

APPENDICES

APPENDIX A

List of chemicals and materials used in this study

Name of chemicals and Materials	Company
Absolute ethanol	Merck, Germany
Acetone	Merck, Germany
40% Acrylamide/Bis solution	Bio-Rad, USA
Ammonium persulfate	Pierce, USA
Antibiotic antimycotic solution	Invitrogen, USA
Bovine serum albumin	Pierce, USA
Bromphenol Blue	Sigma-Aldrich, USA
Cell culture 25 and 75 cm ³ flask and well plates	Corning, USA
Chemiluminescence ECL detection system	GE Healthcare, USA
Complete proteinase inhibitor cocktail, Mini EDTA-free	Roche, Germany
Competent cell DH5 alpha	RBC Bioscience, Taiwan
Coomassie brilliant blue R250	Bio-Rad, USA
CyQUANT [®] dye	Molecular Probes, USA

Name of chemicals and Materials	Company
Developer	AGFA, Belgium
Dimethyl sulfoxide (DMSO)	Amresco, USA
Dithiotheritol (DTT)	USB, USA
Dulbecco's modified Eagle's medium (DMEM)	Invitrogen, USA
Ethylenediaminetetraacetic acid (EDTA)	Fluke, Switzerland
Fetal bovine serum (FBS)	HyClone, USA
Film	Kodak, USA
Fixative	AGFA, Belgium
Glycine	Vivantis, USA
HEPES	Invitrogen, USA
Hydrochloric acid	Merck, Germany
Isopropyl alcohol	Sigma-Aldrich, USA
LB Broth	Criterion, USA
LB Agar	Criterion, USA
Multiscreen MIC 96-well plate	Millipore, USA
Mammalian protein extraction buffer	GE Healthcare, USA
Matrigel	BD Biosciences, USA
Maxima TM SYBR Green qPCR Master Mix (2X)	Fermentas, Canada
Mercaptoethanol	Sigma-Aldrich, USA

Name of chemicals and Materials	Company
Methanol	Merck, Germany
M-MuLV Reverse transcriptase	Fermentas, Canada
Mouse monoclonal anti-FLAG antibody	Sigma-Aldrich, USA
Mouse monoclonal anti-beta actin antibody (HRP conjugated)	Abcam, USA
Non-fat dry milk	Bio-Rad, USA
Nitrocellulose membrane	GE Healthcare, USA
Oligo-(dT)- ₁₈ primers	Bio Basic Inc., Thailand
Potassium chloride	BHD, England
Potassium dihydrogen phosphate	BHD, England
Potassium phosphate	BHD, England
Primers	Bio Basic Inc., Thailand
Protein assay kit	Bio-Rad, USA
Protein loading marker	Fermentus, Canada
QIAprep Spin Miniprep kit	Qiagen, USA
RevertAid TM First Stand cDNA Synthesis kit	Fermentas, Canada
Ribonuclease inhibitor	Fermentas, Canada
RNase Away	Molecular Bio Products, USA

Name of chemicals and Materials	Company
Sodium chloride	BHD, England
Sodium dodecyl sulfate	Sigma-Aldrich, USA
Sodium hydroxide	BHD, England
Sodium hydrogen carbonate	Merck, Germany
TEMED	USB, USA
Thiourea	USB, USA
Tris	Research Organics, USA
Trypan blue	Sigma-Aldrich, USA
Trypsin	Invitrogen, USA
Tween 20	USB, USA
Urea	Research Organics, USA
Vacuum filter/Storage bottle	Corning, USA
Western lightning Chemiluminescent HRP Substrate	PerkinElmer, USA

APPENDIX B

List of instrument used in this study

Instrument	Company
Autoclave	Tomy autoclave SS-240
Automatic pipette	Gilson
Carbon dioxide incubator	Thermoscientific
Centrifuge	KUBOTA CORPORATION
Micro-plate spectrophotometer	Bio-Tek Instrument
Film cassette	Amersham Biosciences
Freezer (-80°C)	Forma Scientific
Freezer (-20°C)	Sanyo
Glassware	Pyrex and Scott duran
Hot air oven	Haraeus
Inverted microscope	NIKON
Laminar flow biological cabinet	NU AIRE
Liquid nitrogen tank	International Cryogenics, Inc.
Magnetic stirrer	Thermolyne
Microcentrifuge 5402, bench top	Eppendorf

