**The effect of aromatic residues on electrical conductivity**

**and structure of α-helical peptides**

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Introduction:

Pili of *G sulfurreducens* bacteria, known as “microbial nanowires”, have shown impressive electrical conductivity.1 Aromatic residues in the α-helical portion of the pili have been reported to play an important role in conferring electrical conductivity.1 However, the electron transfer mechanisms responsible for significant electrical conductivity in these microbial nanowires are still not clear and different mechanisms have been proposed so far.1

Aim:

To better understand the electron transfer mechanisms involved and how aromatic residues affect the fibril formation and peptide structure, we used a de novo peptide design with aliphatic hydrophobic residues to self-assemble into coiled-coil α-helical structure. Then, we substituted the aliphatic residues in the hydrophobic core with two different aromatic residues, tryptophan and phenylalanine, at different positons and combinations to assess the effect of aromatic residues on both peptide structure and electrical properties.

Methods:

We used circular dichroism spectroscopy and atomic force microscopy to characterise peptide secondary structure and fibril formation of peptides. In addition, we used molecular dynamics simulation to analyse how aromatic residues could affect self-assembly of the α-helical peptides. Electrical conductivity of peptides were measured by I/V measurement of peptide films on interdigitated electrode arrays with 5 µm gaps.

Results and discussion:

Results showed that electrical conductivity of peptides were improved by substituting aliphatic residues with aromatic residues. Higher electrical conductivity values were achieved by incorporating tryptophan instead of phenylalanine residues which is in agreement with previous reports that tryptophan has higher efficiency in transferring electrons compared to phenylalanine.1 However, using phenylalanine destabilised the α-helical structure less compared to using tryptophan.

Conclusion:

In overall, while the electrical conductivity of α-helical peptides was improved by incorporating aromatic residues, the α-helical peptide structure and fibril formation was destabilised. The destabilisng effect was studied by using different types and combinations of aromatic residues. Therefore, this study add to the body of the knowledge in this field on how to improve electrical conductivity of peptides designed to be α-helical while minimising the destabilization effect of aromatic residues on peptide structure.

References:

1. R. C. Creasey, A. B. Mostert, T. Nguyen, B. Virdis, S. Freguia and B. Laycock, Acta biomaterialia, 2018.