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Latest Developments in the Forensic Applications of MicroRNA analysis

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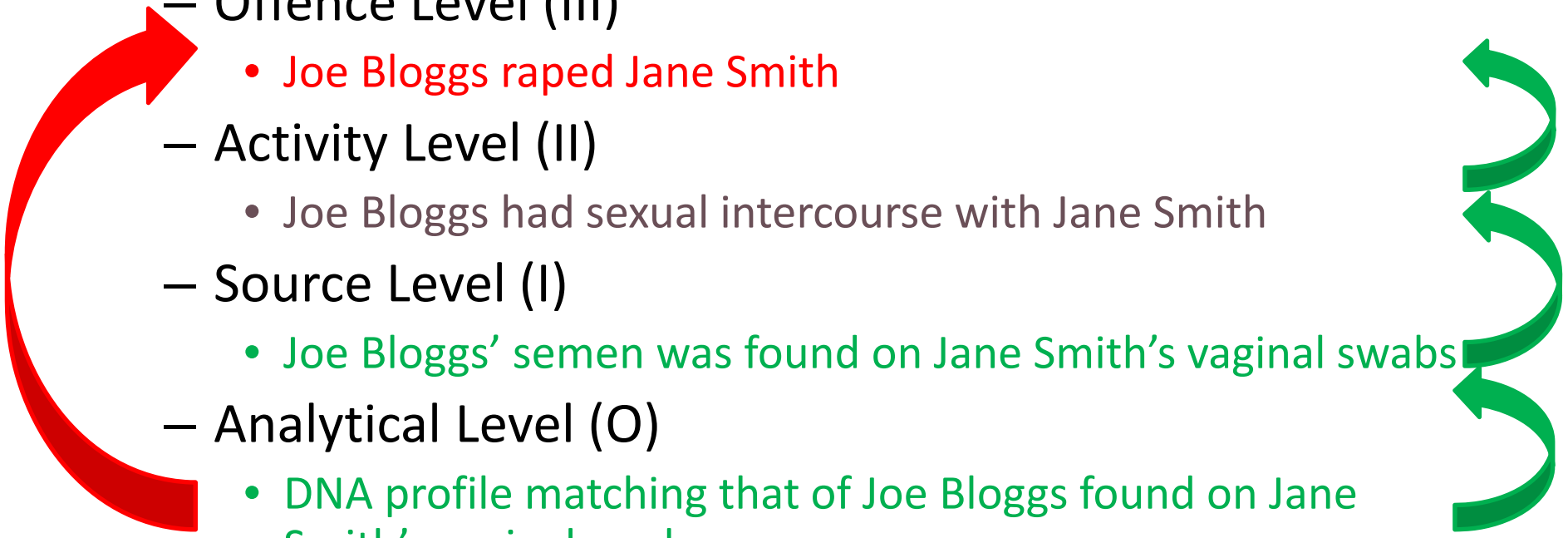
Body fluid identification

