGP pool contains on average~120 µg/mL (up to 152 µg/mL possible). The average dilution to inactivation solution of ~14-fold results in a residual PS content up to ~11 µg/mL. It may be that higher amount of residual PS could cause virus precipitation due to cross-linking/reaction with formalin

B) ZikaV inactivation sample contained~10% sucrose (3-fold dilution of SGP pool containing~30-35% sucrose). Sucrose might have stabilizing effect of viral ZikaV particles during treatment with formalin.

Dilution to DS and Formulation with Aluminium Hydroxide (DP)

For preparation of ZikaV drug substance used in mouse potency assay an antigen content (expressed as total viral particles or SEC peak area) of 5 times higher compared to Ixiaro was targeted. The basis for determination of antigen content was SEC-HPLC. Briefly, a Superose 6 10/300 Increase column (GE Healthcare) equilibrated with PBS+ 250 mM NaCl, pH 7.4 at 1 ml/min and 25° C., was used to detect ZikaV at 214 nm detection wavelength in harvest samples and throughout the downstream process. In the current JEV process the antigen content in NIV is deter-

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mined by a specific ELISA. A good correlation was observed between antigen content determined by ELISA and SEC-HPLC. On average, the antigen content in commercial NIV samples is in the range of 33 AU/mL corresponding to ~5.2 mAU JEV peak area, see FIG. 21.

ZikaV NIV day10 (Zika peak~36 mAU, analysed on Waters HPLC/Superose6 Increase column) was diluted with PBS to a target of 6.3 (~5.7× dilution). Aluminium hydroxide was added to a final concentration of 0.5 mg/mL Aluminium (1/20 v/v Alum 2% stock solution added) to prepare ZikaV Drug Product (DP). The DP was gently mixed for 5 min. An aliquot of the DP was removed, Alum sedimented by centrifugation and the clear supernatant analysed by SEC-HPLC. No ZikaV peak was detected in the supernatant indicating complete adsorption (estimated as >95%) of viral particles on the mineral adjuvant. Formulated ZikaV DP was stored at 2-8° C.

The impurity profile of the inactivated Zika virus DS is comparable to the profile of JEV DS with the exception of a lower PS content (Table 6).

TABLE 6

Determination of impurity profile in Zika and JEV DS samples:			
	Specification (JEV DS)	JEV	Zika
HCP (ng/mL)	<100 LOQ 12 ng/mL	<LOQ	<LOQ
DNA (pg/mL)	<200 LOQ 40 pg/mL	<40	<40
Aggregates by SEC-MALLS (%)	Not specified, part of characterization LOQ 5%	<LOQ	<LOQ
PS (µg/mL)	Specification only at SGP pool to demonstrate consistent process performance (19-152 µg/mL), *PS content in DS calculated based on PS content in SGP pool (~100 µg/mL) and average dilution factor (~28x) to DS; LOQ 2 µg/mL	~4*	<<LOQ

*Typical PS impurity in a JEV sample produced in accordance with protocol disclosed in Srivastava et al. Vaccine 19 (2001) 4557-4565.

SEC-MALLS Results

A representative SEC-HPLC elution profile of ZikaV NIV at 214 nm detection wave length is shown in FIG. 16. Note that BSA (50 µg/mL) was added to the sample to minimize losses in HPLC glass vial due to unspecific surface adsorption. ZikaV monomer content was estimated as ~98% with a multimer content of ~2%.

SEC-MALLS analysis (FIG. 17) of the sample confirmed the radius Rz of the monomer ZikaV population peak 1 as 21.6 nm and ~49 nm for the multimer peak 2. Cumulative particle size distribution showed that 89% of all viral particles are within a radius range between 18 to 25 nm (FIG. 18).

Results confirm purity and homogeneity of ZikaV NIV. Viral Titer by Plaque Assay

TABLE 7

Active ZikaV pfus were quantified by plaque assay throughout the process.	
Sample	Pfu/mL
Harvest day 2 (filtered)	6.4 × 10 ⁷
Harvest day 3 (filtered)	1.0 × 10 ⁸
Harvest day 5 (filtered)	1.5 × 10 ⁸
Harvest day 7 (filtered)	1.1 × 10 ⁸
PS treated harvest 300x concentrate (=SGP load)	9.0 × 10 ⁸

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TABLE 7-continued

Active ZikaV pfus were quantified by plaque assay throughout the process.	
Sample	Pfu/mL
SGP pool	8.9×10^8
Inactivation start (SGP pool 1:3 diluted)	3.4×10^8
Inactivation day 5	<LOD
Inactivation day 10	<LOD

Comparison of PS and Benzonase on Process Performance

A direct comparison of DNA removal method of concentrated ZikaV harvest pool was done. One aliquot was treated with PS (2 mg/mL, 15 min at room temperature), the other aliquot was treated with Benzonase (50 U/mL, 2 mM MgCl₂, 4 h RT, 48 h 2-8° C.). Both samples were further purified by sucrose gradient as described in this report. Interestingly, the Benzonase treated samples did not yield any pure fractions after sucrose gradient centrifugation of the treated ZikaV harvest. In those fractions where the specific virus bands were detected, a high amount of host cell protein was detected throughout the collected fractions. The PS treated material resulted in pure ZikaV containing fractions as expected. This finding may suggest that PS is not only effective for DNA removal by precipitation; in addition it improves the recovery of virus particles in the gradient by disrupting interaction of DNA (fragments) and virus particles. Benzonase treatment does not remove DNA, it only results in its fragmentation. Residual DNA fragments might still interact with virus particles and residual HCPs resulting in cross-contamination and co-purification in the sucrose gradient. Pooled SGP fractions were also analysed by SEC-HPLC. Although a large peak was detected, SDS-PAGE confirmed that this sample was highly contaminated with HCPs. A large peak might be detected at UV214 and 280 nm after SEC-HPLC analysis due to possible interaction of HCPs with large virus particles, changing the UV absorbance.

Immunogenicity of Vero Grown Zika Virus Immunization of Mice

Prior to immunization, groups of ten 6-week-old female CD1 mice were bled via vena facialis and pre-immune sera were prepared. One intraperitoneal immunizations of 200 µL were administered. A dose titration (12 µg, 3 µg, 1 µg, 0.33 µg, 0.11 µg, 0.037 µg and 0.012 µg, equivalent to the protein amount in IXIARO) of inactivated Zika virus formulated with aluminium hydroxide (Al(OH)₃) at a final concentration of 0.7%. Three weeks after immunization, blood was collected and immune sera were prepared. All animal experiments were conducted in accordance with Austrian law (BGB1 Nr. 501/1989) and approved by "Magistratsabteilung 58".

Plaque Reduction Neutralization Test (PRNT)

Twelve well plates were used for PRNT. Each well was seeded with 1 mL medium containing 4×10^5 Vero cells and incubated 35° C. with 5% CO₂ overnight. Pools of heat inactivated sera from each dose group were tested in triplicate. The target viruses (H/PF/2013 (SEQ ID NO: 13) or MR766 (SEQ ID NO: 11)) were diluted to 100 pfu/165 µL. Equal volumes of target virus and serum dilution were incubated at 35° C. with 5% CO₂ for 1 hour. The cell culture medium was aspirated from the Vero cells and 330 µL of the mixture target virus/serum dilution were added to each well and the plates were rocked back and forth 5 times before incubating for 2 hours at 35° C. with 5% CO₂. To each well

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1 mL of a 2% methylcellulose solution containing EMEM and nutrients was added, the plates were then incubated for 5 days at 35° C. with 5% CO₂ before staining the cells for 1 hour with crystal violet/5% formaldehyde and subsequently washed 3 times with deionized water. The plates were air dried and the numbers of plaques in each well were manually counted.

Results

Neutralization was observed with serum pools from mice immunized with inactivated Zika virus vaccine (H/PF/2013) down to 37 ng (dosing equivalent to the amount protein in IXIARO®) against Zika viruses of both the Asian (H/PF/2013) and African (MR766) lineages (FIGS. 19 and 20, respectively). Complete inhibition was seen at the 1:20 serum dilution with an immunization dose down to 110 ng (dosing equivalent to the amount protein in IXIARO®). The neutralization of both the Asian (H/PF/2013) and African (MR766) lineages of the Zika virus was equivalent, which indicates high cross-neutralization between different Zika virus strains of the inactivated Zika virus vaccine (H/PF/2013).

Another neutralization assay was performed using the microneutralization assay as described by Larocca, et al. (2016, Nature doi:10.1038/nature18952). It was found that the inactivated Zika virus of the current invention had an MN50 (microneutralization) titer of 90 at 1 µg of inactivated purified virus.

Further methods: The immunogenicity of inactivated Zika virus preparations is assessed using a mouse model of Zika infection. Groups of adult mice are immunized subcutaneously (s.c.) with 500, 50, or 5 ng of inactivated Zika virus with adjuvant (e.g. aluminium hydroxide with or without IC31®), or without adjuvant. An additional group of mice receive PBS as a negative control. Each group is administered the indicated inoculum at t=0 and in some cases also at three to four weeks later (t=3/4). Beginning approximately three weeks after administration of the last immunization, serum samples are obtained from each of the mice at regular intervals. The serum samples are tested for the presence of neutralizing antibodies using PRNT.

The in vivo protective efficacy of the inactivated Zika virus preparations is also assessed using a mouse model of Zika infection, i.e. IFN-alpha/beta receptor knock-out mice (A129) (see e.g. Dowall et al., 4. Mar. 2016, dx.doi.org/10.1101/042358) or blocking of the IFN-alpha/beta receptor by administration of anti-IFN-alpha/beta receptor monoclonal antibodies to C57BL/6 or BALB/c mice (see e.g. Pinto et al., 7. Dec. 2011, DOI: 10.1371/journal.ppat.1002407). For protection assays, groups of 10 three- to eight-weeks-old A129, C57BL/6 or BALB/c mice are inoculated subcutaneously in the hindquarters with inactivated Zika virus with adjuvant (aluminium hydroxide) or without adjuvant at t=0. Age-matched controls are inoculated with PBS or non-specific antigens in alum. Mice are optionally boosted with a second administration of the indicated inoculation three to four weeks later. The mice are then challenged subcutaneously at three to eight weeks post immunization by inoculation with a deadly dose of live Zika virus. One day prior to challenge of C57BL/6 and BALB/c mice, they are passively administered (intraperitoneally) anti-IFN-alpha/beta receptor monoclonal antibodies. Challenged mice are monitored daily for morbidity and mortality for up to twenty-one days. Another alternative is to challenge intracranially adult vaccinated/non-vaccinated adult mice and observe protection.

It is expected that the Zika virus produced by the process of the invention will provide very similar functional read-

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outs in in vitro, in vivo and finally human trials as the currently licensed JEV vaccine in the EU and US and elsewhere, IXIARO®. The dosage may alter but due to the very similar impurity profile and almost identical manufacture, a very similar efficacy and safety result will be expected as was determined for the currently licensed JEV vaccine (licensed in the EU and US and elsewhere).

Discussion & Conclusion

The existing manufacturing platform for production of inactivated JEV vaccine IXIARO® was used as a basis for a manufacturing feasibility study of inactivated ZikaV vaccine candidate (Asian strain H/PF/2013). The virus was produced on Vero cells cultivated in roller bottles. The virus was purified by PS treatment followed by an optimized sucrose gradient. Inactivation was done by formalin treatment (0.02%, 10 days at 22° C.). For exploratory immunization studies in mice, a DP formulated with Alum was prepared with an estimated 5-fold higher virus particle content compared to IXIARO®, the commercial JEV Vaccine. The impurity profile of the DS met all criteria as defined in the specification for IXIARO®, the commercial JEV vaccine. The neutralization of both the Asian (H/PF/2013) and African (MR766) lineages of the Zika virus was equivalent, which indicates high cross-neutralization between different Zika virus strains of the inactivated Zika virus vaccine (H/PF/2013).

The in vivo data regarding immunogenicity of the inactivated Zika virus vaccine of the current invention indicates that the virus is surprisingly potently immunogenic and also highly cross-protective (very similar immunogenicity in African and Asian strains). Data indicate that immunogenicity was higher than the recently reported inactivated Zika virus vaccine candidate (Larocca, et. al, 2016, supra.). Inactivated viruses are among the safest vaccines and especially preferred for deliver to populations where safety is especially concerning, such as pregnant women, children and immunocompromised individuals, which makes the herein disclosed inactivated Zika virus particularly suitable. Obtaining a high titer of inactivated virus is a challenge in the field. The herein disclosed process for purifying inactivated Zika virus results in not only a high yield, but also a very pure drug substance.

Further more detailed aspects of the invention:

A1. A Zika virus vaccine comprising an inactivated Zika virus particle, wherein the Zika virus particle is able to seroconvert a subject that is administered the Zika virus vaccine with at least a 70% probability.

A2. The Zika virus vaccine of A1, wherein the Zika virus particle is able to seroconvert the subject that is administered the Zika virus vaccine with at least a 80%, 85%, 90%, or 95% probability.

A3. The vaccine of A1 or A2, wherein the Zika virus particle has a RNA genome corresponding to the DNA sequence provided by any one of the nucleic acid sequences of SEQ ID NOs: 2-13 or 72, or a variant nucleic acid sequence that is at least 88% identical to any one of SEQ ID NOs: 2-13 or 72 and able to pack a virulent Zika virus.

A4. The vaccine of any one of A1-A3, wherein the Zika virus particle has an E protein selected from the amino acid sequences provided by any one of SEQ ID NOs: 14-69, or a variant amino acid sequence that is at least 95% identical to any one of SEQ ID NOs: 14-69 and able to pack a virulent Zika virus.

A5. The vaccine of any one of A1-A4, wherein the Zika virus is inactivated by chemical inactivation, thermal inactivation, pH inactivation, or UV inactivation.

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A6. The vaccine of A5, wherein the chemical inactivation comprises contacting the Zika virus with a chemical inactivation agent to completely inactivate the Zika virus as measured by plaque assay.

A7. The vaccine of A6, wherein the chemical inactivation comprises contacting the Zika virus with formaldehyde.

A8. The vaccine of A7, wherein the formaldehyde inactivation comprises contacting the Zika virus with formaldehyde for between 2-10 days.

A9. The vaccine of any one of A5-A8, wherein the chemical activation is performed at about +4° C. or about +22° C.

A10. The vaccine of any one of A1-A9, further comprising an adjuvant.

A11. The vaccine of A10, wherein the adjuvant is an aluminum salt adjuvant.

A12. The vaccine of A11, wherein the aluminum salt adjuvant is aluminium hydroxide or aluminium phosphate salt.

A13. The vaccine of any one of A10-A12, wherein the vaccine comprises or further comprises an adjuvant comprising a peptide and a deoxynucleoside-containing immunostimulatory oligodeoxynucleic acid molecule (I-ODN).

A14. The vaccine of A13, wherein the peptide comprises the sequence KLKL5KLK (SEQ ID NO: 71) and the I-ODN comprises oligo-d(IC)13 (SEQ ID NO: 70).

A15. The vaccine of any one of A1-A14, further comprising one or more pharmaceutically acceptable excipient.

A16. The vaccine of any one of A1-A15, wherein the vaccine contains protamine sulphate or fragments or breakdown products of PS at amounts too low to detect by HPLC, i.e., below 1 µg/mL, especially below 100 ng/mL.

A17. The vaccine of A16, wherein said protamine sulphate or fragments or breakdown products of PS can be detected by mass spectroscopy or another sensitive method.

B1. A kit comprising a Zika virus vaccine of any one of A1-A15.

B2. The kit of B1, further comprising a second vaccine.

B3. The kit of B2, wherein the second vaccine is a West Nile virus vaccine, a Japanese Encephalitis virus vaccine, a Yellow Fever virus vaccine, a Dengue virus vaccine or a Chikungunya virus vaccine.

C1. A method, comprising administering a first dose of a therapeutically effective amount of the Zika virus vaccine of any one of A1-A15 to a subject in need thereof.

C2. The method of C1, further comprising administering a second dose of a therapeutically effective amount of the Zika virus vaccine.

C3. The method of C1 or C2, wherein the second dose of the Zika virus vaccine is administered about 7 days after the first dose of the Zika virus vaccine.

C4. The method of C1 or C2, wherein the second dose of the Zika virus vaccine is administered about 14 days after the first dose of the Zika virus vaccine.

C5. The method of C1 or C2, wherein the second dose of the Zika virus vaccine is administered about 28 days after the first dose of the Zika virus vaccine.

C6. The method of any one of C1-05, wherein the administering results in production of Zika virus neutralizing antibodies.

D1. A method of producing a Zika virus vaccine, comprising

(i) passaging a Zika virus on Vero cells, thereby producing a culture supernatant comprising the Zika virus;

(ii) harvesting the culture medium of (i);

(iii) precipitating the harvested culture medium of (ii), thereby producing a Zika virus supernatant; and

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(iv) optimally inactivating the Zika virus in the Zika virus supernatant of (iii) thereby producing an inactivated Zika virus.

D2. The method of D1, further comprising concentrating the culture medium of (ii) prior to step (iii).

D3. The method of D1 or D2, wherein the precipitating of (iii) comprises contacting the culture medium of (ii) with protamine sulfate or benzoate.

D4. The method of any one of D1-D3, further comprising (v) dialyzing the inactivated Zika virus of (iv), thereby producing a dialyzed Zika virus.

D5. The method of D4, further comprising (vi) filtering the dialyzed Zika virus of (v).

D6. The method of any one of D1-D5, wherein the inactivating is by chemical inactivation, thermal inactivation, pH inactivation, or UV inactivation.

D7. The method of D6, wherein the chemical inactivation comprises contacting the Zika virus with a chemical inactivation agent for at least 4 days.

D8. The method of D6 or D7, wherein the chemical inactivation agent comprises formaldehyde.

D9. The method of any one of D6-D8, wherein the chemical activation is performed at about +4° C. or about +22° C.

D10. The method of D8 or D9, further comprising neutralizing the formaldehyde.

D11. The method of D10, wherein the neutralizing is performed with sodium metabisulfite.

E1. The use of the optimally inactivated Zika virus vaccine of any one of A1-A15 for the treatment and/or prevention of a Zika virus infection.

E2. The use of E1, wherein the inactivated Zika virus vaccine is administered in a first dose of a therapeutically effective amount to a subject in need thereof.

E3. The use of E2, wherein the inactivated Zika virus vaccine is administered in a second dose of a therapeutically effective amount to the subject.

E4. The use of E3, wherein the second dose of the inactivated Zika virus vaccine is administered about 7 days after the first dose of the Zika virus vaccine.

E5. The use of E3, wherein the second dose of the Zika virus vaccine is administered about 14 days after the first dose of the Zika virus vaccine.

E6. The use of E3, wherein the second dose of the Zika virus vaccine is administered about 28 days after the first dose of the Zika virus vaccine.

E7. The use of any one of E1-E6, wherein the vaccine administration results in production of Zika virus neutralizing antibodies.

F1. A pharmaceutical composition for use in the treatment or prevention of a Zika virus infection, wherein said pharmaceutical composition comprises the optimally inactivated Zika virus vaccine of any one of A1-A15.

F2. The pharmaceutical composition of F1, wherein the inactivated Zika virus vaccine is administered in a first dose of a therapeutically effective amount to a subject in need thereof.

F3. The use of F2, wherein the inactivated Zika virus vaccine is administered in a second dose of a therapeutically effective amount to the subject.

F4. The use of F3, wherein the second dose of the inactivated Zika virus vaccine is administered about 7 days after the first dose of the Zika virus vaccine.

F5. The use of F3, wherein the second dose of the Zika virus vaccine is administered about 14 days after the first dose of the Zika virus vaccine.

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F6. The use of F3, wherein the second dose of the Zika virus vaccine is administered about 28 days after the first dose of the Zika virus vaccine.