Instrument	Company
Mini Trans-Blot Electrophoretic Transfer	Bio-Rad
Power supply	Bio-Rad
Vortex	Scientific industries
7500 Fast Real-Time PCR system	Applied Biosystems

APPENDIX C

Preparation of some reagents and buffers

1. Mammalian Cell Culture Media

1.1 DMEM serum free medium with phenol red.

DMEM	13.5	g
HEPES	2.603	g
NaHCO ₃	3.7	g

Add deionized water to 1000 mL and sterilized by vacuum filter (membrane pore sized 0.2 µm) and stored at 4°C

1.2 DMEM with 10% fetal bovine serum.

Incomplete DMEM	89	mL
Fetal bovine serum	10	mL
100X Antibiotic antimycotic solution	1	mL

Stored at 4°C.

1.3 Freezing medium (10%DMSO in 25% FBS-DMEM)

Incomplete DMEM	65	mL
Fetal bovine serum	25	mL
DMSO	10	mL

Prepared freshly.

1.4 0.4% Trypan blue

Trypan blue powder	0.4	g
1X PBS pH 7.2	100	mL

Filtered by Whatman filter paper No. 1 and store at room temperature.

1.5 2mM EDTA in PBS

Ethylenediaminetetraacetic acid	0.12	g
1X PBS pH 7.2	200	mL

Sterilized by vacuum filter (membrane pore sized 0.2 μm) and stored at 4°C.

2. *In vitro* Cell Migration Assay**Prepare matrigel**

Dilute stock Matrigel with cool DMEM serum free medium to 5 $\mu\text{g}/\mu\text{L}$ using cool pipette tips.

3. Protein Electrophoresis and Western Blot Analysis**3.1 Mammalian Protein Extraction Buffer with proteinase inhibitors**

Mammalian Protein Extraction Buffer	10	mL
Complete Protease Inhibitor Cocktail	1	tablet

Aliquoted 1 mL, stored at -20°C.

1.2 Separating gel buffer (1.5M Tris-HCl pH 8.8)

Tris base	18.16	g
Deionized water	80	mL

Adjusted pH to 8.8 by HCl adjusted final volume to 100 mL, and vacuum-filtrated using 0.2 μm Millipore membrane filter and stored at 4°C.

1.3 Stacking gel buffer (0.5M Tris-HCl pH 6.8)

Tris base	6.1	g
Deionized water	80	mL

Adjusted pH to 6.8 by HCl adjusted final volume to 100 mL, and vacuum-filtrated using 0.2 μ m Millipore membrane filter and stored at 4°C.

1.4 2X non-reducing buffer

100mM Tris-HCl pH 6.8	4	mL
20% Glycerol	8	mL
4% Sodium dodecyl sulfate	8	mL
0.2% Bromphenol blue	100	μ L

Mixed well, aliquot and stored at -20°C.

1.5 2X Reducing buffer

2X non-reducing buffer	1	mL
2-Mercaptoethanol	40	μ L

Mixed well, aliquoted and stored at -20°C.

1.6 5X Running buffer

Tris base	30	g
Glycine	142.5	g
Sodium dodecyl sulfate	5	g
Deionized water	1000	mL

Mixed well, prepare before use.

1.7 1X Running buffer

5X Running buffer	200	mL
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Deionized water	800	mL
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Mixed well, stored at 4°C.

1.8 10% APS

Ammonium persulfate	0.1	g
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Deionized water	1	mL
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Mixed well, aliquot and stored at -20°C.

1.9 10% SDS

Sodium dodecyl sulfate	1	g
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Deionized water	10	mL
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Mixed well, stored at room temperature.

