

Contents

Preface	ix
List of Contributors	xi
1 Current and Future Trends in Forensic Molecular Biology	1
<i>Simon J. Walsh</i>	
1.1 Introduction	1
1.2 Developments within the field of forensic molecular biology	2
1.3 Developments influencing law enforcement – operational impacts	7
1.4 Developments influencing the justice system – socio-legal impacts	10
1.5 Summary	11
1.6 References	12
2 Basic Tools and Techniques in Molecular Biology	21
<i>Ralph Rapley and David Whitehouse</i>	
2.1 Introduction	21
2.2 Isolation and separation of nucleic acids	21
2.3 Automated analysis of nucleic acid fragments	23
2.4 Molecular biology and bioinformatics	24
2.5 The polymerase chain reaction (PCR)	25
2.6 Applications of the PCR	28
2.7 Nucleotide sequencing of DNA	30
2.8 Conclusion	34
2.9 References	34
3 Automated DNA Extraction Techniques for Forensic Analysis	37
<i>Marion Nagy</i>	
3.1 Introduction	37
3.2 Principal steps of DNA extraction	38
3.3 DNA extraction techniques	39
3.4 Modified techniques for DNA extraction from challenging forensic samples	43
3.5 Automation of DNA extraction	45
3.6 References	56
4 Real-time Quantitative PCR in Forensic Science	59
<i>Antonio Alonso and Oscar García</i>	
4.1 Introduction	59
4.2 Current real-time PCR chemistries	60

4.3	Human nuclear DNA quantification	61
4.4	Human mitochondrial DNA quantification	65
4.5	Detection and quantification of non-human species	66
4.6	Concluding remarks and perspectives	67
4.7	References	67
5	Minisatellite and Microsatellite DNA Typing Analysis	71
	<i>Keiji Tamaki</i>	
5.1	Introduction	71
5.2	Minisatellites	71
5.3	Microsatellites	80
5.4	Acknowledgements	86
5.5	References	86
6	Application of SNPs in Forensic Casework	91
	<i>Claus Borsting, Juan J. Sanchez and Niels Morling</i>	
6.1	Introduction	91
6.2	Single nucleotide polymorphisms	92
6.3	Single nucleotide polymorphism typing technology	94
6.4	Single nucleotide polymorphisms for human identification	95
6.5	Single nucleotide polymorphisms in mitochondrial DNA	98
6.6	Forensic DNA phenotyping	98
6.7	Ethical considerations of SNP genotyping	100
6.8	References	100
7	The X Chromosome in Forensic Science: Past, Present and Future	103
	<i>Reinhard Szibor</i>	
7.1	Introduction	103
7.2	History of forensic utilization of the X chromosome	104
7.3	Chromosomal X short tandem repeats	107
7.4	Power of ChrX markers in trace analysis	111
7.5	Power of ChrX markers in kinship testing	111
7.6	Chromosomal X marker mapping and haplotype analysis	114
7.7	Chromosomal X-chromosomal Y homologous markers	119
7.8	Chromosomal X STR allele and haplotype distribution in different populations	119
7.9	Ethical considerations in ChrX marker testing	120
7.10	Concluding remarks	121
7.11	References	121
8	Mitochondrial Analysis in Forensic Science	127
	<i>Hirokazu Matsuda and Nobuhiro Yukawa</i>	
8.1	Introduction	127
8.2	Mitochondrial DNA (mtDNA) biology	128
8.3	Identification of individuals (mtDNA typing)	132
8.4	Topics of forensic interest	134
8.5	References	138

9	Y-Chromosomal Markers in Forensic Genetics	141
	<i>Manfred Kayser</i>	
9.1	Introduction	141
9.2	Identification of the male sex	142
9.3	Identification of male lineages	143
9.4	Identification of a male's paternity	148
9.5	Identification of a male's geographical origin	151
9.6	The future of Y-chromosomal markers in forensics	155
9.7	Acknowledgements	156
9.8	References	157
10	Laser Microdissection in Forensic Science	163
	<i>Luigi Saravo, Davide Di Martino, Nicola Staiti, Carlo Romano, Enrico Di Luise, Dario Piscitello, Salvatore Spitaleri, Ernesto Ginestra, Ignazio Ciuna, Fabio Quadrana, Beniamino Leo, Giuseppe Giuffrè and Giovanni Tuccari</i>	
10.1	Introduction	163
10.2	Histological, biochemical analysis	166
10.3	References	169
11	Laboratory Information Systems for Forensic Analysis of DNA Evidence	171
	<i>Benoît Leclair and Tom Scholl</i>	
11.1	Introduction	171
11.2	The specifications of forensic genotyping assays	173
11.3	Automated pipetting	174
11.4	Analysis of STR data	176
11.5	Bioinformatics	178
11.6	Conclusion	180
11.7	References	181
12	Statistical Presentation of Forensic Data	185
	<i>Mark A. Best</i>	
12.1	Introduction	185
12.2	Techniques	185
12.3	Laboratory issues	188
12.4	Statistical analysis	189
12.5	Other issues	193
12.6	Special situations	194
12.7	References	195
13	Protein Profiling for Forensic and Biometric Applications	197
	<i>Mikhail Soloviev, Julian Bailes, Nina Salata and Paul Finch</i>	
13.1	Introduction	197
13.2	Protein assays in molecular forensics: current status	197
13.3	Novel technologies and the remaining challenges	204
13.4	Protein markers for use in forensic and biometric applications	208
13.5	References	217

14 Application of MRS in Forensic Pathology	221
<i>Eva Scheurer, Michael Ith and Chris Boesch</i>	
14.1 Forensic, criminalistic and ethical significance of time of death	221
14.2 Classical methods for the determination of PMI	222
14.3 Magnetic resonance spectroscopy	224
14.4 How to predict PMI based on MRS measurements	229
14.5 Outlook	232
14.6 References	235
Index	241