4th Queensland Annual Chemistry Symposium
QACS 2019

Friday 29th November 2019
8:30am – 5:30pm

Physiology Lecture Theatres (Building 63)
University of Queensland, St Lucia Campus

Programme

A copy of this programme and abstracts will also available online at
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Morning Programme

Registrations will commence from 8:00am	**Venue: Physiology Building 63-L3 Foyer**
Morning Plenary Session - Chair: A/ Prof. Joanne Blanchfield	**Venue: 63-348**
8:40	**Opening remarks: A/ Prof. Joanne Blanchfield**
8:45	**Plenary lecture P1: A/ Prof. Bronwyn Laycock (UQ)** *Biodegradable Polymers and their role in the Circular Economy.*
9:30	**Morning tea** — **Venue: Physiology Building 63-L3 Foyer**
Morning Parallel Sessions	
	Analytical Chemistry - Chair: Dr. Ashley Tronoff (QH) — **Venue: 63-348**
10:00	A1 - **Mahnaz D. Gholami** (QUT) *Visual detection of biothiols in food industry and biological matrix.*
10:15	A2 - **Paul Denman** (UQ) *Cobalamins as Reactive Surface Enhanced Raman Probes for the Detection & Quantification of Sulfite.*
10:30	A3 - **Zhi Hung Loh** (UQ) *Mitigating the Effects of the Toxin Simplexin in Pimelea Poisoning of Cattle by Development of a Microbial Probiotic.*
10:45	A4 - **Saiqa Muneer** (QUT) *Label-free SERS quantification of TNF blockers in complex biological matrices.*
11:00	A5 - **Shammy Sarwar** (UQ) *Effect of curcumin-based photodynamic treatment on nutritional properties of strawberry fruit.*
11:15	A6 - **Venkateswara R. Narreddula** (QUT) *Identification of unusual fatty acids from vernix caseosa by photodissociation mass spectrometry.*
11:30	A7 - **Russell J. Gordon** (UQ) *Are toxic Pimelea secondary compounds absorbed via the intestinal lymph?*
11:45	A8 - **Ali R. Elnaa**s (GU) *Escaping Bio-Assay Guided Isolation: Nature's Tools for Chemical Biology.*
12:00	*End of session*
	Organic and Medicinal Chemistry – Chair: A/Prof. Ross McGeary (UQ) — **Venue: 63-358**
10:00	B1 - **Anh Dao Thi Phan** (UQ) *Bioactive compounds and functional properties of Pittosporum angustifolium (Gumby Gumby), an Australian native plant.*
10:15	B2 - **Gabriele Netzel** (UQ) *Structurally different anthocyanidin-glycosides and their metabolic fate in vivo.*
10:30	B3 - **Hung Trieu Hong** (UQ) *Optimisation of extraction and saponification for the determination of free- and bound-carotenoids in orange capsicum and avocado.*
10:45	B4 - **Louise C. Forster** (UQ) *Dynamic NMR studies and conformational analyses inform stereochemical analysis of dendrillane terpenes from the nudibranch Goniobranchus coi.*
11:00	B5 - **Ahmed H. Elbanna** (UQ) *Fish-derived fungi as new sources for new, rare and bioactive metabolites.*
11:15	B6 - **Michael Netzel** (UQ) *Folate in strawberry and avocado – profile, distribution and total content.*
11:30	B7 - **Amanda Tauber** (BondU) *In vitro inhibitory evaluation of novel amine and amide compounds against the post-translational modifier enzyme, ARTD8.*
11:45	B8 - **Gabriel Luiz Lopes Fraga** (UQ) *Palladium-catalysed transfer hydrogenation of guaiacol: effect of alternative hydrocarbons as hydrogen sources.*
12:00	*End of session*
	Polymers and Theoretical Chemistry – Chair: Dr. Li Li (UQ) — **Venue: 63-360**
10:00	C1 - **Tianlong Zhang** (UQ) *Lignocellulosic biomass hydrothermal liquefaction to generate feedstock for polyhydroxyalkanoate production.*
10:15	C2 - **Francis McCallum** (UQ) *Design and Synthesis of High χ Galactose-based Block Copolymers for Next Generation Nanolithography.*
10:30	C3 - **Tom Rufford** (UQ) *Catalyst--Electrolyte Interactions in Aqueous Reline Solutions for Highly Selective Electrochemical CO2 Reduction.*
10:45	C4 - **Yuao Wu** (UQ) *Novel nanotechnology approach for diagnosis and treatment of ROS related inflammatory diseases.*
11:00	C5 - **Yue (Cassie) Yuan** (UQ) *Modelling the controlled release of toxins in a rumen environment.*
11:15	C6 - **Dushanthi Wanninayake** (USQ) *Removal of PFAS compounds in water using a Combined Adsorption and Electrochemical Regeneration Technology.*
11:30	C7 - **Yuk Ping Chin** (UQ) *Application of Transition State Force Field in the Prediction of Asymmetric Catalysts Efficiency.*
11:45	C8 - **Alicia M. Kirk** (UQ) *A tale of two fates: Modelling cytochrome P450 catalysed dehydrogenation.*
12:00	*End of session*
12:00	**Lunch** — **Venue: Physiology Building 63-L3 Foyer**

Afternoon Programme

Afternoon Parallel Sessions	
	Analytical, Medicinal and Inorganic Chemistry - Chair: Dr Stephanie Schweiker (BondU) **Venue: 63-348**
1:30	A9 - **Phil M. Choi** (UQ) *Anthropogenic chemicals in wastewater and their link to peoples' socioeconomic status.*
1:45	A10 (S) - **Hyo Jeong (Minnie) Kim** (BondU) *Development and application of method to analyse the sialylation of the cells.*
1:50	A11 - **Gethmini Kodagoda** (UQ) *The effect of storage temperature on the accumulation of anthocyanins in different fruit tissues of Queen Garnet Plum.*
2:05	A12 (S) - **Sukirtha Srivarathan** (UQ) *Nutritional profile and phytochemical characteristics of Australian grown Samphire.*
2:10	A13 (S) - **Amila Agampodi Dewa** (UQ) *Isolation of novel compounds using combination of NOMETA and GNPS molecular networking approaches.*
2:15	A14 - **Tobias Nitsche** (QUT) *Pushing the Limits of Single Chain Compaction Analysis by Observing the Stepwise Size Reduction via Mass Spectrometry Coupled to Size Exclusion Chromatography.*
2:30	A15 (S) - **Qiuda Zheng** (UQ) *Developing a large-volume Injection method for analysis of anabasine and anatabine in wastewater by LC-MS/MS.*
2:35	A16 (S) - **Satish N. Dighe** (QUT) *Discovery of novel DNA gyrase targeted antimicrobial leads by structure-based virtual screening.*
2:40	A17 - **Elvis D. Okoffo** (UQ) *Identification and quantification of selected plastics in biosolids by pressurized liquid extraction combined with double-shot pyrolysis gas chromatography-mass spectrometry.*
2:55	A18 (S) - **Bhautikkumar Patel** (GU) *Design, Synthesis and Biological Evaluation of Novel Simplified Muraymycins Analogues.*
3:00	A19 (S) - **Brijesh M. Jakasaniya (Patel)** (GU) *Rational design, synthesis and biological evaluation of galectin-8N antagonists.*
3:05	A20 - **Hang T. Ta** (UQ) *Metal and metal oxide based nanomaterials for advanced diagnosis and treatment of cardiovascular diseases.*
3:20	A21 (S) - **Vivek Makwana** (GU) *Bisubstrate analogue as inhibitor probes to study O-GlcNAc transferase (OGT).*
3:25	*End of session*
	Medicinal and Organic Chemistry - Chair: Prof. Sally-Ann Poulsen (GU) **Venue: 63-358**
1:30	B9 - **Jianying Han** (GU) *Exploring the potential of endophytes and fungi as sources of antibacterial compounds.*
1:45	B10 (S) - **Ye Yuan** (UQ) *Hydroxyl substituted benzoic acid/cinnamic acid derivatives as potent tyrosinase inhibitors: bio-evaluation.*
1:50	B11 - **Nicole C. Wheatley** (UQ) *Optimisation of Free Energy Calculations for use in Structure-based Drug Design.*
2:05	B12 (S) - **Caleb M. T. Kam** (BondU) *Design, Synthesis, and Evaluation of Potential Inhibitors for PARP1 and PARP14.*
2:10	B13 (S) - **Nicholas A. Rosser** (GU) *Synthesis and biological evaluation of butenolides as anti-cancer agents.*
2:15	B14 - **Benjamin J. Tombling** (UQ) *Design of a potent peptide inhibitor of PCSK9 for treating familial hypercholesterolemia.*
2:30	B15 (S) - **Sara Motamen** (GU) *Discovery of Ligand Structure-activity Relationship by Mass Spectrometry.*
2:35	B16 (S) - **Wanli Jin** (UQ) *Bio-evaluation of Tyrosinase Inhibitors as Potential Anti-melanoma Agents.*
2:40	B17 - **Julia L. Kurz** (UQ) *A Novel Ketol-acid Reductoisomerase Inhibitor with Potential as a Tuberculosis Drug.*
2:55	B18 (S) - **Mohammad Omer Faruck** (UQ) *Development an oral-delivery system for peptide based nano vaccine against Group A Streptococcus.*
3:00	B19 (S) - **Astrid Larin** (QUT) *Flavonoid-Nitroxide Hybrid Antioxidant Drugs for the Treatment of Neurodegenerative Diseases.*
3:05	B20 - **Tamim Mosaiab** (GU) *Liposomes vs Micelles; a comparison study to deliver therapeutics to macrophages.*
3:20	B21 (S) - **Viviene S. Santiago** (UQ) *Can you dig it? Exploring an Extinct Volcano Crater Soil Microbiome as a Prolific Source of Microbial Natural Products.*
3:25	*End of session*

