Simple toxin identification using a chemical ‘tongue’

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Chemistry postgraduate symposium. 27th May 2015
University of Warwick
Cholera toxin and Ricin

- Enzymatic domain
- Carbohydrate binding domain

3-5 million cases a year
100-120,000 deaths

A dose the same size as a couple of grains of table salt can kill an adult.
# Cholera Infection and Ricin Poisoning

## Severe Cholera Infection
- Vomiting
- Diarrhea
- Severe dehydration
- Drop in blood pressure
- Clinical shock
- Stomach cramps
- Death

## Ricin Poisoning through Ingestion
- Vomiting
- Diarrhea
- Severe dehydration
- Drop in blood pressure
- Clinical shock
- Seizures
- Hematuria
- Multiple organ failure
- Death
Protein Carbohydrate interactions

Carbohydrate microarray: oligosaccharides

Various oligosaccharides = £102,000 per g

Specific ✓
High-throughput ✓
Simple ✗

Fluorescence (RFU)

Various oligosaccharides

Consortium for Functional Glycomics, CFG
Carbohydrate microarray: mono-/di-saccharides

Various mono- and di-saccharides

Fluorescence (RFU)

0.1
1
10
100
1000
10000

Specific
High-throughput
Simple

= £1 per g

Consortium for Functional Glycomics, CFG
Linear Discriminant Analysis
Linear Discriminant Analysis

Linear Discriminant 1

Linear Discriminant 2
Carbohydrate surfaces

Carbohydrate binding

Fluorescence (RFU)

Lectin

Mannose
Galactose
Glucose
50% Gal: 50% Man

Sample classification

100% correct identification of ‘blind’ lectin samples

<table>
<thead>
<tr>
<th>Sample</th>
<th>Predicted</th>
<th>Actual</th>
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<tbody>
<tr>
<td>U1</td>
<td>RCA120</td>
<td>RCA120</td>
</tr>
<tr>
<td>U2</td>
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Label free techniques

Richards, S-J., Otten, L. and Gibson, M.I., in preparation


Richards, S. et al., ACS Macro Letters (2014)
Other applications - Bacteria

Antimicrobial resistance deaths by 2050

Review on antimicrobial resistance, 2014
Protein Carbohydrate interactions
Bacteria Labelling

Unpublished results

\[
\text{NH}_2 + \text{R} \quad \xrightarrow{\text{pH 7}} \quad \text{OH} + \text{NH}_2 \quad \xrightarrow{\text{pH 7}} \quad \text{R}
\]

Unpublished results
Bacterial binding profiles

Unpublished results
Conclusions and further work

Conclusions:
• Linear discriminant analysis has been shown to aid in the identification of blind lectin samples
• It has also shown to be applicable to identification of bacterial species

Future work:
• Increase the number of bacterial species examined
• Identification of Influenza A strains through differential carbohydrate binding will also be analysed.
Acknowledgements

Matthew Gibson
Elizabeth Fullam
Sarah-Jane Richards