Easy Identification of Pathogens via Binding to Glycosylated Materials

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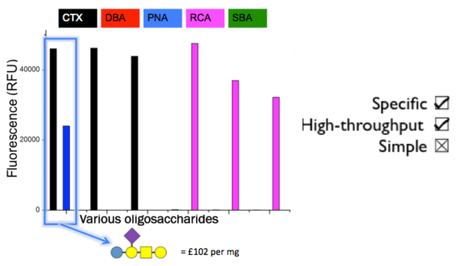
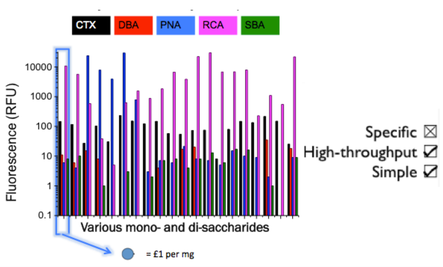
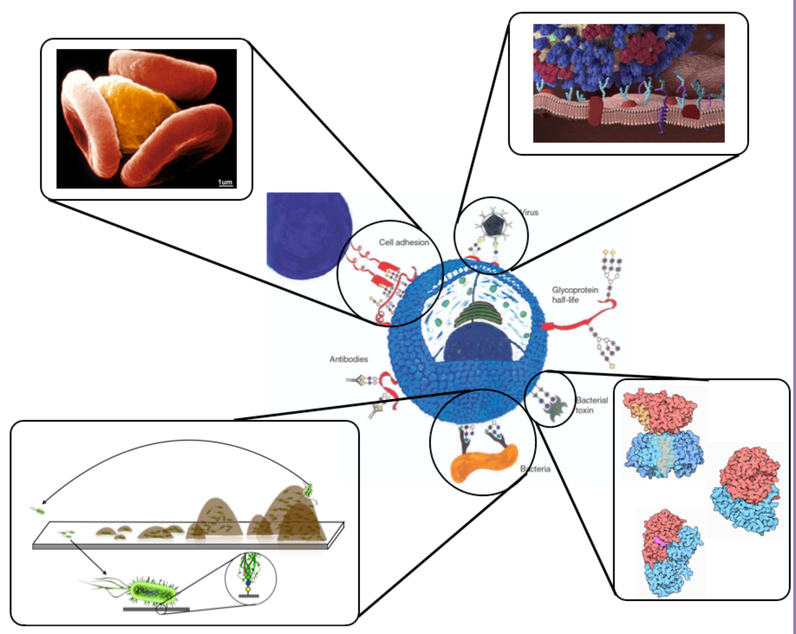
Background and current challenges



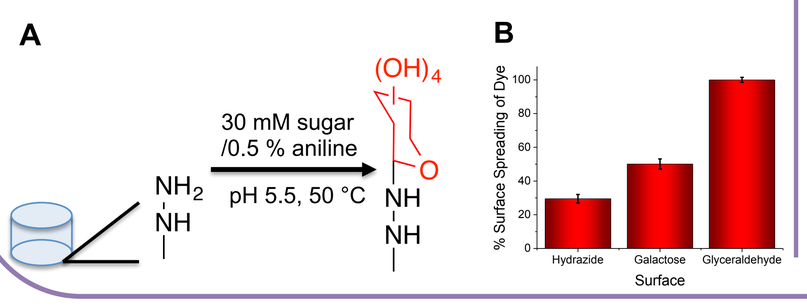


- The prevalence of protein-carbohydrate interactions in important biological processes means that they are readily exploited by bacteria, bacterial toxins, viruses and immune system escape of malaria infected red blood cells[1]
- Their importance in pathogen adhesion makes carbohydrates an attractive target for identification and detection. However care needs to be taken to ensure that detection is specific and not influenced by binding of contaminants from biological samples
- A carbohydrate array can be designed that is highly specific for the toxin but this can be challenging and expensive as it requires the purification of oligosaccharides
- An ideal array would utilise monosaccharides, but this is also a challenge due to the promiscuity of lectins.[2] The use of a powerful data classification algorithm can aid in the improvement of this system for identification and detection purposes.