Afternoon Parallel Sessions cont.	
	Theoretical, Polymer, Inorganic and Organic Chemistry - Chair: Dr. Nathan Boase (QUT) **Venue: 63-360**
1:30	C9 - **Jonathan Y. C. Ting** (UQ) *Molecular Modelling of Covalent Inhibition of Bruton's Tyrosine Kinase by Cyanoacrylamides.*
1:45	C10 (S) - **Ras Baizureen Roseli** (UQ) *The Reversibility of Michael Additions: What controls reactivity?*
1:50	C11 - **Mirella S. Santos** (UQ) *Molecular dynamics simulations for the prediction of self-diffusion coefficients of confined fluids.*
2:05	C12 (S) - **Tania Alajo** (UQ) *Influence of simulated weathering on polyethylene and polypropylene types of microplastics, characteristics, quantification and analysis.*
2:10	C13 (S) - **Alexandra L. Mutch** (UQ) *Design of surface-modified polycaprolactone: considering degradation and fate of modified biomaterials.*
2:15	C14 - **Timothy T. Duignan** (UQ) *Using Quantum mechanical simulation of ion hydration to predict electrolyte solution properties.*
2:30	C15 (S) - **Ben Sellers** (QUT) *Development of Profluorescent Micelles for the Use in Optoacoustic Imaging.*
2:35	C16 (S) - **Marco Pandullo** (QUT) *Metallosupramolecular polyhedra for inclusion in multicomponent co-crystals.*
2:40	C17 - **Jessica K. Bilyj** (UQ) *Bis-Dithiocarbazate Ligands and their Non-Innocent Relationship with Copper.*
2:55	C18 (S) - **Miguel Gonzalvez** (UQ) *Self-Assembled Highly Positively Charged Crowns: Study of the Counterion Effect.*
3:00	C19 (S) - **Xing Wan** (UQ) *An investigation of the antimicrobial efficacy of silver coated glass.*
3:05	C20 - **Michael Pfrunder** (UQ) *Construction of Photoactive Supramolecular Coordination Cages.*
3:20	C21 (S) - **Yusi Jiao** (GU) *Fragment-Based Drug Discovery Library from Traditional Chinese medicine.*
3:25	*End of session*
3:00	**Afternoon tea** **Venue: Physiology Building 63-L3 Foyer**
Afternoon Plenary Session - Chair: Dr. Baris Demir (UQ)	**Venue: 63-348**
4:00	**Plenary lecture P2: A/ Prof. Debbie Silvester-Dean (CU)** *Electrochemical Detection of Gases and Explosives in Ionic Liquids.*
4:45	Presentation of Prizes for Contributed Talks and Short Presentations and Closing Remarks.
5:00	**The symposium will be followed by a social gathering to stimulate further networking opportunities at the Pizza Café.**

Key:
GU – Griffith University
QUT – Queensland University of Technology
UQ – University of Queensland
BondU – Bond University
USQ – University of Southern Queensland
QH – Queensland Health
CU – Curtin University

(S) denotes a short talk

P1. Biodegradable Polymers and their role in the Circular Economy

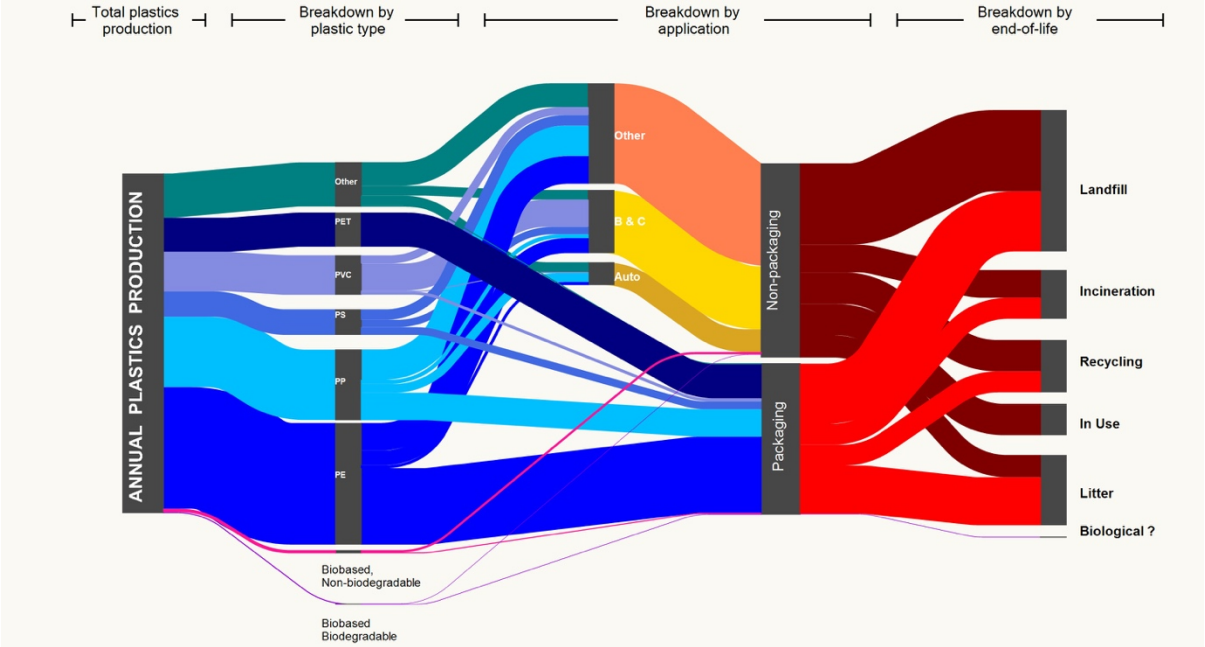
Bronwyn Laycock[1, 2], Leela Dilkes-Hoffman[1], Steven Pratt[1], Paul Lant[1]

[1] School of Chemical Engineering, The University of Queensland

[2] Dow Centre for Sustainable Engineering Innovation, The University of Queensland

Currently, in excess of 320 million tons of different classes of plastic are produced annually, and this rate of production is increasing exponentially. These plastics are primarily derived from petroleum - a non-renewable resource - and are generally non-(bio)degradable, meaning there is inevitable ongoing and increasing accumulation in the environment following leakage from our current collection systems (**Fig. 1**). A transition to a sustainable plastics economy is urgently needed. Bioplastics are often touted as a sustainable alternative to conventional plastics, where the term 'bioplastic' broadly represents plastics that are bioderived and/or biodegradable. But are these a 'silver bullet' for plastic pollution? And what is the general attitude of the Australian public to such materials?