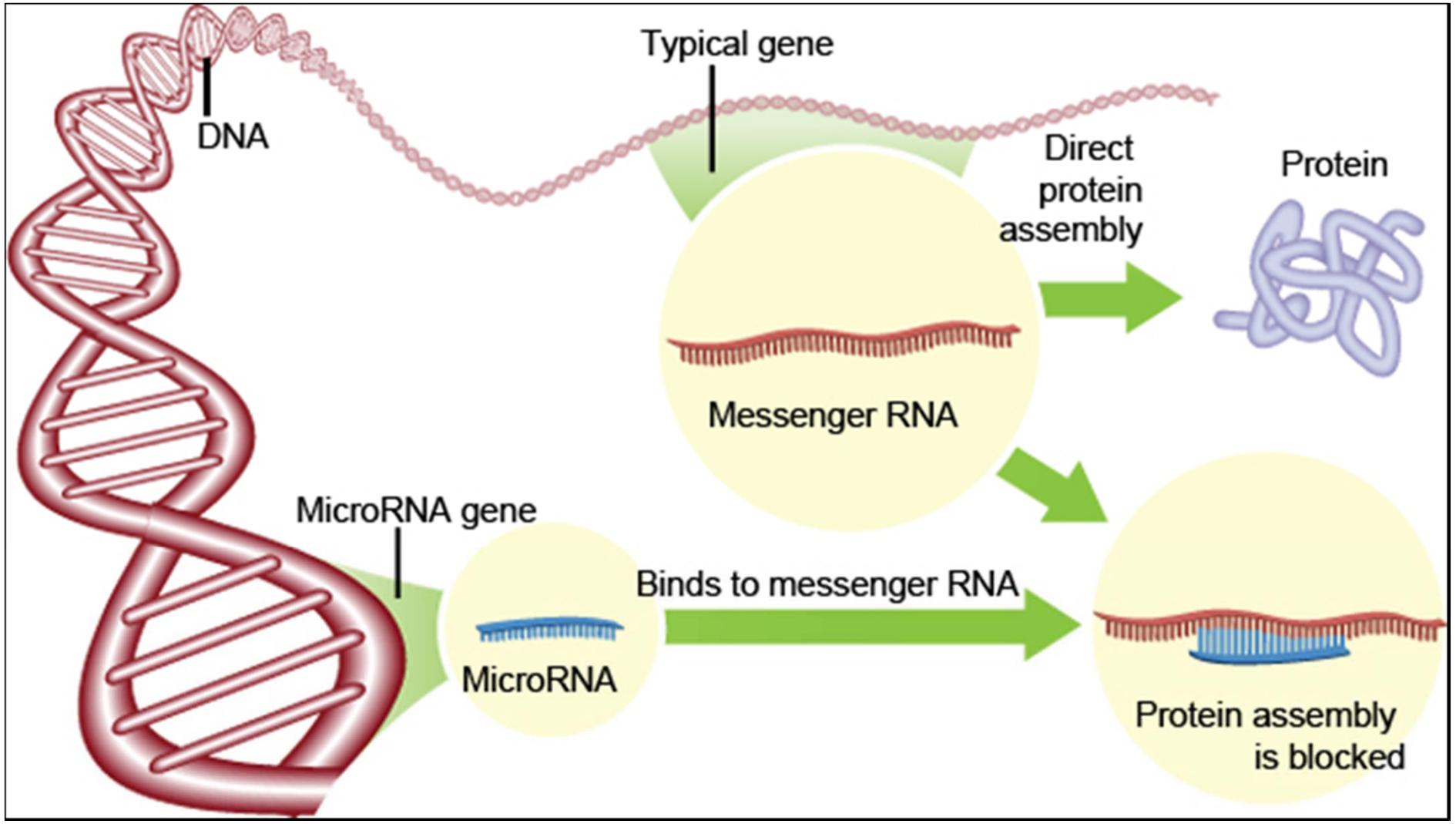
- Current tests are enzymatic, immunological, or histological
  - Most require some visualisation of stains before robust reporting
  - Nearly all has issues with sensitivity and specificity
- Relatively unchanged in decades
- Major capability shortfall in relation to DNA

Why is BFID necessary?