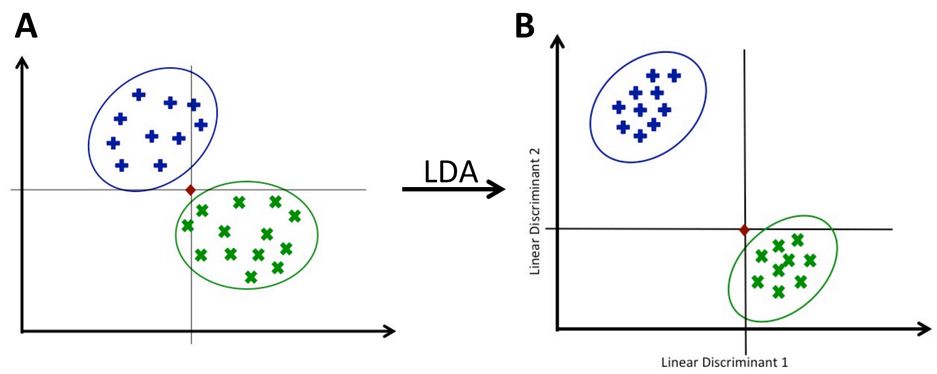
Surface modification

Hydrazide functionalised 96-well plates were further functionalised with various glycans in the procedure summarised in A and Functionalisation was confirmed using a modified drop shape analysis technique (B).[3]



Data Analysis

Classification of an unknown sample (◆) using the initial data set is challenging as it could belong to either group (A). Linear discriminant analysis (LDA) transforms the data set to minimise the overlap between classes in the x and y plane thus aiding in the classification of samples (B). After LDA the unknown sample can be classified as belonging to the green class.

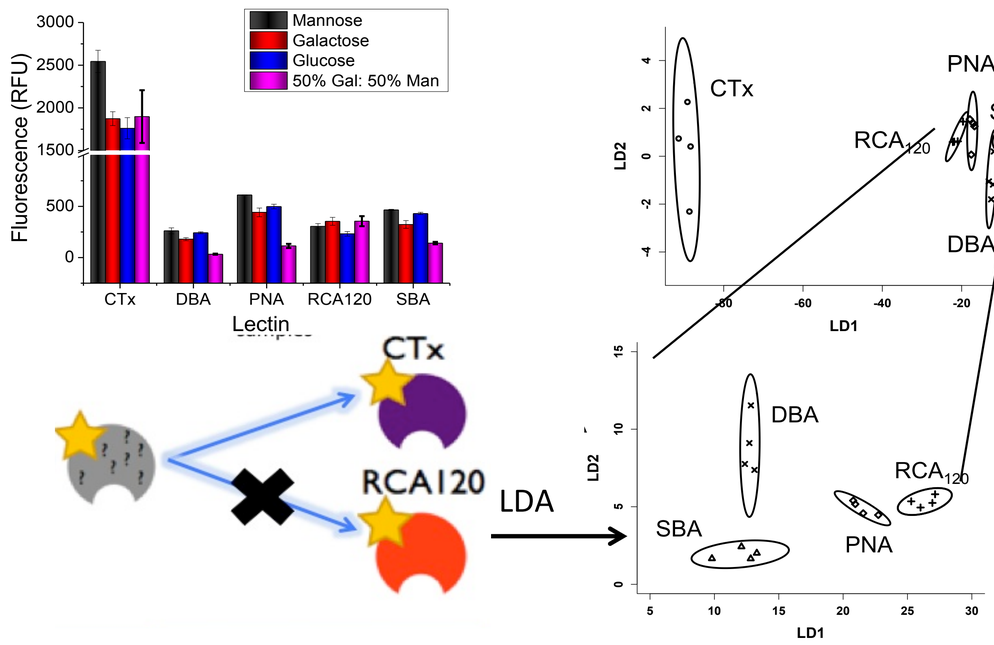


Otten, L., and Gibson, M.I. *RSC Advances*, **2015**

Case 1: Toxins

Cholera is caused by the secretion of CTx from the bacteria *Vibrio cholerae* and is common in war-torn countries. Infection causes symptoms similar to those seen in Ricin poisoning and thus toxin identification is crucial in determining appropriate treatment.

- Binding profiles of fluorescently labeled cholera toxin, RCA120 (a non-toxic derivative of ricin) and several environmental lectins of plant origin to 4 sugar surfaces was determined



- Linear discriminant analysis of the original binding data produced a model in which all toxins were well resolved from each other.