Figure 1. World plastic flows in 2015[1]



This presentation will introduce the key drivers and strategies underlying the new model of a plastics economy, set in the context of the Australian public's attitude to plastics and bioplastics based on a recent survey. It will then compare and contrast the role of bioplastics in this new model, in terms of their utility and biodegradability, and consider the scenarios in which they could be applied in order to tackle plastic pollution.

[1] L. Dilkes-Hoffman, P. Ashworth, B. Laycock, S. Pratt, P. Lant, Public attitudes towards bioplastics – Knowledge, perception and end-of-life management, submitted to Resources, Conservation and Recycling, 28th June 2019

P2. Electrochemical Detection of Gases and Explosives in Ionic Liquids

Debbie S. Silvester

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Gas detection is important in a wide range of fields, as highlighted in Figure 1a, relying on the accurate determination and quantification of gases in the environment. One type of electrochemical sensor, amperometric gas sensors (AGSs, Figures 1b-d) are popular for this purpose due their high sensitivity, high selectivity, low-cost, wide detection range, and low power requirements.[1] The first amperometric gas sensor was introduced by Leyland Clark and colleagues in 1953,[2] and many modern commercially-available AGSs are still based on variations of this design. Room temperature ionic liquids (RTILs) have strong potential for use as alternative 'designer solvents' in membrane-free AGSs,[3] which would solve the existing technological problems of commercial AGSs, including the slow diffusion and solvent evaporation. Their non-volatility would enable the membrane to be dispensed with, and the entire sensor to be miniaturised to provide optimal functionality over a much wider range of ambient conditions and with a significantly longer lifespan. This allows and encourages innovative designs, with the potential for gas sensors to move from single, finite devices to more sophisticated systems that exploit recent advances in portable electronics and computing.

In this talk, I will discuss some of the challenges facing ionic-liquid based sensors, such as solvent leakage, sensitivity to moisture and accumulation of electrogenerated products, and how we can innovatively design electrode materials and electrolytes to overcome these challenges. In particular, I will show that the choice of ionic liquid is crucial in high humidity gas environments, due to the structuring and layering of the ions in the electrical double layer.[5] I will also discuss the possibility to detect explosive compounds in RTILs, and polymer-RTIL mixtures. Overall, it is clear that RTILs show tremendous promise as electrolytes in sensors, but more understanding of their long-term operation and utility in real environments is still needed.

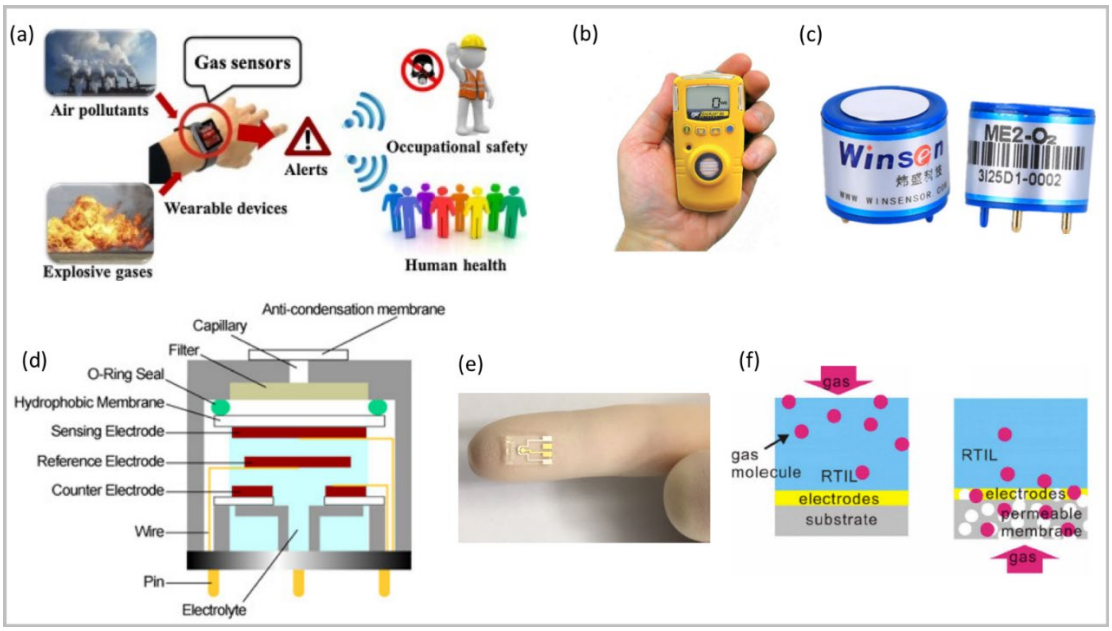

Figure 1. Overview of commercially available AGSs and new miniaturised planar devices being used increasingly by academic researchers.

References:

1. Stetter JR, Li J *Chem. Rev.* **2008**, 108, 352–366.
2. Clark JR LC, Wold R, Granger D, Taylor Z *J. Appl. Physiol.* **1953**, 6, 189–193.
3. Buzzeo MC, Hardacre C, Compton RG *Anal. Chem.* **2004**, 76, 4583–4588.
4. Silvester, DS *Curr. Opinion Electrochem.* **2019**, 15, 7–17.
5. Doblinger S, Lee J, Silvester DS *J. Phys. Chem. C* **2019**, 123, 10727−10737.

A1. Visual detection of biothiols in food industry and biological matrix

Mahnaz D. Gholami*, Emad L. Izake, Godwin A. Ayoko, Prashant Sonar

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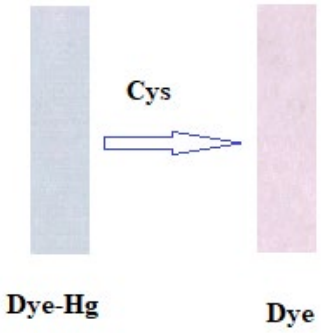
Abstract:

It is known that mercury has high affinity towards thiol-containing amino acids and the thiol- containing amino acid preferentially coordinates with the mercury ions of the dye-Hg (II) complex. In this work, a novel dye- Hg (II) complex was introduced and used for the rapid and visual determination of cysteine (Cys) in aqueous solution by UV-Vis spectroscopy down to 1×10^{-7} M. A distinct colour change from blue to pink was observed by the naked eye through the addition of aqueous Cys to the dye-Hg (II) complex. This was confirmed by observing the UV-Vis spectrum of the dye-Hg (II) complex before and after the addition of Cys. The absorption band of the dye-Hg (II) complex at 585 nm disappeared and that the free dye re-appeared at 540 nm upon the addition of Cys. The change in colour and UV-Vis absorption spectra is attributed to the dissociation of the blue-coloured complex and the liberation of the pink-coloured dye. The colour change of the dye- Hg (II) complex from blue to pink was selective to the Cys biothiol while other non-thiol containing amino acids did not cause a colour change. For the in-field application, filter paper strips were loaded with dye- Hg (II) complex and used as a disposable sensor for the detection of cysteine (Cys) by the naked eye. Therefore, this chemosensor offers a sensitive, selective and rapid tool for the detection purified biothiols, such cysetine, homocysteine and glutathione in biology research and pharmaceutical/ food industries.