F7. The use of any one of F1-F6, wherein the vaccine administration results in production of Zika virus neutralizing antibodies.

G1. Use of an optimized sucrose gradient centrifugation for removal of protamine sulphate from purified infectious Zika virus particles.

G2. The use according to G1, wherein said optimized sucrose gradient centrifugation comprises a virus comprising fraction in a 10%+/-1% (w/w) sucrose solution and three further layers of sucrose solutions with different densities, i.e. a first sucrose solution with 15%+/-1% (w/w) sucrose, a second sucrose solution with 35%+/-1% (w/w) sucrose, and a third sucrose solution with a 50%+/-1% (w/w) sucrose.

G3. A process of purification of infectious Zika virus particles, comprising the steps of:

- a) providing a crude harvest (a) comprising virus particles and impurities, wherein the impurities are generated from growing said virus particles on a cell substrate;
- b) reducing impurities from the crude harvest (a) by precipitation with an agent comprising protamine, preferably a protamine salt, more preferably a protamine sulphate, even more preferably a recombinant protamine sulphate, to obtain a virus preparation (b);
- c) further purifying the virus preparation (b) by an optimized sucrose density gradient centrifugation, wherein the optimized sucrose gradient is provided such that the protamine can be completely or almost completely separated from the virus fraction; and wherein the protamine concentration is reduced by this step to the extent that the protamine concentration in the final drug substance is below 1 µg/ml, preferably below 0.5 µg/mL, more preferably below 0.1 µg/mL, most preferably below 0.05 µg/mL.

G4. The process of G3, wherein said optimized sucrose density gradient centrifugation comprises a virus comprising fraction in a 10%+/-1% (w/w) sucrose solution and three layers of sucrose with different densities, i.e. a first sucrose solution with 15%+/-1% (w/w) sucrose, a second sucrose solution with 35%+/-1% (w/w) sucrose, and a third sucrose solution with a 50%+/-1% (w/w) sucrose.

G5. The process of any one of G3 to G4, additionally comprising a further purification step of: (d) a solid-phase matrix packed in a column comprising a ligand-activated core and an inactive shell comprising pores, wherein the molecular weight cut off of the pores excludes the virus particles from entering the ligand-activated core, and wherein a molecule smaller than the molecular weight cutoff of the pores can enter the ligand-activated core and collecting the virus particles.

G6. The process of any of G3 to G5, wherein the residual host cell DNA content of the Zika virus preparation (c) is less than 10 ng/mL and the residual host cell protein content of the final virus preparation (c) is less than 100 ng/mL.

G7. The process of any of G3 to G6, wherein said crude harvest (a) comprising Zika virus particles and impurities is subjected to one or more pre-purification step(s) prior to step (b).

G8. The process of G7, wherein the one or more pre-purification step(s) comprises

- a) filtration using a filter having a pore size equal to or less than 0.2 µm; and/or
- b) digestion of host cell genomic DNA by enzymatic treatment; and/or

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c) ultra/diafiltration using a hollow fiber membrane having a pore size equal to or greater than 300 kDa, preferably equal to or greater than 100 kDa.

G9. The process of any one of G3 to G8, wherein the concentration of protamine sulphate is 0.5 to 3 mg/ml, more preferably 1 to 2 mg/ml, more preferably 1.2 to 1.8 mg/ml, more preferably 1.4 to 1.6 mg/ml, most preferably 1.6 mg/ml or 2 mg/ml.

G10. The process of any one of G3 to G9, wherein the enrichment of infectious Zika virus particles in the virus preparation (c) or any final virus preparation relative to total virus products in the crude harvest (a) is in the range from at least 50% to 95%, preferably at least 80%.

G11. The process of any one of G7 to G10, wherein the one or more pre-purification step(s) prior to step (b) of any of G8 to G11 is performed using a filter having a pore size equal to or less than 1 μ m, preferably 0.2 μ m.

G12. The process of any one of G3 to G11, wherein the residual impurity of the Zika virus preparation (c) is less than 10%.

G13. The process of any one of G3 to G12, wherein the Zika virus is propagated in a cell line selected from the group consisting of an EB66 cell line, a Vero cell line, a Vero- α His cell line, a HeLa cell line, a HeLa-S3 cell line, a 293 cell line, a PC12 cell line, a CHO cell line, a 3T3 cell line, a PerC6 cell line, a MDSK cell line, a chicken embryonic fibroblast cell line, a duck cell line, and a diploid avian cell line.

G14. The process of G13, wherein said cell line is a Vero cell line.

G15. The process of any one of G3 to G14, wherein said infectious Zika virus particle is an infectious virus particle that is a live virus, a live attenuated virus, a chimeric virus, a modified live virus, or a recombinant live virus.

G16. The process of any one of G3 to G15, wherein said Zika virus is preferably a strain of the Asian lineage.

G17. The process of any one of G3 to G16, wherein said process resulting in final virus preparation (c) or (d) is followed by an inactivation step, wherein the virus is inactivated preferably by formaldehyde.

G18. Use of the process according to any one of G3 to G17 for manufacturing a composition for immunization against a virus infection.

G19. The use according to G18, wherein said virus infection is an infection caused by a Zika virus.

Q1. A process of purification of infectious Zika virus particles, comprising the steps of:

(a) providing a crude harvest (a) comprising Zika virus particles and impurities, wherein the impurities are generated from growing said virus particles on a cell substrate;

(b) reducing impurities from the crude harvest (a) by precipitation with an agent comprising protamine, preferably a protamine salt, more preferably a protamine sulphate, even more preferably a recombinant protamine sulphate, to obtain a virus preparation (b);

(c) further purifying the virus preparation (b) by an optimized sucrose density gradient centrifugation, wherein the optimized sucrose gradient is provided such that the protamine can be completely or almost completely separated from the virus fraction; and wherein the protamine concentration is reduced by this step to the extent that the protamine concentration in the final drug substance is below 1 μ g/ml, preferably below 0.5 μ g/ml, more preferably below 0.1 μ g/ml, most preferably below 0.05 μ g/ml.

Q2. The process of Q2, wherein the virus particles are from Zika virus.

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Q3. The process of Q1 or Q2, additionally comprising the step of:

(d) a solid-phase matrix packed in a column comprising a ligand-activated core and an inactive shell comprising pores, wherein the molecular weight cut off of the pores excludes the virus particles from entering the ligand-activated core, and wherein a molecule smaller than the molecular weight cutoff of the pores can enter the ligand-activated core and collecting the virus particles.

Q4. The process of any of Q1 to 3, wherein the residual host cell DNA of the virus preparation (c) is less than 10 ng/mL and the residual host cell protein of the final virus preparation (c) is less than 100 ng/mL.

Q5. The process of any of Q1 to 4, wherein the crude harvest (a) comprising virus particles and impurities is subjected to one or more pre-purification step(s) prior to step (b).

Q6. The process of Q5, wherein the one or more pre-purification step(s) comprises

(a) filtration using a filter having a pore size equal to or less than 0.2 μ m; and/or

(b) digestion of host cell genomic DNA by enzymatic treatment; and/or

(c) ultra/diafiltration using a hollow fiber membrane having a pore size equal to or greater than 300 kDa, preferably equal to or greater than 100 kDa.

Q7. The process of any one of Q1 to 6, wherein the concentration of protamine sulphate is 0.5 to 3 mg/ml, more preferably 1 to 2 mg/ml, more preferably 1.2 to 1.8 mg/ml, more preferably 1.4 to 1.6 mg/ml, most preferably 1.6 mg/ml or 2 mg/ml.

Q8. The process of any one of Q1 to 7, wherein the enrichment of infectious virus particles in the virus preparation (c) or any final virus preparation relative to total virus products in the crude harvest (a) is in the range from at least 50% to 95%, preferably at least 80%.

Q9. The process of any one of Q5 to 8, wherein the one or more pre-purification step(s) prior to step (b) of any of Q5 to 8 is performed using a filter having a pore size equal to or less than 1 μ m, preferably 0.2 μ m.

Q10. The process of any one of Q1 to 9, wherein the residual impurity of the virus preparation (c) is less than 10%.

Q11. The process of any one of Q1 to 10, wherein the virus is propagated in a cell line selected from the group consisting of an EB66 cell line, a Vero cell line, a Vero- α His cell line, a HeLa cell line, a HeLa-S3 cell line, a 293 cell line, a PC12 cell line, a CHO cell line, a 3T3 cell line, a PerC6 cell line, a MDSK cell line, a chicken embryonic fibroblast cell line, a duck cell line, and a diploid avian cell line.

Q12. The process of Q11, wherein said cell line is a Vero cell line.

Q13. The process of any one of Q1 to 12, wherein the infectious virus particles is an infectious Zika virus particle that is a live virus, an attenuated live virus, a chimeric virus, a modified live virus, or a recombinant live virus.

Q14. The process of any one of Q1 to 13, wherein the Zika virus is a Zika virus strain of the Asian lineage or an immunogenic variant thereof.

Q15. The process of any one of Q1 to 14, wherein said process resulting in final virus preparation (c) or (d) is followed by an inactivation step, wherein the virus is inactivated preferably by formaldehyde.

Q16. Use of the process according to any one of Q1 to 15 for manufacturing a composition for immunization against a virus infection.

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Q17. The use according to Q16, wherein the composition for immunization against a virus infection is an infection caused by Zika virus.

Q18. A composition comprising the virus particles obtainable or obtained by the process of any one of Q1 to 17 for treating and/or preventing an infection, such as e.g. a Zika virus infection.

Q19. A Zika virus vaccine comprising an inactivated Zika virus particle grown on vero cells, wherein the Zika virus particle is able to seroconvert a subject that is administered the Zika virus vaccine with at least a 70% probability and comprises minor amounts of protamine sulphate, preferably below the detection limit.

Q20. The Zika virus vaccine of Q19, wherein the Zika virus particle is able to seroconvert the subject that is administered the Zika virus vaccine with at least a 80%, 85%, 90%, or 95% probability, preferably a 80% probability.

Q21. The vaccine of Q19 or 20, wherein the Zika virus particle has a RNA genome corresponding to the DNA sequence provided by any one of the nucleic acid sequences of SEQ ID NOs: 2-13, or a variant nucleic acid sequence that is at least 88% identical to any one of SEQ ID NOs: 2-13 and able to pack a virulent Zika virus.

Q22. The vaccine of any one of Q19, 20 and 21, wherein the Zika virus particle has an E protein selected from the amino acid sequences provided by any one of SEQ ID NOs: 14-69 or 72, or a variant amino acid sequence that is at least 95% identical to any one of SEQ ID NOs: 14-69 or 72 and able to pack a virulent Zika virus.

Q23. The vaccine of any one of Q19, 20 to 22, wherein the Zika virus obtained by culturing on Vero cells is purified by protamine sulfate precipitation and sucrose gradient centrifugation.

Q24. The vaccine of Q23, wherein the sucrose gradient centrifugation is an optimized sucrose gradient centrifugation.

Q25. The vaccine of Q24, wherein the optimized sucrose gradient centrifugation comprises a virus comprising fraction in a 10% (w/w) sucrose solution and three layers of sucrose with different densities, i.e. a first sucrose solution with 15% (w/w) sucrose solution, a second sucrose solution with 35% (w/w) sucrose solution, and a third sucrose solution with a 50% (w/w) sucrose solution.

Q26. The vaccine of any one of Q19, 20 to 25, wherein the Zika virus is inactivated by chemical inactivation, thermal inactivation, pH inactivation, or UV inactivation.

Q27. The vaccine of Q26, wherein the chemical inactivation comprises contacting the Zika virus with a chemical inactivation agent for longer than is required to completely inactivate the Zika virus as measured by plaque assay.

Q28. The vaccine of Q27, wherein the chemical inactivation comprises contacting the Zika virus with formaldehyde.

Q29. The vaccine of Q28, wherein the formaldehyde inactivation comprises contacting the Zika virus with formaldehyde for between 2-10 days.

Q30. The vaccine of any one of Q27-29, wherein the chemical activation is performed at about +4° C. or about +22° C.

Q31. The vaccine of any one of Q19 to 30, further comprising an adjuvant.

Q32. The vaccine of Q31, wherein the adjuvant is an aluminum salt adjuvant.

Q33. The vaccine of Q32, wherein the aluminum salt adjuvant is aluminium hydroxide or aluminium phosphate salt.

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Q34. The vaccine of Q32, wherein the aluminum salt adjuvant is aluminium hydroxide with less than 1.25 ppb Cu based on the final pharmaceutical composition comprising the Zika virus, preferably the inactivated Zika virus.

Q35. The vaccine of any one of Q19 to 34, further comprising one or more pharmaceutically acceptable excipient.

R1. Use of protamine, preferably a protamine salt, to separate infectious and non-infectious Zika virus particles, host cell proteins and/or undefined low molecular weight materials.

R2. A process of purification of infectious Zika virus particles, comprising the steps of:

(a) providing a crude harvest (a) comprising Zika virus particles and impurities, wherein the impurities are generated from growing said virus particles on a cell substrate;

(b) reducing impurities from the crude harvest (a) by precipitation with an agent comprising protamine, preferably a protamine salt, more preferably a protamine sulphate, even more preferably a recombinant protamine sulphate, to obtain a virus preparation (b), wherein the enrichment of infectious virus particles in the virus preparation (b) relative to total virus products in the crude harvest (a) is in the range from at least 50% to 95%, preferably at least 80%.

R3. The use of R1 or the process of R2, wherein the virus particles are from Zika virus.

R4. A process of purification of infectious Zika virus particles, comprising the steps of:

(a) providing a crude harvest (a) comprising Zika virus particles and impurities, wherein the impurities are generated from growing said virus particles on a cell substrate;

(b) reducing impurities from the crude harvest (a) by precipitation with an agent comprising protamine, preferably a protamine salt, more preferably a protamine sulphate, even more preferably a recombinant protamine sulphate, to obtain a virus preparation (b);

(c) further purifying the virus preparation (b) by one or more size exclusion methods such as (i) a sucrose density gradient centrifugation, (ii) a solid-phase matrix packed in a column comprising a ligand-activated core and an inactive shell comprising pores, wherein the molecular weight cut off of the pores excludes the virus particles from entering the ligand-activated core, and wherein a molecule smaller than the molecular weight cutoff of the pores can enter the ligand-activated core and collecting the virus particles, and/or (iii) size exclusion chromatography to obtain a virus preparation (c) comprising the infectious virus particles, wherein the residual host cell DNA of the virus preparation (c) is less than 100 ng/mL and the residual host cell protein and the residual aggregates of infectious virus particles of the final virus preparation (c) is less than 1 µg/mL.

R5. The process of R4, wherein the residual host cell DNA of the virus preparation (c) is less than 10 ng/mL and the residual host cell protein of the final virus preparation (c) is less than 100 ng/mL.

R6. The process of any of R2 to 5, wherein the crude harvest (a) comprising virus particles and impurities is subjected to one or more pre-purification step(s) prior to step (b).

R7. The process of R6, wherein the one or more pre-purification step(s) comprises

(a) filtration using a filter having a pore size equal to or less than 0.2 µm; and/or

(b) digestion of host cell genomic DNA by enzymatic treatment; and/or

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(c) ultra/diafiltration using a hollow fiber membrane having a pore size equal to or greater than 300 kDa, preferably equal to or greater than 100 kDa.

R8. The process of any one of R2 to 7, wherein the concentration of protamine sulphate is 0.5 to 3 mg/ml, more preferably 1 to 2 mg/ml, more preferably 1.2 to 1.8 mg/ml, more preferably 1.4 to 1.6 mg/ml, most preferably 1.6 mg/ml.

R9. The process of any one of R2 to 8, wherein the enrichment of infectious virus particles in the virus preparation (c) or any final virus preparation relative to total virus products in the crude harvest (a) is in the range from at least 50% to 95%, preferably at least 80%.

R10. The process of any one of R6 to 9, wherein the one or more pre-purification step(s) prior to step (b) of any of R6 to 9 is performed using a filter having a pore size equal to or less than 1 μ m, preferably 0.2 μ m.

R11. The process of any one of R2 to 10, wherein the residual impurity of the virus preparation (c) is less than 10%.

R12. The process of any one of R2 to 11, wherein the virus is propagated in a cell line selected from the group consisting of an EB66 cell line, a Vero cell line, a Vero- α His cell line, a HeLa cell line, a HeLa-S3 cell line, a 293 cell line, a

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PC12 cell line, a CHO cell line, a 3T3 cell line, a PerC6 cell line, a MDSK cell line, a chicken embryonic fibroblast cell line, a duck cell line, and a diploid avian cell line.

R13. The process of R12, wherein said cell line is a Vero cell line.

R14. The process of any one of R2 to 13, wherein the Zika virus is a live virus, an attenuated live virus, a chimeric virus, a modified live virus, or a recombinant live virus.

R15. The process of any one of R2 to 14, wherein the Zika virus is a Zika virus strain of the Asian lineage or an immunogenic variant thereof.

R16. The process of any one of R2 to 15, wherein said process resulting in final virus preparation (c) is followed by an inactivation step, wherein the virus is inactivated preferably by formaldehyde.

R17. Use of the process according to any one of R1 to 16 for manufacturing a composition for immunization against a virus infection.

R18. The use according to R17, wherein the composition for immunization against a virus infection is an infection caused by a Zika virus.

R19. A composition comprising the virus particles obtainable or obtained by the process of any one of R2 to 16 for treating and/or preventing an infection.

