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Williams, Graham

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Latest Developments in the Forensic Applications of MicroRNA analysis

Dr Graham Williams

Senior Lecturer in Forensic Genetics

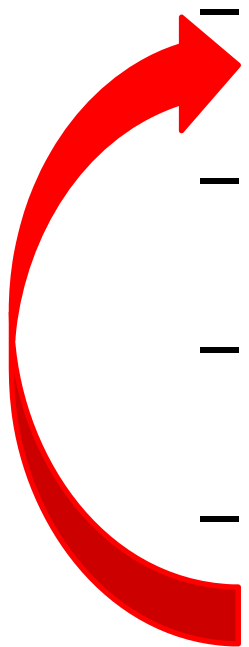
Forensic Biology Group

Body fluid identification

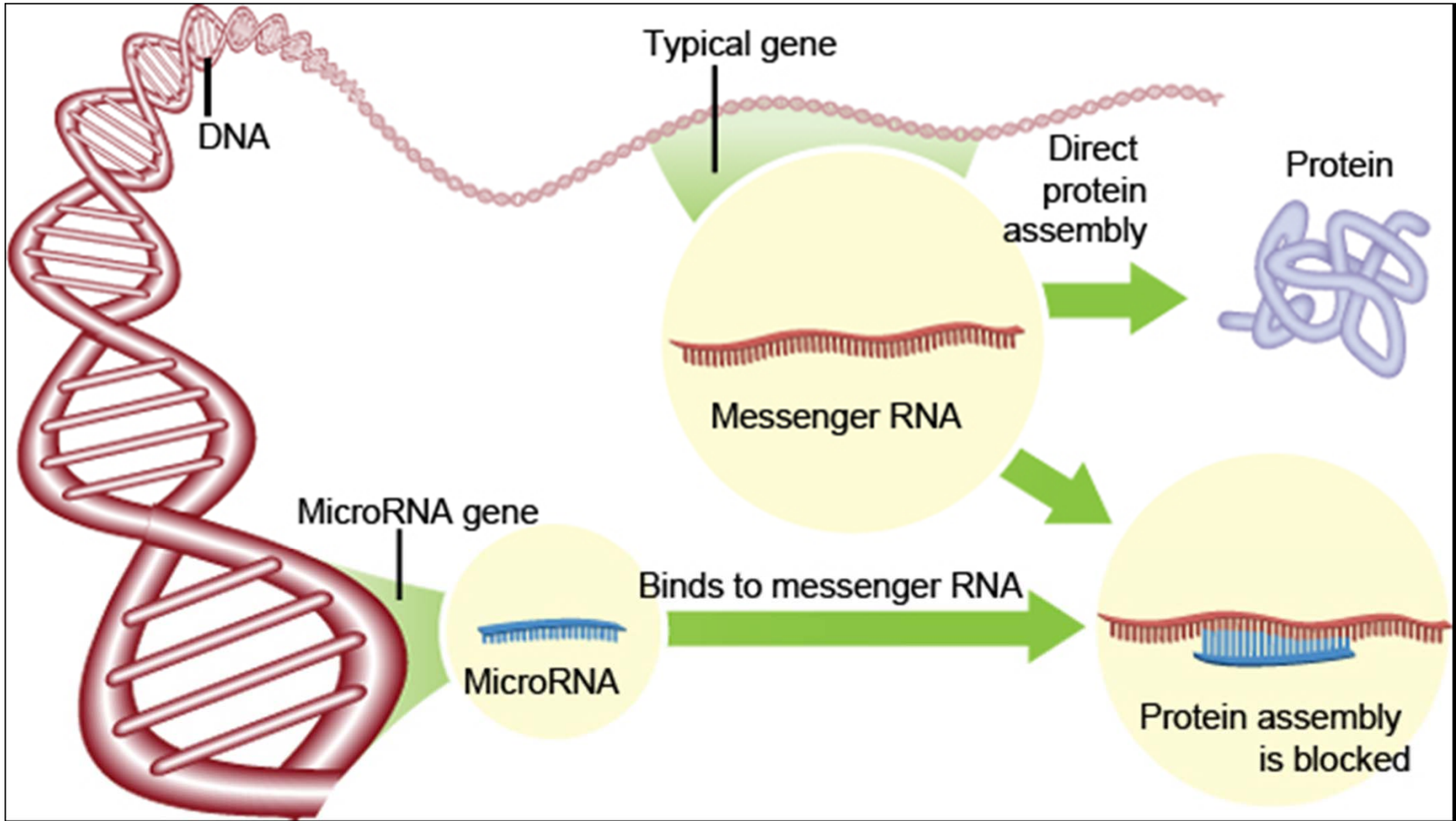
- Current tests are enzymatic, immunological, or histological
 - Most require some visualisation of stains before robust reporting
 - Nearly all has issues with sensitivity and specificity
- Relatively unchanged in decades
- Major capability shortfall in relation to DNA