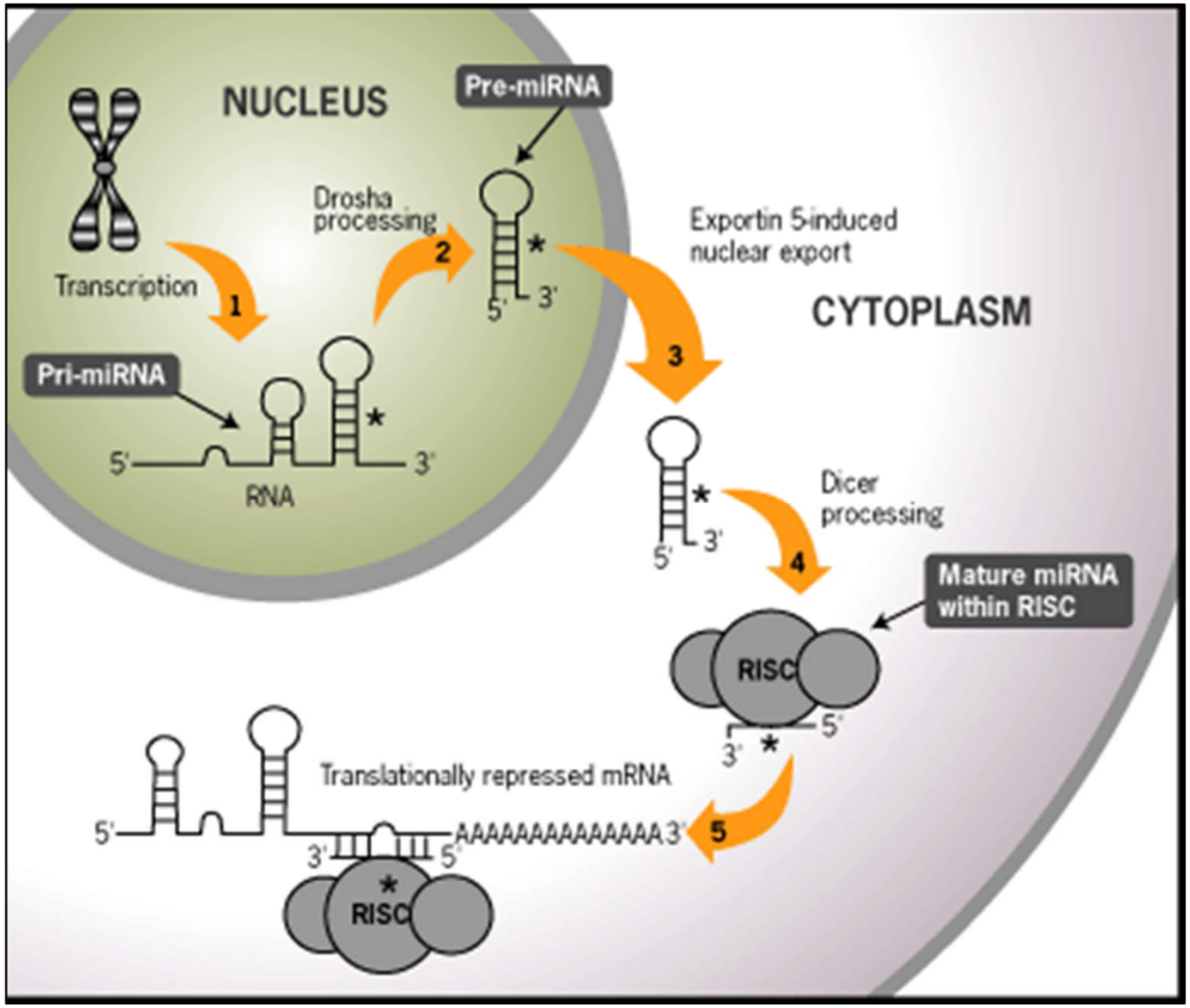
- Hierarchy of Propositions is a fundamental concept in forensic investigations
  - Offence Level (III)
    - Joe Bloggs raped Jane Smith
  - Activity Level (II)
    - Joe Bloggs had sexual intercourse with Jane Smith
  - Source Level (I)
    - Joe Bloggs' semen was found on Jane Smith's vaginal swabs
  - Analytical Level (O)
    - DNA profile matching that of Joe Bloggs found on Jane Smith's vaginal swabs



What is microRNA?