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gagttcttcc	tgaatagtc	cgtgaagcca	taaaaacaag	actccgtact	tgatcttag	5220

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atgccacctt	cacttcacgt	ctactacagc	caatcagagt	ccccactat	aatctgtata	5400
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caagggttga	gatgggcgag	gcggtgcga	tcttcatgac	cgccacgcca	ccaggaaacc	5520
gtgacgcatt	tccgactcc	aactcaccaa	ttatggacac	cgaagtggaa	gtcccagaga	5580
gagctggag	ctcaggcttt	gattgggtga	cggatcattc	tggaaaaaca	gtttggttg	5640
ttccaagcgt	gaggaacggc	aatgagatcg	cagcttgtct	gacaaaggct	ggaaaacggg	5700
tcatacagct	cagcagaag	acttttgaga	cagagttcca	gaaaacaaaa	catcaagagt	5760
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atcccaacaa	acctggagat	gagtatctgt	atggaggtgg	gtgcgcagag	actgacgaag	6000
accatgcaca	ctggcttgaa	gcaagaatgc	tccttgacaa	tatttacctc	caagatggcc	6060
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gacacggaga	gaaaagagt	ctcaaaccga	ggtggatgga	cgccagagtt	tgttcagatc	6360
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tgatggaagc	cctgggaaca	ctgccaggac	acatgacaga	gagattccag	gaagccattg	6480
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tgactcttgg	ggccagcgca	tggctcatgt	ggctctcgga	aattgagcca	gccagaattg	6720
catgtgtcct	cattgttgtg	ttcctattgc	tgggtgtgct	catacctgag	ccagaaaagc	6780
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cagctcagc	ttgggccatc	tatgtgcct	tgacaacttt	cattacccca	gccgtccaac	7020
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tgttgtttgg	tatgggcaaa	gggatgccat	tctacgcatg	ggactttgga	gtcccgtgc	7140
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tcgtggcgca	ctacatgtac	ttgatcccag	ggctgcaggc	agcagctgcg	cgtgctgccc	7260
agaagagaac	ggcagctggc	atcatgaaga	accctgttgt	ggatggaata	gtggtgactg	7320
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tagcagtagc	cgtctccagc	gccatactgt	cgcggaccgc	ctgggggtgg	ggggaggctg	7440
gggcctgat	cacagcggca	acttccactt	tgtgggaagg	ctctccgaac	aagtactgga	7500
actcctctac	agccacttca	ctgtgtaaca	tttttagggg	aagttacttg	gctggagctt	7560

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ctctaatacta cacagtaaca agaaacgctg gcttgggtcaa gagacgtggg ggtggaacag	7620
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tgggtggagcg gggatacctg cagccctatg gaaaggatcat tgatcttga tgtggcagag	7860
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aaggaggccc tggatcatgaa gaacccatgt tgggtgcaaag ctatgggtgg aacatagtc	7980
gtcttaagag tggggtggac gtctttcata tggcggtga gccgtgtgac acgttgctgt	8040
gtgacatagg tgagtcatca tctagtctg aagtgaaga agcacggacg ctgagagtc	8100
tctccatggt gggggatttg cttgaaaaa gaccaggagc cttttgtata aaagtgttgt	8160
gccatacac cagcactatg atggaaaccc tggagcgact gcagcgtagg tatgggggag	8220
gactgggtcag agtgcacac tcccgcaact ctacacatga gatgtactgg gtctctggag	8280
cgaagagcaa caccataaaa agtgtgtcca ccacgagcca gctcctcttg gggcgcatgg	8340
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cagaccccca agaaggcact cgtcagggtta tgagcatggt ctcttcttg ttgtggaag	8760
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gtagcaatgc agcattaggg gcaatatgtg aagaggaaaa agagtggaag actgcagtgg	8880
aagctgtgaa cgatccaagg tcttgggtc tagtgggcaa ggaaagagag caccacctga	8940
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ctgaaaaagg gaagacagtt atggacatta tttcgagaca agaccaaagg gggagcggac	9420
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atatgggaaa agtttaggaag gacacacaag agtggaaacc ctcaactgga tgggacaact	9720
gggaagaagt tccgttttgc tcccaccact tcaacaagct ccatctcaag gacgggaggt	9780
ccattgtggt tcctgcgcg caccaagatg aactgattgg ccgggcccgc gtctctccag	9840
gggcgggatg gagcatccgg gagactgctt gcctagcaaa atcatatgag caaatgtggc	9900
agtccttcta tttccacaga agggacctcc gactgatggc caatgccatt tgttcatctg	9960

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tgccagttga ctgggttcca actgggagaa ctacctggtc aatccatgga aaggagaaat 10020
ggatgaccac tgaagacatg cttgtggtgt ggaacagagt gtggattgag gagaacgacc 10080
acatggaaga caagacccca gttacgaaat ggacagacat tccctatttg ggaaaaaggg 10140
aagacttggt gtgtggatct ctcatagggc acagaccgag caccacctgg gctgagaaca 10200
ttaaaaacac agtcaacatg gtgcgcagga tcataggtga tgaagaaaag tacatggact 10260
acctatccac ccaagtgcgc tacttgggtg aagaagggtc tacacctgga gtgctgtaag 10320
caccaatctt agtgttgta ggctgtctag tcagccacag cttggggaaa gctgtgcagc 10380
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gcacggaaga agccatgctg cctgtgagcc cctcagagga cactgagtca aaaaacccca 10500
cgcgcttgga ggcgaggat gggaaaagaa ggtggcgacc ttccccccc ttcaatctgg 10560
ggcctgaact ggagatcagc tgtggatctc cagaagaggg actagtgggt agaggag 10617

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<210> SEQ ID NO 14

<211> LENGTH: 498

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 14

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Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1           5           10          15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20          25          30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35          40          45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50          55          60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65          70          75          80
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85          90          95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100         105         110
Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys
115         120         125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130         135         140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Glu Asn Arg Ala Lys
145         150         155         160
Val Glu Val Thr Pro Asn Ser Pro Arg Ala Glu Ala Thr Leu Gly Gly
165         170         175
Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro Arg Thr Gly Leu Asp Phe
180         185         190
Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn Lys His Trp Leu Val His
195         200         205
Lys Glu Trp Phe His Asp Ile Pro Leu Pro Trp His Ala Gly Ala Asp
210         215         220
Thr Gly Thr Pro His Trp Asn Asn Lys Glu Ala Leu Val Glu Phe Lys
225         230         235         240
Asp Ala His Ala Lys Arg Gln Thr Val Val Val Leu Gly Ser Gln Glu
245         250         255

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Gly Ala Val His Thr Ala Leu Ala Gly Ala Leu Glu Ala Glu Met Asp
 260 265 270
 Gly Ala Lys Gly Arg Leu Phe Ser Gly His Leu Lys Cys Arg Leu Lys
 275 280 285
 Met Asp Lys Leu Arg Leu Lys Gly Val Ser Tyr Ser Leu Cys Thr Ala
 290 295 300
 Ala Phe Thr Phe Thr Lys Val Pro Ala Glu Thr Leu His Gly Thr Val
 305 310 315 320
 Thr Val Glu Val Gln Tyr Ala Gly Thr Asp Gly Pro Cys Lys Val Pro
 325 330 335
 Ala Gln Met Ala Val Asp Met Gln Thr Leu Thr Pro Val Gly Arg Leu
 340 345 350
 Ile Thr Ala Asn Pro Val Ile Thr Glu Ser Thr Glu Asn Ser Lys Met
 355 360 365
 Met Leu Glu Leu Asp Pro Pro Phe Gly Asp Ser Tyr Ile Val Ile Gly
 370 375 380
 Val Gly Asp Lys Lys Ile Thr His His Trp His Arg Ser Gly Ser Thr
 385 390 395 400
 Ile Gly Lys Ala Phe Glu Ala Thr Val Arg Gly Ala Lys Arg Met Ala
 405 410 415
 Val Leu Gly Asp Thr Ala Trp Asp Phe Gly Ser Val Gly Gly Val Phe
 420 425 430
 Asn Ser Leu Gly Lys Gly Ile His Gln Ile Phe Gly Ala Ala Phe Lys
 435 440 445
 Ser Leu Phe Gly Gly Met Ser Trp Phe Ser Gln Ile Leu Ile Gly Thr
 450 455 460
 Leu Leu Val Trp Leu Gly Leu Asn Thr Lys Asn Gly Ser Ile Ser Leu
 465 470 475 480
 Thr Cys Leu Ala Leu Gly Gly Val Met Ile Phe Leu Ser Thr Ala Val
 485 490 495
 Ser Ala

<210> SEQ ID NO 15
 <211> LENGTH: 498
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 15

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125

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Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
  130          135          140

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Glu Asn Arg Ala Lys
  145          150          155          160

Val Glu Val Thr Pro Asn Ser Pro Arg Ala Glu Ala Thr Leu Gly Gly
          165          170          175

Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro Arg Thr Gly Leu Asp Phe
          180          185          190

Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn Lys His Trp Leu Val His
          195          200          205

Lys Glu Trp Phe His Asp Ile Pro Leu Pro Trp His Ser Gly Ala Asp
  210          215          220

Thr Glu Thr Pro His Trp Asn Asn Lys Glu Ala Leu Val Glu Phe Lys
  225          230          235          240

Asp Ala His Ala Lys Arg Gln Thr Val Val Val Leu Gly Ser Gln Glu
          245          250          255

Gly Ala Val His Thr Ala Leu Ala Gly Ala Leu Glu Ala Glu Met Asp
          260          265          270

Gly Ala Lys Gly Arg Leu Ser Ser Gly His Leu Lys Cys Arg Leu Lys
          275          280          285

Met Asp Lys Leu Arg Leu Lys Gly Val Ser Tyr Ser Leu Cys Thr Ala
  290          295          300

Ala Phe Thr Phe Thr Lys Val Pro Ala Glu Thr Leu His Gly Thr Val
  305          310          315          320

Thr Val Glu Val Gln Tyr Ala Gly Arg Asp Gly Pro Cys Lys Val Pro
          325          330          335

Ala Gln Met Ala Val Asp Met Gln Thr Leu Thr Pro Val Gly Arg Leu
          340          345          350

Ile Thr Ala Asn Pro Val Ile Thr Glu Ser Thr Glu Asn Ser Lys Met
          355          360          365

Met Leu Glu Leu Asp Pro Pro Phe Gly Asp Ser Tyr Ile Val Ile Gly
  370          375          380

Val Gly Asp Lys Lys Ile Thr His His Trp His Arg Ser Gly Ser Ile
  385          390          395          400

Ile Gly Lys Ala Phe Glu Ala Thr Val Arg Gly Ala Lys Arg Met Ala
          405          410          415

Val Leu Gly Asp Thr Ala Trp Asp Phe Gly Ser Val Gly Gly Val Phe
          420          425          430

Asn Ser Leu Gly Lys Gly Ile His Gln Ile Phe Gly Ala Ala Phe Lys
          435          440          445

Ser Leu Phe Gly Gly Met Ser Trp Phe Ser Gln Ile Leu Ile Gly Thr
          450          455          460

Leu Leu Val Trp Leu Gly Leu Asn Thr Lys Asn Gly Ser Ile Ser Leu
  465          470          475          480

Thr Cys Leu Ala Leu Gly Gly Val Met Ile Phe Leu Ser Thr Ala Val
          485          490          495

Ser Ala

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<210> SEQ ID NO 16
<211> LENGTH: 504
<212> TYPE: PRT
<213> ORGANISM: Zika virus
<220> FEATURE:
<221> NAME/KEY: misc_feature
<222> LOCATION: (156)..(162)

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<223> OTHER INFORMATION: X=any amino acid

<400> SEQUENCE: 16

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Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1      5      10      15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20      25      30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35      40      45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50      55      60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65      70      75      80
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85      90      95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100     105     110
Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys
115     120     125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130     135     140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Xaa Xaa Xaa Xaa Xaa
145     150     155     160
Xaa Xaa Asn Arg Ala Glu Val Glu Val Thr Pro Asn Ser Pro Arg Ala
165     170     175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180     185     190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195     200     205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210     215     220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225     230     235     240
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245     250     255
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260     265     270
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Phe Ser Gly His
275     280     285
Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
290     295     300
Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Val Pro Ala Glu
305     310     315     320
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
325     330     335
Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
340     345     350
Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
355     360     365
Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
370     375     380
Ser Tyr Ile Val Ile Gly Val Gly Asp Lys Lys Ile Thr His His Trp
385     390     395     400

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His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
405 410 415

Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
420 425 430

Ser Val Gly Gly Val Phe Asn Ser Leu Gly Lys Gly Ile His Gln Ile
435 440 445

Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
450 455 460

Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys
465 470 475 480

Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile
485 490 495

Phe Leu Ser Thr Ala Val Ser Ala
500

<210> SEQ ID NO 17
<211> LENGTH: 504
<212> TYPE: PRT
<213> ORGANISM: Zika virus
<220> FEATURE:
<221> NAME/KEY: misc_feature
<222> LOCATION: (152)..(156)
<223> OTHER INFORMATION: X=any amino acid

<400> SEQUENCE: 17

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20 25 30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35 40 45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50 55 60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100 105 110

Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys
115 120 125

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130 135 140

Gly Ser Gln His Ser Gly Met Xaa Xaa Xaa Xaa Gly His Glu Thr
145 150 155 160

Asp Glu Asn Arg Ala Lys Val Glu Val Thr Pro Asn Ser Pro Arg Ala
165 170 175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180 185 190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195 200 205

Lys His Arg Leu Val Arg Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210 215 220

Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225 230 235 240

Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val

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245				250				255							
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala
	260							265				270			
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Phe	Ser	Gly	His
	275						280					285			
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser
	290					295					300				
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Val	Pro	Ala	Glu
	305				310					315					320
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp
			325							330				335	
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu
		340							345				350		
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser
		355					360						365		
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp
	370					375					380				
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Asp	Lys	Lys	Ile	Thr	His	His	Trp
	385				390					395					400
Leu	Lys	Lys	Gly	Ser	Ser	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg
			405						410					415	
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly
			420						425				430		
Ser	Val	Gly	Gly	Val	Phe	Asn	Ser	Leu	Gly	Lys	Gly	Val	His	Gln	Ile
		435					440						445		
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser
	450					455					460				
Gln	Ile	Leu	Ile	Gly	Thr	Leu	Leu	Val	Trp	Leu	Gly	Leu	Asn	Thr	Lys
	465				470					475					480
Asn	Gly	Ser	Ile	Ser	Leu	Thr	Cys	Leu	Ala	Leu	Gly	Gly	Val	Met	Ile
			485						490					495	
Phe	Leu	Ser	Thr	Ala	Val	Ser	Ala								
			500												

<210> SEQ ID NO 18

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 18

Ile	Arg	Cys	Ile	Gly	Val	Ser	Asn	Arg	Asp	Phe	Val	Glu	Gly	Met	Ser
1				5					10					15	
Gly	Gly	Thr	Trp	Val	Asp	Val	Val	Leu	Glu	His	Gly	Gly	Cys	Val	Thr
		20						25					30		
Val	Met	Ala	Gln	Asp	Lys	Pro	Thr	Val	Asp	Ile	Glu	Leu	Val	Thr	Thr
		35					40					45			
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser
		50				55				60					
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala
	65				70					75				80	
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu
			85					90						95	
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser
			100				105							110	

Leu	Val	Thr	Cys	Ala	Lys	Phe	Thr	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys
		115					120					125			
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His
	130					135					140				
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Ile	Gly	His	Glu	Thr
	145				150					155					160
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Val	Thr	Pro	Asn	Ser	Pro	Arg	Ala
				165					170					175	
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro
			180					185					190		
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn
		195					200					205			
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro
	210					215					220				
Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu
	225				230					235					240
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val
				245					250					255	
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala
			260					265					270		
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Phe	Ser	Gly	His
		275					280					285			
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser
	290					295					300				
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Val	Pro	Ala	Glu
	305				310					315					320
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp
				325					330					335	
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu
			340					345					350		
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser
		355					360					365			
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp
	370					375					380				
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Asp	Lys	Lys	Ile	Thr	His	His	Trp
	385				390					395					400
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg
				405					410					415	
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly
			420					425					430		
Ser	Val	Gly	Gly	Val	Phe	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile
		435					440					445			
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser
	450					455					460				
Gln	Ile	Leu	Ile</												

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<213> ORGANISM: Zika virus

<400> SEQUENCE: 19

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Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1           5           10           15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20           25           30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35           40           45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50           55           60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65           70           75           80
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85           90           95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100          105          110
Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys
115          120          125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130          135          140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Ile Gly His Glu Thr
145          150          155          160
Asp Glu Asn Arg Ala Lys Val Glu Val Thr Pro Asn Ser Pro Arg Ala
165          170          175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180          185          190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195          200          205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210          215          220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225          230          235          240
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245          250          255
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260          265          270
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Phe Ser Gly His
275          280          285
Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
290          295          300
Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Val Pro Ala Glu
305          310          315          320
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
325          330          335
Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
340          345          350
Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
355          360          365
Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
370          375          380
Ser Tyr Ile Val Ile Gly Val Gly Asp Lys Lys Ile Thr His His Trp
385          390          395          400

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His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
405 410 415

Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
420 425 430

Ser Val Gly Gly Val Phe Asn Ser Leu Gly Lys Gly Ile His Gln Ile
435 440 445

Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
450 455 460

Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys
465 470 475 480

Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile
485 490 495

Phe Leu Ser Thr Ala Val Ser Ala
500

<210> SEQ ID NO 20
<211> LENGTH: 504
<212> TYPE: PRT
<213> ORGANISM: Zika virus

<400> SEQUENCE: 20

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20 25 30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35 40 45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50 55 60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100 105 110

Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys
115 120 125

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130 135 140

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Ile Gly His Glu Thr
145 150 155 160

Asp Glu Asn Arg Ala Lys Val Glu Val Thr Pro Asn Ser Pro Arg Ala
165 170 175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180 185 190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195 200 205

Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210 215 220

Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225 230 235 240

Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245 250 255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260 265 270

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Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Phe Ser Gly His
 275 280 285
 Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300
 Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Val Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Asp Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Val Phe Asn Ser Leu Gly Lys Gly Val His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 21
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 21

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His

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130	135	140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Ile Gly His Glu Thr		
145	150	155 160
Asp Glu Asn Arg Ala Lys Val Glu Val Thr Pro Asn Ser Pro Arg Ala		
	165	170 175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro		
	180	185 190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn		
	195	200 205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro		
	210	215 220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu		
	225	230 235 240
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val		
	245	250 255
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala		
	260	265 270
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Phe Ser Gly His		
	275	280 285
Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser		
	290	295 300
Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Val Pro Ala Glu		
	305	310 315 320
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp		
	325	330 335
Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu		
	340	345 350
Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser		
	355	360 365
Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp		
	370	375 380
Ser Tyr Ile Val Ile Gly Val Gly Asp Lys Lys Ile Thr His His Trp		
	385	390 395 400
His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg		
	405	410 415
Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly		
	420	425 430
Ser Val Gly Gly Val Phe Asn Ser Leu Gly Lys Gly Val His Gln Ile		
	435	440 445
Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser		
	450	455 460
Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys		
	465	470 475 480
Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile		
	485	490 495
Phe Leu Ser Thr Ala Val Ser Ala		
	500	

<210> SEQ ID NO 22

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 22

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Ile	Arg	Cys	Ile	Gly	Val	Ser	Asn	Arg	Asp	Phe	Val	Glu	Gly	Met	Ser	1	5	10	15
Gly	Gly	Thr	Trp	Val	Asp	Val	Val	Leu	Glu	His	Gly	Gly	Cys	Val	Thr	20	25	30	
Val	Met	Ala	Gln	Asp	Lys	Pro	Thr	Val	Asp	Ile	Glu	Leu	Val	Thr	Thr	35	40	45	
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser	50	55	60	
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala	65	70	75	80
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu	85	90	95	
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser	100	105	110	
Leu	Val	Thr	Cys	Ala	Lys	Phe	Thr	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys	115	120	125	
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His	130	135	140	
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Thr	Gly	His	Glu	Thr	145	150	155	160
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Val	Thr	Pro	Asn	Ser	Pro	Arg	Ala	165	170	175	
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro	180	185	190	
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn	195	200	205	
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro	210	215	220	
Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu	225	230	235	240
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val	245	250	255	
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala	260	265	270	
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Phe	Ser	Gly	His	275	280	285	
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser	290	295	300	
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Val	Pro	Ala	Glu	305	310	315	320
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp	325	330	335	
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu	340	345	350	
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser	355	360	365	
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp	370	375	380	
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Asp	Lys	Lys	Ile	Thr	His	His	Trp	385	390	395	400
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg	405	410	415	
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly				

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420	425	430
Ser Val Gly Gly Val Phe Asn Ser Leu Gly Lys Gly Ile His Gln Ile		
435	440	445
Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser		
450	455	460
Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys		
465	470	475
Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile		
485	490	495
Phe Leu Ser Thr Ala Val Ser Ala		
500		
 <210> SEQ ID NO 23		
<211> LENGTH: 504		
<212> TYPE: PRT		
<213> ORGANISM: Zika virus		
 <400> SEQUENCE: 23		
Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser		
1	5	10
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr		
20	25	30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr		
35	40	45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser		
50	55	60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala		
65	70	75
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu		
85	90	95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser		
100	105	110
Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys		
115	120	125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His		
130	135	140
Gly Ser Gln His Ser Gly Met Thr Val Asn Asp Ile Gly Tyr Glu Thr		
145	150	155
Asp Glu Asn Arg Ala Lys Val Glu Val Thr Pro Asn Ser Pro Arg Ala		
165	170	175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro		
180	185	190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn		
195	200	205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro		
210	215	220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu		
225	230	235
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val		
245	250	255
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala		
260	265	270
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Lys Leu Phe Ser Gly His		
275	280	285

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Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300
 Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Val Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Ile Pro Val Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Asp Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Val Phe Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 24
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 24

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140
 Gly Ser Gln His Ser Gly Met Thr Val Asn Asp Ile Gly Tyr Glu Thr
 145 150 155 160

