SENSING SIALIC ACIDS WITH MULTI-FUNCTIONAL ELECTROCHEMICAL PROBES

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Sialic acids (Sias) are carbohydrates found on the surface of cells or in bodily fluids. They play important roles in the human nervous/immune system, and altered levels can reflect multiple disorders. Therefore, the design of new analytical methodologies for this family of monosaccharides may be useful for disease treatment and diagnosis [1]. Boronic acids are well-known carbohydrate receptors which form pH-dependent covalent interactions with diol-containing target molecules, leading to boronate ester species; at acidic pH values, they bind α-hydroxy acids, which are present in Sias. Electrochemical sensing of Sias using commercially available electroactive boronic acids is limited by their structural simplicity and can result in lactic acid interference, but it can be easily implemented compared to other methods and may avoid interference from neutral saccharides [2].
In this work, a series of novel electroactive ferrocene phenylboronic acids were synthesised and characterised; their ability to bind with the model sialic acid *N*-acetyl-D-neuraminic acid (Neu5Ac) was examined. Neu5Ac is the most common Sia naturally found in healthy humans, and it may be found free in solutions such as the cerebrospinal fluid of people with pyogenic meningitis [1]. The presence of an α-hydroxy acid group, carbohydrate structure and the anionic nature of Neu5Ac (p*K*a = 2.6) [1] was exploited for selectivity purposes, providing rationale for probe design and binding conditions employed. For example, a phenyl ring may allow for CH-π interactions [3]. The redox properties of the synthetic probes were established (cyclic voltammetry and differential pulse voltammetry), which led to the most promising compound for Neu5Ac recognition (see crystal structure in Figure 1). Qualitative and quantitative Neu5Ac interactions were examined by monitoring the altered redox properties of this chemoreceptor (Fc-LC) both in solution and via confinement within a carbon paste matrix. Neu5Ac binding *vs.* competing interferents (lactic acid and co-existing biological mono/disaccharides) establishes the potential of this methodology as a portable, rapid and s elective biodiagnostic tool. Fc-LC apparently recognises Sialic acid with reduced interference from lactic acid.

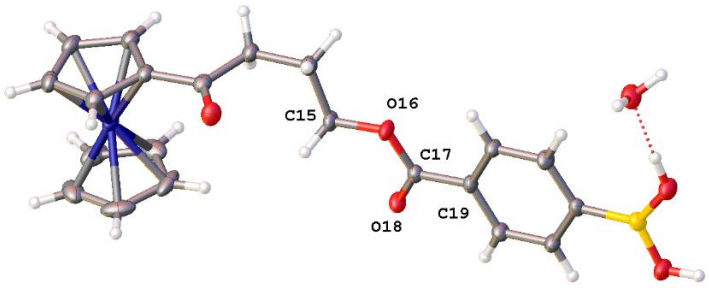

Figure 1.

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References:
1. S.K. Guin, T. Velasco-Torrijos, E. Dempsey, *Sens. Diagn.* **2022**, *1,* 10-70.
2. S.K. Guin, T. Krämer, E. Dempsey, *Electrochim. Acta* **2023**, *460,* 142618.
3. A. Di Pasquale, S. Tommasone, L. Xi, J. Ma, P.M. Mendes, *J. Org. Chem.* **2020**, *85,* 8330-8338.