Why is BFID necessary?

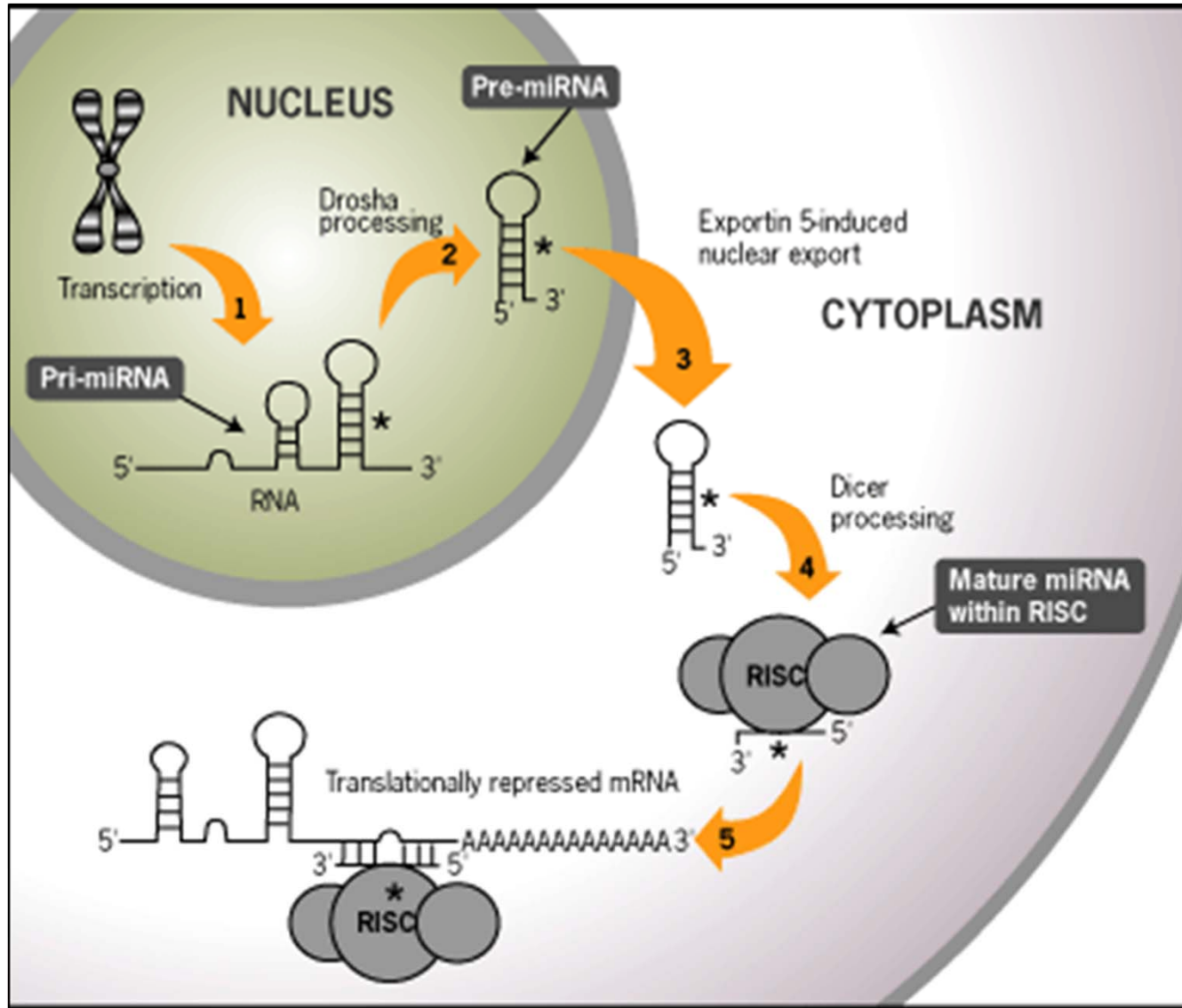
- Hierarchy of Propositions is a fundamental concept in forensic investigations
 - Offence Level (III)
 - Joe Bloggs raped Jane Smith
 - Activity Level (II)
 - Joe Bloggs had sexual intercourse with Jane Smith
 - Source Level (I)
 - Joe Bloggs' semen was found on Jane Smith's vaginal swabs
 - Analytical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