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20							25					30				
Val	Met	Ala	Gln	Asp	Lys	Pro	Thr	Val	Asp	Ile	Glu	Leu	Val	Thr	Thr	
		35					40					45				
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser	
		50				55					60					
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala	
65					70					75					80	
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu	
			85					90						95		
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser	
			100					105					110			
Leu	Val	Thr	Cys	Ala	Lys	Phe	Thr	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys	
		115					120					125				
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His	
	130					135					140					
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Thr	Gly	Tyr	Glu	Thr	
145					150					155					160	
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Val	Thr	Pro	Asn	Ser	Pro	Arg	Ala	
				165					170					175		
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro	
			180					185					190			
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn	
		195					200					205				
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro	
	210					215					220					
Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu	
225					230					235					240	
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val	
				245					250					255		
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala	
		260					265						270			
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Lys	Leu	Phe	Ser	Gly	His	
		275					280					285				
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser	
	290					295					300					
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Val	Pro	Ala	Glu	
305					310					315					320	
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp	
			325					330						335		
Gly	Pro	Cys	Lys	Ile	Pro	Val	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu	
			340					345					350			
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser	
		355					360					365				
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp	
	370					375					380					
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Asp	Lys	Lys	Ile	Thr	His	His	Trp	
385					390					395					400	
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg	
			405						410					415		
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly	
			420					425					430			
Ser	Val	Gly	Gly	Val	Phe	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile	
		435					440					445				

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Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460

Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480

Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile
 485 490 495

Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 26
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 26

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110

Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Ile Gly His Glu Thr
 145 150 155 160

Asp Glu Asn Arg Ala Lys Val Glu Val Thr Pro Asn Ser Pro Arg Ala
 165 170 175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205

Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220

Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240

Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270

Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Phe Ser Gly His
 275 280 285

Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300

Tyr Ser Leu Cys Thr Ala Val Cys Thr Ala Ala Lys Val Pro Ala Glu

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305	310	315	320
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp			
	325	330	335
Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu			
	340	345	350
Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser			
	355	360	365
Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp			
	370	375	380
Ser Tyr Ile Val Ile Gly Val Gly Asp Lys Lys Ile Thr His His Trp			
	385	390	395
His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg			
	405	410	415
Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly			
	420	425	430
Ser Val Gly Gly Val Phe Asn Ser Leu Gly Lys Gly Ile His Gln Ile			
	435	440	445
Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser			
	450	455	460
Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys			
	465	470	475
Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile			
	485	490	495
Phe Leu Ser Thr Ala Val Ser Ala			
	500		

<210> SEQ ID NO 27

<211> LENGTH: 500

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 27

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser			
1	5	10	15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr			
	20	25	30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr			
	35	40	45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser			
	50	55	60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala			
	65	70	75
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu			
	85	90	95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser			
	100	105	110
Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys			
	115	120	125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His			
	130	135	140
Gly Ser Gln His Ser Gly Met Ile Gly Tyr Glu Thr Asp Glu Asp Arg			
	145	150	155
Ala Lys Val Glu Val Thr Pro Asn Ser Pro Arg Ala Glu Ala Thr Leu			
	165	170	175

-continued

Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro Arg Thr Gly Leu
 180 185 190
 Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn Lys His Trp Leu
 195 200 205
 Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro Trp His Ala Gly
 210 215 220
 Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu Ala Leu Val Glu
 225 230 235 240
 Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val Val Leu Gly Ser
 245 250 255
 Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala Leu Glu Ala Glu
 260 265 270
 Met Asp Gly Ala Lys Gly Arg Leu Phe Ser Gly His Leu Lys Cys Arg
 275 280 285
 Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser Tyr Ser Leu Cys
 290 295 300
 Thr Ala Ala Phe Thr Phe Thr Lys Val Pro Ala Glu Thr Leu His Gly
 305 310 315 320
 Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp Gly Pro Cys Lys
 325 330 335
 Ile Pro Val Gln Met Ala Val Asp Met Gln Thr Leu Thr Pro Val Gly
 340 345 350
 Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser Thr Glu Asn Ser
 355 360 365
 Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp Ser Tyr Ile Val
 370 375 380
 Ile Gly Val Gly Asp Lys Lys Ile Thr His His Trp His Arg Ser Gly
 385 390 395 400
 Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg Gly Ala Lys Arg
 405 410 415
 Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly Ser Val Gly Gly
 420 425 430
 Val Phe Asn Ser Leu Gly Lys Gly Ile His Gln Ile Phe Gly Ala Ala
 435 440 445
 Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser Gln Ile Leu Ile
 450 455 460
 Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys Asn Gly Ser Ile
 465 470 475 480
 Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile Phe Leu Ser Thr
 485 490 495
 Ala Val Ser Ala
 500

<210> SEQ ID NO 28
 <211> LENGTH: 500
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 28

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45

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Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser
50						55					60				
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala
65				70					75					80	
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu
			85					90					95		
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser
			100					105					110		
Leu	Val	Thr	Cys	Ala	Lys	Phe	Thr	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys
			115				120					125			
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His
	130					135					140				
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Gly	Tyr	Glu	Thr	Asp	Glu	Asp	Arg
145				150						155				160	
Ala	Lys	Val	Glu	Val	Thr	Pro	Asn	Ser	Pro	Arg	Ala	Glu	Ala	Thr	Leu
			165					170						175	
Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro	Arg	Thr	Gly	Leu
			180					185					190		
Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn	Lys	His	Trp	Leu
	195						200					205			
Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro	Trp	His	Ala	Gly
	210					215					220				
Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu	Ala	Leu	Val	Glu
225					230					235				240	
Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val	Val	Leu	Gly	Ser
			245					250					255		
Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala	Leu	Glu	Ala	Glu
			260					265					270		
Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Phe	Ser	Gly	His	Leu	Lys	Cys	Arg
	275						280					285			
Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser	Tyr	Ser	Leu	Cys
	290					295					300				
Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Val	Pro	Ala	Glu	Thr	Leu	His	Gly
305					310					315				320	
Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp	Gly	Pro	Cys	Lys
			325					330					335		
Ile	Pro	Val	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu	Thr	Pro	Val	Gly
		340						345					350		
Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser	Thr	Glu	Asn	Ser
	355					360						365			
Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp	Ser	Tyr	Ile	Val
	370					375				380					
Ile	Gly	Val	Gly	Asp	Lys	Lys	Ile	Thr	His	His	Trp	His	Arg	Ser	Gly
385					390					395				400	
Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg	Gly	Ala	Lys	Arg
			405					410					415		
Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly	Ser	Val	Gly	Gly
		420						425					430		
Val	Phe	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile	Phe	Gly	Ala	Ala
	435					440						445			
Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser	Gln	Ile	Leu	Ile
	450					455					460				

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Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys Asn Gly Ser Ile
 465 470 475 480
 Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile Phe Leu Ser Thr
 485 490 495
 Ala Val Ser Ala
 500
 <210> SEQ ID NO 29
 <211> LENGTH: 500
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus
 <400> SEQUENCE: 29
 Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Thr Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140
 Gly Ser Gln His Ser Gly Met Ile Gly Tyr Glu Thr Asp Glu Asp Arg
 145 150 155 160
 Ala Lys Val Glu Val Thr Pro Asn Ser Pro Arg Ala Glu Ala Thr Leu
 165 170 175
 Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro Arg Thr Gly Leu
 180 185 190
 Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn Lys His Trp Leu
 195 200 205
 Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro Trp His Ala Gly
 210 215 220
 Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu Ala Leu Val Glu
 225 230 235 240
 Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val Val Leu Gly Ser
 245 250 255
 Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala Leu Glu Ala Glu
 260 265 270
 Met Asp Gly Ala Lys Gly Arg Leu Phe Ser Gly His Leu Lys Cys Arg
 275 280 285
 Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser Tyr Ser Leu Cys
 290 295 300
 Thr Ala Ala Phe Thr Phe Thr Lys Val Pro Ala Glu Thr Leu His Gly
 305 310 315 320
 Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp Gly Pro Cys Lys
 325 330 335

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Ile Pro Val Gln Met Ala Val Asp Met Gln Thr Leu Thr Pro Val Gly
      340              345              350

Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser Thr Glu Asn Ser
      355              360              365

Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp Ser Tyr Ile Val
      370              375              380

Ile Gly Val Gly Asp Lys Lys Ile Thr His His Trp His Arg Ser Gly
      385              390              395              400

Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg Gly Ala Lys Arg
      405              410              415

Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly Ser Val Gly Gly
      420              425              430

Val Phe Asn Ser Leu Gly Lys Gly Ile His Gln Ile Phe Gly Ala Ala
      435              440              445

Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser Gln Ile Leu Ile
      450              455              460

Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys Asn Gly Ser Ile
      465              470              475              480

Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Met Ile Phe Leu Ser Thr
      485              490              495

Ala Val Ser Ala
      500

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<210> SEQ ID NO 30
<211> LENGTH: 504
<212> TYPE: PRT
<213> ORGANISM: Zika virus

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<400> SEQUENCE: 30

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Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1          5          10          15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20          25          30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35          40          45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50          55          60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65          70          75          80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85          90          95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100         105         110

Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
115         120         125

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130         135         140

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
145         150         155         160

Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
165         170         175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180         185         190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn

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195					200					205					
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro
210					215					220					
Trp	His	Thr	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu
225					230					235					240
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val
				245					250					255	
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala
			260				265					270			
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Ser	Ser	Gly	His
		275					280					285			
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser
	290					295					300				
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu
305					310					315					320
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp
			325					330						335	
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu
		340					345					350			
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Gly
		355					360					365			
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp
	370					375					380				
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp
385					390					395					400
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg
			405					410						415	
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly
		420						425					430		
Ser	Val	Gly	Gly	Val	Leu	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile
	435					440						445			
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser
	450					455					460				
Gln	Ile	Leu	Ile	Gly	Thr	Leu	Leu	Met	Trp	Leu	Gly	Leu	Asn	Thr	Lys
465				470					475					480	
Asn	Gly	Ser	Ile	Ser	Leu	Met	Cys	Leu	Ala	Leu	Gly	Gly	Val	Leu	Ile
			485					490						495	
Phe	Leu	Ser	Thr	Ala	Val	Ser	Ala								
			500												

<210> SEQ ID NO 31

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 31

Ile	Arg	Cys	Ile	Gly	Val	Ser	Asn	Arg	Asp	Phe	Val	Glu	Gly	Met	Ser
1				5					10					15	
Gly	Gly	Thr	Trp	Val	Asp	Val	Val	Leu	Glu	His	Gly	Gly	Cys	Val	Thr
		20						25					30		
Val	Met	Ala	Gln	Asp	Lys	Pro	Thr	Val	Asp	Ile	Glu	Leu	Val	Thr	Thr
		35					40					45			
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser
	50						55					60			

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Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala	
65					70					75					80	
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu	
			85						90					95		
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser	
			100					105					110			
Leu	Val	Thr	Cys	Ala	Lys	Phe	Ala	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys	
		115					120					125				
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His	
	130					135					140					
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Thr	Gly	His	Glu	Thr	
	145				150					155					160	
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Ile	Thr	Pro	Asn	Ser	Pro	Arg	Ala	
			165						170					175		
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro	
		180						185					190			
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn	
		195					200					205				
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro	
	210					215					220					
Trp	His	Thr	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu	
	225				230					235					240	
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val	
			245						250					255		
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala	
		260						265					270			
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Ser	Ser	Gly	His	
	275						280					285				
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser	
	290					295					300					
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu	
	305				310					315					320	
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp	
			325						330					335		
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu	
			340					345					350			
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Gly	
		355					360					365				
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp	
	370					375					380					
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp	
	385				390					395					400	
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg	
			405						410					415		
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly	
			420					425					430			
Ser	Val	Gly	Gly	Val	Leu	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile	
		435				440						445				
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser	
	450					455					460					
Gln	Ile	Leu	Ile	Gly	Thr	Leu	Leu	Met	Trp	Leu	Gly	Leu	Asn	Thr	Lys	
	465				470					475					480	
Asn	Gly	Ser	Ile	Ser	Leu	Met	Cys	Leu	Ala	Leu	Gly	Gly	Val	Leu	Ile	

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485	490	495
Phe Leu Ser Thr Ala Val Ser Ala		
500		
<210> SEQ ID NO 32		
<211> LENGTH: 504		
<212> TYPE: PRT		
<213> ORGANISM: Zika virus		
<400> SEQUENCE: 32		
Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser		
1 5 10 15		
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr		
20 25 30		
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr		
35 40 45		
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser		
50 55 60		
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala		
65 70 75 80		
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu		
85 90 95		
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser		
100 105 110		
Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys		
115 120 125		
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His		
130 135 140		
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr		
145 150 155 160		
Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala		
165 170 175		
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro		
180 185 190		
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn		
195 200 205		
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro		
210 215 220		
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu		
225 230 235 240		
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val		
245 250 255		
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala		
260 265 270		
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His		
275 280 285		
Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser		
290 295 300		
Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu		
305 310 315 320		
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp		
325 330 335		
Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu		
340 345 350		

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Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 33
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 33

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140
 Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
 145 150 155 160
 Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175
 Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190
 Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205
 Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220

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Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240
 Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255
 Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270
 Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275 280 285
 Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300
 Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 34
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 34

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu

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85								90				95			
Val	Asp	Arg	Gly 100	Trp	Gly	Asn	Gly	Cys 105	Gly	Leu	Phe	Gly	Lys 110	Gly	Ser
Leu	Val	Thr	Cys 115	Ala	Lys	Phe	Ala 120	Cys	Ser	Lys	Lys	Met 125	Thr	Gly	Lys
Ser	Ile	Gln	Pro	Glu	Asn 135	Leu	Glu	Tyr	Arg	Ile	Met 140	Leu	Ser	Val	His
Gly 145	Ser	Gln	His	Ser	Gly 150	Met	Ile	Val	Asn 155	Asp	Thr	Gly	His	Glu	Thr 160
Asp	Glu	Asn	Arg	Ala 165	Lys	Val	Glu	Ile	Thr 170	Pro	Asn	Ser	Pro	Arg	Ala 175
Glu	Ala	Thr	Leu 180	Gly	Gly	Phe	Gly	Ser 185	Leu	Gly	Leu	Asp	Cys 190	Glu	Pro
Arg	Thr	Gly 195	Leu	Asp	Phe	Ser	Asp 200	Leu	Tyr	Tyr	Leu	Thr 205	Met	Asn	Asn
Lys	His	Trp	Leu 210	Val	His	Lys 215	Glu	Trp	Phe	His	Asp 220	Ile	Pro	Leu	Pro
Trp 225	His	Ala	Gly	Ala	Asp 230	Thr	Gly	Thr	Pro	His 235	Trp	Asn	Asn	Lys	Glu 240
Ala	Leu	Val	Glu	Phe 245	Lys	Asp	Ala	His	Ala 250	Lys	Arg	Gln	Thr	Val 255	Val
Val	Leu	Gly	Ser 260	Gln	Glu	Gly	Ala	Val 265	His	Thr	Ala	Leu	Ala 270	Gly	Ala
Leu	Glu	Ala 275	Glu	Met	Asp	Gly	Ala 280	Lys	Gly	Arg	Leu	Ser 285	Ser	Gly	His
Leu	Lys 290	Cys	Arg	Leu	Lys	Met 295	Asp	Lys	Leu	Arg	Leu 300	Lys	Gly	Val	Ser
Tyr 305	Ser	Leu	Cys	Thr	Ala 310	Ala	Phe	Thr	Phe	Thr 315	Lys	Ile	Pro	Ala	Glu 320
Thr	Leu	His	Gly	Thr 325	Val	Thr	Val	Glu	Val 330	Gln	Tyr	Ala	Gly	Thr 335	Asp
Gly	Pro	Cys	Lys 340	Val	Pro	Ala	Gln	Met 345	Ala	Val	Asp	Met	Gln 350	Thr	Leu
Thr	Pro	Val 355	Gly	Arg	Leu	Ile	Thr 360	Ala	Asn	Pro	Val	Ile 365	Thr	Glu	Ser
Thr	Glu 370	Asn	Ser	Lys	Met	Met 375	Leu	Glu	Leu	Asp 380	Pro	Pro	Phe	Gly	Asp
Ser 385	Tyr	Ile	Val	Ile	Gly 390	Val	Gly	Glu	Lys	Lys 395	Ile	Thr	His	His	Trp 400
His	Arg	Ser	Gly	Ser	Thr 405	Ile	Gly	Lys	Ala 410	Phe	Glu	Ala	Thr	Val	Arg
Gly	Ala	Lys	Arg 420	Met	Ala	Val	Leu	Gly 425	Asp	Thr	Ala	Trp	Asp 430	Phe	Gly
Ser	Val	Gly 435	Gly	Ala	Leu	Asn	Ser 440	Leu	Gly	Lys	Gly	Ile 445	His	Gln	Ile
Phe 450	Gly	Ala	Ala	Phe	Lys	Ser 455	Leu	Phe	Gly	Gly	Met 460	Ser	Trp	Phe	Ser
Gln 465	Ile	Leu	Ile	Gly	Thr 470	Leu	Leu	Met	Trp	Leu 475	Gly	Leu	Asn	Thr	Lys 480
Asn	Gly	Ser	Ile 485	Ser	Leu	Met	Cys	Leu	Ala 490	Leu	Gly	Gly	Val	Leu	Ile
Phe	Leu	Ser	Thr 500	Ala	Val	Ser	Ala								

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<210> SEQ ID NO 35
<211> LENGTH: 504
<212> TYPE: PRT
<213> ORGANISM: Zika virus

<400> SEQUENCE: 35

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1          5          10          15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20          25          30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35          40          45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50          55          60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65          70          75          80
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85          90          95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100         105         110
Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
115         120         125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130         135         140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
145         150         155         160
Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
165         170         175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180         185         190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195         200         205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210         215         220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225         230         235         240
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245         250         255
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260         265         270
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
275         280         285
Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
290         295         300
Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
305         310         315         320
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
325         330         335
Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
340         345         350
Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
355         360         365
Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp

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370	375	380
Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp		
385	390	395 400
His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg		
	405	410 415
Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly		
	420	425 430
Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile		
	435	440 445
Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser		
	450	455 460
Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys		
465	470	475 480
Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile		
	485	490 495
Phe Leu Ser Thr Ala Val Ser Ala		
	500	
<210> SEQ ID NO 36		
<211> LENGTH: 504		
<212> TYPE: PRT		
<213> ORGANISM: Zika virus		
<400> SEQUENCE: 36		
Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser		
1	5	10 15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr		
	20	25 30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr		
	35	40 45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser		
	50	55 60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala		
65	70	75 80
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu		
	85	90 95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser		
	100	105 110
Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys		
	115	120 125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His		
	130	135 140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr		
145	150	155 160
Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala		
	165	170 175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro		
	180	185 190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn		
	195	200 205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro		
	210	215 220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu		
225	230	235 240

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Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245 250 255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260 265 270

Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
275 280 285

Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
290 295 300

Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
305 310 315 320

Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
325 330 335

Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
340 345 350

Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
355 360 365

Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
370 375 380

Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
385 390 395 400

His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
405 410 415

Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
420 425 430

Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
435 440 445

Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
450 455 460

Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
465 470 475 480

Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
485 490 495

Phe Leu Ser Thr Ala Val Ser Ala
500

<210> SEQ ID NO 37

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 37

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20 25 30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35 40 45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50 55 60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100 105 110

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Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140
 Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
 145 150 155 160
 Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175
 Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190
 Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205
 Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220
 Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240
 Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255
 Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270
 Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275 280 285
 Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300
 Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 38

<211> LENGTH: 504

-continued

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 38

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Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1          5          10          15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
          20          25          30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
          35          40          45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
          50          55          60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65          70          75          80
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
          85          90          95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
          100          105          110
Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
          115          120          125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
          130          135          140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
145          150          155          160
Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
          165          170          175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
          180          185          190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
          195          200          205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
          210          215          220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225          230          235          240
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
          245          250          255
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
          260          265          270
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
          275          280          285
Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
          290          295          300
Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
305          310          315          320
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
          325          330          335
Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
          340          345          350
Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
          355          360          365
Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
          370          375          380
Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
385          390          395          400