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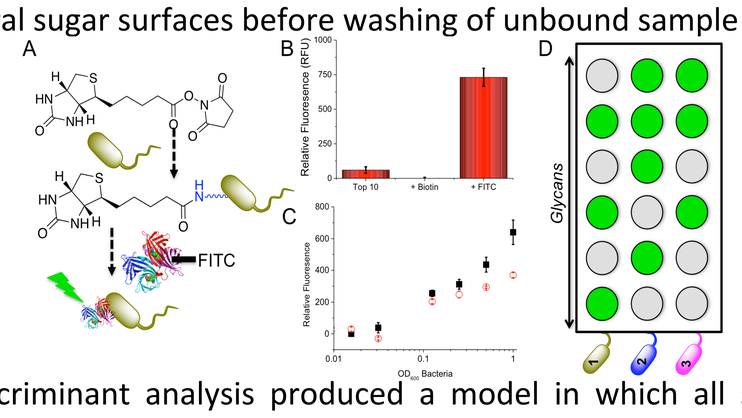
Conclusion: The model was able to **correctly identify blind samples of all lectins** and was able to detect the presence of a toxin even in the presence of another lectin.

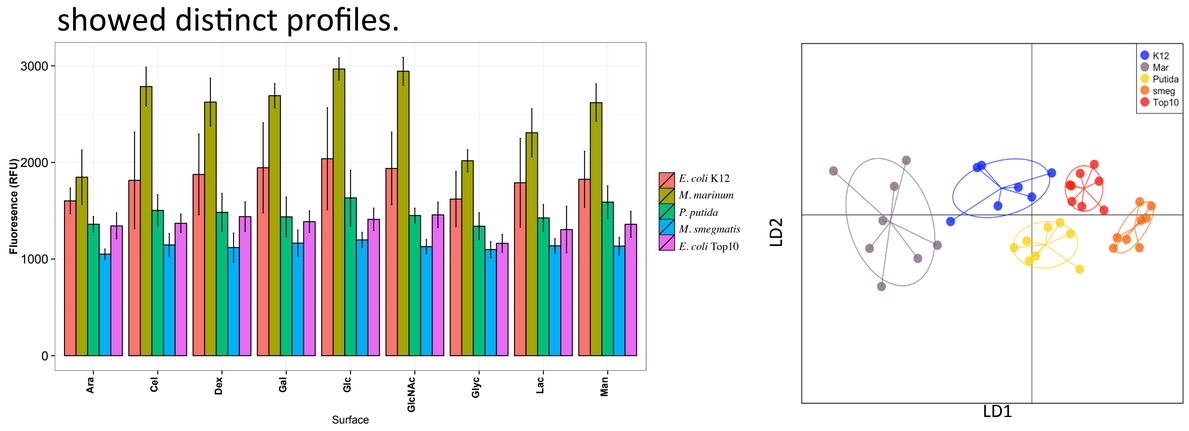
Case 2: Bacteria

Antibiotic resistance remains a global health concern with deaths as a result of antimicrobial resistance due to outnumber those from cancer by 2050. Current bacterial identification techniques are often time consuming, expensive or challenging and as such development of facile point-of-care diagnostic tools remains an important research goal.

- Samples of 5 bacterial species were fluorescently labeled prior to incubation with several sugar surfaces before washing of unbound sample



- Linear discriminant analysis produced a model in which all species analysed showed distinct profiles.



Otten, L., Fullam, E., Gibson, M.I. *in preparation*

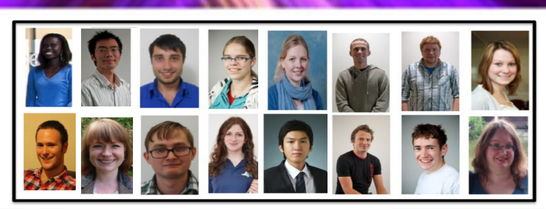
Conclusion: The model was able to **correctly identify all bacterial species** with 92 % accuracy and was able to **identify a completely blind sample** of one of the bacterial species.

Background References

1. Holgerrson *et al.*, Immunology and Cell Biology, 2005.
2. http://www.functionalglycomics.org
3. Godula and Bertozzi, J. AM. CHEM. SOC., 2010

Acknowledgements

- *Dr Matthew Gibson*
- *Dr Elizabeth Fullam*
- *The Gibson Group*



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