References:

1. H. A. Spiller, Clin. Toxicol, 2018, 56, 313-326.

A2. Cobalamins as Reactive Surface Enhanced Raman Probes for the Detection & Quantification of Sulfite

Paul Denman[1], Kevin Jack[3], James Blinco[4], Idriss Blakey[1,2]

[1]Australian Institute of Bio-engineering & Nanotechnology University of Queensland, St. Lucia, Queensland 4072, Australia, [2]Centre for Advanced Imaging, University of Queensland, St. Lucia, Queensland 4072, Australia, [3]Centre for Microscopy and Microanalysis, University of Queensland, St. Lucia, Queensland 4072, Australia, [4]Science and Engineering Faculty, Queensland University of Technology, Brisbane, Queensland, 4001, Australia

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Surface Enhanced Raman Spectroscopy (SERS) has been shown to be a highly promising molecular sensing technique, especially in aqueous and biological applications due to high sensitivity, rich spectroscopic information and excellent water compatibility. Due to the nature of SERS, a noble metal substrate is required to achieve Raman signal amplification and gold nanoparticle (AuNP) aggregates can provide an easy to modify, and simple to synthesise substrate that provides excellent Raman signal enhancement. However, this system can have issues with agglomeration and sedimentation which can be prevented through incorporation of aggregates into a polymer hydrogel substrate,[1] or slowed down by coating the particles with suitable molecular stabilisers.[2] Direct SERS based sensing has selectivity issues with molecular detection in complex mixtures, which can be overcome with the incorporation of a reactive probe such as a cobalamin that then targets the desired analyte – resulting in highly sensitive, selective detection.

Cobalamins have a rich chemistry that has been consistently investigated, chiefly relating to its biological role in the body. Here we show they also have a novel application as a reactive probe in an AuNP based SERS sensing system for the detection of sulphite. By first coating AuNPs with cyanocobalamin, followed by aggregation in order to generate high SERS enhancements, we successfully demonstrate that this pH tuneable system can give a ratiometric SERS signal for the quantification of sulphite in complex solutions such as wine down to nano-molar concentrations. Further trapping of these aggregates in an agarose hydrogel to improve stability allows detection of sulphur dioxide gas down to ppb levels.

1. Pastoriza-Santos, I.; Kinnear, C.; Pérez-Juste, J.; Mulvaney, P.; Liz-Marzán, L. M., Plasmonic polymer nanocomposites. Nature Reviews Materials 2018

2. Blakey, I.; Merican, Z.; Thurecht, K. J., A method for controlling the aggregation of gold nanoparticles: tuning of optical and spectroscopic properties. Langmuir 2013, 29 (26), 8266-74.

A3. Mitigating the Effects of the Toxin Simplexin in *Pimelea* Poisoning of Cattle by Development of a Microbial Probiotic

Loh, ZH[1]*, Hungerford, NL[1], Ouwerkerk, D[2], Klieve, AV[1], Fletcher, MT[1]

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Pimelea poisoning of cattle (also known as St. George disease or Marree disease) is a uniquely Australian disease caused by native *Pimelea* pasture species. Simplexin was identified to be the culprit toxin and was successfully isolated and characterised. A previous cattle trial reported that cattle fed with a diet containing increasing low doses of simplexin showed reduced poisoning symptoms over time [1]. It was hypothesised that the rumen microorganisms in the cattle were able to adapt and detoxify simplexin. To this date, there is no study on simplexin detoxification by rumen microorganisms. The aim of the project is to develop a microbial probiotic capable of simplexin detoxification to allow cattle to consume *Pimelea* plants without adverse effects. Studies are ongoing to determine the effect of incubated simplexin in *in-vitro* rumen fermentations and isolated rumen bacteria incubations. Preliminary experiments showed decrease in simplexin levels in both fermentation and incubation trials suggesting the possible involvement of rumen microorganisms in simplexin degradation. Acid hydrolysis of simplexin was conducted and possible simplexin metabolites were identified. Simplexin and its predicted metabolites are analysed by liquid chromatography coupled with high resolution, accurate mass (HRAM) spectrometry, which allows simplexin quantification at sub ppb concentrations and elucidation of novel simplexin metabolites. Further studies include full identification and characterisation of simplexin metabolites in fermentation trials, incubation trials and commercial enzymes incubation trials.

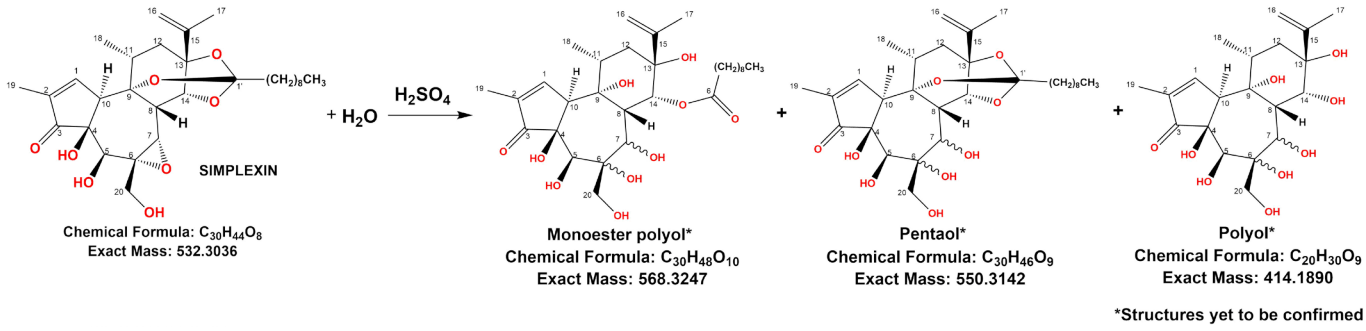

Figure 1: Acid hydrolysis of simplexin with sulfuric acid and postulated acid degradation products identified using LC-MS.

[1]MT. Fletcher, S. Chow, SM. Ossedryver, "Effect of Increasing Low-Dose Simplexin Exposure in Cattle Consuming *Pimelea trichostachya*," *Journal of Agricultural and Food Chemistry*, 2014, *62*, 7402-7406, DOI: 10.1021/jf5005644.

A4. Label-free SERS quantification of TNF blockers in complex biological matrices

Saiqa Muneer [1]*, Godwin A. Ayoko, Nazrul Islam, Emad L. Izake

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School of Chemistry, Physics and Mechanical Engineering, Science and Engineering Faculty, Queensland University of Technology, Australia.

A rapid and non-destructive technique for trace level detection of TNF-blockers in complex biological matrices is surface enhanced Raman spectroscopy (SERS). However, the current techniques such as HPLC-MS and ELISA are time consuming, expensive and lack the required sensitivity for accurate quantification of these drugs in biological fluids. Label free SERS corresponds to the direct detection of drug without using Raman tag. A key feature of SERS is that it utilizes noble metal nanostructures to increase the weak Raman signals from analytes. We present a novel SERS substrate involving gold nanoparticles functionalized on an extractor chip. To observe the desired Raman spectral signatures of these drugs, the molecular structure of the purified TNF blocker was then modified and directly loaded onto gold nano sensor and quantified by surface enhanced Raman spectroscopy down to 1 fM by a handheld Raman spectrophotometer. The results presented here indicate that SERS is a useful tool for identifying TNF blockers at point of care and pathology and for therapeutic drug monitoring.

