

Molecular Genetics of Recombination

Bearbeitet von
Andrés Aguilera, Rodney Rothstein

1. Auflage 2007. Buch. xxiv, 524 S. Hardcover

ISBN 978 3 540 71020 2

Format (B x L): 15,5 x 23,5 cm

Gewicht: 982 g

[Weitere Fachgebiete > Chemie, Biowissenschaften, Agrarwissenschaften > Botanik > Pflanzenreproduktion, Verbreitung, Genetik](#)

schnell und portofrei erhältlich bei


DIE FACHBUCHHANDLUNG

Die Online-Fachbuchhandlung beck-shop.de ist spezialisiert auf Fachbücher, insbesondere Recht, Steuern und Wirtschaft. Im Sortiment finden Sie alle Medien (Bücher, Zeitschriften, CDs, eBooks, etc.) aller Verlage. Ergänzt wird das Programm durch Services wie Neuerscheinungsdienst oder Zusammenstellungen von Büchern zu Sonderpreisen. Der Shop führt mehr als 8 Millionen Produkte.

Table of contents

Genetics of recombination in the model bacterium <i>Escherichia coli</i>	1
Bénédicte Michel, Zeynep Baharoglu, and Roxane Lestini	1
Abstract	1
1 Introduction	1
2 Genes and pathways	2
2.1 The key steps of the homologous recombination reaction	2
2.2 Alternative pathways of DSB repair	6
2.3 Homologous recombination in plasmids	7
2.4 Ligase and polymerase I	8
2.5 Proteins that antagonize homologous recombination	8
3 The repair of DNA lesions	8
3.1 RecFOR- dependent DNA repair	9
3.2 RecBC-dependent recombinational repair	10
4 Recombination and replication	11
4.1 Replication inactivation induces RecA-independent recombination	11
4.2 Recombination proteins participate in the resetting of replication forks	13
Acknowledgments	18
References	18
Homologous recombination in low dC + dG Gram-positive bacteria	27
Humberto Sanchez, Begoña Carrasco, Silvia Ayora, and Juan C. Alonso	27
Abstract	27
1 Proteins required for recombinational repair	27
2 Recombination avenues	34
2.1 DNA damage recognition	35
2.2 DNA end-processing	36
2.3 DSB coordination	37
2.4 RecA loading, homologous pairing and strand exchange	37
2.5 Branch migration and resolution	38
3 Horizontal gene transfer	39
3.1 Transport and uptake of dsDNA or ssDNA	39
4 Fate of the incoming DNA	40
5 Barriers for HGT	46
Acknowledgements	46
References	46
The bacterial RecA protein: structure, function, and regulation	53
Michael M. Cox	53
Abstract	53

1 The role of recombination in DNA metabolism.....	53
2 The RecA protein of <i>Escherichia coli</i>	54
2.1 Overview	54
2.2 Structure.....	55
2.3 Binding to DNA.....	58
2.4 ATP hydrolysis and RecA filament states	59
2.5 DNA strand exchange is a multi-step process	61
2.6 The role of ATP hydrolysis in DNA strand exchange	63
3 Regulation of RecA function.....	65
3.1 Autoregulation by the RecA C-terminus	65
3.2 Proteins that modulate RecA function	67
3.3 The single-strand DNA binding protein (SSB).....	67
3.4 The RecFOR proteins	67
3.5 The DinI and RecX proteins	71
3.6 The PsiB and RdgC proteins.....	73
3.7 The UvrD helicase	75
4 Regulation summary	76
References	77
Biochemistry of eukaryotic homologous recombination.....	95
Wolf-Dietrich Heyer.....	95
Abstract	95
1 Introduction	95
2 Homologous recombination in different contexts	97
3 Biochemistry of recombination proteins	98
3.1 Structure of the presynaptic Rad51 filament.....	99
3.2 Presynapsis: different pathways leading to Rad51 filament formation and the function of distinct mediator proteins.....	103
3.3 Synapsis: homology search and DNA strand invasion	113
3.4 Postsynapsis: many subpathways call for context-specific factors ..	114
4 Regulation of recombination.....	119
4.1 Negative regulation of HR and the roles of the Srs2 DNA helicase and MMR.....	119
4.2 Post-translational modification of HR proteins	120
5 Conclusion	122
Acknowledgements	123
References	123
DNA helicases in recombination	135
Hannah L. Klein	135
Abstract	135
1 Recombination pathways and models	135
2 DNA helicases in mitotic recombination	140
2.1 Srs2	141
2.2 Fbh1	145
2.3 Sgs1	145