1.10 Polyacrylamide gels

Solution	Separating gel				Stacking gel
	8%	10%	12%	14%	
Deionized water	11 mL	10 mL	9 mL	8 mL	3.19 mL
40% Polyacrylamide solution	5 mL	6 mL	7 mL	8 mL	0.56 mL
Separating gel buffer (1.5M Tris-HCl pH 8.8)	5 mL	5 mL	5 mL	5 mL	-
Stacking gel buffer (0.5M Tris-HCl pH 6.8)	-	-	-	-	1.25 mL
10% SDS	200 μ L	200 μ L	200 μ L	200 μ L	-
10% APS	65 μ L	65 μ L	65 μ L	65 μ L	25 μ L
TEMED	30 μ L	30 μ L	30 μ L	30 μ L	5 μ L
Total	20 mL	20 mL	20 mL	20 mL	5 mL

3.11 10X Transfer buffer

Tris base	22	g
Glycine	108	g
Deionized water	1000	mL

Mixed well, prepared before use.

3.12 1X Transfer buffer

10X Transfer buffer	100	mL
Methanol	100	mL
Deionized water	1000	mL

Mixed well, stored at 4°C.

3.13 1X Tris-buffer saline (TBS)

Tris base	2.43	g
NaCl	8	g
Deionized water	900	mL

Adjusted pH to 6.8 by HCl adjusted final volume to 100 mL, mixed well and stored at 4°C.

3.14 0.15% Tween 20-Tris-buffer saline (T-TBS)

TBS	1000	mL
50% Tween 20	3	mL

Mixed well, stored at 4°C.

2. Bacterial Culture**4.1 LB agar**

LB broth	100	mL
Bacterial agar	2	g

Mixed well, autoclaved, and stored at RT.

4.2 LB broth

Tryptone	10	g
Yeast Extract	5	g
NaCl	10	g
Deionized water	900	mL

Adjusted final volume to 1000 mL, mixed well, autoclave and stored at RT.

5 *In vitro* Cell-fibronectin Adhesion Assay**5.1 0.2% Crystal violet in 10% ethanol**

Crystal violet dye	0.2	g
Absolute ethanol	10	mL
Deionized water	90	mL

Mixed well, stored at 4°C.

5.2 0.1 M Sodium phosphate (NaH₂PO₄)

NaH ₂ PO ₄	1.2	g
Deionized water	100	mL

Mixed well, stored at 4°C.

6 2-D Gel Electrophoresis Analysis**6.1 Rehydration stock solution without IPG buffer**

Urea	2.4	g
CHAPS	0.2	g
Bromophenol blue	0.02	g
Deionized water	5	mL

Mixed well, stored at -20°C.

6.2 SDS equilibration buffer

Tris-HCl pH 8.8	10	mL
Urea	72.07	g
Glycerol	69	mL
SDS	4	g
Bromophenol blue	0.4	g
Deionized water	200	mL

Mixed well, stored at -20°C.

6.3 SDS equilibration buffer 1

SDS equilibration buffer	5	mL
Dithiothreitol (DTT)	50	mg

Mixed well, stored at 4°C.

6.4 SDS equilibration buffer 2

SDS equilibration buffer	5	mL
Iodoacetamide (IAA)	125	mg

Mixed well, stored at 4°C.

6.5 Coomassie brilliant blue R-250

Coomassie R-250 dye	3	g
Methanol	900	mL
Acetic acid	200	mL
Deionized water	2900	mL

Mixed well, stored at RT.

6.6 Destaining solution

Methanol 450 mL

Acetic acid 100 mL

Deionized water 1450 mL

Mixed well, stored at RT.

APPENDIX D

List of Proteins Significantly Differentially Expressed in MDA-MB-231 Cells by the RCL of Maspin

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
Protocadherin gamma-A5 isoform 2 precursor [<i>Homo sapiens</i>]	gi 14196471	13.53	0.00	0.00	7.67	0.00	5.81	3.69
Alpha 1 chain-like collagen COLA1L precursor [<i>Homo sapiens</i>]	gi 17974510	7.68	1.22	0.00	5.52	1.78	4.31	2.68
SH2 domain-containing protein 4B isoform 2 [<i>Homo sapiens</i>]	gi 224591408	14.05	2.26	0.00	5.24	0.00	7.52	2.42
Bruno-like 4, RNA binding protein (Drosophila), isoform CRA_b [<i>Homo sapiens</i>]	gi 119621800	15.51	2.15	0.00	4.80	1.39	6.15	2.06