A5. Effect of curcumin-based photodynamic treatment on nutritional properties of strawberry fruit

Shammy Sarwar[a*], Ram Mereddy[b], Michael E. Netzel[a], Gabriele Netzel[a] and Yasmina Sultanbawa[a]

[a]Queensland Alliance for Agriculture and Food Innovation (QAAFI), The University of Queensland, Coopers Plains, QLD, Australia

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ABSTRACT

Strawberry is an attractive and highly consumed fruit and can be an important source of essential nutrients as well as polyphenolic compounds such as anthocyanins and phenolic acids. But at room temperature, this fruit is highly vulnerable to physical injury and fungal spoilage. An innovative, cost effective and environmentally friendly photodynamic technique, photosensitization, has been applied with the aim to prevent microbial growth and minimize the loss of nutrients and bioactive polyphenols. Photosensitization works based on the combined action of photosensitizer, light and oxygen, which produce reactive oxygen species that inactivate microorganisms. Curcumin, known for its antifungal activity, was used as the photosensitizer in this study. To assess the effect of photosensitization on the nutritional properties of strawberry fruit, physicochemical parameters, anthocyanins (main polyphenols; UHPLC), total phenolic content (Folin-Ciocalteu assay) and total sugar (HPLC) in fresh (control) and treated strawberries (*Cv*. 'Albion') were determined. There were no changes ($p<0.05$) in colour, pH, titratable acidity, total soluble solids and moisture content between treated and untreated strawberries. Anthocyanins (20.8 ± 1.15 vs. 20.0 ± 0.54 mg/100 g FW) and total phenolic content (192.9 ± 3.16 vs. 195.8 ± 3.05 mg gallic acid equivalents/100 g FW) were unaffected by photosensitization, whereas the sugar content of photosensitized strawberry was significantly ($p<0.05$) higher than that of the control (5.29 ± 0.26 vs. 4.12 ± 0.13 g/100 g FW). These preliminary results suggest that photosensitization could be a promising technique that has the potential to be used in the horticulture industry for preservation of strawberry.

A6. Identification of unusual fatty acids from vernix caseosa by photodissociation mass spectrometry

Venkateswara R. Narreddula[1,2], Nathan R. Boase[1], David L. Marshall[2], Berwyck L. J. Poad[2], Adam J. Trevitt[3], Todd W. Mitchell[4,5] and Stephen J. Blanksby[1,2].

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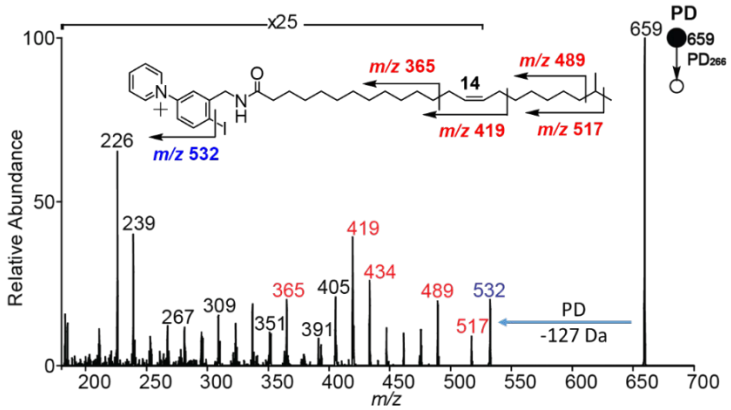
Abstract: Fatty acids (FAs) are fundamental building blocks of complex lipids in living systems which perform a myriad of functions including formation of cell membranes, energy sources and signalling agents. Analysis of FAs from complex lipid extracts is a challenging task because of structural diversity of lipids and interference from other biomolecules. Photodissociation mass spectrometry, using different wavelengths of light, has gained acceptance as an alternative activation tool for structural elucidation of biomolecules (*e.g.*, lipids, proteins). We have recently developed a new derivatization reagent, *N*-(3-aminomethylphenyl-4-iodophenyl)pyridinium (4-I-AMPP$^+$), that incorporates a photolabile aryl-iodine motif and fixed charge.[1] This derivative has been demonstrated to be effective for the detection and structural elucidation of FAs when used in concert with laser photodissociation at 266 nm. In these experiments, targeted liquid chromatography-photodissociation mass spectrometry (LC-PD-MS) of 4-I-AMPP$^+$ derivatives of mixture of 37 FAs produced photodissociation mass spectra with characteristic features assigned to site(s) unsaturation and methyl branching on the hydrocarbon chain. Application of the 4-I-AMPP$^+$ strategy for analysis of FAs from vernix caseosa by LC-PD-MS revealed several unusual isomers of unsaturated and branched chain FAs having hydrocarbon chain length as long as 32 carbons.



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(1) Narreddula, V. R.; Boase, N. R.; Ailuri, R.; Marshall, D. L.; Poad, B. L.; Kelso, M. J.; Trevitt, A. J.; Mitchell, T. W.; Blanksby, S. J., *Analytical Chemistry* **2019**, *91*, 9901-9909.

A7. Are toxic *Pimelea* secondary compounds absorbed via the intestinal lymph?

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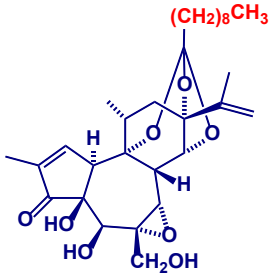
Pimelea poisoning develops in cattle grazing on toxic *Pimelea* species (*P. simplex, P. trichostachya, P. elongata*) that contain the lipophilic toxin simplexin (**1**), which is a potent protein kinase c agonist. Diagnosis is generally made by documenting plant exposure and identifying physiological signs. Attempts have been made previously to measure simplexin in bovine tissues and blood.[1] However the lymphatic system, which has a significant role in absorption and transport of dietary fats and fat soluble compounds, regulating tissue fluid homeostasis and immune cell trafficking has, until now, not been analysed, although previously postulated as the main pathway for absorption of simplexin from the small intestine.[2] Therefore, the detection of simplexin residues in the mesenteric lymph nodes and rumen fluid was the aim of this research. To achieve this, simplexin was extracted from the sample using liquid-liquid partitioning and then analysed using UHPLC-Q-Orbitrap high resolution mass spectrometry. The suitability of this method was further demonstrated by detecting simplexin residues in lymph nodes and rumen fluid samples from recent cases of *Pimelea* poisoning. The analytical method demonstrates that simplexin can be detected in intestinal lymph nodes and rumen fluid of poisoned animals, thereby providing a long-awaited diagnostic test for *Pimelea* poisoning as the cause of animal deaths. Finally, the results contribute to the limited but growing field of research on the lymphatic transport of plant secondary compounds in herbivores. Future work will focus on validating the method in terms of accuracy, precision, limit of quantitation (LOQ) and limit of detection (LOD).



(**1**)

1. Fletcher, M. T.; Chow, S.; Ossedryver, S. M., Effect of increasing low-dose simplexin exposure in cattle consuming Pimelea trichostachya. *J Agric Food Chem* **2014,** *62* (30), 7402-6.
2. Fletcher, M. T.; Ossedryver, S. M.; Chow, K., Effect of the Pimelea Toxin Simplexin on Cattle. In *Poisonous Plants: Toxicology, Ecology, Management, and Medicine*, Zhao, M.; Wierenga, T. L.; Panter, K. E., Eds. ISOPP9,: Hohhot, Inner Mongolia, China, 2015; pp 83-88.

A8. Escaping Bio-Assay Guided Isolation: Nature's Tools for Chemical Biology

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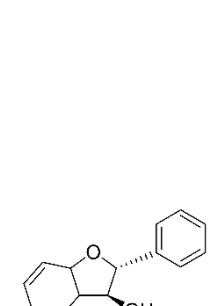
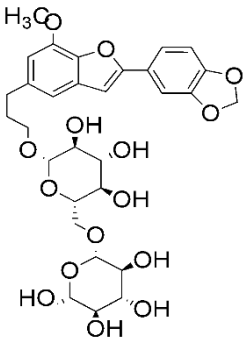
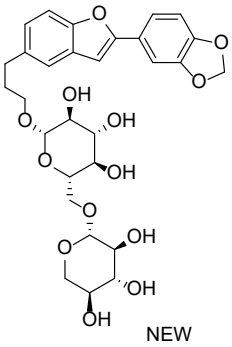
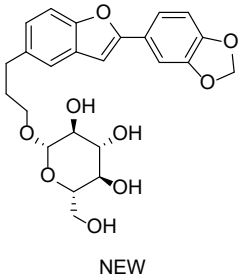
Abstract