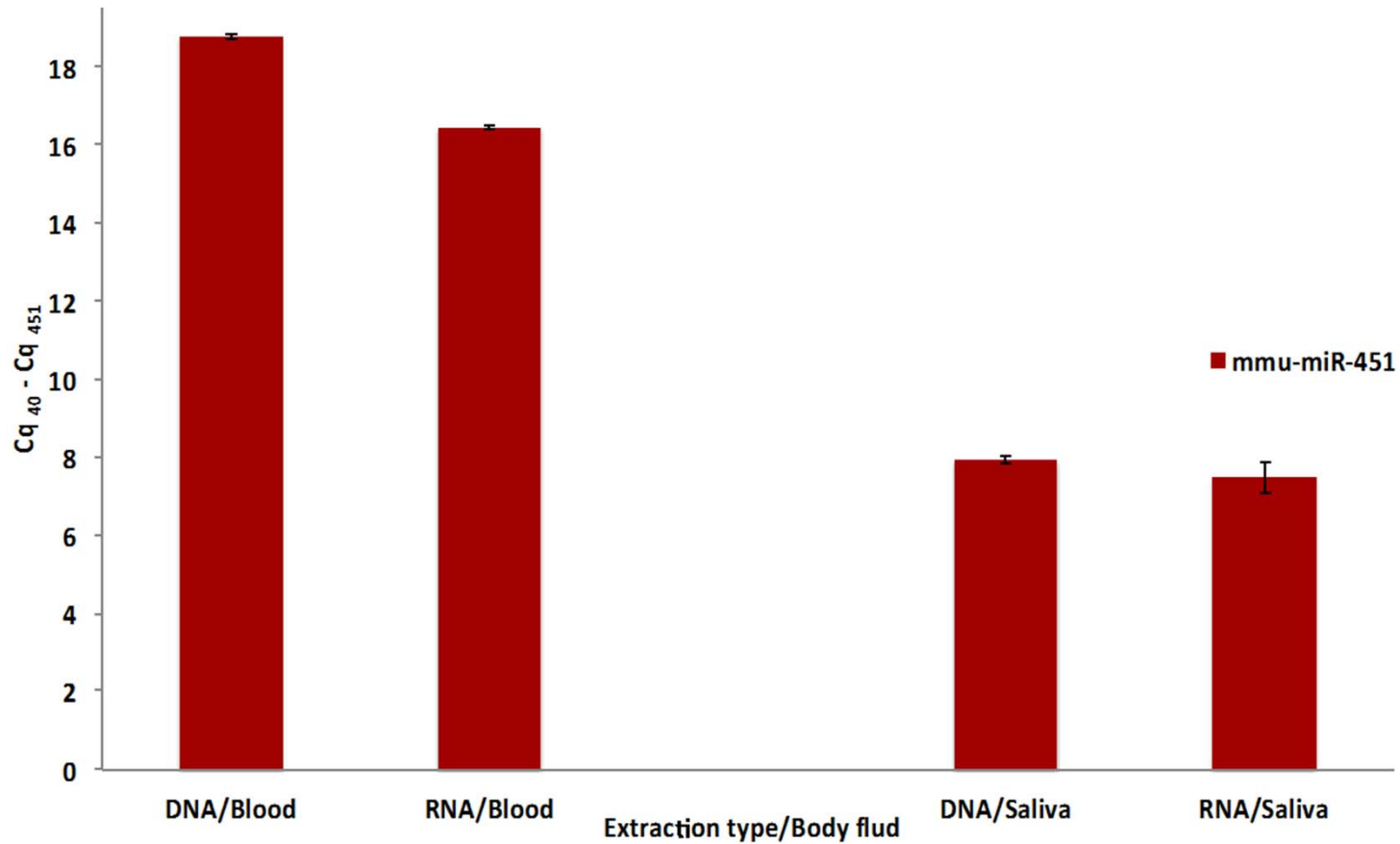
What is microRNA?