2.4 WRN	147
2.5 BLM.....	147
2.6 Rad3/Rem1	148
2.7 Rrm3 and Pif1	149
3 DNA helicases in meiotic recombination	149
3.1 Mer3.....	150
3.2 Srs2	150
3.3 Sgs1	151
3.4 BLM.....	151
4 Replication and repair helicases	152
4.1 Mph1	152
4.2 HEF/FANCM.....	152
4.3 BRIP1/BACH1/FANCI	153
4.4 HEL308/MUS308.....	153
4.5 RecQ5 β	154
4.6 RecQL1.....	154
4.7 Hmi1	154
5 Conclusions	155
Acknowledgements	156
References	156
Holliday junction resolution	169
Matthew C. Whitby	169
Abstract	169
1 A brief overview of HJ formation and processing.....	169
2. The HJ resolvases.....	172
2.1 Structural relationships	172
2.2 Junction recognition and distortion.....	174
2.3 Sequence-specific cleavage and the need for branch migration.....	176
2.4 The catalysis of cleavage	177
2.5 Coordination of cleavage events.....	178
2.6 Directing the orientation of junction cleavage	179
2.7 Searching for the elusive nuclear HJ resolvase.....	180
3 Mus81.....	182
3.1 Mus81 is related to the XPF family of endonucleases	182
3.2 The substrate specificity of Mus81*	183
3.3 The role of Mus81* in meiosis	185
3.4 Mus81 and links to cancer	186
3.5 Mus81 and DSB repair in vegetative cells.....	187
3.6 Mus81 and stalled replication forks.....	188
3.7 Mus81 and inter-strand cross-link repair	189
4 Future perspectives.....	190
Acknowledgements	191
References	191

Replication forks and replication checkpoints in repair.....	201
Dana Branzei and Marco Foiani	201
Abstract	201
1 DNA replication, checkpoint proteins, and chromosome integrity	201
2 Stalled versus collapsed replication forks and fork stabilization versus fork restart	202
3 Sensing stalled forks and checkpoint mediated stabilization of stalled forks	203
4 Replication fork restart and repair mechanisms	205
4.1 Recombination-mediated fork restart and repair	207
4.2 Checkpoint-mediated regulation of recombination.....	207
4.3 Other fork restart mechanisms: damage tolerance or postreplication repair pathways	208
4.4 Damage bypass at the fork versus postreplication repair.....	210
5 Coordination between DNA replication, topology, and chromatin structure.....	211
Acknowledgements.....	213
References	213
Sister chromatid recombination.....	221
Felipe Cortés-Ledesma, Félix Prado and Andrés Aguilera.....	221
Abstract	221
1 Introduction	221
2 Homologous recombination: a mechanism with major activity during replication	222
2.1 What makes a replication fork stall or collapse?	222
2.2 The role of recombination during DNA replication.....	224
3 Methods for the measurement of sister-chromatid recombination	226
3.1 5-Bromodeoxyuridine labelling.....	227
3.2 Detection of SCE in circular molecules.....	227
3.3 Genetic assays based on direct repeats	228
3.4 Molecular analysis of SCR	229
4 DNA repair genes required for SCR	230
5 Specific functions required for SCR	235
5.1 Cohesins.....	235
5.2 Other SMC complexes.....	238
5.3 The MRX(N) complex.....	239
6 Concluding remarks	240
Acknowledgements.....	241
References	241
Mating-type switching in <i>S. pombe</i>	251
Benoit Arcangioli, Laura Roseaulin, and Allyson Holmes.....	251
Abstract	251
1 Fission yeast life cycle	251