The classical bio-assay guided approach is to screen extracts for biological activity and then use an iterative cycle of fractionation/assay/fractionation until the active compound is purified. This is time consuming and structure elucidation occurs once the pure compound is obtained and usually known compounds are re-discovered. As NMR reveals all compounds containing hydrogen and is quantitative, it can be used to guarantee that all compounds within a fraction are isolated. Drug development require cellular activity and identification of the target before a compound can progress. Combining the results of biological and molecular activity in one assay (PhenoTarget assay) is an effective tool for natural products drug discovery. Even though there is weak cellular activity, the specific target was found very quickly. Other methods always give multiple putative targets requiring significant efforts in drug target validation. TB is an infectious disease worldwide, causing death every 25 seconds, and a new drug is urgently needed because of the multi-drug resistance developed by *Mycobacterium tuberculosis*. The approach is being used to analyse the results of a recent HTS against *M. tuberculosis* H37Rv. All pure compounds were tested on *M. smegmatus* and *M. tuberculosis*. Altholactone showed activity at 500 µM (116 µg/mL) against *M. smegmatus* and showed binding affinity to *Mtb* Rv1466-putative uncharacterized protein target at calculated K_D of 41.95 ± 6.12 µM. Also, egonol gentiobioside showed binding affinity to *Mtb* protein target phenylalanyl-tRNA synthetase alpha chain Phes. Fraction of two new compounds showed estimated activity against *M. tuberculosis* at 100 µM and 136 µM.









A9. Anthropogenic chemicals in wastewater and their link to peoples' socioeconomic status

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Various social, economic and demographic factors drive chemical (diet, illicit drug, pharmaceutical) consumption patterns. Traditional survey or biomonitoring methods have limitations in studying these relationships among large numbers of people. Wastewater-based epidemiology is a useful method for measuring chemical consumption and patterns of entire populations. Here, we measured wastewater from 21 populations covering 21.1% of the Australian population during the time of the 2016 census. Liquid chromatography tandem mass spectrometry was used to measure the concentration of various diet, drug and lifestyle biomarkers from wastewater. 42 socioeconomic descriptors (age, socioeconomic status (SES), income, occupation etc) were computed for each population from census data. Correlations between these and the biomarker loads were studied. Atenolol and hydrochlorothiazide were positively correlated with average age in the catchment. Measures of caffeine and a dietary fibre biomarker, enterodiol had a strong positive correlation with SES, while tramadol, atenolol and pregabalin had strong negative correlation with SES. We further discuss how specific sociodemographic descriptors such as education or income level correlate with each biomarker, and discuss their implications. Our study demonstrates that analysis of small molecules in wastewater can be used as a public health assessment tool to understand sociodemographic influences and disparities in chemical consumption patterns.

Choi PM, Tscharke B, Samanipour S, Hall WD, Gartner CE, Mueller JF, Thomas KV and O'Brien JW (2019), Social, economic and demographic correlates of food and chemical consumption as measured by wastewater-based epidemiology, *Proceedings of the National Academy of Science USA*, **116** (43) 21864-21873.

A10. Development and Application of Method to Analyse the Sialylation of the Cells

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Sialyltransferases (STs) catalyse the transfer of sialic acids (sias) to the cell surface and hence participate in key biophysiological processes in human health and diseases, such as cancer. Therefore, ST is a potent therapeutic target in anti-cancer drug development. However, there are currently no easily obtainable or cost-effective ST inhibitor screening assays to measure the effectiveness of proposed inhibitors. This project, therefore, aimed to develop a simple method to determine sias in cells to evaluate the extent of sialylation caused by proposed ST inhibitors.

The most common type of sia in human, N-5-acetylneuraminic acid (Neu5Ac), was successfully detected and quantified via a reverse phase HPLC with triisopropanolamine buffer solution as the ion-pairing reagent. The proposed method resulted in the successful separation of Neu5Ac with the retention time of 6.344min at 0.4mL/min. The method was validated according to the AOAC guideline: R^2=0.999, LOD=0.002487mM, LOQ=0.007537mM, average recovery of 102% from spiking, with 1.99% and 9.44% of average inter-day and intra-day precision.

From the developed method, deoxycholic acid (DOC) – a known ST inhibitor, was added to the HeLa cells to evaluate the extent of sialylation inhibited by DOC against the control (no DOC added). As depicted in Figure 1, the proposed method was able to evaluate the extent that DOC changed the sialylation of the cells, as Neu5Ac level decreased significantly as the concentration of DOC increased.

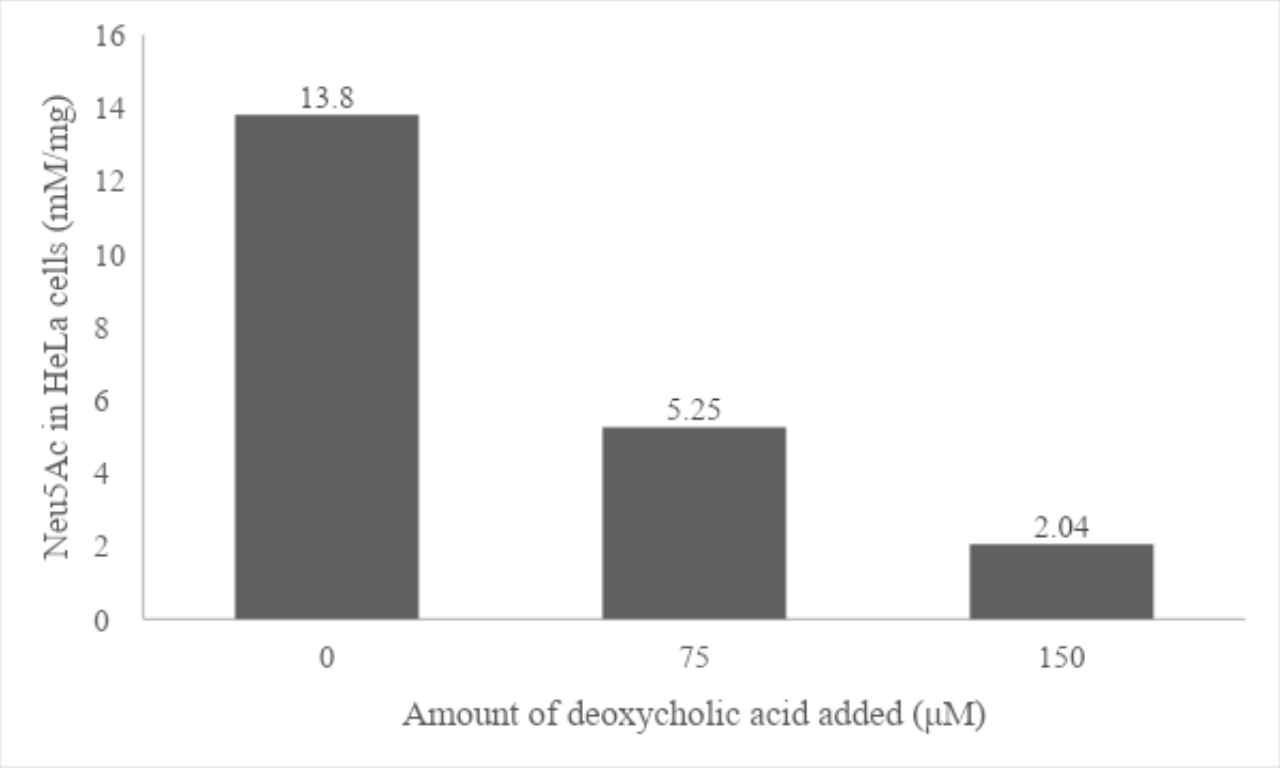

Figure 1. *The changes in Neu5Ac level in Hela cells according to various concentrations of deoxycholic acid (0 µM), 75 µM and 150 µM). The values are mean±SD, n=3. The asterisks indicate the Neu5Ac level for 75 µM and 150 µM was statistically significantly different to the control: * P < 0.05; **P < 0.001.*

References: Wang, L., Liu, Y., Wu, L. and Sun, X. (2016). Sialyltransferase inhibition and recent advances. *Biochimica et Biophysica Acta*, (1864), pp.143-153.