Why microRNA?

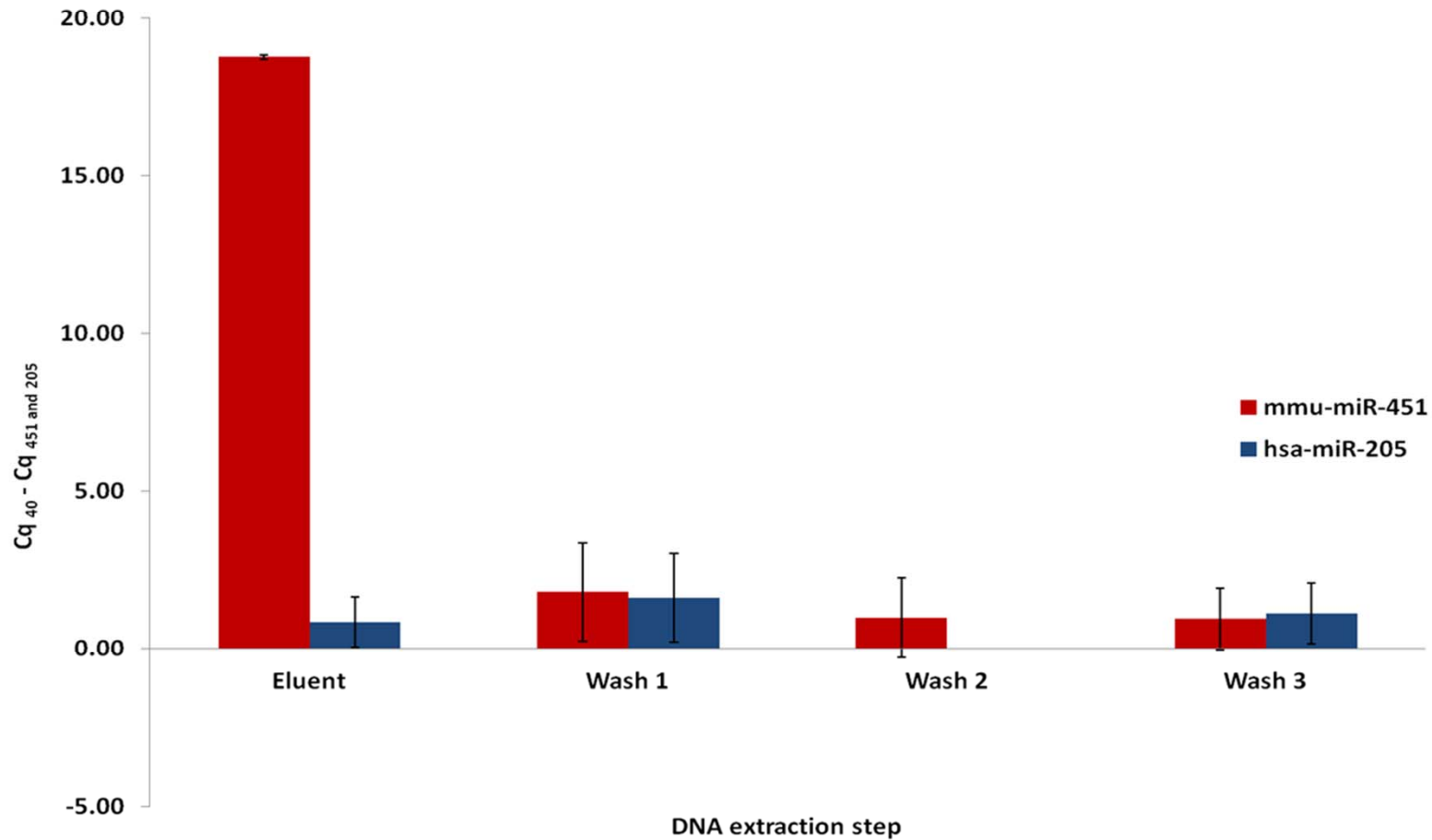


Co-extraction of DNA and miRNA



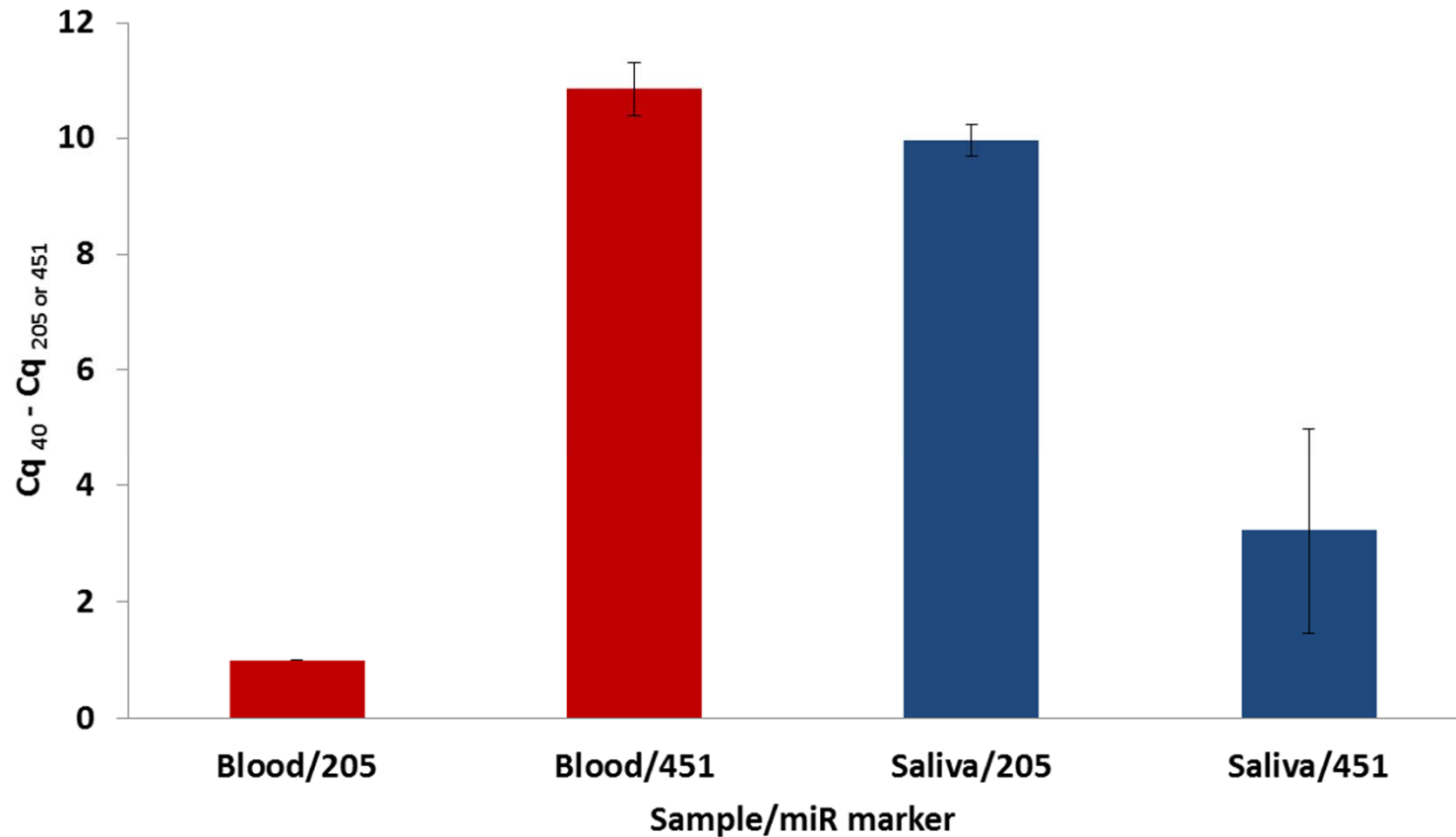
Omelia E. J., Uchimoto M. L. Anal. Biochem. (2013) 120-122

DNA extraction and washes using blood (n=15)