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His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
405 410 415

Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
420 425 430

Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
435 440 445

Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
450 455 460

Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
465 470 475 480

Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
485 490 495

Phe Leu Ser Thr Ala Val Ser Ala
500

<210> SEQ ID NO 39
<211> LENGTH: 504
<212> TYPE: PRT
<213> ORGANISM: Zika virus

<400> SEQUENCE: 39

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20 25 30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35 40 45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50 55 60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100 105 110

Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
115 120 125

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130 135 140

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
145 150 155 160

Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
165 170 175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180 185 190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195 200 205

Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210 215 220

Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225 230 235 240

Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245 250 255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala

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260	265	270
Leu Glu Ala Glu Met Asp Gly	Ala Lys Gly Arg	Leu Ser Ser Gly His
275	280	285
Leu Lys Cys Arg Leu Lys Met	Asp Lys Leu Arg	Leu Lys Gly Val Ser
290	295	300
Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr	Lys Ile Pro Ala Glu	
305	310	315
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp		
325	330	335
Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu		
340	345	350
Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser		
355	360	365
Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp		
370	375	380
Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp		
385	390	395
His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg		
405	410	415
Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly		
420	425	430
Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile		
435	440	445
Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser		
450	455	460
Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys		
465	470	475
Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile		
485	490	495
Phe Leu Ser Thr Ala Val Ser Ala		
500		

<210> SEQ ID NO 40

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 40

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser		
1	5	10
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr		
20	25	30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr		
35	40	45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser		
50	55	60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala		
65	70	75
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu		
85	90	95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser		
100	105	110
Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys		
115	120	125

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Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130                135                140

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
145                150                155                160

Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
                165                170                175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
                180                185                190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195                200                205

Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210                215                220

Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225                230                235                240

Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
                245                250                255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260                265                270

Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275                280                285

Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290                295                300

Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
305                310                315                320

Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325                330                335

Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340                345                350

Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355                360                365

Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370                375                380

Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
385                390                395                400

His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405                410                415

Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420                425                430

Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435                440                445

Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450                455                460

Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
465                470                475                480

Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485                490                495

Phe Leu Ser Thr Ala Val Ser Ala
 500

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<210> SEQ ID NO 41

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 41

Ile 1	Arg	Cys	Ile 5	Gly	Val	Ser	Asn	Arg	Asp 10	Phe	Val	Glu	Gly	Met 15	Ser
Gly	Gly	Thr	Trp 20	Val	Asp	Val	Val	Leu 25	Glu	His	Gly	Gly	Cys 30	Val	Thr
Val	Met	Ala 35	Gln	Asp	Lys	Pro	Thr 40	Val	Asp	Ile	Glu	Leu 45	Val	Thr	Thr
Thr	Val 50	Ser	Asn	Met	Ala	Glu 55	Val	Arg	Ser	Tyr	Cys 60	Tyr	Glu	Ala	Ser
Ile 65	Ser	Asp	Met	Ala	Ser 70	Asp	Ser	Arg	Cys	Pro 75	Thr	Gln	Gly	Glu	Ala 80
Tyr	Leu	Asp	Lys 85	Gln	Ser	Asp	Thr	Gln 90	Tyr	Val	Cys	Lys	Arg	Thr 95	Leu
Val	Asp	Arg	Gly 100	Trp	Gly	Asn	Gly	Cys 105	Gly	Leu	Phe	Gly	Lys 110	Gly	Ser
Leu	Val 115	Thr	Cys	Ala	Lys	Phe	Ala 120	Cys	Ser	Lys	Lys	Met 125	Thr	Gly	Lys
Ser	Ile 130	Gln	Pro	Glu	Asn 135	Leu	Glu	Tyr	Arg	Ile	Met 140	Leu	Ser	Val	His
Gly 145	Ser	Gln	His	Ser	Gly 150	Met	Ile	Val	Asn	Asp 155	Thr	Gly	His	Glu	Thr 160
Asp	Glu	Asn	Arg 165	Ala	Lys	Val	Glu	Ile	Thr 170	Pro	Asn	Ser	Pro	Arg 175	Ala
Glu	Ala	Thr 180	Leu	Gly	Gly	Phe	Gly 185	Ser	Leu	Gly	Leu	Asp 190	Cys	Glu	Pro
Arg	Thr 195	Gly	Leu	Asp	Phe	Ser	Asp 200	Leu	Tyr	Tyr	Leu	Thr 205	Met	Asn	Asn
Lys	His 210	Trp	Leu	Val	His	Lys 215	Glu	Trp	Phe	His	Asp 220	Ile	Pro	Leu	Pro
Trp 225	His	Ala	Gly	Ala	Asp 230	Thr	Gly	Thr	Pro	His 235	Trp	Asn	Asn	Lys	Glu 240
Ala	Leu	Val 245	Glu	Phe	Lys	Asp	Ala	His	Ala 250	Lys	Arg	Gln	Thr	Val 255	Val
Val	Leu	Gly 260	Ser	Gln	Glu	Gly	Ala 265	Val	His	Thr	Ala	Leu 270	Ala	Gly	Ala
Leu	Glu 275	Ala	Glu	Met	Asp	Gly	Ala 280	Lys	Gly	Arg	Leu	Ser 285	Ser	Gly	His
Leu	Lys 290	Cys	Arg	Leu	Lys	Met 295	Asp	Lys	Leu	Arg	Leu 300	Lys	Gly	Val	Ser
Tyr 305	Ser	Leu	Cys	Thr	Ala 310	Ala	Phe	Thr	Phe	Thr 315	Lys	Ile	Pro	Ala	Glu 320
Thr	Leu	His 325	Gly	Thr	Val	Thr	Val	Glu 330	Val	Gln	Tyr	Ala	Gly	Thr 335	Asp
Gly	Pro	Cys 340	Lys	Val	Pro	Ala	Gln	Met 345	Ala	Val	Asp	Met	Gln 350	Thr	Leu
Thr	Pro 355	Val	Gly	Arg	Leu	Ile	Thr 360	Ala	Asn	Pro	Val	Ile 365	Thr	Glu	Ser
Thr 370	Glu	Asn	Ser	Lys	Met	Met 375	Leu	Glu	Leu	Asp 380	Pro	Pro	Phe	Gly	Asp
Ser 385	Tyr	Ile	Val	Ile	Gly 390	Val	Gly	Glu	Lys	Lys 395	Ile	Thr	His	His	Trp 400
His	Arg	Ser 405	Gly	Ser	Thr	Ile	Gly	Lys 410	Ala	Phe	Glu	Ala	Thr	Val	Arg

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Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430

Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445

Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460

Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480

Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495

Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 42
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 42

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110

Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
 145 150 155 160

Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205

Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220

Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240

Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270

Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275 280 285

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Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300
 Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 43
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 43

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140
 Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr

145				150				155				160			
Asp	Glu	Asn	Arg	Ala 165	Lys	Val	Glu	Ile	Thr 170	Pro	Asn	Ser	Pro	Arg	Ala 175
Glu	Ala	Thr	Leu 180	Gly	Gly	Phe	Gly	Ser 185	Leu	Gly	Leu	Asp	Cys 190	Glu	Pro
Arg	Thr	Gly 195	Leu	Asp	Phe	Ser	Asp 200	Leu	Tyr	Tyr	Leu	Thr 205	Met	Asn	Asn
Lys	His 210	Trp	Leu	Val	His	Lys 215	Glu	Trp	Phe	His	Asp 220	Ile	Pro	Leu	Pro
Trp 225	His	Ala	Gly	Ala	Asp 230	Thr	Gly	Thr	Pro	His 235	Trp	Asn	Asn	Lys	Glu 240
Ala	Leu	Val	Glu	Phe 245	Lys	Asp	Ala	His	Ala 250	Lys	Arg	Gln	Thr	Val 255	Val
Val	Leu	Gly	Ser 260	Gln	Glu	Gly	Ala 265	Val	His	Thr	Ala	Leu 270	Ala	Gly	Ala
Leu	Glu 275	Ala	Glu	Met	Asp	Gly	Ala 280	Lys	Gly	Arg	Leu 285	Ser	Ser	Gly	His
Leu	Lys 290	Cys	Arg	Leu	Lys 295	Met	Asp	Lys	Leu	Arg	Leu 300	Lys	Gly	Val	Ser
Tyr 305	Ser	Leu	Cys	Thr	Ala 310	Ala	Phe	Thr	Phe	Thr 315	Lys	Ile	Pro	Ala	Glu 320
Thr	Leu	His	Gly 325	Thr	Val	Thr	Val	Glu	Val 330	Gln	Tyr	Ala	Gly	Thr 335	Asp
Gly	Pro	Cys	Lys 340	Val	Pro	Ala	Gln	Met 345	Ala	Val	Asp	Met	Gln 350	Thr	Leu
Thr	Pro 355	Val	Gly	Arg	Leu	Ile	Thr 360	Ala	Asn	Pro	Val 365	Ile	Thr	Glu	Ser
Thr 370	Glu	Asn	Ser	Lys	Met	Met 375	Leu	Glu	Leu	Asp 380	Pro	Pro	Phe	Gly	Asp
Ser 385	Tyr	Ile	Val	Ile	Gly 390	Val	Gly	Glu	Lys	Lys 395	Ile	Thr	His	His	Trp 400
His	Arg	Ser	Gly 405	Ser	Thr	Ile	Gly	Lys	Ala 410	Phe	Glu	Ala	Thr	Val 415	Arg
Gly	Ala	Lys	Arg 420	Met	Ala	Val	Leu	Gly 425	Asp	Thr	Ala	Trp	Asp 430	Phe	Gly
Ser	Val 435	Gly	Gly	Ala	Leu	Asn	Ser 440	Leu	Gly	Lys	Gly	Ile 445	His	Gln	Ile
Phe 450	Gly	Ala	Ala	Phe	Lys	Ser 455	Leu	Phe	Gly	Gly	Met 460	Ser	Trp	Phe	Ser
Gln 465	Ile	Leu	Ile	Gly	Thr 470	Leu	Leu	Met	Trp	Leu 475	Gly	Leu	Asn	Thr	Lys 480
Asn	Gly	Ser	Ile 485	Ser	Leu	Met	Cys	Leu	Ala 490	Leu	Gly	Gly	Val	Leu 495	Ile
Phe	Leu	Ser	Thr 500	Ala	Val	Ser	Ala								

<400> SEQUENCE: 44

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Gly	Gly	Thr	Trp	Val	Asp	Val	Val	Leu	Glu	His	Gly	Gly	Cys	Val	Thr
		20						25					30		
Val	Met	Ala	Gln	Asp	Lys	Pro	Thr	Val	Asp	Ile	Glu	Leu	Val	Thr	Thr
		35					40					45			
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser
		50				55					60				
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala
65					70					75					80
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu
			85					90						95	
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser
			100					105					110		
Leu	Val	Thr	Cys	Ala	Lys	Phe	Ala	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys
		115					120					125			
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His
	130					135					140				
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Thr	Gly	His	Glu	Thr
145					150					155					160
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Ile	Thr	Pro	Asn	Ser	Pro	Arg	Ala
			165					170						175	
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro
		180						185					190		
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn
		195					200					205			
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro
	210					215					220				
Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu
225					230					235					240
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val
			245					250						255	
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala
		260						265					270		
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Ser	Ser	Gly	His
		275					280					285			
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser
	290					295					300				
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu
305					310					315					320
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp
			325					330						335	
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu
			340					345					350		
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser
		355					360					365			
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp
	370					375					380				
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp
385					390					395					400
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg
			405					410					415		
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly
			420					425					430		
Ser	Val	Gly	Gly	Ala	Leu	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile

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435	440	445
Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser		
450	455	460
Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys		
465	470	475
Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile		
485	490	495
Phe Leu Ser Thr Ala Val Ser Ala		
500		

<210> SEQ ID NO 45

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 45

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser		
1	5	10
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr		
20	25	30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr		
35	40	45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser		
50	55	60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala		
65	70	75
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu		
85	90	95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser		
100	105	110
Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys		
115	120	125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His		
130	135	140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr		
145	150	155
Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala		
165	170	175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro		
180	185	190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn		
195	200	205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro		
210	215	220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu		
225	230	235
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val		
245	250	255
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala		
260	265	270
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His		
275	280	285
Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser		
290	295	300

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Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 46
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 46

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140
 Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
 145 150 155 160
 Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175

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Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190
 Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205
 Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220
 Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240
 Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255
 Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270
 Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275 280 285
 Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300
 Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 47
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 47

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr

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35					40					45					
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser
50						55					60				
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala
65					70					75					80
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu
				85					90					95	
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser
			100					105					110		
Leu	Val	Thr	Cys	Ala	Lys	Phe	Ala	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys
			115				120					125			
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His
	130					135					140				
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Thr	Gly	His	Glu	Thr
145					150					155					160
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Ile	Thr	Pro	Asn	Ser	Pro	Arg	Ala
				165					170						175
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro
			180					185					190		
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn
			195				200						205		
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro
	210					215					220				
Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu
225					230					235					240
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val
				245					250						255
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala
			260					265						270	
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Ser	Ser	Gly	His
			275				280					285			
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser
	290					295					300				
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu
305					310					315					320
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp
				325					330						335
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu
			340					345					350		
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser
			355				360						365		
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp
	370					375					380				
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp
385					390					395					400
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg
				405					410						415
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly
			420						425					430	
Ser	Val	Gly	Gly	Ala	Leu	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile
			435				440						445		
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser
	450					455					460				

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Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480

Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495

Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 48
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 48

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110

Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
 145 150 155 160

Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205

Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220

Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240

Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270

Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275 280 285

Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300

Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320

Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp

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325					330					335					
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu
			340					345					350		
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser
		355					360					365			
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp
	370					375					380				
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp
	385					390					395				400
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg
			405						410					415	
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly
			420						425				430		
Ser	Val	Gly	Gly	Ala	Leu	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile
		435					440					445			
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser
	450					455					460				
Gln	Ile	Leu	Ile	Gly	Thr	Leu	Leu	Met	Trp	Leu	Gly	Leu	Asn	Thr	Lys
	465					470					475				480
Asn	Gly	Ser	Ile	Ser	Leu	Met	Cys	Leu	Ala	Leu	Gly	Gly	Val	Leu	Ile
				485					490					495	
Phe	Leu	Ser	Thr	Ala	Val	Ser	Ala								
				500											

<210> SEQ ID NO 49

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 49

Ile	Arg	Cys	Ile	Gly	Val	Ser	Asn	Arg	Asp	Phe	Val	Glu	Gly	Met	Ser
1				5					10					15	
Gly	Gly	Thr	Trp	Val	Asp	Ile	Val	Leu	Glu	His	Gly	Gly	Cys	Val	Thr
		20						25					30		
Val	Met	Ala	Gln	Asp	Lys	Pro	Thr	Val	Asp	Ile	Glu	Leu	Val	Thr	Thr
		35					40					45			
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser
		50					55				60				
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala
	65					70				75				80	
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu
			85					90					95		
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser
			100					105					110		
Leu	Val	Thr	Cys	Ala	Lys	Phe	Ala	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys
		115					120					125			
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His
		130					135				140				
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Thr	Gly	His	Glu	Thr
	145					150				155				160	
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Ile	Thr	Pro	Asn	Ser	Pro	Arg	Ala
				165					170					175	
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro
			180					185					190		

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Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205
 Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220
 Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240
 Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255
 Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270
 Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275 280 285
 Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300
 Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 50
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 50

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Ile Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60

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Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala	
65					70					75					80	
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu	
			85						90					95		
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser	
			100					105						110		
Leu	Val	Thr	Cys	Ala	Lys	Phe	Ala	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys	
			115				120						125			
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His	
			130			135					140					
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Thr	Gly	His	Glu	Thr	
145					150					155					160	
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Ile	Thr	Pro	Asn	Ser	Pro	Arg	Ala	
				165					170						175	
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro	
			180					185					190			
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn	
			195				200					205				
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro	
			210			215					220					
Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu	
225					230					235					240	
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val	
				245					250					255		
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala	
			260					265					270			
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Ser	Ser	Gly	His	
			275				280					285				
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser	
			290			295					300					
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu	
305					310					315					320	
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp	
				325					330					335		
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu	
			340					345					350			
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser	
			355				360					365				
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp	
			370			375					380					
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp	
385					390					395					400	
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg	
				405					410					415		
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly	
			420						425				430			
Ser	Val	Gly	Gly	Ala	Leu	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile	
			435				440					445				
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser	
			450			455					460					
Gln	Ile	Leu	Ile	Gly	Thr	Leu	Leu	Met	Trp	Leu	Gly	Leu	Asn	Thr	Lys	
465					470					475					480	

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Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495

Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 51
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 51

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45

Thr Val Ser Asn Met Ala Glu Ile Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110

Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
 145 150 155 160

Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205

Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220

Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240

Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270

Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275 280 285

Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300

Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320

Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335

Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350

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Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 52
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 52

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140
 Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
 145 150 155 160
 Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175
 Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190
 Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205
 Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro

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210				215				220							
Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu
225					230					235					240
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val
				245					250					255	
Val	Leu	Gly	Thr	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala
				260					265					270	
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Ser	Ser	Gly	His
		275					280					285			
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser
	290					295					300				
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu
305					310					315					320
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp
				325						330				335	
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu
			340						345				350		
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser
		355					360						365		
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp
	370					375					380				
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp
385					390					395					400
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg
				405					410					415	
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly
			420						425				430		
Ser	Val	Gly	Gly	Ala	Leu	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile
		435					440						445		
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser
	450					455					460				
Gln	Ile	Leu	Ile	Gly	Thr	Leu	Leu	Met	Trp	Leu	Gly	Leu	Asn	Thr	Lys
465					470					475					480
Asn	Gly	Ser	Ile	Ser	Leu	Met	Cys	Leu	Ala	Leu	Gly	Gly	Val	Leu	Ile
				485					490					495	
Phe	Leu	Ser	Thr	Ala	Val	Ser	Ala								
				500											

<210> SEQ ID NO 53

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 53

Ile	Arg	Cys	Ile	Gly	Val	Ser	Asn	Arg	Asp	Phe	Val	Glu	Gly	Met	Ser
1				5					10					15	
Gly	Gly	Thr	Trp	Val	Asp	Val	Val	Leu	Glu	His	Gly	Gly	Cys	Val	Thr
			20					25					30		
Val	Met	Ala	Gln	Asp	Lys	Pro	Thr	Val	Asp	Ile	Glu	Leu	Val	Thr	Thr
		35					40					45			
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser
	50					55				60					
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala
65					70					75					80

Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu	
				85					90					95		
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser	
				100					105					110		
Leu	Val	Thr	Cys	Ala	Lys	Phe	Ala	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys	
				115					120					125		
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His	
				130					135					140		
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Thr	Gly	His	Glu	Thr	
				145					150					155		
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Ile	Thr	Pro	Asn	Ser	Pro	Arg	Ala	
				165					170					175		
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro	
				180					185					190		
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn	
				195					200					205		
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro	
				210					215					220		
Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu	
				225					230					235		
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val	
				245					250					255		
Val	Leu	Gly	Thr	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala	
				260					265					270		
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Ser	Ser	Gly	His	
				275					280					285		
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser	
				290					295					300		
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu	
				305					310					315		
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp	
				325					330					335		
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu	
				340					345					350		
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser	
				355					360					365		
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp	
				370					375					380		
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp	
				385					390					395		
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg	
				405					410					415		
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly	
				420					425					430		
Ser	Val	Gly	Gly	Ala	Leu	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile	
				435					440					445		
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser	
				450					455					460		
Gln	Ile	Leu	Ile	Gly	Thr	Leu	Leu	Met	Trp	Leu	Gly	Leu	Asn	Thr	Lys	
				465					470					475		
Asn	Gly	Ser	Ile	Ser	Leu	Met	Cys	Leu	Ala	Leu	Gly	Gly				