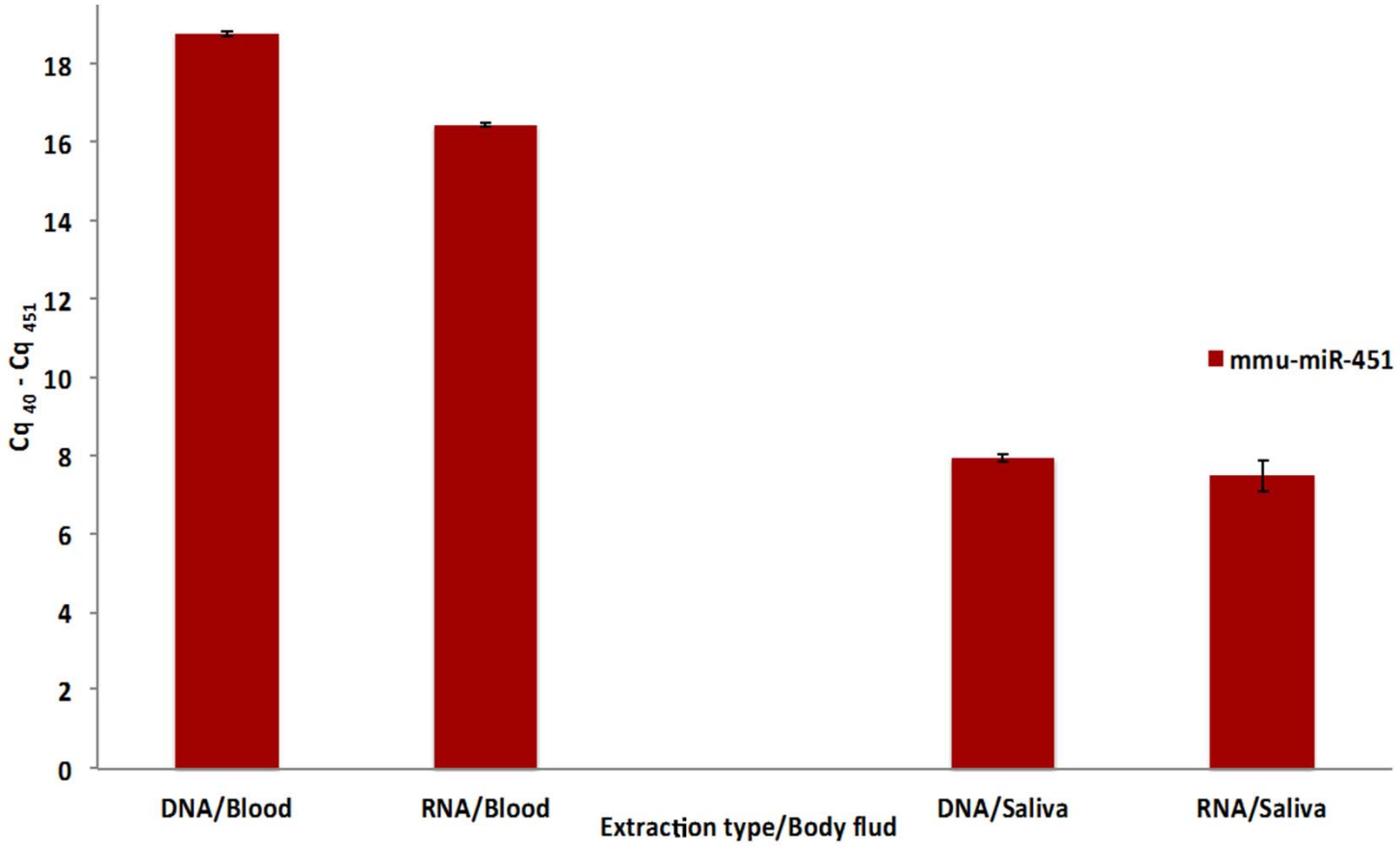


Why microRNA?