2 The pattern of switching.....	252
3 The mating-type region	253
4 A site- and strand-specific imprint at <i>mat1</i>	254
5 Cis-acting elements controlling the imprint	257
6 Trans-acting <i>swi</i> (switch) genes	257
6.1 Class Ia.....	258
6.2 Class Ib	260
6.3 Class II.....	261
7 The direction of replication model	263
8 Imprinting formation is coupled to DNA replication	264
9 Imprinting protection.....	267
10 Mating-type switching.....	267
10.1 Initiation.....	268
10.2 Choice of the donor.....	269
10.3 Gene conversion and its resolution	270
11 Mus81 is the essential nuclease resolving sister chromatid recombination.....	272
12 Outlook and future directions.....	273
Acknowledgements	275
References	275

Multiple mechanisms of repairing meganuclease-induced double-strand DNA breaks in budding yeast285

James E. Haber	285
Abstract	285
1 Introduction	285
2 <i>MAT</i> switching in <i>Saccharomyces</i> , a paradigm for DSB repair	286
2.1 Physical monitoring of <i>MAT</i> switching.....	287
2.2 Monitoring of recombination protein binding to the DSB	288
2.3 Primer extension	289
3 HO and I-SceI-induced ectopic gene conversions and the control of reciprocal crossing-over	291
3.1 Most ectopic recombination occurs by SDSA	292
3.2 Control of crossing-over associated with gene conversion	295
4 Single-strand annealing (SSA)	297
5 Break-induced replication (BIR).....	299
5.1 At least two pathways of BIR can be shown for non-telomere sequences in <i>S. cerevisiae</i>	301
5.2 RAD51-dependent BIR.....	302
5.3 Analysis of BIR using plasmids and transformation assays.....	303
6 Nonhomologous end-joining (NHEJ).....	305
7 Future prospects	308
Acknowledgements	308
References	308

The cell biology of mitotic recombination in <i>Saccharomyces cerevisiae</i>	317
Michael Lisby and Rodney Rothstein.....	317
Abstract.....	317
1 Choreography of DNA double-strand break repair	317
2 Cell cycle regulation of recombination foci	321
3 The cellular response to stalled and collapsed DNA replication forks...	322
4 Spontaneous foci	324
5 Dynamics of proteins in foci	324
6 Centers of recombinational DNA repair.....	325
7 Nucleolar exclusion of homologous recombination	326
8 Cohesins	326
9 Molecular switches.....	326
10 Future perspectives.....	327
References.....	328
 The cell biology of homologous recombination.....	 335
Sheba Agarwal, Roland Kanaar, and Jeroen Essers.....	335
Abstract	335
1 Introduction	335
2 Cell biological analyses of homologous recombination proteins	336
3 Controlled induction of DNA damage	337
4 Homologous recombination pathways	340
4.1 Detection and processing of DSBs	340
4.2 Nucleoprotein filament formation.....	343
4.3 Resolution	347
5 Recombination and replication.....	348
6 The function of DNA damage induced foci	349
References.....	351
 BRCA2: safeguarding the genome through homologous recombination	 363
Nicole Christ, Mary Ellen Moynahan, Maria Jasin	363
Abstract	363
1 Introduction	363
2 BRCA2: a tumor suppressor with diverse domain structures in different organisms.....	364
2.1 BRCA2 in vertebrates.....	364
2.2 BRCA2 in non-vertebrate species.....	365
3 Binding Partners of BRCA2.....	366
3.1 Rad51: the BRC repeats.....	366
3.2 Rad51: exon 27-encoded sequences	366
3.3 DNA	367
3.4 DSS1.....	367
3.5 PALB2 and other proteins	368
4 BRCA2 and homologous recombination.....	368
4.1 Studies <i>in vitro</i>	368

