

## РОЛЬ ИНТРОНОВ В ЭВОЛЮЦИИ

© 2015 г. Р. Н. Мустафин<sup>2</sup>, Э. К. Хуснутдинова<sup>1,2</sup>.

*Федеральное государственное бюджетное учреждение науки Института биологии и генетики Уфимского научного центра РАН.*

*Башкирский Государственный Университет<sup>2</sup>.*

В статье описана роль интронов в эволюции эукариот. Накапливающиеся в интронных областях полиморфизмы, входящие для сплайсинговых изоформ в рамки считывания, могут приводить к изменению свойства альтернативного продукта экспрессии гена, что дает основу адаптации к меняющимся условиям существования, закрепляясь эволюционно на уровне популяции и вида. Описаны основные механизмы обеспечения динамичности генома эукариот и роль ассоциативных комбинаций в генезе мультифакториальных заболеваний.

**Ключевые слова:** Альтернативный сплайсинг, избыточная ДНК, мультифакториальные заболевания, мобильные элементы генома, нуклеотидные последовательности, сателлитная ДНК.

### ВВЕДЕНИЕ

Описана адаптирующая роль альтернативного сплайсинга к внутренней и внешней среде. В отношении внутренней среды организма регуляция экспрессии определенных сплайсинговых изоформ белков способствует тканеспецифической активности данного белка. В отношении внешней среды альтернативный сплайсинг способствует эволюционным преобразованиям. Сопоставляя накапливающиеся полиморфизмы в интронных областях и возможность экспрессии сплайсинговых изоформ жизненно-важных белков с расширением рамки считывания, можно предположить существование особого способа эволюции у эукариот. Данный способ, в отличие от изменения нормальных изоформ белков под действием мутаций, является более безопасным, что может служить одним из объяснений целесообразности мозаичной структуры генов эукариот. Интронные полиморфизмы, для определенных сплайсинговых изоформ белка могут входить в рамку считывания и влиять на функционирование продукта гена, в том числе в отношении лучшей приспособляемости к изменениям среды, в связи с чем в ряду поколений возможен отбор в пользу экспрессии данных изоформ.

Представлена схема приобретения геномом эукариот свойств динамичности в виде кооперации четырех важных процессов – внедрения транспозонов в геном, появления высокомутабельной сателлитной ДНК, межгенной компенсации и альтернативного сплайсинга. Ключевым моментом

для образования эукариот послужила адаптирующая роль внедрения мобильных генетических элементов в геном прокариот. Внедрение мобильных генетических элементов имеет свои пределы для каждого вида, у организмов в процессе эволюции сформировались механизмы, «сдерживающие» интеграцию транспозонов, ретротранспозонов и ретровирусов в геном. Внедрение транспозонов, ретротранспозонов и ретровирусов послужило основным фактором эволюции эукариот и причиной огромного разнообразия живой природы. Динамичность генома – главное отличительное свойство эукариот от прокариот.

### ОСОБЕННОСТИ ГЕНОМА ЧЕЛОВЕКА И ЭУКАРИОТ

Геном человека содержит около 25 000 ядерных генов, при этом кодирующая часть генов составляет менее 3% [7], по последним данным – 1,5% всего генома [25]. Остальная часть ДНК не несет кодирующей функции, при этом 75% нуклеотидных последовательностей (НП) находится между генами [7]. Недавние исследования показали, что геном человека содержит 69% повторяющихся последовательностей, главным образом копий транспозонов [16]. Соотношение ДНК человека в зависимости от повторяемости представлено в табл. 1. Повторы разделены на *LINE*-, *SINE*-, *ALU*-элементы, сателлиты и другие. *LINE*- и *ALU*-элементы распределены по всему геному. Сателлиты расположены, в основном,

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## **Table of Contents Sistemokvanty Fiziologicheskikh Protsebov**

1. Understanding the eBook Sistemokvanty Fiziologicheskikh Protsebov
  - The Rise of Digital Reading Sistemokvanty Fiziologicheskikh Protsebov
  - Advantages of eBooks Over Traditional Books
2. Identifying Sistemokvanty Fiziologicheskikh Protsebov
  - Exploring Different Genres
  - Considering Fiction vs. Non-Fiction
  - Determining Your Reading Goals
3. Choosing the Right eBook Platform
  - Popular eBook Platforms
  - Features to Look for in an Sistemokvanty Fiziologicheskikh Protsebov
  - User-Friendly Interface
4. Exploring eBook Recommendations from Sistemokvanty Fiziologicheskikh Protsebov
  - Personalized Recommendations
  - Sistemokvanty Fiziologicheskikh Protsebov User Reviews and Ratings
  - Sistemokvanty Fiziologicheskikh Protsebov and Bestseller Lists
5. Accessing Sistemokvanty Fiziologicheskikh Protsebov Free and Paid eBooks

- Sistemokvanty Fiziologicheskikh Protsebov Public Domain eBooks
  - Sistemokvanty Fiziologicheskikh Protsebov eBook Subscription Services
  - Sistemokvanty Fiziologicheskikh Protsebov Budget-Friendly Options
6. Navigating Sistemokvanty Fiziologicheskikh Protsebov eBook Formats
- ePub, PDF, MOBI, and More
  - Sistemokvanty Fiziologicheskikh Protsebov Compatibility with Devices
  - Sistemokvanty Fiziologicheskikh Protsebov Enhanced eBook Features
7. Enhancing Your Reading Experience
- Adjustable Fonts and Text Sizes of Sistemokvanty Fiziologicheskikh Protsebov
  - Highlighting and Note-Taking Sistemokvanty Fiziologicheskikh Protsebov
  - Interactive Elements Sistemokvanty Fiziologicheskikh Protsebov
8. Staying Engaged with Sistemokvanty Fiziologicheskikh Protsebov
- Joining Online Reading Communities
  - Participating in Virtual Book Clubs
  - Following Authors and Publishers Sistemokvanty Fiziologicheskikh Protsebov
9. Balancing eBooks and Physical Books Sistemokvanty Fiziologicheskikh Protsebov
- Benefits of a Digital Library
  - Creating a Diverse Reading Collection Sistemokvanty Fiziologicheskikh Protsebov
10. Overcoming Reading Challenges
- Dealing with Digital Eye Strain
  - Minimizing Distractions
  - Managing Screen Time
11. Cultivating a Reading Routine Sistemokvanty Fiziologicheskikh Protsebov
- Setting Reading Goals Sistemokvanty Fiziologicheskikh Protsebov
  - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Sistemokvanty Fiziologicheskikh Protsebov
- Fact-Checking eBook Content of Sistemokvanty Fiziologicheskikh Protsebov
  - Distinguishing Credible Sources
13. Promoting Lifelong Learning
- Utilizing eBooks for Skill Development

- Exploring Educational eBooks

#### 14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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