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Non-coding RNAs

Insights on the Regulatory Genome

Chapter 13

Bioinformatics Approaches in Noncoding RNAs Research



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Abstract In recent years, noncoding RNAs have sparked significant interest in understanding the diverse roles of ncRNAs in cellular regulation and disease processes. Noncoding RNAs (ncRNAs), encompassing small noncoding RNAs (sncRNAs) and long noncoding RNAs (lncRNAs), are critical regulators of gene expression, epigenetic modifications, and various cellular processes within the human genome. The diverse nature ncRNAs, along with certain complex features, has made them difficult to study through traditional experimental methods. As a result, bioinformatics tools have expanded the possibilities for offering new insights through advanced computational strategies. This chapter explores the recent advancements in ncRNA databases, emphasizing their importance and the innovative *in silico* strategies that enable the prediction and analysis of biological interactions, particularly for miRNAs and lncRNAs. It offers an in-depth overview of the structural properties, classification, and functions of various types of noncoding RNAs, highlighting their crucial roles in cellular processes. Additionally, the chapter discusses the significant therapeutic potential of ncRNAs, focusing on their applications in treating cancer and other severe diseases. These insights are pivotal in advancing the development of targeted therapies and precision medicine.

Keywords Epigenetics · Transcriptome · miRNA · ncRNA · sncRNA · lncRNA · Bioinformatics · *In silico* · Genome

Abbreviations

ncRNAs	Noncoding RNAs
lncRNAs	Long noncoding RNAs
lincRNAs	Long intergenic ncRNAs
meRNAs	Multiexonic RNAs
circRNAs	Circular RNAs
miRNAs	MicroRNAs
CTLs	cytotoxic T lymphocytes
RNA-seq	RNA sequencing

13.1 Introduction

Over the past decade, recent findings have revealed that noncoding RNAs (ncRNAs) are extensively expressed and serve critical functions in the regulation of genes. A growing number of noncoding RNAs are being recognized for their involvement in gene expression and cellular regulation. However, many ncRNAs still await detailed functional analysis. Despite years of research, the field continues to progress, with each newly discovered ncRNA undergoing processes like biogenesis, characterization, and functional annotation. Both bioinformatics approaches and traditional