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
Coagulation factor V [<i>Homo sapiens</i>]	gi 86451093	9.86	0.00	0.00	4.71	2.04	5.40	0.00
Small ubiquitin-related modifier 3 precursor [<i>Homo sapiens</i>]	gi 48928058	63.89	3.23	1.76	5.62	2.37	6.24	2.93
Connexin45 [<i>Homo sapiens</i>]	gi 424134	15.5	2.26	1.38	4.23	0.00	3.74	1.93
Sorting nexin-33 [<i>Homo sapiens</i>]	gi 23397574	30.28	2.45	2.01	6.06	0.00	6.47	1.90
RecName: Full=Putative uncharacterized protein ENSP00000382790 [<i>Homo sapiens</i>]	gi 218563318	13.7	0.00	0.00	2.89	1.63	3.74	0.00
DnaJ (Hsp40) homolog, subfamily C, member 13 [<i>Homo sapiens</i>]	gi 153217514	4.3	0.00	1.68	4.26	1.08	3.18	2.24

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
Coiled-coil domain-containing protein 165 [<i>Homo sapiens</i>]	gi 16364431 6	2.79	0.00	1.47	3.57	0.67	3.88	0.00
Leucine-rich repeats and IQ motif containing 1, isoform CRA_a [<i>Homo sapiens</i>]	gi 11961779 9	18.47	2.02	1.67	3.38	0.00	3.16	1.86
Inositol polyphosphate 1-phosphatase [<i>Homo sapiens</i>]	gi 4504703	10.83	1.63	1.65	3.24	1.32	4.58	1.40
Chain A, Structure Of The Spliceosomal Phosphopeptide P140 (Phosphorylated Form) [<i>Homo sapiens</i>]	gi 31310347 4	7.26	2.57	2.35	4.60	0.00	4.56	0.00
Ventricular zone expressed PH domain homolog 1 [<i>Homo sapiens</i>]	gi 75517805	37.45	1.58	1.89	3.65	0.00	3.03	1.83

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
RecName: Full=Putative protein PABPC1-like; AltName: Full=Polyadenylate-binding protein pseudogene 2 [<i>Homo sapiens</i>]	gi 74762343	8.78	4.57	4.16	7.80	4.79	6.93	5.23
PREDICTED: ankyrin repeat domain- containing protein 36B isoform 1 [<i>Homo sapiens</i>]	gi 31011896 6	15.13	2.20	2.20	4.10	1.68	6.07	1.97
Immunoglobulin heavy chain variable region [<i>Homo sapiens</i>]	gi 11269627 5	9.56	1.28	1.67	3.08	0.96	3.83	2.94
Cytochrome b5 domain-containing protein 1 [<i>Homo sapiens</i>]	gi 40255060	6.15	0.00	2.50	4.32	1.24	4.47	2.58

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
Chain B, Crystal Structure Of The Epha4-Ephrina2 Complex [<i>Homo sapiens</i>]	gi 262118440	8.12	2.34	2.77	4.62	2.28	4.25	2.38
Immunoglobulin gamma 1 heavy chain variable region [<i>Homo sapiens</i>]	gi 304563428	12.45	3.19	5.67	9.28	0.00	9.35	2.86
Lysine-specific demethylase 2B isoform a [<i>Homo sapiens</i>]	gi 54112382	9.63	0.00	0.00	1.68	0.00	2.33	0.00
Kinesin-like protein KIF26B [<i>Homo sapiens</i>]	gi 124430752	5.89	2.13	2.57	4.14	0.00	4.06	0.93
hCG30082, isoform CRA_b [<i>Homo sapiens</i>]	gi 119608517	3.18	2.37	4.52	7.13	2.58	7.52	2.34