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500

<210> SEQ ID NO 54

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 54

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Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1           5           10           15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20           25           30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35           40           45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50           55           60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65           70           75           80
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85           90           95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100          105          110
Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
115          120          125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130          135          140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
145          150          155          160
Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
165          170          175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180          185          190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195          200          205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210          215          220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225          230          235          240
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245          250          255
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260          265          270
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
275          280          285
Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
290          295          300
Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
305          310          315          320
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
325          330          335
Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
340          345          350
Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
355          360          365

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Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Arg Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 55
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 55

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140
 Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
 145 150 155 160
 Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175
 Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190
 Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205
 Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220
 Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240

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Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245 250 255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260 265 270

Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
275 280 285

Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
290 295 300

Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
305 310 315 320

Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
325 330 335

Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
340 345 350

Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
355 360 365

Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
370 375 380

Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
385 390 395 400

His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
405 410 415

Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
420 425 430

Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
435 440 445

Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
450 455 460

Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys
465 470 475 480

Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
485 490 495

Phe Leu Ser Thr Ala Val Ser Ala
500

<210> SEQ ID NO 56

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 56

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20 25 30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35 40 45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50 55 60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser

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100							105					110				
Leu	Val	Thr	Cys	Ala	Lys	Phe	Ala	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys	
		115					120					125				
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His	
	130					135					140					
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Thr	Gly	His	Glu	Thr	
145					150					155				160		
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Ile	Thr	Pro	Asn	Ser	Pro	Arg	Ala	
				165					170					175		
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro	
			180					185					190			
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn	
		195					200					205				
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro	
	210					215					220					
Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu	
225					230					235				240		
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val	
				245					250					255		
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala	
			260					265					270			
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Ser	Ser	Gly	His	
	275						280					285				
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser	
	290					295					300					
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu	
305					310					315				320		
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp	
				325					330					335		
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu	
			340					345					350			
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser	
	355						360					365				
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp	
	370				375						380					
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp	
385					390					395				400		
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg	
				405					410					415		
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly	
			420					425					430			
Ser	Val	Gly	Gly	Ala	Leu	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile	
	435					440						445				
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser	
	450				455						460					
Gln	Ile	Leu	Ile	Gly	Thr	Leu	Leu	Met	Trp	Leu	Gly	Leu	Asn	Ala	Lys	
465					470					475				480		
Asn	Gly	Ser	Ile	Ser	Leu	Met	Cys	Leu	Ala	Leu	Gly	Gly	Val	Leu	Ile	
				485					490					495		
Phe	Leu	Ser	Thr	Ala	Val	Ser	Ala									
				500												

<210> SEQ ID NO 57

-continued

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 57

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Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1          5          10          15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20          25          30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35          40          45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50          55          60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65          70          75          80
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85          90          95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100         105         110
Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
115         120         125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130         135         140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
145         150         155         160
Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
165         170         175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180         185         190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195         200         205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210         215         220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225         230         235         240
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245         250         255
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260         265         270
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
275         280         285
Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
290         295         300
Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
305         310         315         320
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
325         330         335
Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
340         345         350
Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
355         360         365
Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
370         375         380
Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp

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385	390	395	400
His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg	405	410	415
Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly	420	425	430
Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile	435	440	445
Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser	450	455	460
Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Ala Lys	465	470	475
Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile	485	490	495
Phe Leu Ser Thr Ala Val Ser Ala	500		

<210> SEQ ID NO 58
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 58

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser	1	5	10	15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr	20	25	30	
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr	35	40	45	
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser	50	55	60	
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala	65	70	75	80
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu	85	90	95	
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser	100	105	110	
Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys	115	120	125	
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His	130	135	140	
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr	145	150	155	160
Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala	165	170	175	
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro	180	185	190	
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn	195	200	205	
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro	210	215	220	
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu	225	230	235	240
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val	245	250	255	

Val	Leu	Gly	Ser 260	Gln	Glu	Gly	Ala 265	Val	His	Thr	Ala	Leu	Ala 270	Gly	Ala
Leu	Glu	Ala 275	Glu	Met	Asp	Gly	Ala 280	Lys	Gly	Arg	Leu	Ser 285	Ser	Gly	His
Leu	Lys 290	Cys	Arg	Leu	Lys	Met 295	Asp	Lys	Leu	Arg	Leu 300	Lys	Gly	Val	Ser
Tyr 305	Ser	Leu	Cys	Thr	Ala 310	Ala	Phe	Thr	Phe	Thr 315	Lys	Ile	Pro	Ala	Glu 320
Thr	Leu	His	Gly	Thr 325	Val	Thr	Val	Glu	Val 330	Gln	Tyr	Ala	Gly	Thr 335	Asp
Gly	Pro	Cys	Lys 340	Val	Pro	Ala	Gln	Met 345	Ala	Val	Asp	Thr 350	Gln	Thr	Leu
Thr	Pro 355	Val	Gly	Arg	Leu	Ile	Thr 360	Ala	Asn	Pro	Val 365	Ile	Thr	Glu	Ser
Thr 370	Glu	Asn	Ser	Lys	Met 375	Met	Leu	Glu	Leu	Asp 380	Pro	Pro	Phe	Gly	Asp
Ser 385	Tyr	Ile	Val	Ile	Gly 390	Val	Gly	Glu	Lys	Lys 395	Ile	Thr	His	His	Trp 400
His	Arg	Ser	Gly 405	Ser	Thr	Ile	Gly	Lys	Ala 410	Phe	Glu	Ala	Thr	Val 415	Arg
Gly	Ala	Lys 420	Arg	Met	Ala	Val	Leu	Gly 425	Asp	Thr	Ala	Trp 430	Asp	Phe	Gly
Ser	Val 435	Gly	Gly	Ala	Leu	Asn 440	Ser	Leu	Gly	Lys	Gly 445	Ile	His	Gln	Ile
Phe 450	Gly	Ala	Ala	Phe	Lys 455	Ser	Leu	Phe	Gly	Gly 460	Met	Ser	Trp	Phe	Ser
Gln 465	Ile	Leu	Ile	Gly	Thr 470	Leu	Leu	Met	Trp 475	Leu	Gly	Leu	Asn	Thr	Lys 480
Asn	Gly	Ser	Ile 485	Ser	Leu	Met	Cys	Leu 490	Ala	Leu	Gly	Gly	Val 495	Leu	Ile
Phe	Leu	Ser 500	Thr	Ala	Val	Ser	Ala								

<400> SEQUENCE: 59

213

-continued

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140
 Gly Ser Gln His Ser Gly Met Ile Val Asn Gly Thr Gly His Glu Thr
 145 150 155 160
 Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175
 Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190
 Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205
 Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220
 Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240
 Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255
 Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270
 Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275 280 285
 Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300
 Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 60
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

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<400> SEQUENCE: 60

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Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1      5      10      15
Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20      25      30
Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35      40      45
Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50      55      60
Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65      70      75      80
Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85      90      95
Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100     105     110
Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
115     120     125
Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130     135     140
Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
145     150     155     160
Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
165     170     175
Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180     185     190
Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195     200     205
Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210     215     220
Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225     230     235     240
Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245     250     255
Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260     265     270
Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
275     280     285
Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
290     295     300
Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
305     310     315     320
Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
325     330     335
Gly Pro Cys Lys Val Leu Ala Gln Met Ala Val Asp Met Gln Thr Leu
340     345     350
Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
355     360     365
Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
370     375     380
Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
385     390     395     400
His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
405     410     415

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Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 61
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 61

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Ala Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140
 Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
 145 150 155 160
 Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175
 Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190
 Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205
 Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220
 Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240
 Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255
 Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270
 Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His

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275				280				285							
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser
290						295					300				
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu
305					310					315					320
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp
			325							330				335	
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu
			340							345				350	
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser
			355				360							365	
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp
	370				375						380				
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp
385					390					395					400
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg
			405							410				415	
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly
			420							425				430	
Ser	Val	Gly	Gly	Ala	Leu	Asn	Ser	Leu	Gly	Lys	Gly	Ile	His	Gln	Ile
		435				440								445	
Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser
	450				455						460				
Gln	Ile	Leu	Ile	Gly	Thr	Leu	Leu	Val	Trp	Leu	Gly	Leu	Asn	Thr	Lys
465					470					475					480
Asn	Gly	Ser	Ile	Ser	Leu	Thr	Cys	Leu	Ala	Leu	Gly	Gly	Val	Leu	Ile
			485							490				495	
Phe	Leu	Ser	Thr	Ala	Val	Ser	Ala								
			500												

<210> SEQ ID NO 62

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 62

Ile	Arg	Cys	Ile	Gly	Val	Ser	Asn	Arg	Asp	Phe	Val	Glu	Gly	Met	Ser
1				5						10				15	
Gly	Gly	Thr	Trp	Val	Asp	Val	Val	Leu	Glu	His	Gly	Gly	Cys	Val	Thr
		20						25					30		
Val	Met	Ala	Gln	Asp	Lys	Pro	Thr	Val	Asp	Ile	Glu	Leu	Val	Thr	Thr
	35						40					45			
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser
	50					55				60					
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala
65					70					75				80	
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu
			85						90					95	
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser
			100					105					110		
Leu	Val	Thr	Cys	Ala	Lys	Phe	Ala	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys
		115					120					125			
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His
	130					135					140				

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Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
 145 150 155 160
 Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175
 Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190
 Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205
 Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220
 Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240
 Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255
 Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270
 Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275 280 285
 Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300
 Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 63

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 63

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15

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Gly	Gly	Thr	Trp	Val	Asp	Val	Val	Leu	Glu	His	Gly	Gly	Cys	Val	Thr
			20					25					30		
Val	Met	Ala	Gln	Asp	Lys	Pro	Thr	Val	Asp	Ile	Glu	Leu	Val	Thr	Thr
	35						40					45			
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser
	50					55					60				
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala
65					70				75						80
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu
			85					90						95	
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser
			100					105					110		
Leu	Val	Thr	Cys	Ala	Lys	Phe	Ala	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys
		115					120					125			
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His
	130					135					140				
Gly	Ser	Gln	His	Ser	Gly	Met	Ile	Val	Asn	Asp	Thr	Gly	His	Glu	Thr
145					150					155					160
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Ile	Thr	Pro	Asn	Ser	Pro	Arg	Ala
				165					170					175	
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro
			180					185					190		
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn
	195						200					205			
Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro
	210					215					220				
Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu
225					230					235					240
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val
			245					250						255	
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala
		260						265					270		
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Ser	Ser	Gly	His
	275					280						285			
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser
	290					295					300				
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu
305					310					315					320
Thr	Leu	His	Gly	Thr	Val	Thr	Val	Glu	Val	Gln	Tyr	Ala	Gly	Thr	Asp
			325					330						335	
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu
			340					345					350		
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser
		355				360						365			
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp
	370					375					380				
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp
385					390					395					400
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg
				405					410					415	
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly
			420					425					430		

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Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
435 440 445

Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
450 455 460

Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys
465 470 475 480

Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Leu Ile
485 490 495

Phe Leu Ser Thr Ala Val Ser Ala
500

<210> SEQ ID NO 64
<211> LENGTH: 504
<212> TYPE: PRT
<213> ORGANISM: Zika virus

<400> SEQUENCE: 64

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20 25 30

Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Ser Thr
35 40 45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Thr
50 55 60

Ile Ser Asp Ile Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100 105 110

Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
115 120 125

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130 135 140

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His Glu Thr
145 150 155 160

Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
165 170 175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180 185 190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195 200 205

Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210 215 220

Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225 230 235 240

Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Ala Val
245 250 255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260 265 270

Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
275 280 285

Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
290 295 300

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Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 65
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus
 <220> FEATURE:
 <221> NAME/KEY: misc_feature
 <222> LOCATION: (1)..(504)
 <223> OTHER INFORMATION: X=any amino acid

<400> SEQUENCE: 65

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15
 Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
 20 25 30
 Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
 65 70 75 80
 Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
 85 90 95
 Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
 130 135 140

-continued

Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Xaa Gly His Glu Thr
 145 150 155 160
 Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
 165 170 175
 Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
 180 185 190
 Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
 195 200 205
 Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
 210 215 220
 Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn Lys Glu
 225 230 235 240
 Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
 245 250 255
 Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
 260 265 270
 Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
 275 280 285
 Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
 290 295 300
 Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Asp Lys Lys Ile Thr His His Trp
 385 390 395 400
 Xaa Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Phe Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Val Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Thr Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Ala
 500

<210> SEQ ID NO 66

<211> LENGTH: 504

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 66

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
 1 5 10 15

-continued

Gly	Gly	Thr	Trp	Val	Asp	Val	Val	Leu	Glu	His	Gly	Gly	Cys	Val	Thr
			20					25					30		
Ala	Met	Ala	Gln	Asp	Lys	Pro	Thr	Val	Asp	Ile	Glu	Leu	Val	Thr	Thr
	35						40					45			
Thr	Val	Ser	Asn	Met	Ala	Glu	Val	Arg	Ser	Tyr	Cys	Tyr	Glu	Ala	Ser
	50					55					60				
Ile	Ser	Asp	Met	Ala	Ser	Asp	Ser	Arg	Cys	Pro	Thr	Gln	Gly	Glu	Ala
65					70				75						80
Tyr	Leu	Asp	Lys	Gln	Ser	Asp	Thr	Gln	Tyr	Val	Cys	Lys	Arg	Thr	Leu
			85					90						95	
Val	Asp	Arg	Gly	Trp	Gly	Asn	Gly	Cys	Gly	Leu	Phe	Gly	Lys	Gly	Ser
			100					105					110		
Leu	Val	Thr	Cys	Ala	Lys	Phe	Ala	Cys	Ser	Lys	Lys	Met	Thr	Gly	Lys
		115					120					125			
Ser	Ile	Gln	Pro	Glu	Asn	Leu	Glu	Tyr	Arg	Ile	Met	Leu	Ser	Val	His
	130					135					140				
Gly	Ser	Gln	His	Ser	Gly	Met	Leu	Val	Asn	Asp	Thr	Gly	His	Glu	Thr
145					150					155					160
Asp	Glu	Asn	Arg	Ala	Lys	Val	Glu	Ile	Thr	Pro	Asn	Ser	Pro	Arg	Ala
				165					170					175	
Glu	Ala	Thr	Leu	Gly	Gly	Phe	Gly	Ser	Leu	Gly	Leu	Asp	Cys	Glu	Pro
			180					185					190		
Arg	Thr	Gly	Leu	Asp	Phe	Ser	Asp	Leu	Tyr	Tyr	Leu	Thr	Met	Asn	Asn
		195					200					205			
Lys	His	Trp	Leu	Ala	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro
	210					215					220				
Trp	His	Ala	Gly	Ala	Ala	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu
225					230					235					240
Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val
			245						250					255	
Val	Leu	Gly	Ser	Gln	Glu	Gly	Ala	Val	His	Thr	Ala	Leu	Ala	Gly	Ala
		260						265					270		
Leu	Glu	Ala	Glu	Met	Asp	Gly	Ala	Lys	Gly	Arg	Leu	Ser	Ser	Gly	His
	275					280						285			
Leu	Lys	Cys	Arg	Leu	Lys	Met	Asp	Lys	Leu	Arg	Leu	Lys	Gly	Val	Ser
	290					295					300				
Tyr	Ser	Leu	Cys	Thr	Ala	Ala	Phe	Thr	Phe	Thr	Lys	Ile	Pro	Ala	Glu
305					310					315					320
Thr	Val	Asp	Gly	Thr	Val	Thr	Val	Glu	Gly	Gln	Tyr	Gly	Gly	Thr	Asp
			325						330					335	
Gly	Pro	Cys	Lys	Val	Pro	Ala	Gln	Met	Ala	Val	Asp	Met	Gln	Thr	Leu
			340					345					350		
Thr	Pro	Val	Gly	Arg	Leu	Ile	Thr	Ala	Asn	Pro	Val	Ile	Thr	Glu	Ser
		355					360					365			
Thr	Glu	Asn	Ser	Lys	Met	Met	Leu	Glu	Leu	Asp	Pro	Pro	Phe	Gly	Asp
	370					375					380				
Ser	Tyr	Ile	Val	Ile	Gly	Val	Gly	Glu	Lys	Lys	Ile	Thr	His	His	Trp
385					390					395					400
His	Arg	Ser	Gly	Ser	Thr	Ile	Gly	Lys	Ala	Phe	Glu	Ala	Thr	Val	Arg
				405					410					415	
Gly	Ala	Lys	Arg	Met	Ala	Val	Leu	Gly	Asp	Thr	Ala	Trp	Asp	Phe	Gly
			420					425					430		

-continued

Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
435 440 445

Ile Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
450 455 460

Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
465 470 475 480

Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
485 490 495

Phe Leu Ser Thr Ala Val Ser Gly
500

<210> SEQ ID NO 67
<211> LENGTH: 504
<212> TYPE: PRT
<213> ORGANISM: Zika virus

<400> SEQUENCE: 67

Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly Met Ser
1 5 10 15

Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys Val Thr
20 25 30

Ala Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val Thr Thr
35 40 45

Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
50 55 60

Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly Glu Ala
65 70 75 80

Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg Thr Leu
85 90 95

Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys Gly Ser
100 105 110

Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr Gly Lys
115 120 125

Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser Val His
130 135 140

Gly Ser Gln His Ser Gly Met Leu Val Asn Asp Thr Gly His Glu Thr
145 150 155 160

Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro Arg Ala
165 170 175

Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys Glu Pro
180 185 190

Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met Asn Asn
195 200 205

Lys His Trp Leu Ala His Lys Glu Trp Phe His Asp Ile Pro Leu Pro
210 215 220

Trp His Ala Gly Ala Ala Thr Gly Thr Pro His Trp Asn Asn Lys Glu
225 230 235 240

Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr Val Val
245 250 255

Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala Gly Ala
260 265 270

Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser Gly His
275 280 285

Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly Val Ser
290 295 300

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Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro Ala Glu
 305 310 315 320
 Thr Val Asp Gly Thr Val Thr Val Glu Gly Gln Tyr Gly Gly Thr Asp
 325 330 335
 Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln Thr Leu
 340 345 350
 Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr Glu Ser
 355 360 365
 Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe Gly Asp
 370 375 380
 Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His His Trp
 385 390 395 400
 His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr Val Arg
 405 410 415
 Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp Phe Gly
 420 425 430
 Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His Gln Ile
 435 440 445
 Ile Gly Ala Ala Phe Lys Ser Leu Phe Gly Gly Met Ser Trp Phe Ser
 450 455 460
 Gln Ile Leu Ile Gly Thr Leu Leu Met Trp Leu Gly Leu Asn Thr Lys
 465 470 475 480
 Asn Gly Ser Ile Ser Leu Met Cys Leu Ala Leu Gly Gly Val Leu Ile
 485 490 495
 Phe Leu Ser Thr Ala Val Ser Gly
 500

<210> SEQ ID NO 68
 <211> LENGTH: 504
 <212> TYPE: PRT
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 68

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 35 40 45
 Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu Ala Ser
 50 55 60
 Leu Ser Asp Met Ala Ser Ala Ser Arg Cys Pro Thr Gln Gly Glu Pro
 65 70 75 80
 Ser Leu Asp Lys Gln Ser Asp Thr Gln Ser Val Cys Lys Arg Thr Leu
 85 90 95
 Gly Asp Arg Gly Trp Gly Asn Gly Cys Gly Ile Phe Gly Lys Gly Ser
 100 105 110
 Leu Val Thr Cys Ser Lys Phe Thr Cys Cys Lys Lys Met Pro Gly Lys
 115 120 125
 Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Pro Val His
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 Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Ile Gly His Glu Thr
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 Asp Glu Asn Arg Ala Lys Val Glu Val Thr Pro Asn Ser Pro Arg Ala

