

Contents

1	Discovery of the Outer Membrane Vesicles: Revisiting Contemporary Works	1
1.1	Introduction	1
1.2	Discovery of OMVs	2
1.3	Production of OMVs	3
1.4	A Novel Secretion Process	6
1.5	Bleb Formation Under Abnormal Vis-à-Vis Normal Growth Conditions	8
1.6	A Temporary Setback	9
1.7	Further Work on Bleb Formation	10
1.8	Confirmation of the Discovery by Contemporary Investigators	11
1.9	Essential Findings of the Discovery Vis-à-Vis Later Works	11
	References	12
2	Gram-Negative Bacteria: The cell Membranes	15
2.1	Inner and Outer Membranes	15
2.2	Structure of OMVs	18
2.3	Chemical Composition of OMVs	19
2.4	Proteomic Profile of OMVs	20
2.4.1	Isolation and Purification	20
2.4.2	Protein Separation	28
	References	30
3	Factors Affecting Production of Outer Membrane Vesicles	35
3.1	Natural and Unnatural OMVs	35
3.2	Pathogenic and Nonpathogenic Bacteria	36
3.3	Bacterial Growth Conditions	37
3.4	Impact of LPS Structure	38
3.5	Vesicle Production Within the Infected Host	38

3.6	Antibiotic Treatment and Vesicle Formation	39
3.7	Stress Response and OMV Production	40
	References	41
4	Outer Membrane Vesicles as Carriers of Biomaterials.	47
4.1	Packaging and Predatory Activities	47
4.2	Toxins	48
4.3	Non-Toxin Virulence Factors.	52
4.4	Enrichment of Virulence Factors in OMVs	54
4.5	DNA.	55
4.6	Antibiotics.	56
4.7	Engineered Recombinant OMVs	57
	References	60
5	Outer Membrane Vesicles and the Biofilm Formation	65
	References	68
6	Outer Membrane Vesicles: Interaction with Prokaryotes and Eukaryotes	71
6.1	Binding with Target Cells Membrane	74
6.2	Fusion with Target Cell Membrane	75
6.3	Entry into the Target Cells	75
	References	77
7	Biogenesis of Outer Membrane Vesicles	81
7.1	Model of OMV Biogenesis	85
	References	88
8	Release of Outer Membrane Vesicles: Is it a Novel Secretion Mechanism?	91
	References	93
9	Outer Membrane Vesicles: Physiological Medical Applications . .	95
9.1	Activation of Innate Immune Response.	95
9.2	B-Cell Activation by OMVs	96
9.3	Interaction of OMVs with Complement System	99
9.4	OMV Triggers Cell-Mediated Immunity	101
9.5	OMV Stimulates Proinflammatory Response	102
9.6	OMVs as Immunogens	104
9.6.1	Neisseria meningitidis.	105
9.6.2	Neisseria lactamica.	108
9.6.3	Vibrio cholerae	109
9.6.4	Acinetobacter baumannii.	110
9.6.5	Bordetella pertussis	111

9.6.6	Burkholderia pseudomallei	112
9.6.7	Porphyromonas gingivalis	113
9.6.8	Salmonella typhimurium	114
9.6.9	Shigella flexneri	116
9.6.10	Treponema pallidum	117
9.7	OMVs as Vaccine	118
9.7.1	OMVs as Vaccines for Meningococcal Diseases	119
9.7.2	Markers of Protection Against Meningococcal Disease	119
9.7.3	Challenges for Vaccine Development	120
9.7.4	Detergent-Treated OMVs as Vaccine	120
9.7.5	Native OMVs as Vaccine	125
9.7.6	OMV Vaccines in Combination	127
9.7.7	Recombinant OMV Vaccines Using Reverse Vaccinology Approach	130
9.7.8	OMVs in Vaccine Delivery	133
9.7.9	OMVs as Adjuvant	133
9.7.10	OMV as Controlled Release System for Vaccine	134
	References	135
10	Concluding Notes	147
Index		151