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
Presenilin-associated protein [<i>Homo sapiens</i>]	gi 6409316	3.46	3.06	2.44	3.62	1.76	4.07	1.49
D4, zinc and double PHD fingers family 1, isoform CRA_c [<i>Homo sapiens</i>]	gi 11957716 6	3.81	1.73	2.93	3.51	2.41	4.25	0.00
Poly [ADP-ribose] polymerase 1 [<i>Homo sapiens</i>]	gi 15652396 8	6.17	2.20	3.85	4.40	2.72	4.50	2.44
Proteasome subunit beta type-3 [<i>Homo sapiens</i>]	gi 22538465	61.11	7.18	5.32	4.72	5.09	0.00	6.73
Villin-1 [<i>Homo sapiens</i>]	gi 19439423 7	13.9	10.23	9.70	8.36	9.42	8.64	9.59

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
Protein FAM71B [<i>Homo sapiens</i>]	gi 22241863 3	11.45	7.25	4.84	3.86	6.38	2.07	4.09
Immunoglobulin heavy chain variable region [<i>Homo sapiens</i>]	gi 19034193 7	5.45	4.69	3.45	2.61	4.02	2.73	4.20
AP-2 complex subunit beta isoform b [<i>Homo sapiens</i>]	gi 4557469	24.49	8.59	7.55	5.69	8.30	5.80	8.12
Glutamate receptor 2 [<i>Homo sapiens</i>]	gi 493134	19.05	5.71	5.54	4.13	6.37	2.09	5.74
Proteasome subunit alpha type-1 isoform 2 [<i>Homo sapiens</i>]	gi 4506179	15.08	4.67	2.27	1.61	5.68	1.57	4.58
Metallopeptidase [<i>Homo sapiens</i>]	gi 4138016	10.16	5.94	4.09	2.88	4.66	2.88	4.93
MSTP094 [<i>Homo sapiens</i>]	gi 33337990	6.11	3.21	1.34	2.59	1.08	3.85	0.00

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
hCG1805148 [<i>Homo sapiens</i>]	gi 11962314 7	8.27	8.18	8.07	5.39	7.09	5.31	8.17
Minichromosome maintenance complex component 10 [<i>Homo sapiens</i>]	gi 55957755	25.18	3.30	9.09	5.95	8.63	5.99	9.07
hCG2012599 [<i>Homo sapiens</i>]	gi 11957909 0	6.24	5.86	5.77	3.69	4.22	1.78	5.92
Mitochondrial 2-oxodicarboxylate carrier isoform 1 [<i>Homo sapiens</i>]	gi 13449279	9.93	8.37	8.61	5.47	7.41	4.95	7.80
Tetratricopeptide repeat domain 13, isoform CRA_b [<i>Homo sapiens</i>]	gi 27502765	13.12	5.95	7.63	4.70	6.59	3.24	5.75
Dedicator of cytokinesis protein 9 isoform a [<i>Homo sapiens</i>]	gi 24308029	9.55	6.20	5.32	3.23	8.75	3.05	9.29

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
MUC18 glycoprotein [<i>Homo sapiens</i>]	gi 529724	15.98	6.37	6.31	3.82	5.78	4.35	6.51
Terminal uridylyltransferase 4 isoform a [<i>Homo sapiens</i>]	gi 57863248	6.47	3.97	5.10	2.75	7.82	2.48	5.56
hCG1644059 [<i>Homo sapiens</i>]	gi 11960768 1	4.95	4.82	4.30	2.28	6.37	2.30	4.37
Chain A, Crystal Structure Of Hscarg From Homo Sapiens In Complex With Nadp [<i>Homo sapiens</i>]	gi 11938938 4	12.5	5.24	5.24	2.73	5.10	2.50	7.71
Guanylate cyclase soluble subunit alpha-2 [<i>Homo sapiens</i>]	gi 4504211	10.81	3.32	5.22	2.63	5.80	2.75	5.05
hCG1985469, isoform CRA_a [<i>Homo sapiens</i>]	gi 11961070 2	14.84	2.46	5.34	2.60	8.40	2.57	5.05