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Lys	His	Trp	Leu	Val	His	Lys	Glu	Trp	Phe	His	Asp	Ile	Pro	Leu	Pro
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Trp	His	Ala	Gly	Ala	Asp	Thr	Gly	Thr	Pro	His	Trp	Asn	Asn	Lys	Glu
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Ala	Leu	Val	Glu	Phe	Lys	Asp	Ala	His	Ala	Lys	Arg	Gln	Thr	Val	Val
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Phe	Gly	Ala	Ala	Phe	Lys	Ser	Leu	Phe	Gly	Gly	Met	Ser	Trp	Phe	Ser
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Gln	Ile	Leu	Ile	Gly	Thr	Leu	Leu	Val	Trp	Leu	Gly	Leu	Asn	Thr	Lys
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Asn	Gly	Ser	Ile	Ser	Leu	Thr	Cys	Leu	Ala	Leu	Gly	Gly	Val	Met	Ile
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Phe	Leu	Ser	Thr	Ala	Val	Ser	Ala								
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<210> SEQ ID NO 69

<211> LENGTH: 498

<212> TYPE: PRT

<213> ORGANISM: Zika virus

<400> SEQUENCE: 69

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450	455	460	
Leu Leu Val Trp Leu Gly Leu Asn Thr Lys Asn Gly Ser Ile Ser Leu			
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Thr Cys Leu Ala Leu Gly Gly Val Met Ile Phe Leu Ser Thr Ala Val			
	485	490	495

Ser Ala

<210> SEQ ID NO 70
 <211> LENGTH: 26
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 <213> ORGANISM: Artificial Sequence
 <220> FEATURE:
 <223> OTHER INFORMATION: synthetic polynucleotide
 <220> FEATURE:
 <221> NAME/KEY: misc_feature
 <222> LOCATION: (1)..(26)
 <223> OTHER INFORMATION: n=inosine

<400> SEQUENCE: 70

nnnnnnnnnn nnnnnnnnnn nnnnnnnnnn 26

<210> SEQ ID NO 71
 <211> LENGTH: 11
 <212> TYPE: PRT
 <213> ORGANISM: Artificial Sequence
 <220> FEATURE:
 <223> OTHER INFORMATION: synthetic peptide

<400> SEQUENCE: 71

Lys Leu Lys Leu Leu Leu Leu Lys Leu Lys
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<210> SEQ ID NO 72
 <211> LENGTH: 10773
 <212> TYPE: DNA
 <213> ORGANISM: Zika virus

<400> SEQUENCE: 72

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atggacatta tttcgagaca agaccaaagg gggagcggac aagttgtcac ttacgtctct	9480
aacacattta ccaacctagt ggtgcaactc attcggaata tggaggctga ggaagttcta	9540
gagatgcaag acttgtggct gctgcggagg tcagagaaag tgaccaactg gttgcagagc	9600
aacggatggg ataggctcaa acgaatggca gtcagtggag atgattgcgt tgtgaagcca	9660
attgatgata ggtttgacac tgccctcagg ttcttgaatg atatgggaaa agttaggaa	9720
gacacacaag agtggaaacc ctcaactgga tgggacaact gggaagaagt tccgttttgc	9780
tcccaccact tcaacaagct ccactcgaag gacgggaggt ccattgtggt tccctgccgc	9840
caccaagatg aactgattgg ccggggcccgc gtctctccag gggcgggatg gagcatccgg	9900
gagactgctt gcctagcaaa atcatatgag caaatgtggc agctccttta tttccacaga	9960
agggacctcc gactgatggc caatgccatt tgttcactg tgccagtga ctgggttcca	10020
actgggagaa ctacctggc aatccatgga aagggagaat ggatgaccac tgaagacatg	10080
cttgtggtgt ggaacagagt gtggattgag gagaacgacc acatggaaga caagacccca	10140
gttacgaaat ggacagacat tccctatttg gaaaaaggg aagacttggt gtgtggatct	10200
ctcatagggc acagaccgag caccacctgg gctgagaaca ttaaaacac agtcaacatg	10260
gtgcgcagga tcataggtga tgaagaaaag tacatggact acctatccac ccaagttcgc	10320
tacttgggtg aagaagggtc tacacctgga gtgctgtaag caccaatctt agtgtgtgca	10380
ggcctgctag tcagccacag cttggggaaa gctgtgcagc ctgtgacccc ccaggagaa	10440

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gctgggaaac caagcctata gtcagccga gaacgccatg gcacggaaga agccatgctg 10500
cctgtgagcc cctcagagga cactgagtca aaaaacccca cgcgcttgga ggcgagcagat 10560
gggaaaagaa ggtggcgacc ttccccaccc ttcaatctgg ggectgaact ggagatcagc 10620
tgtggatctc cagaagaggg actagtgggt agaggagacc ccccggaata cgcaaacag 10680
catattgacg ctgggaaaga ccagagactc catgagtttc caccacgctg gccgccaggc 10740
acagatcgcc gaatagcggc ggccggtgtg ggg 10773

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<210> SEQ ID NO 73
<211> LENGTH: 3423
<212> TYPE: PRT
<213> ORGANISM: Zika virus

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<400> SEQUENCE: 73

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Met Lys Asn Pro Lys Lys Lys Ser Gly Gly Phe Arg Ile Val Asn Met
1      5      10      15
Leu Lys Arg Gly Val Ala Arg Val Ser Pro Phe Gly Gly Leu Lys Arg
20     25     30
Leu Pro Ala Gly Leu Leu Leu Gly His Gly Pro Ile Arg Met Val Leu
35     40     45
Ala Ile Leu Ala Phe Leu Arg Phe Thr Ala Ile Lys Pro Ser Leu Gly
50     55     60
Leu Ile Asn Arg Trp Gly Ser Val Gly Lys Lys Glu Ala Met Glu Ile
65     70     75     80
Ile Lys Lys Phe Lys Lys Asp Leu Ala Ala Met Leu Arg Ile Ile Asn
85     90     95
Ala Arg Lys Glu Lys Lys Arg Arg Gly Ala Asp Thr Ser Val Gly Ile
100    105    110
Val Gly Leu Leu Leu Thr Thr Ala Met Ala Ala Glu Val Thr Arg Arg
115    120    125
Gly Ser Ala Tyr Tyr Met Tyr Leu Asp Arg Asn Asp Ala Gly Glu Ala
130    135    140
Ile Ser Phe Pro Thr Thr Leu Gly Met Asn Lys Cys Tyr Ile Gln Ile
145    150    155    160
Met Asp Leu Gly His Met Cys Asp Ala Thr Met Ser Tyr Glu Cys Pro
165    170    175
Met Leu Asp Glu Gly Val Glu Pro Asp Asp Val Asp Cys Trp Cys Asn
180    185    190
Thr Thr Ser Thr Trp Val Val Tyr Gly Thr Cys His His Lys Lys Gly
195    200    205
Glu Ala Arg Arg Ser Arg Arg Ala Val Thr Leu Pro Ser His Ser Thr
210    215    220
Arg Lys Leu Gln Thr Arg Ser Gln Thr Trp Leu Glu Ser Arg Glu Tyr
225    230    235    240
Thr Lys His Leu Ile Arg Val Glu Asn Trp Ile Phe Arg Asn Pro Gly
245    250    255
Phe Ala Leu Ala Ala Ala Ala Ile Ala Trp Leu Leu Gly Ser Ser Thr
260    265    270
Ser Gln Lys Val Ile Tyr Leu Val Met Ile Leu Leu Ile Ala Pro Ala
275    280    285
Tyr Ser Ile Arg Cys Ile Gly Val Ser Asn Arg Asp Phe Val Glu Gly
290    295    300
Met Ser Gly Gly Thr Trp Val Asp Val Val Leu Glu His Gly Gly Cys
305    310    315    320

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Val Thr Val Met Ala Gln Asp Lys Pro Thr Val Asp Ile Glu Leu Val	325	330	335
Thr Thr Thr Val Ser Asn Met Ala Glu Val Arg Ser Tyr Cys Tyr Glu	340	345	350
Ala Ser Ile Ser Asp Met Ala Ser Asp Ser Arg Cys Pro Thr Gln Gly	355	360	365
Glu Ala Tyr Leu Asp Lys Gln Ser Asp Thr Gln Tyr Val Cys Lys Arg	370	375	380
Thr Leu Val Asp Arg Gly Trp Gly Asn Gly Cys Gly Leu Phe Gly Lys	385	390	395
Gly Ser Leu Val Thr Cys Ala Lys Phe Ala Cys Ser Lys Lys Met Thr	405	410	415
Gly Lys Ser Ile Gln Pro Glu Asn Leu Glu Tyr Arg Ile Met Leu Ser	420	425	430
Val His Gly Ser Gln His Ser Gly Met Ile Val Asn Asp Thr Gly His	435	440	445
Glu Thr Asp Glu Asn Arg Ala Lys Val Glu Ile Thr Pro Asn Ser Pro	450	455	460
Arg Ala Glu Ala Thr Leu Gly Gly Phe Gly Ser Leu Gly Leu Asp Cys	465	470	475
Glu Pro Arg Thr Gly Leu Asp Phe Ser Asp Leu Tyr Tyr Leu Thr Met	485	490	495
Asn Asn Lys His Trp Leu Val His Lys Glu Trp Phe His Asp Ile Pro	500	505	510
Leu Pro Trp His Ala Gly Ala Asp Thr Gly Thr Pro His Trp Asn Asn	515	520	525
Lys Glu Ala Leu Val Glu Phe Lys Asp Ala His Ala Lys Arg Gln Thr	530	535	540
Val Val Val Leu Gly Ser Gln Glu Gly Ala Val His Thr Ala Leu Ala	545	550	555
Gly Ala Leu Glu Ala Glu Met Asp Gly Ala Lys Gly Arg Leu Ser Ser	565	570	575
Gly His Leu Lys Cys Arg Leu Lys Met Asp Lys Leu Arg Leu Lys Gly	580	585	590
Val Ser Tyr Ser Leu Cys Thr Ala Ala Phe Thr Phe Thr Lys Ile Pro	595	600	605
Ala Glu Thr Leu His Gly Thr Val Thr Val Glu Val Gln Tyr Ala Gly	610	615	620
Thr Asp Gly Pro Cys Lys Val Pro Ala Gln Met Ala Val Asp Met Gln	625	630	635
Thr Leu Thr Pro Val Gly Arg Leu Ile Thr Ala Asn Pro Val Ile Thr	645	650	655
Glu Ser Thr Glu Asn Ser Lys Met Met Leu Glu Leu Asp Pro Pro Phe	660	665	670
Gly Asp Ser Tyr Ile Val Ile Gly Val Gly Glu Lys Lys Ile Thr His	675	680	685
His Trp His Arg Ser Gly Ser Thr Ile Gly Lys Ala Phe Glu Ala Thr	690	695	700
Val Arg Gly Ala Lys Arg Met Ala Val Leu Gly Asp Thr Ala Trp Asp	705	710	715
Phe Gly Ser Val Gly Gly Ala Leu Asn Ser Leu Gly Lys Gly Ile His	725	730	735

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1145	1150	1155
Val Leu Val Ile Leu Leu Met	Val Gln Glu Gly Leu Lys Lys Arg	
1160	1165	1170
Met Thr Thr Lys Ile Ile Ile	Ser Thr Ser Met Ala Val Leu Val	
1175	1180	1185
Ala Met Ile Leu Gly Gly Phe	Ser Met Ser Asp Leu Ala Lys Leu	
1190	1195	1200
Ala Ile Leu Met Gly Ala Thr	Phe Ala Glu Met Asn Thr Gly Gly	
1205	1210	1215
Asp Val Ala His Leu Ala Leu	Ile Ala Ala Phe Lys Val Arg Pro	
1220	1225	1230
Ala Leu Leu Val Ser Phe Ile	Phe Arg Ala Asn Trp Thr Pro Arg	
1235	1240	1245
Glu Ser Met Leu Leu Ala Leu	Ala Ser Cys Leu Leu Gln Thr Ala	
1250	1255	1260
Ile Ser Ala Leu Glu Gly Asp	Leu Met Val Leu Ile Asn Gly Phe	
1265	1270	1275
Ala Leu Ala Trp Leu Ala Ile	Arg Ala Met Val Val Pro Arg Thr	
1280	1285	1290
Asp Asn Ile Thr Leu Ala Ile	Leu Ala Ala Leu Thr Pro Leu Ala	
1295	1300	1305
Arg Gly Thr Leu Leu Val Ala	Trp Arg Ala Gly Leu Ala Thr Cys	
1310	1315	1320
Gly Gly Phe Met Leu Leu Ser	Leu Lys Gly Lys Gly Ser Val Lys	
1325	1330	1335
Lys Asn Leu Pro Phe Val Met	Ala Leu Gly Leu Thr Ala Val Arg	
1340	1345	1350
Leu Val Asp Pro Ile Asn Val	Val Gly Leu Leu Leu Leu Thr Arg	
1355	1360	1365
Ser Gly Lys Arg Ser Trp Pro	Pro Ser Glu Val Leu Thr Ala Val	
1370	1375	1380
Gly Leu Ile Cys Ala Leu Ala	Gly Gly Phe Ala Lys Ala Asp Ile	
1385	1390	1395
Glu Met Ala Gly Pro Met Ala	Ala Val Gly Leu Leu Ile Val Ser	
1400	1405	1410
Tyr Val Val Ser Gly Lys Ser	Val Asp Met Tyr Ile Glu Arg Ala	
1415	1420	1425
Gly Asp Ile Thr Trp Glu Lys	Asp Ala Glu Val Thr Gly Asn Ser	
1430	1435	1440
Pro Arg Leu Asp Val Ala Leu	Asp Glu Ser Gly Asp Phe Ser Leu	
1445	1450	1455
Val Glu Asp Asp Gly Pro Pro	Met Arg Glu Ile Ile Leu Lys Val	
1460	1465	1470
Val Leu Met Thr Ile Cys Gly	Met Asn Pro Ile Ala Ile Pro Phe	
1475	1480	1485
Ala Ala Gly Ala Trp Tyr Val	Tyr Val Lys Thr Gly Lys Arg Ser	
1490	1495	1500
Gly Ala Leu Trp Asp Val Pro	Ala Pro Lys Glu Val Lys Lys Gly	
1505	1510	1515
Glu Thr Thr Asp Gly Val Tyr	Arg Val Met Thr Arg Arg Leu Leu	
1520	1525	1530
Gly Ser Thr Gln Val Gly Val	Gly Val Met Gln Glu Gly Val Phe	
1535	1540	1545

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His Thr	Met Trp	His Val	Thr	Lys Gly	Ser Ala	Leu	Arg Ser Gly
1550			1555			1560	
Glu Gly	Arg Leu Asp	Pro Tyr	Trp Gly	Asp Val	Lys	Gln Asp Leu	
1565		1570			1575		
Val Ser	Tyr Cys Gly	Pro Trp	Lys Leu Asp	Ala	Ala	Trp Asp Gly	
1580		1585			1590		
His Ser	Glu Val Gln	Leu Leu	Ala Val Pro	Pro Gly	Glu Arg Ala		
1595		1600			1605		
Arg Asn	Ile Gln Thr	Leu Pro	Gly Ile Phe	Lys Thr	Lys Asp Gly		
1610		1615			1620		
Asp Ile	Gly Ala Val	Ala Leu	Asp Tyr Pro	Ala Gly	Thr Ser Gly		
1625		1630			1635		
Ser Pro	Ile Leu Asp	Lys Cys	Gly Arg Val	Ile Gly	Leu Tyr Gly		
1640		1645			1650		
Asn Gly	Val Val Ile	Lys Asn	Gly Ser Tyr	Val Ser	Ala Ile Thr		
1655		1660			1665		
Gln Gly	Arg Arg Glu	Glu Glu	Thr Pro Val	Glu Cys	Phe Glu Pro		
1670		1675			1680		
Ser Met	Leu Lys Lys	Lys Gln	Leu Thr Val	Leu Asp	Leu His Pro		
1685		1690			1695		
Gly Ala	Gly Lys Thr	Arg Arg	Val Leu Pro	Glu Ile	Val Arg Glu		
1700		1705			1710		
Ala Ile	Lys Thr Arg	Leu Arg	Thr Val Ile	Leu Ala	Pro Thr Arg		
1715		1720			1725		
Val Val	Ala Ala Glu	Met Glu	Glu Ala Leu	Arg Gly	Leu Pro Val		
1730		1735			1740		
Arg Tyr	Met Thr Thr	Ala Val	Asn Val Thr	His Ser	Gly Thr Glu		
1745		1750			1755		
Ile Val	Asp Leu Met	Cys His	Ala Thr Phe	Thr Ser	Arg Leu Leu		
1760		1765			1770		
Gln Pro	Ile Arg Val	Pro Asn	Tyr Asn Leu	Tyr Ile	Met Asp Glu		
1775		1780			1785		
Ala His	Phe Thr Asp	Pro Ser	Ser Ile Ala	Ala Arg	Gly Tyr Ile		
1790		1795			1800		
Ser Thr	Arg Val Glu	Met Gly	Glu Ala Ala	Ala Ile	Phe Met Thr		
1805		1810			1815		
Ala Thr	Pro Pro Gly	Thr Arg	Asp Ala Phe	Pro Asp	Ser Asn Ser		
1820		1825			1830		
Pro Ile	Met Asp Thr	Glu Val	Glu Val Pro	Glu Arg	Ala Trp Ser		
1835		1840			1845		
Ser Gly	Phe Asp Trp	Val Thr	Asp His Ser	Gly Lys	Thr Val Trp		
1850		1855			1860		
Phe Val	Pro Ser Val	Arg Asn	Gly Asn Glu	Ile Ala	Ala Cys Leu		
1865		1870			1875		
Thr Lys	Ala Gly Lys	Arg Val	Ile Gln Leu	Ser Arg	Lys Thr Phe		
1880		1885			1890		
Glu Thr	Glu Phe Gln	Lys Thr	Lys His Gln	Glu Trp	Asp Phe Val		
1895		1900			1905		
Val Thr	Thr Asp Ile	Ser Glu	Met Gly Ala	Asn Phe	Lys Ala Asp		
1910		1915			1920		
Arg Val	Ile Asp Ser	Arg Arg	Cys Leu Lys	Pro Val	Ile Leu Asp		
1925		1930			1935		