A11. The effect of storage temperature on the accumulation of anthocyanins in different fruit tissues of Queen Garnet Plum

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Anthocyanins are a group of naturally occurring flavonoids which are responsible for the dark-red to blue-purple colour in plants. They have been associated with various health attributes, including diabetes control, cardiovascular disease prevention and anti-inflammatory activity. The aim of this study was to determine the effect of storage temperature and time on the accumulation of anthocyanins in different tissues of Queen Garnet Plum (QGP) including the peel, outer flesh (OF) and inner flesh (IF). Anthocyanins were determined by ultra-high-performance liquid chromatography with diode array detection (UHPLC-DAD). The main anthocyanins identified in QGP were cyanidin-3-glucoside (Cy3G) and cyanidin-3-rutinoside (Cy3R). It was evident that the peel had the highest total anthocyanin content (TAC) followed by OF, and then IF. The highest TAC was observed in the peel after 10 days of storage at 23 °C, which was three times the initial concentration (increase from 418 to 1251 mg/100 g FW). A significant ($p<0.05$) increase of TAC was observed in all tissues during storage, except in the IF of fruit stored at 4 °C. Interestingly, a variation was observed in the percentage (ratio) of individual anthocyanins in the different tissues. Specifically, the percentage of Cy3G increased in all the tissues, except in OF at 4 °C. The results of the storage study demonstrate that storage temperature and time can significantly increase individual and total anthocyanin content of all fruit tissues in QGP.

A12. Nutritional profile and phytochemical characteristics of Australian grown Samphire (*Tecticornia sp*.)

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Strong evidence from recent studies indicates that plant-based diets show beneficial effects against diabetes, heart disease and obesity. Wild edible plants, in particular, are reported as having significant biological activities that are most likely attributed to their phytochemicals. Samphire (*Tecticornia sp*) is a wild plant from the same family as spinach but grows in arid and semi-arid regions. Most of the samphire species are well known for food and non-food uses among indigenous people of Australia, while scientific information is limited on their nutritional composition and potential bioactivities. This study systematically evaluated the nutritional composition, main bioactive compounds (phytochemicals) and antioxidant capacity of six Australian grown samphire from different locations and baby spinach as a "control"/comparison. State-of-the-art UHPLC-MS/MS technique was used for the analysis of phytochemicals, with Celosianin II being identified as the predominant phytochemical in samphire 2 and 4. There were only slight differences in the proximate composition, whereas a significant (p<0.05) difference could be observed in the fibre content (26.4 ± 0.22 (samphire 5) to 46.8 ± 0.14 (samphire 6) g/100 g DW).The results of total phenolic content (TPC) showed that all seven samples had different values, with samphire 2 having the highest (p< 0.05) TPC and also the highest (p<0.05) DPPH radical scavenging capacity. The high fibre content and antioxidant capacity in the analysed samphire samples are promsing initial results. However, further studies need to be carried out to determine the complete nutritional profiles and potential bioactivity of the different samphire species before commercial application.

A13. Isolation of novel compounds using combination of NOMETA and GNPS molecular networking approaches

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Nitric Oxide Mediated Transcriptional Activation (NOMETA) is a novel technique to activate otherwise silent biosynthetic gene clusters (BGC) to produce new natural products. We implemented an innovative approach for the exogenous delivery of NO to microbial cultures. The approach involves the addition of the cheap, commercially available vintage blood pressure vasodilator drug, sodium nitroprusside (SNP) [$Na_2Fe(CN)_5NO.2H_2O$], to deliver up to 5 days sustained NO pulse. This technique was applied to Australian termite nest derived microbes (·20) by culturing microbes in micro bioreactor under ·11 different media conditions, in broth shaken, broth static and solid phase modes in the presence and absence of SNP. The resulted extracts were subjected to 6545 UPLC-QTOF mass spectrometer, capable of interrogating MATRIX and NOMETA experiments, with data analysis by Global Natural Products Social Networking (GNPS) dereplication function. GNPS is a molecular network that allows the visual display of the chemical space present in tandem mass spectrometry (MS/MS) experiments.

Chemical investigation of the crude extract from Australian termite nest derived fungi, CMB-TN6F revealed the production of new natural products only in the presence of SNP in M1 media broth shaken condition, while CMB-TN39F revealed the same chemistry without any specific activation. Large scale cultivation of CMB-TN39F followed by isolation and chemical characterization yielded three compounds that belongs to a rare class of terpene glycosides. Structure elucidation of the new natural products is still in progress.

A14. Pushing the Limits of Single Chain Compaction Analysis by Observing the Stepwise Size Reduction via Mass Spectrometry Coupled to Size Exclusion Chromatography

***Tobias Nitsche*[1], Jan Steinkoenig[1,2], Fabian R. Bloesser[1], James Blinco*[1] , Stephen Blanksby*[1] and Christopher Barner-Kowollik*[1,2].**

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Single chain nanoparticles (SCNP) have attracted considerable interest for a wide range of applications associated with their adjustable morphology. While mass spectrometry is an essential tool for the characterization of polymeric materials, it is fundamentally challenged in making direct observations of morphological changes in SCNPs. Herein, we introduce a new approach based on the hyphenation of size-exclusion chromatography with high resolution mass spectrometry to selectively follow the size reduction of discrete polymer chains that have uniform elemental composition and thus molecular mass.[1] We employ a polystyrene backbone functionalized with tetrazole and fumarate moieties in order to utilize the nitrile imine-mediated tetrazole-ene cycloaddition (NITEC) as the compaction reaction. Since every compaction step is accompanied by a loss of one nitrogen molecule, it can be traced via high-resolution electrospray ionisation mass spectrometry. The hyphenation with size exclusion chromatography enables the direct correlation of changes in mass (triggered by loss of nitrogen) with changes in morphology arising from NITEC cross-links (Figure 1). By establishing a calibration between the retention time and the hydrodynamic radius, extracted ion chromatograms (XICs) can be directly utilized to determine the reduction in hydrodynamic radius associated with each cross-linking event. The optimisation of this technology underpins the development of new SCNPs for different applications.

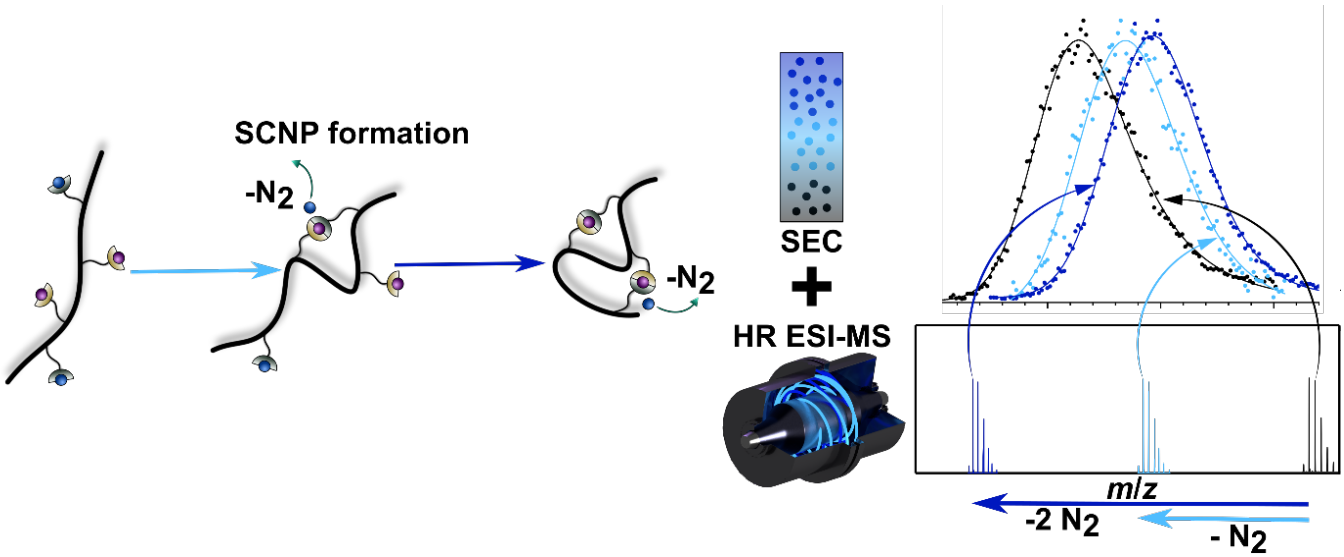

Figure 1. Schematic depiction of the hyphenation of size exclusion chromatography with high resolution electrospray ionisation mass spectrometry giving access to the elution behaviour of discrete polymer chains with a defined number of crosslinks.

