

Preface

In 2005, I wrote the editorial article entitled “10 years of rolling the minicircles: RCA assays in DNA diagnostics” [Expert Rev Mol Diagn 5(4):477–478], where I have summarized significant achievements of the first decade of rolling circle amplification (RCA) technology in identification of pathogens, oncogenes, hot spot mutations, and SNPs, as well as in multiplexed genomics and proteomics profiling with microarrays. A year before, I have compiled and edited the book published by Horizon Bioscience that covered existing DNA amplification techniques, with several chapters being devoted to various innovative diagnostic methods involving RCA. Since then, another decade has passed, and continuing developments in the RCA-based diagnostics become more and more capable and more close to real-life applications.

I have worked with RCA for several years, which resulted in a number of related research and review publications, some of which are referenced in the aforementioned editorial. And though I left the research bench a while ago by switching to the intellectual property consulting business, I have kept an eye on the RCA innovations, and I am pleased to see a great progress in the RCA field toward the development of new clinical diagnostics. I am also excited about the recently discovered RCA pharmaceutical capabilities. All this prompted me to compile the book presenting these new RCA achievements.

To my knowledge, this is the first book devoted entirely to the RCA technology, and it intends to present the current state of the art of this technology related to nucleic acid diagnostics with the major focus on clinically relevant applications. Notably, the RCA technology is now extending beyond the field of molecular diagnostics (where new robust RCA methods and sensors have been developed that are presented in the corresponding “diagnostic” section of this book) into the area of drug delivery vehicles and nucleic acid drugs. In accord with that, a section of this book is devoted to prospective RCA-based therapeutics. Two other sections cover new enzymes useful in RCA and RCA-involving techniques with enhanced signal amplification.

Note that with exception of the first chapter, all other chapters deal with RCA of small, ≤ 50 -nt-long DNA circles since only short circularized DNAs serve as

convenient probes in the RCA-based diagnostics and/or as templates in the RCA-based therapeutics. The stand-alone chapter describes the engineered DNA polymerases with enhanced abilities for RCA of long circular DNAs in genomics and sequencing protocols. And I decided to present these innovations just to illustrate the possible ways of RCA improvements and also to encourage testing these new polymerases in diagnostic RCA.

To those readers who may consider the contents of this book as somewhat patchy, I would say that according to PubMed database, nearly 800 articles related to RCA have been presently published, with more than 100 articles being published last year. Hence, it was inevitable for me to focus the first book on RCA to a certain area, and I chose the area of clinical diagnostics and prospective therapeutics as the one more close to my expertise.

Therefore, although exciting, certain RCA-related topics are out of the scope of this book, such as the RCA applications in DNA nanotechnology, RCA-derived sequencing templates and cell-free RCA cloning, or the use of RCA to introduce random mutations. But even so, with several dozen interesting studies performed and published in recent years on RCA-based diagnostics and emerging therapeutics, it was a tough task for me to choose among them for a reasonable, and rather limited, number of chapters.

In my opinion, the choice of topics covered in this book is sufficient to show the wealth of ideas in this particular area of RCA research. Still, I would like to express my sincerest apologies to those researchers developing innovative RCA diagnostics and therapeutics, who are not presented in this book.

Given the great progress achieved in the clinically related diagnostic RCA applications and in the RCA sensors field, as it is presented in this book, I anticipate that commercial RCA-based diagnostic kits and sensors will soon be on the market [to the best of my knowledge, no commercial RCA diagnostics are so far available]. I also believe that some RCA-based drugs will enter preclinical trials in not so distant future.

My other dream is that the contents of this book would stimulate novel promising developments in the RCA field. So, I am glad with the opportunity given to me to compile and edit this book. And I am very grateful to all contributors and to the Springer editors and production managers who made this book possible.

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