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

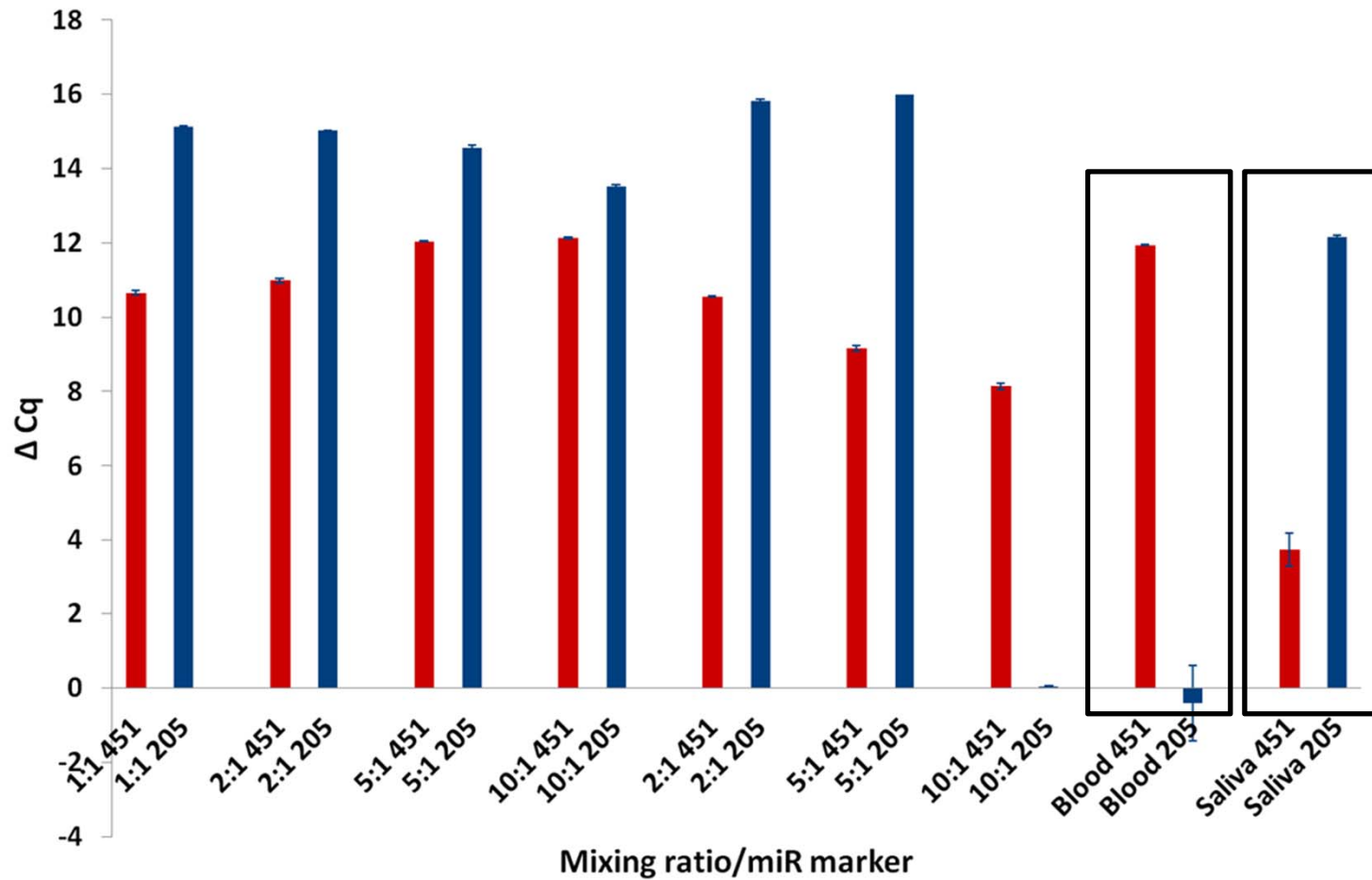
DNA extraction on blood and saliva samples (n=90)