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Gly	Glu	Arg	Val	Ile	Leu	Ala	Gly	Pro	Met	Pro	Val	Thr	His	Ala
1940						1945					1950			
Ser	Ala	Ala	Gln	Arg	Arg	Gly	Arg	Ile	Gly	Arg	Asn	Pro	Asn	Lys
1955						1960					1965			
Pro	Gly	Asp	Glu	Tyr	Leu	Tyr	Gly	Gly	Gly	Cys	Ala	Glu	Thr	Asp
1970						1975					1980			
Glu	Asp	His	Ala	His	Trp	Leu	Glu	Ala	Arg	Met	Leu	Leu	Asp	Asn
1985						1990					1995			
Ile	Tyr	Leu	Gln	Asp	Gly	Leu	Ile	Ala	Ser	Leu	Tyr	Arg	Pro	Glu
2000						2005					2010			
Ala	Asp	Lys	Val	Ala	Ala	Ile	Glu	Gly	Glu	Phe	Lys	Leu	Arg	Thr
2015						2020					2025			
Glu	Gln	Arg	Lys	Thr	Phe	Val	Glu	Leu	Met	Lys	Arg	Gly	Asp	Leu
2030						2035					2040			
Pro	Val	Trp	Leu	Ala	Tyr	Gln	Val	Ala	Ser	Ala	Gly	Ile	Thr	Tyr
2045						2050					2055			
Thr	Asp	Arg	Arg	Trp	Cys	Phe	Asp	Gly	Thr	Thr	Asn	Asn	Thr	Ile
2060						2065					2070			
Met	Glu	Asp	Ser	Val	Pro	Ala	Glu	Val	Trp	Thr	Arg	His	Gly	Glu
2075						2080					2085			
Lys	Arg	Val	Leu	Lys	Pro	Arg	Trp	Met	Asp	Ala	Arg	Val	Cys	Ser
2090						2095					2100			
Asp	His	Ala	Ala	Leu	Lys	Ser	Phe	Lys	Glu	Phe	Ala	Ala	Gly	Lys
2105						2110					2115			
Arg	Gly	Ala	Ala	Phe	Gly	Val	Met	Glu	Ala	Leu	Gly	Thr	Leu	Pro
2120						2125					2130			
Gly	His	Met	Thr	Glu	Arg	Phe	Gln	Glu	Ala	Ile	Asp	Asn	Leu	Ala
2135						2140					2145			
Val	Leu	Met	Arg	Ala	Glu	Thr	Gly	Ser	Arg	Pro	Tyr	Lys	Ala	Ala
2150						2155					2160			
Ala	Ala	Gln	Leu	Pro	Glu	Thr	Leu	Glu	Thr	Ile	Met	Leu	Leu	Gly
2165						2170					2175			
Leu	Leu	Gly	Thr	Val	Ser	Leu	Gly	Ile	Phe	Phe	Val	Leu	Met	Arg
2180						2185					2190			
Asn	Lys	Gly	Ile	Gly	Lys	Met	Gly	Phe	Gly	Met	Val	Thr	Leu	Gly
2195						2200					2205			
Ala	Ser	Ala	Trp	Leu	Met	Trp	Leu	Ser	Glu	Ile	Glu	Pro	Ala	Arg
2210						2215					2220			
Ile	Ala	Cys	Val	Leu	Ile	Val	Val	Phe	Leu	Leu	Leu	Val	Val	Leu
2225						2230					2235			
Ile	Pro	Glu	Pro	Glu	Lys	Gln	Arg	Ser	Pro	Gln	Asp	Asn	Gln	Met
2240						2245					2250			
Ala	Ile	Ile	Ile	Met	Val	Ala	Val	Gly	Leu	Leu	Gly	Leu	Ile	Thr
2255						2260					2265			
Ala	Asn	Glu	Leu	Gly	Trp	Leu	Glu	Arg	Thr	Lys	Ser	Asp	Leu	Ser
2270						2275					2280			
His	Leu	Met	Gly	Arg	Arg	Glu	Glu	Gly	Ala	Thr	Ile	Gly	Phe	Ser
2285						2290					2295			
Met	Asp	Ile	Asp	Leu	Arg	Pro	Ala	Ser	Ala	Trp	Ala	Ile	Tyr	Ala
2300						2305					2310			
Ala	Leu	Thr	Thr	Phe	Ile	Thr	Pro	Ala	Val	Gln	His	Ala	Val	Thr
2315						2320					2325			
Thr	Ser	Tyr	Asn	Asn	Tyr	Ser	Leu	Met	Ala	Met	Ala	Thr	Gln	Ala

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2330	2335	2340
Gly Val Leu Phe Gly Met Gly Lys Gly Met Pro Phe Tyr Ala Trp		
2345	2350	2355
Asp Phe Gly Val Pro Leu Leu Met Ile Gly Cys Tyr Ser Gln Leu		
2360	2365	2370
Thr Pro Leu Thr Leu Ile Val Ala Ile Ile Leu Leu Val Ala His		
2375	2380	2385
Tyr Met Tyr Leu Ile Pro Gly Leu Gln Ala Ala Ala Ala Arg Ala		
2390	2395	2400
Ala Gln Lys Arg Thr Ala Ala Gly Ile Met Lys Asn Pro Val Val		
2405	2410	2415
Asp Gly Ile Val Val Thr Asp Ile Asp Thr Met Thr Ile Asp Pro		
2420	2425	2430
Gln Val Glu Lys Lys Met Gly Gln Val Leu Leu Ile Ala Val Ala		
2435	2440	2445
Val Ser Ser Ala Ile Leu Ser Arg Thr Ala Trp Gly Trp Gly Glu		
2450	2455	2460
Ala Gly Ala Leu Ile Thr Ala Ala Thr Ser Thr Leu Trp Glu Gly		
2465	2470	2475
Ser Pro Asn Lys Tyr Trp Asn Ser Ser Thr Ala Thr Ser Leu Cys		
2480	2485	2490
Asn Ile Phe Arg Gly Ser Tyr Leu Ala Gly Ala Ser Leu Ile Tyr		
2495	2500	2505
Thr Val Thr Arg Asn Ala Gly Leu Val Lys Arg Arg Gly Gly Gly		
2510	2515	2520
Thr Gly Glu Thr Leu Gly Glu Lys Trp Lys Ala Arg Leu Asn Gln		
2525	2530	2535
Met Ser Ala Leu Glu Phe Tyr Ser Tyr Lys Lys Ser Gly Ile Thr		
2540	2545	2550
Glu Val Cys Arg Glu Glu Ala Arg Arg Ala Leu Lys Asp Gly Val		
2555	2560	2565
Ala Thr Gly Gly His Ala Val Ser Arg Gly Ser Ala Lys Leu Arg		
2570	2575	2580
Trp Leu Val Glu Arg Gly Tyr Leu Gln Pro Tyr Gly Lys Val Ile		
2585	2590	2595
Asp Leu Gly Cys Gly Arg Gly Gly Trp Ser Tyr Tyr Ala Ala Thr		
2600	2605	2610
Ile Arg Lys Val Gln Glu Val Lys Gly Tyr Thr Lys Gly Gly Pro		
2615	2620	2625
Gly His Glu Glu Pro Met Leu Val Gln Ser Tyr Gly Trp Asn Ile		
2630	2635	2640
Val Arg Leu Lys Ser Gly Val Asp Val Phe His Met Ala Ala Glu		
2645	2650	2655
Pro Cys Asp Thr Leu Leu Cys Asp Ile Gly Glu Ser Ser Ser Ser		
2660	2665	2670
Pro Glu Val Glu Glu Ala Arg Thr Leu Arg Val Leu Ser Met Val		
2675	2680	2685
Gly Asp Trp Leu Glu Lys Arg Pro Gly Ala Phe Cys Ile Lys Val		
2690	2695	2700
Leu Cys Pro Tyr Thr Ser Thr Met Met Glu Thr Leu Glu Arg Leu		
2705	2710	2715
Gln Arg Arg Tyr Gly Gly Gly Leu Val Arg Val Pro Leu Ser Arg		
2720	2725	2730

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Asn Ser Thr His Glu Met Tyr Trp Val Ser Gly Ala Lys Ser Asn 2735 2740 2745	
Thr Ile Lys Ser Val Ser Thr Thr Ser Gln Leu Leu Leu Gly Arg 2750 2755 2760	
Met Asp Gly Pro Arg Arg Pro Val Lys Tyr Glu Glu Asp Val Asn 2765 2770 2775	
Leu Gly Ser Gly Thr Arg Ala Val Val Ser Cys Ala Glu Ala Pro 2780 2785 2790	
Asn Met Lys Ile Ile Gly Asn Arg Ile Glu Arg Ile Arg Ser Glu 2795 2800 2805	
His Ala Glu Thr Trp Phe Phe Asp Glu Asn His Pro Tyr Arg Thr 2810 2815 2820	
Trp Ala Tyr His Gly Ser Tyr Glu Ala Pro Thr Gln Gly Ser Ala 2825 2830 2835	
Ser Ser Leu Ile Asn Gly Val Val Arg Leu Leu Ser Lys Pro Trp 2840 2845 2850	
Asp Val Val Thr Gly Val Thr Gly Ile Ala Met Thr Asp Thr Thr 2855 2860 2865	
Pro Tyr Gly Gln Gln Arg Val Phe Lys Glu Lys Val Asp Thr Arg 2870 2875 2880	
Val Pro Asp Pro Gln Glu Gly Thr Arg Gln Val Met Ser Met Val 2885 2890 2895	
Ser Ser Trp Leu Trp Lys Glu Leu Gly Lys His Lys Arg Pro Arg 2900 2905 2910	
Val Cys Thr Lys Glu Glu Phe Ile Asn Lys Val Arg Ser Asn Ala 2915 2920 2925	
Ala Leu Gly Ala Ile Phe Glu Glu Glu Lys Glu Trp Lys Thr Ala 2930 2935 2940	
Val Glu Ala Val Asn Asp Pro Arg Phe Trp Ala Leu Val Asp Lys 2945 2950 2955	
Glu Arg Glu His His Leu Arg Gly Glu Cys Gln Ser Cys Val Tyr 2960 2965 2970	
Asn Met Met Gly Lys Arg Glu Lys Lys Gln Gly Glu Phe Gly Lys 2975 2980 2985	
Ala Lys Gly Ser Arg Ala Ile Trp Tyr Met Trp Leu Gly Ala Arg 2990 2995 3000	
Phe Leu Glu Phe Glu Ala Leu Gly Phe Leu Asn Glu Asp His Trp 3005 3010 3015	
Met Gly Arg Glu Asn Ser Gly Gly Gly Val Glu Gly Leu Gly Leu 3020 3025 3030	
Gln Arg Leu Gly Tyr Val Leu Glu Glu Met Ser Arg Ile Pro Gly 3035 3040 3045	
Gly Arg Met Tyr Ala Asp Asp Thr Ala Gly Trp Asp Thr Arg Ile 3050 3055 3060	
Ser Arg Phe Asp Leu Glu Asn Glu Ala Leu Ile Thr Asn Gln Met 3065 3070 3075	
Glu Lys Gly His Arg Ala Leu Ala Leu Ala Ile Ile Lys Tyr Thr 3080 3085 3090	
Tyr Gln Asn Lys Val Val Lys Val Leu Arg Pro Ala Glu Lys Gly 3095 3100 3105	
Lys Thr Val Met Asp Ile Ile Ser Arg Gln Asp Gln Arg Gly Ser 3110 3115 3120	

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Gly	Gln	Val	Val	Thr	Tyr	Ala	Leu	Asn	Thr	Phe	Thr	Asn	Leu	Val
3125						3130					3135			
Val	Gln	Leu	Ile	Arg	Asn	Met	Glu	Ala	Glu	Glu	Val	Leu	Glu	Met
3140						3145					3150			
Gln	Asp	Leu	Trp	Leu	Leu	Arg	Arg	Ser	Glu	Lys	Val	Thr	Asn	Trp
3155						3160					3165			
Leu	Gln	Ser	Asn	Gly	Trp	Asp	Arg	Leu	Lys	Arg	Met	Ala	Val	Ser
3170						3175					3180			
Gly	Asp	Asp	Cys	Val	Val	Lys	Pro	Ile	Asp	Asp	Arg	Phe	Ala	His
3185						3190					3195			
Ala	Leu	Arg	Phe	Leu	Asn	Asp	Met	Gly	Lys	Val	Arg	Lys	Asp	Thr
3200						3205					3210			
Gln	Glu	Trp	Lys	Pro	Ser	Thr	Gly	Trp	Asp	Asn	Trp	Glu	Glu	Val
3215						3220					3225			
Pro	Phe	Cys	Ser	His	His	Phe	Asn	Lys	Leu	His	Leu	Lys	Asp	Gly
3230						3235					3240			
Arg	Ser	Ile	Val	Val	Pro	Cys	Arg	His	Gln	Asp	Glu	Leu	Ile	Gly
3245						3250					3255			
Arg	Ala	Arg	Val	Ser	Pro	Gly	Ala	Gly	Trp	Ser	Ile	Arg	Glu	Thr
3260						3265					3270			
Ala	Cys	Leu	Ala	Lys	Ser	Tyr	Ala	Gln	Met	Trp	Gln	Leu	Leu	Tyr
3275						3280					3285			
Phe	His	Arg	Arg	Asp	Leu	Arg	Leu	Met	Ala	Asn	Ala	Ile	Cys	Ser
3290						3295					3300			
Ser	Val	Pro	Val	Asp	Trp	Val	Pro	Thr	Gly	Arg	Thr	Thr	Trp	Ser
3305						3310					3315			
Ile	His	Gly	Lys	Gly	Glu	Trp	Met	Thr	Thr	Glu	Asp	Met	Leu	Val
3320						3325					3330			
Val	Trp	Asn	Arg	Val	Trp	Ile	Glu	Glu	Asn	Asp	His	Met	Glu	Asp
3335						3340					3345			
Lys	Thr	Pro	Val	Thr	Lys	Trp	Thr	Asp	Ile	Pro	Tyr	Leu	Gly	Lys
3350						3355					3360			
Arg	Glu	Asp	Leu	Trp	Cys	Gly	Ser	Leu	Ile	Gly	His	Arg	Pro	Arg
3365						3370					3375			
Thr	Thr	Trp	Ala	Glu	Asn	Ile	Lys	Asn	Thr	Val	Asn	Met	Val	Arg
3380						3385					3390			
Arg	Ile	Ile	Gly	Asp	Glu	Glu	Lys	Tyr	Met	Asp	Tyr	Leu	Ser	Thr
3395						3400					3405			
Gln	Val	Arg	Tyr	Leu	Gly	Glu	Glu	Gly	Ser	Thr	Pro	Gly	Val	Leu
3410						3415					3420			

<210> SEQ ID NO 74
 <211> LENGTH: 28
 <212> TYPE: DNA
 <213> ORGANISM: Artificial Sequence
 <220> FEATURE:
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28

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taactcgagc rcagatacca tcttccc 27

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ttaggatccc ttatgtgctt ggccttag 28

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taactcgagt cttcagcctc catgtg 26

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ttaggatcca atgcccactc aaacataga 29

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taactcgagt cattctcttc ttcagccctt 30

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taactcgagg aatctctctg tcatgtgtcc t 31

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<400> SEQUENCE: 104

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ttaggatcct gctgcccaga agagaa

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25

<210> SEQ ID NO 108
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<223> OTHER INFORMATION: primer

<400> SEQUENCE: 108

taactcgagc aatgatcttc atgttggg 28

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<223> OTHER INFORMATION: primer

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<212> TYPE: DNA

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ttaggatcca ggaaggatgt atgcagatg 29

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<220> FEATURE:

<223> OTHER INFORMATION: primer

<400> SEQUENCE: 114

taactcgaga catttgcgca tatgatttg 30

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<400> SEQUENCE: 115

ttaggatcca ggaaggacac acaagagt

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<210> SEQ ID NO 116
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taactcgaga caggtgcac agcttt

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<210> SEQ ID NO 117
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ttaggatcct ctctcatagg gcacagac

28

What is claimed is:

1. A Zika virus vaccine comprising a Zika virus having an RNA genome corresponding to the DNA sequence provided by SEQ ID NO: 72 or a variant nucleic acid having at least 80% identity to SEQ ID NO: 72, wherein said Zika virus vaccine is capable of stimulating a neutralizing antibody titer greater than 15 in at least 70% of vaccinated subjects, wherein the neutralizing antibody titer is determined using a microneutralization assay (MN₅₀).

2. The Zika virus vaccine according to claim 1, wherein said MN₅₀ is greater than 20, 25, 30, 35, 40, or 45.

3. The Zika virus vaccine according to claim 1, wherein the Zika virus vaccine is capable of stimulating a MN₅₀ titer greater than 15 in at least 75%, 80%, 90%, 95%, 96%, 97%, 98%, or at least 99% of vaccinated subjects.

4. The Zika virus vaccine according to claim 1, wherein the Zika virus comprises an E protein having an amino acid sequence provided by any one of SEQ ID NOs: 14-69, or a variant amino acid sequence that is at least 95% identical to any one of SEQ ID NOs: 14-69 and able to pack a virulent Zika virus.

5. The Zika virus vaccine according to claim 1, wherein the Zika virus is inactivated by chemical inactivation, thermal inactivation, pH inactivation, or UV inactivation.

6. The Zika virus vaccine according to claim 5, wherein the chemical inactivation comprises contacting the Zika virus with a chemical inactivation agent for longer than is required to completely inactivate the Zika virus as measured by plaque assay.

7. The Zika virus vaccine according to claim 5, wherein the chemical inactivation comprises contacting the Zika virus with formaldehyde.

8. The Zika virus vaccine according to claim 7, wherein the chemical inactivation comprises contacting the Zika virus with formaldehyde for between 2-10 days.

9. The Zika virus vaccine according to claim 5, wherein the chemical activation is performed at about +4° C. or about +22° C.

10. The Zika virus vaccine according to claim 1, further comprising an adjuvant.

11. The Zika virus vaccine according to claim 10, wherein the adjuvant is an aluminium salt adjuvant.

12. The Zika virus vaccine according to claim 11, wherein said aluminium salt adjuvant is aluminium hydroxide with less than 1.25 parts per billion (ppb) copper (Cu) based on a final pharmaceutical composition comprising the Zika virus.

13. The Zika virus vaccine according to claim 10, wherein the adjuvant comprises a peptide and a deoxyinosine-containing immunostimulatory oligodeoxynucleic acid molecule (I-ODN).

14. The Zika virus vaccine according to claim 13, wherein the peptide comprises the sequence KLKL₅KLK (SEQ ID NO: 71) and the I-ODN comprises oligo-d(IC)₁₃ (SEQ ID NO: 70).

15. The Zika virus vaccine according to claim 1, further comprising one or more pharmaceutically acceptable excipients.

16. The Zika virus vaccine according to claim 1, wherein the vaccine comprises protamine sulphate (PS) or fragments or break-down products of PS at amounts below the limits of detection by high performance liquid chromatography (HPLC).

17. The Zika virus vaccine according to claim 16, wherein said PS or fragments or break-down products of PS are detectable by mass spectroscopy.

18. A method for purifying infectious Zika virus, comprising the steps of

i) providing a crude harvest (a) comprising infectious Zika virus particles, non-infectious Zika virus particles,

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and impurities, wherein the impurities are generated from growing said Zika virus on a cell substrate;

ii) contacting said crude harvest (a) with an agent comprising protamine to obtain a Zika virus preparation (b) comprising infectious Zika virus particles; and

iii) further purifying said Zika virus preparation (b) by one or more size exclusion methods, wherein said one or more size exclusion methods comprise

(A) sucrose density gradient centrifugation,

(B) a solid-phase matrix packed in a column comprising a ligand-activated core and an inactive shell comprising pores, wherein the pores comprise a molecular weight cut-off that excludes the virus particles from entering the ligand-activated core, and wherein a molecule smaller than the molecular weight cut-off of the pores can enter the ligand-activated core, and/or

(C) size exclusion chromatography;

to obtain a purified Zika virus preparation (c) comprising infectious Zika virus particles, less than 100 ng/mL residual host cell DNA, less than 1 µg/mL residual host cell protein, and less than 1 µg/mL residual aggregates of virus particles.

19. The method according to claim 18, wherein the purified Zika virus preparation (c) comprises less than 10 ng/mL residual host cell DNA and less than 100 ng/mL residual host cell protein.

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20. The method according to claim 18, wherein said crude harvest (a) is subjected to one or more pre-purification step(s) prior to step ii), wherein the one or more pre-purification step(s) comprise

filtration using a filter having a pore size equal to or less than 0.2 µm,

digestion of host cell genomic DNA by enzymatic treatment, and/or

ultra/diafiltration using a hollow fiber membrane having a pore size equal to or greater than 100 kDa.

21. The Zika virus vaccine according to claim 1, wherein said variant nucleic acid has at least 90% identity to SEQ ID NO: 72.

22. The Zika virus vaccine according to claim 1, wherein said variant nucleic acid has at least 95% identity to SEQ ID NO: 72.

23. The Zika virus vaccine according to claim 1, wherein said variant nucleic acid has at least 99% identity to SEQ ID NO: 72.

24. The Zika virus vaccine according to claim 2, wherein said MN50 is greater than 50, 55, 60, 65, 70, 75, 80, or 85.

25. The Zika virus vaccine according to claim 2, wherein said MN50 is greater or equal to 90.

26. The Zika virus vaccine according to claim 1, wherein the vaccine comprises protamine sulphate (PS) or fragments or break-down products of PS at amounts below 1 µg/mL or below 100 ng/mL.

* * * * *