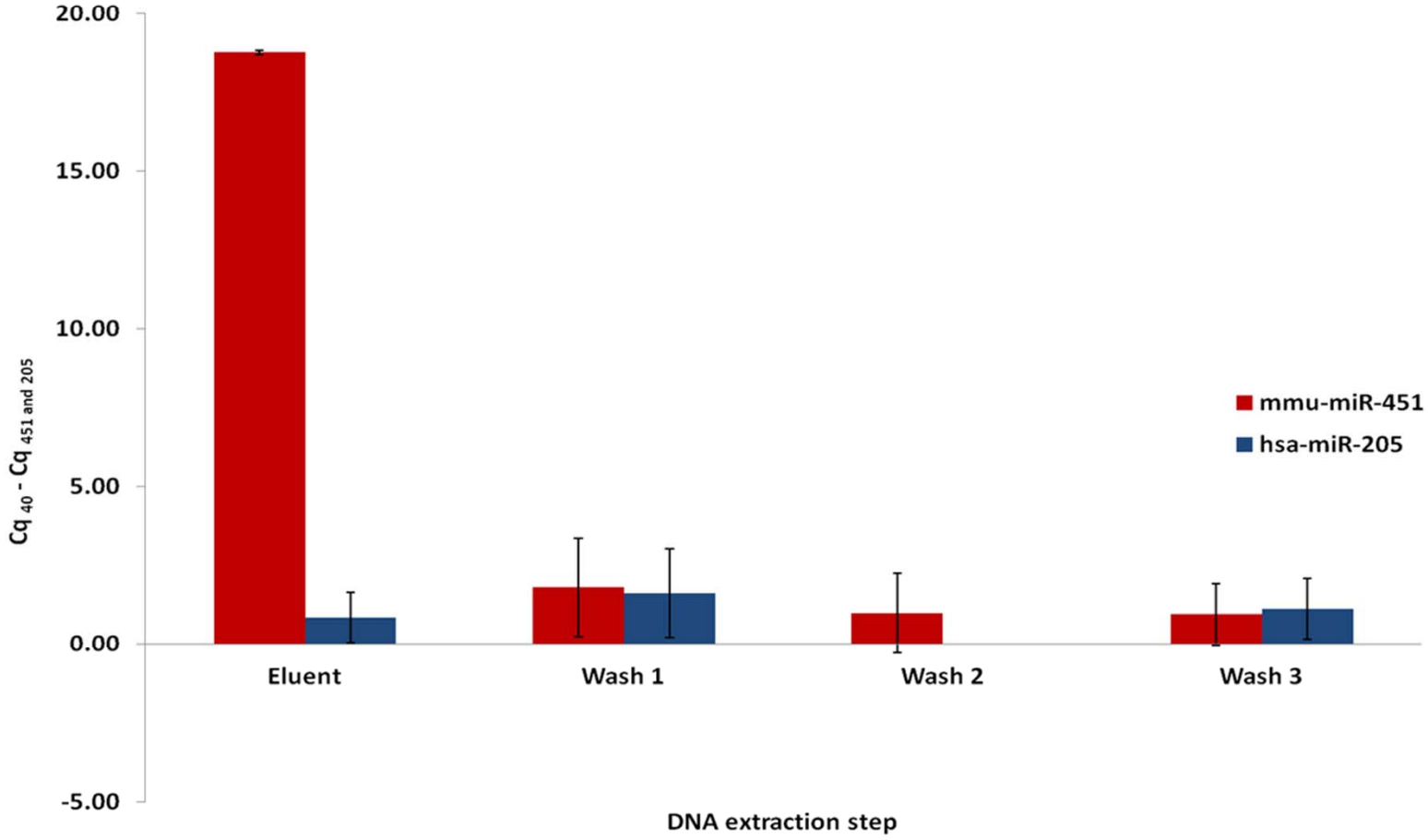
http://rnasilencing.wordpress.com

Co-extraction of DNA and miRNA



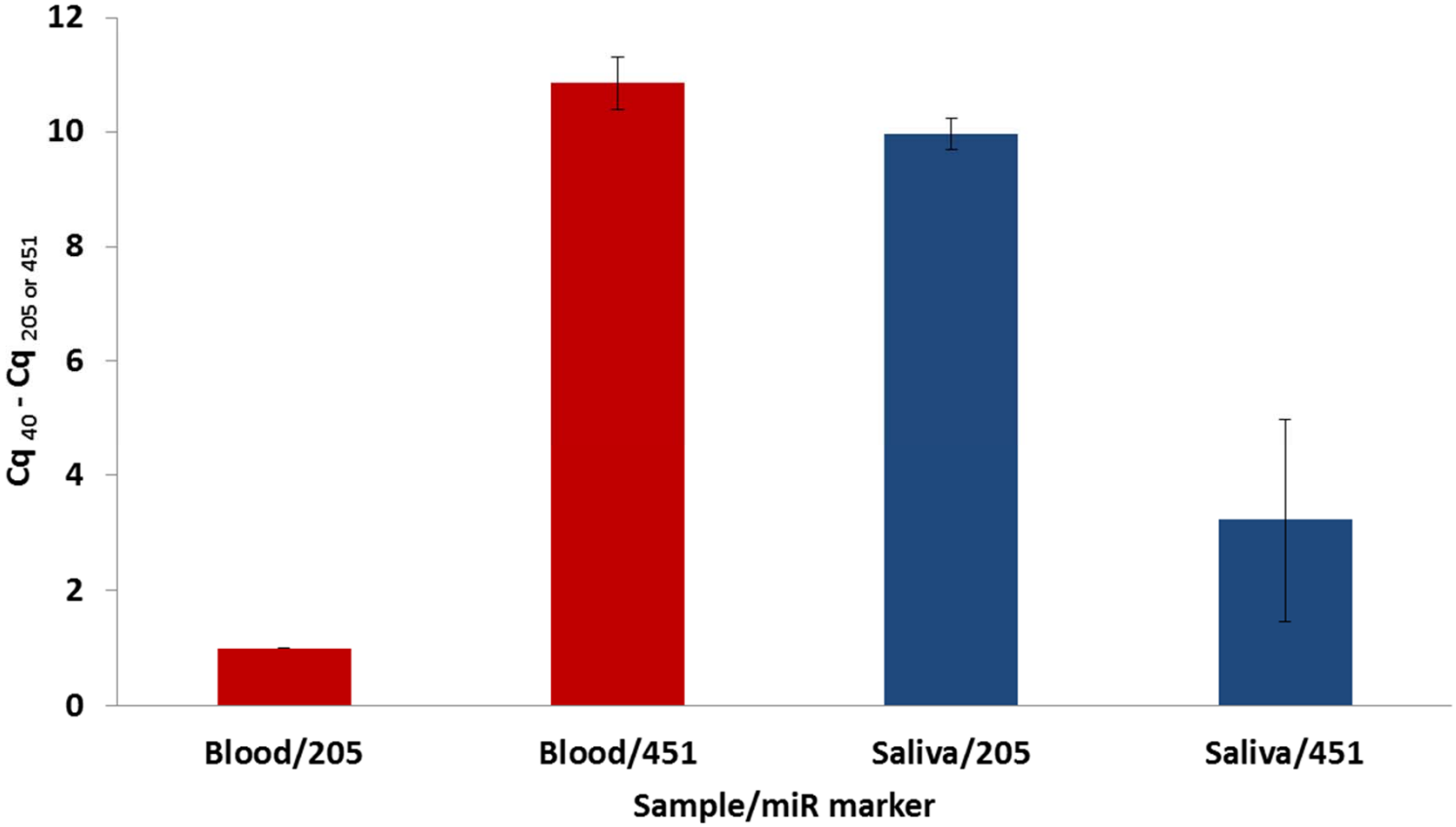
Omelia E. J., Uchimoto M. L. Anal. Biochem. (2013) 120-122