4.2 Studies <i>in vivo</i>	369
5 BRCA2 is essential for development but dispensable for the survival of cancer cells	370
5.1 <i>BRCA2</i> and cancer predisposition in humans	370
5.2 BRCA2 is essential during embryogenesis	371
5.3 Tumorigenesis in conditional <i>Brca2</i> mutants	372
5.4 How do BRCA2-deficient cells escape genome surveillance checkpoints?	372
6 Conclusions	373
Acknowledgments	373
References	374
Meiotic recombination	381
Neil Hunter	381
Abstract	381
1 Overview	381
2 Meiosis	381
2.1 Meiotic chromosome structure and the synaptonemal complex	382
2.2 Stages of meiotic prophase I	384
2.3 Recombination nodules	384
3 Overview of meiotic recombination	385
3.1 The pathway of meiotic recombination	385
3.2 Monitoring meiotic recombination intermediates	385
4 Initiation of meiotic recombination	387
4.1 The Spo11 complex	387
4.2 Other factors that Influence DSB formation	394
4.3 Resection of DSB-ends	398
4.4 Assembly of the Spo11 complex and triggering of Spo11 cleavage	399
5 Homolog pairing and formation of joint molecules	400
5.1 Dmc1	401
5.2 Assembly of the strand-exchange complex	401
5.3 The Hop2–Mnd1 complex	403
5.4 How do strand-exchange proteins promote homolog pairing?	405
5.5 Strand-exchange and joint molecule formation	406
6 Interhomolog bias	408
6.1 Suppression of intersister recombination	408
6.2 Interhomolog only functions	412
7 Crossover control	412
7.1 Crossover assurance	412
7.2 Crossover interference	413
7.3 Crossover and noncrossover pathways	414
7.4 Pro-crossover factors	414
7.5 A molecular model of crossover and noncrossover pathways	419
8 Closing remarks	421
Acknowledgements	422

References	422
Site-specific recombination.....	443
Ian Grainge and David J. Sherratt.....	443
Abstract	443
1 Introduction	443
2 The two families of recombinases: tyrosine and serine.....	445
3 The tyrosine recombinase family	446
3.1 Topoisomerases and tyrosine recombinase active sites	446
3.2 Control of the recombination reaction	448
4 Serine family recombinases	451
4.1 Domain organisation and active site of serine family recombinases	451
4.2 Mechanism of recombination by serine family recombinases.....	452
5 Directing recombination outcome	453
5.1 Accessory proteins, sequences, and topological selectivity	453
5.2 Recombination between asymmetric accessory sites can give reaction directionality	454
6 Applications of site-specific recombination	456
7 Related proteins.....	457
7.1 Large serine recombinases.....	457
7.2 Integrons	457
7.3 Conjugative transposons	459
7.4 telomeres of linear prokaryotic chromosomes	460
7.5 Xer recombination: a multifunctional recombination system	461
8 Concluding remarks	462
References	463
V(D)J recombination: mechanism and consequences	469
Martin Gellert	469
Abstract	469
1 Introduction	469
2 General properties of V(D)J recombination	470
2.1 Recombination sites.....	470
3 The RAG genes and proteins	472
3.1 DNA cleavage by the RAG proteins.....	472
3.2 Coupled cleavage.....	473
3.3 RSS recognition.....	474
3.4 RAG protein binding to DNA.....	475
3.5 DNA transposition by RAG1/2.....	476
3.6 implications of RAG1/2 transposition for the evolution of the immune system and for chromosomal translocations	477
3.7 Sequence motifs and mutational studies of the RAG proteins.....	478
3.8 Other functions of the RAG proteins	479
4 End processing and joining in V(D)J recombination	480
References	482

Nonhomologous end-joining: mechanisms, conservation and relationship to illegitimate recombination.....	487
Thomas E. Wilson	487
Abstract	487
1 Introduction	487
2 DNA mechanisms of nonhomologous end-joining	488
2.1 Double strand breaks	488
2.2 Overhang-to-overhang joining.....	488
2.3 Blunt end joining and polymerization across the break	490
2.4 Use of internal microhomologies	490
2.5 The balance between joining modes	490
3 Protein pathways for nonhomologous end-joining.....	491
3.1 Ku- and Lig4-dependent NHEJ.....	491
3.2 MMEJ	493
3.3 SSA and related mechanisms.....	494
3.4 SSBR applied to DSBs	495
4 Species conservation of Ku-dependent NHEJ	497
4.1 Vertebrates and related	497
4.2 Insects and worms.....	497
4.3 <i>S. cerevisiae</i>	498
4.4 Other fungi.....	499
4.5 Protozoa	500
4.6 Plants.....	500
4.7 Bacteria	500
4.8 Viruses	501
5 NHEJ interplay with host cell processes	502
5.1 Chromatin	502
5.2 Checkpoints	503
5.3 Cell cycle	503
6 Outcomes of NHEJ and its deficiency.....	504
6.1 Accurate repair and maintenance of genome integrity.....	504
6.2 Adaptive and targeted mutagenesis.....	504
7 Concluding remarks	505
References	505
Abbreviations	512
Index	515