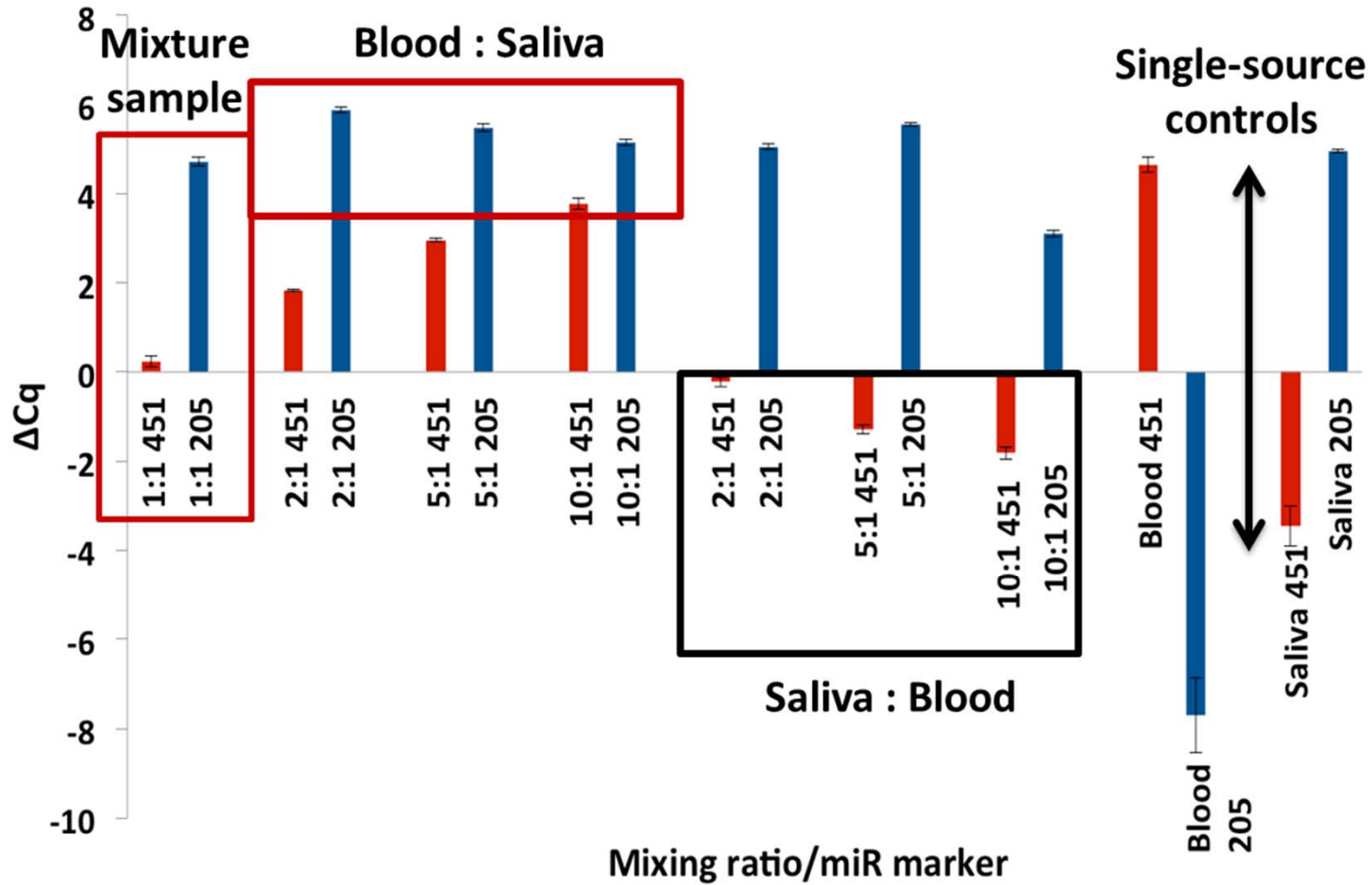
Body fluid mixtures

- 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

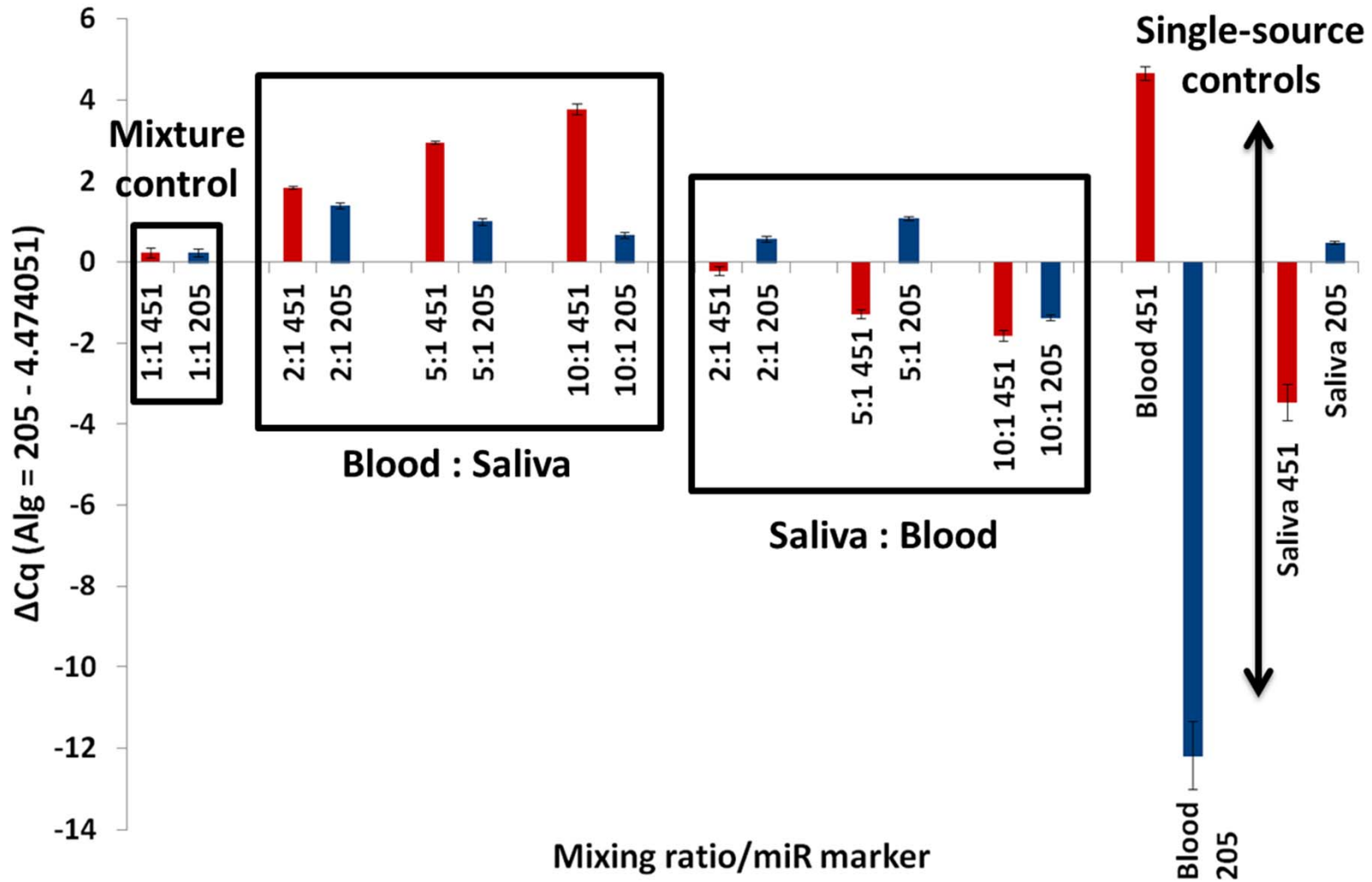
miR applications in blood and saliva mixtures



Mixtures (RNU44)



Mixtures (normalization)

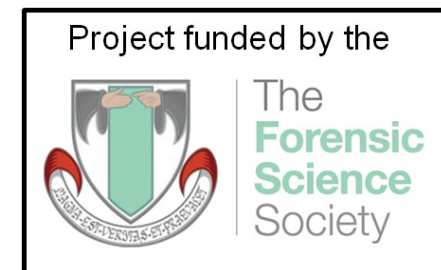


Endogenous controls

- 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



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

1. Mari Uchimoto
2. Kimberley Bexon
3. Donny van der Meer
4. Fathi Farag
5. Fisal Asaghiar
6. Charlotte Beever
7. Leander Stewart
8. Gabriela Roberts



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Inspiring tomorrow's professionals

Thank you for listening

Any questions?