DNA extraction and washes using blood (n=15)



Omelia E. J., Uchimoto M. L. Anal. Biochem. (2013) 120-122

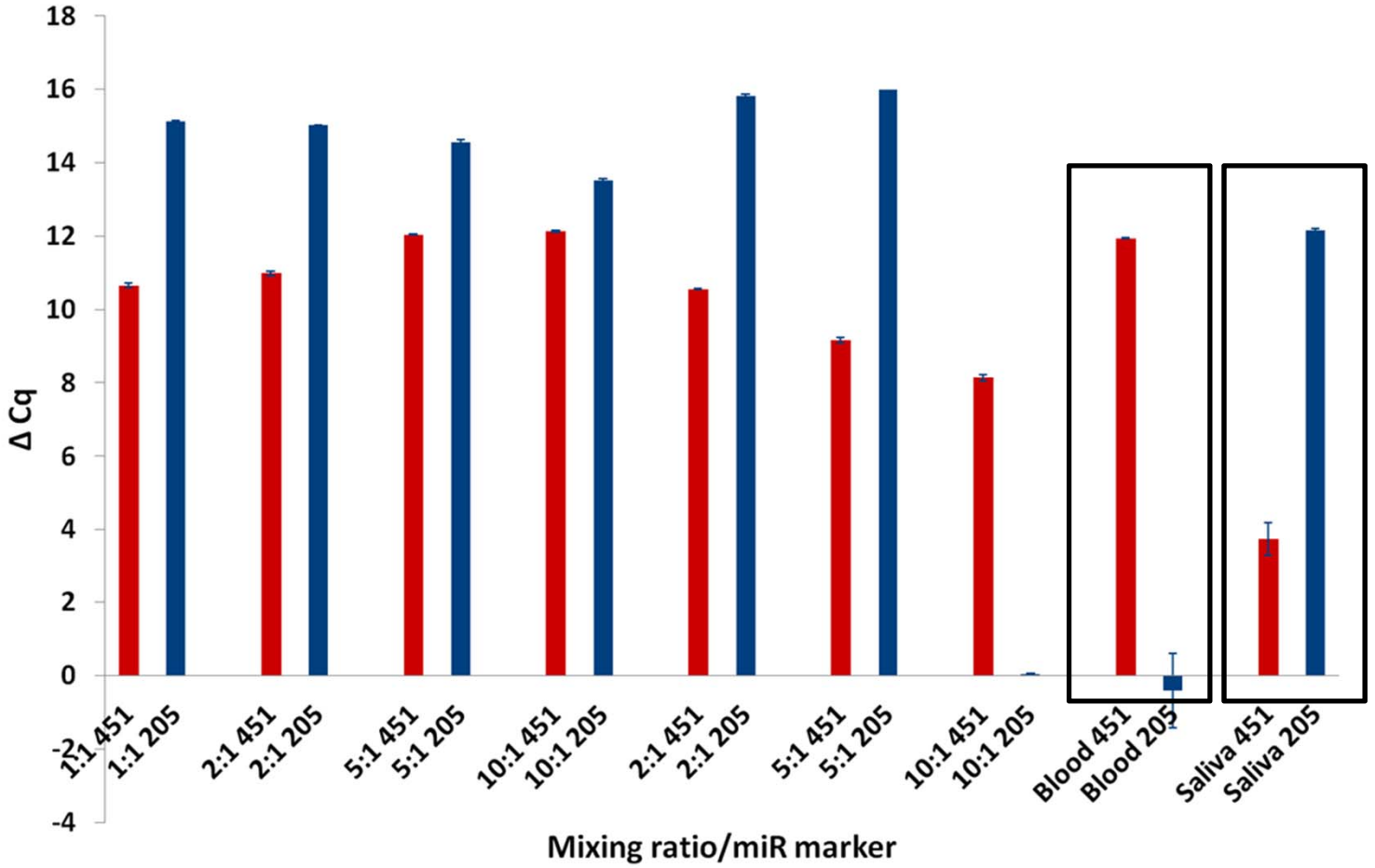
DNA extraction on blood and saliva samples (n=90)