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
Max-like protein X isoform beta [<i>Homo sapiens</i>]	gi 38201612	16.58	5.44	5.59	2.69	6.02	0.00	7.87
Transcription factor T-box 5 [<i>Homo sapiens</i>]	gi 14041802	6.7	5.26	5.35	2.53	8.29	2.75	6.19
hCG2038456 [<i>Homo sapiens</i>]	gi 11958265 2	8.43	5.95	6.04	2.84	5.74	2.93	5.80
Tripartite motif-containing protein 65 [<i>Homo sapiens</i>]	gi 38679905	3.7	5.17	4.71	2.20	3.05	1.59	5.56
Bullous pemphigoid antigen 1 eA [<i>Homo sapiens</i>]	gi 30704862	9.3	4.56	4.93	2.26	6.80	2.36	4.74
Rho GDP-dissociation inhibitor 2 [<i>Homo sapiens</i>]	gi 56676393	9.62	4.32	4.38	1.99	4.12	1.92	4.14

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
OK/KNS-CL.3 [<i>Homo sapiens</i>]	gi 21104504	5.76	5.23	4.62	1.75	3.77	0.00	4.56
Fork head-related protein like B [<i>Homo sapiens</i>]	gi 27529939	14.78	8.46	8.31	2.97	8.58	3.04	5.20
Epithelial cell transforming 2 [<i>Homo sapiens</i>]	gi 34978932	12.55	5.27	8.08	2.60	7.55	2.59	5.13
Myotubularin-related protein 5 [<i>Homo sapiens</i>]	gi 23973551 9	18.37	7.38	7.29	2.32	7.12	4.50	7.20
Immunoglobulin heavy chain variable region [<i>Homo sapiens</i>]	gi 7573057	2.48	5.37	6.74	1.97	7.20	4.46	7.29
Homeobox containing 1 transcript variant b [<i>Homo sapiens</i>]	gi 89280952	4.07	2.15	4.15	1.10	3.44	2.01	3.05

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
Chain A, Human Deltaf508 Nbd1 With Three Solubilizing Mutations [<i>Homo sapiens</i>]	gi 82408077	9.4	2.82	5.80	0.00	9.36	0.00	5.95
Interleukin 17 receptor E, isoform CRA_a [<i>Homo sapiens</i>]	gi 21756363	20.43	1.50	3.30	0.00	3.64	1.84	3.94
Latexin [<i>Homo sapiens</i>]	gi 19447371 4	34.49	4.80	3.55	0.00	5.32	2.44	6.32
Zinc-finger motif-enhancer binding-protein-1 beta [<i>Homo sapiens</i>]	gi 50657089	1.03	6.46	4.35	0.00	4.16	2.13	6.24
Thioredoxin reductase GRIM-12 [<i>Homo sapiens</i>]	gi 3820535	27.2	5.77	7.13	5.93	9.65	5.62	9.19

Protein name	Accession number	MOWSE Score	Neg mean	Mock mean	Maspin mean	MOM mean	OMO mean	Oval mean
Ankyrin repeat domain containing protein [<i>Homo sapiens</i>]	gi 32126756 0	12.38	6.65	5.76	9.78	2.63	8.83	0.00
Arginine and glutamate-rich protein 1 [<i>Bos taurus</i>]	gi 84000355	4.3	1.90	4.10	6.44	4.73	6.49	3.68
hCG2038875 [<i>Homo sapiens</i>]	gi 11957079 9	15.26	4.78	5.20	8.01	2.46	8.06	2.69

CURRICULUM VITAE

Name Mr. Chakkrit Khanaree

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Education

March, 1999 Certificate of Junior high school, Yupparaj Wittayalai
Chiang Mai school, Chiang Mai, Thailand

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Chiang Mai school, Chiang Mai, Thailand

March, 2005 B.S. (Medical Technology), Chiang Mai University,
Chiang Mai, Thailand

Poster presentation

Khanaree C, Chairatvit K, Roytrakul S, Wongnoppavich A. Requirement of the Reactive Center Loop of maspin for inhibition of human MDA-MB-231 breast cancer cell invasion. The 13th FAOBMB International Congress of Biochemistry and Molecular Biology. 25-29th November, 2012. Bangkok, Thailand.

Publication

Khanaree C, Chairatvit K, Roytrakul S, Wongnoppavich A. Reactive center loop moiety is essential for the maspin activity on cellular invasion and ubiquitin-proteasome level. *Oncol Res.* 2013; In Press