Body fluid mixtures

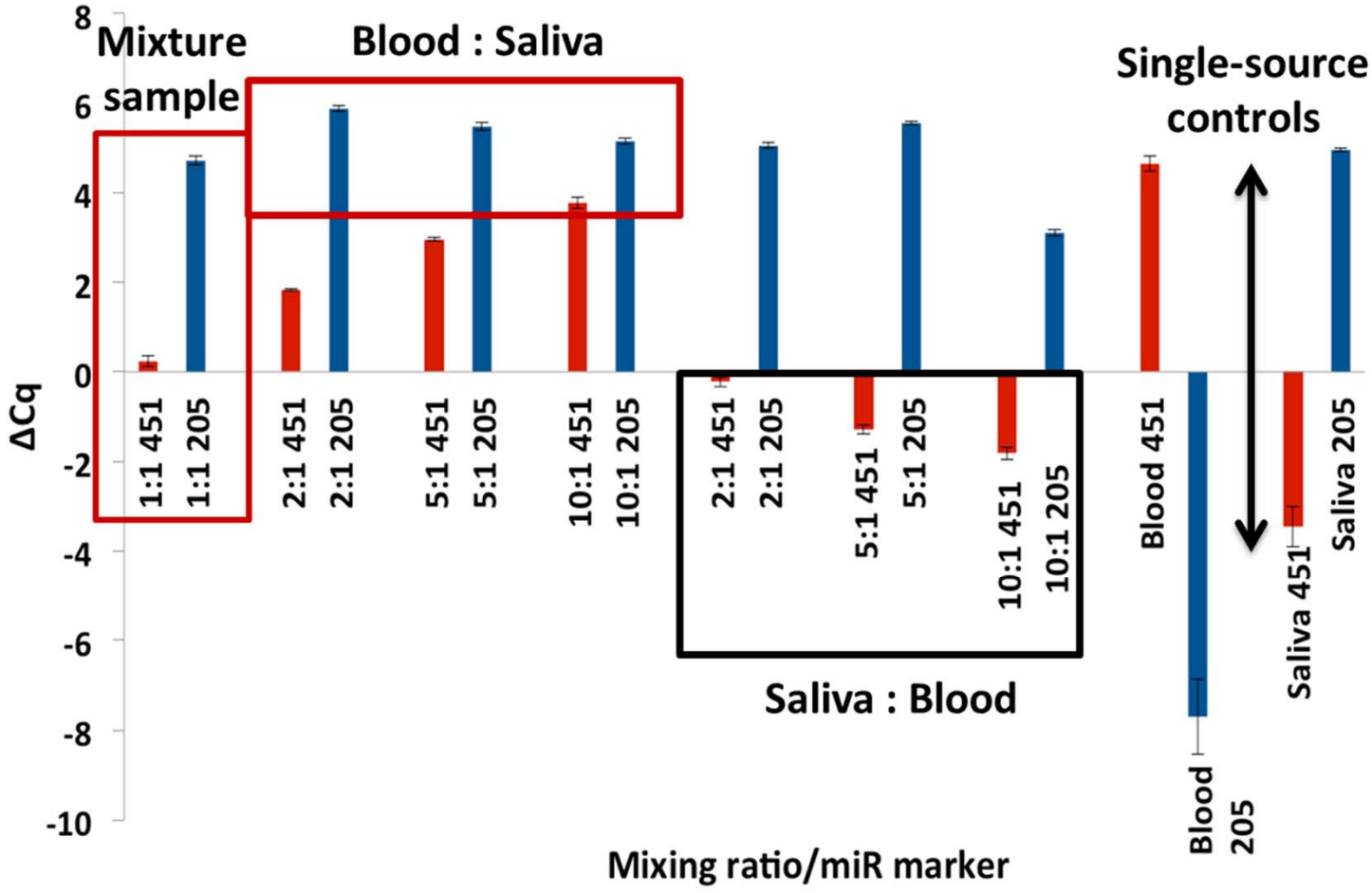
- Body fluid mixture common, particularly in sexual assaults
- Given sensitivity of microRNA analysis, mixed results are inevitable.
- Minimum criteria is that the RNA based test can actually identify the presence of mixtures

miR applications in blood and saliva mixtures



Uchimoto M. L. et al FSI: Genetics (2013) 418-421

Mixtures (RNU44)



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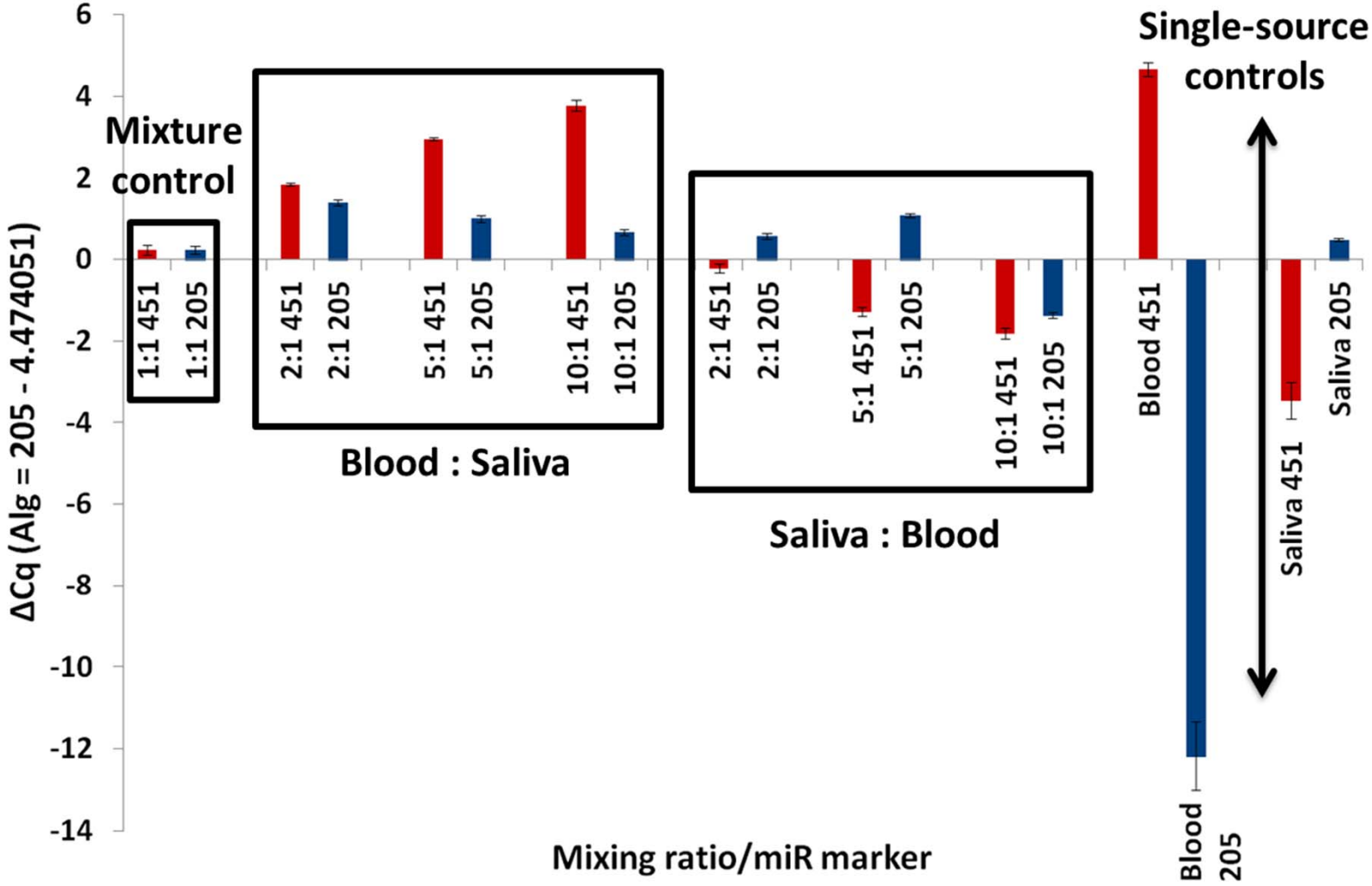
Mixtures (normalization)



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Endogenous controls

- Current work is exploring the appropriate endogenous controls; which are:
  - Human Specific
  - Equally expressed in all body fluids
- However, issues to date include:
  - Both factors are unlikely to be in the same marker, thus multiple markers required
  - The sensitivity and stability of markers must also be equivalent to that of the target markers

Current work

- Endogenous controls
- Specificity and Sensitivity

- Focus upon intimate body fluids
  - Variations within menstrual cycle
    - Including effects of contraceptive pill
  - Effect of vasectomies and infertility upon semen samples

Project funded by the
The Forensic Science Society

Future work in miRNA analysis

- Age estimation
- Alteration in response to cytotoxicity
  - Potential application in long-interval toxicological analysis
- Comparison with mRNA and DNA methylation

The Forensic Genetics Research Group

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5. Fisal Asaghiar
6. Charlotte Beever
7. Leander Stewart
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Thank you for listening

Any questions?