[1]T. Nitsche, J. Steinkoenig, K. De Bruycker, F. R. Bloesser, S. J. Blanksby, J. P. Blinco, C. Barner-Kowollik, *Macromolecules* **2019**, *51*, 3967-3974

A15. Developing a large-volume Injection method for analysis of anabasine and anatabine in wastewater by LC-MS/MS

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Anabasine (ANBA) and anatabine (ANTA) are present in high concentrations in tobacco products compared to fruit and vegetables, therefore ANBA and ANTA are identified as specific tobacco biomarkers in wastewater reflecting tobacco consumption at the population. In previous studies that analysed ANBA and ANTA in wastewater, solid phase extraction (SPE) is required as a sample pre-treatment for concentrate and clean-up from wastewater matrix and LC-MS/MS is used in analysis. The aim of this study was to develop a simplified, rapid method based on Large-Volume Injection LC-MS/MS (LVI-LC-MS/MS) to analyse of ANBA and ANTA in wastewater. The optimized method was achieved by filtering wastewater through a pre-conditioned SPE cartridge (Oasis HLB 30 mg) before injection 50 µL into LC-MS/MS. The method was validated by relative matrix effect and quality control at three spiking levels (20, 50 and 100 ng/L) and procedural blank samples (Figure 1). 30 daily influent wastewater samples were analysed with ANBA ranging from 20.1 to 35.4 ng/L and 45.9 to 79.6 ng/L for ANTA. ANBA showed a positive correction with cotinine (r= 0.41, p<0.05) and nicotine (r= 0.40, p<0.05) concentration in wastewater by person correlation coefficients (Table 1). The study presents the application of LVI-LC-MS/MS in ANTA and ANBA in wastewater matrix and identified these two tobacco alkaloids be specific biomarker in estimation of tobacco consumption by wastewater analysis.

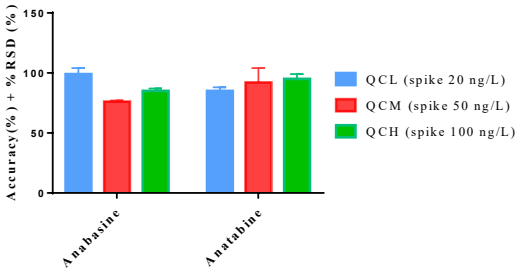

Figure 1. Accuracy and precision of 3 spiking level in wastewater matrix.

Table 1. The Pearson correlation matrix between tobacco alkaloids

	ANTA	Cotinine	Nicotine	ANBA
ANTA				
Cotinine	0.15			
Nicotine	0.17	0.67**		
ANBA	0.30	0.41*	0.39*	

*Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at the 0.01 level (2-tailed)

A16. Discovery of novel DNA gyrase targeted antimicrobial leads by structure-based virtual screening

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Antibiotics were considered "Super Drugs" when first discovered in the 20th century. Since then, they have been used as first-line treatments for many bacterial infections. However, over the years, bacteria have developed resistance to antimicrobial agents, thereby making treatment of antibiotic-resistant bacterial infections difficult. DNA gyrase is a type IIA topoisomerase, which catalyses changes in DNA during replication by introducing negative supercoils and, hence, is a well validated drug target for antibacterial drug discovery. Currently, fluoroquinolones classes of antibiotics act by inhibiting bacterial DNA gyrase. However, the fluoroquinolone class of antibiotics is primarily used for Gram-negative bacterial infections as the activity against Gram-positive bacteria is limited.

Computer-aided drug design has emerged as an important tool for drug discovery within the last decade. Therefore, in the proposed work, we utilised a structure-based virtual screening approach (SBVS) to identify novel DNA gyrase inhibitors. In the SBVS study, the CoCoCo database containing seven million molecules was subjected to an *in-silico* docking-based virtual screening workflow against DNA gyrase (Protein Data Bank entry: 2XCR). From the virtual screening work, 38 molecules were selected and evaluated for their antimicrobial activity. Of these, four non-fluoroquinolone class of compounds were shown to elicit a minimum inhibitory concentration value between 0.5-8 μg/mL against eight strains of bacteria including two clinical isolates of MRSA. In future, all four lead compounds will be tested for their DNA gyrase inhibitory potential and used as a basis to develop DNA gyrase targeted antibiotics.

A17. Identification and quantification of selected plastics in biosolids by pressurized liquid extraction combined with double-shot pyrolysis gas chromatography-mass spectrometry

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Abstract
The extent and scope of how plastics may be introduced into soil systems is not fully understood, however it has been recognised worldwide that they can be introduced into soils through the practice of applying biosolids (treated sludge) to agricultural land. Plastics entering the soil environment through the land application of biosolids have aroused increasing concern as they pose potential threats to soil organisms and health. Although studies have tried to quantify plastics in biosolids, samples usually suffer from an extensive clean-up process to remove organic materials before plastic particles are separated, counted and identified using spectroscopic techniques such as Raman and Fourier-transform infrared spectroscopy. These techniques are size dependent and in many cases are not able to detect nano-sized plastics leading to underestimation.

In this study we tested the potential of using a pressurized liquid extraction (PLE) technique to extract seven commonly used polymers (PS, PC, PMMA, PP, PET, PE and PVC) in biosolid samples regardless of the size of the particles, without pre-treatment. The resulting extracts were analysed using a double-shot pyrolysis gas chromatography - mass spectrometry (Pyr-GC/MS) for plastics identification and mass related quantifications. The results of this work demonstrate that PLE extraction technique combined with Pyr-GC/MS is a suitable method for the identification and quantification of plastics in environmental samples. The use of the double-shot feature of the Pyr-GC/MS allows for the effective thermal desorption of interfering compounds that were co-extracted from biosolids with PLE, reducing processing time and the necessity to pre-treat environmental samples before accurate analysis of the selected polymers. The method allows for replicate samples to be analysed and for extracts to be diluted based on the load of plastics. It is suggested that the combined method can be considered as a rapid extraction and analysis method for polymer identification and quantification.

Keywords: Plastics, pressurized liquid extraction, Pyr GC-MS, biosolids

A18. Design, Synthesis and Biological Evaluation of Novel Simplified Muraymycins Analogues

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Bacterial resistance against clinically used antibiotics is an emerging health concern in contemporary healthcare.[1] The suggested long-term solution to tackle the globally prevalent multidrug resistance is to explore new classes of antibiotics.[2] Bacterial cell-wall peptidoglycan layer biosynthesis has been promising antibacterial target for decades since the discovery of clinically useful β-lactam (penicillin) and glycopeptide (vancomycin) classes of antibiotics.[3] However, current cell wall inhibitors target the late extracellular steps of peptidoglycan synthesis. The early intracellular steps of peptidoglycan synthesis are not well explored clinically, therefore provide an exciting opportunity to explore the current need for novel targets.[4] The transmembrane enzyme MraY (phospho-*N*-acetylmuramoyl-pentapeptide-transferase) is one such intracellular enzyme, which fulfils the requirement of a novel target.[5] MraY catalyses the first membrane-associated step of peptidoglycan formation which involves transfer of an UDP-*N*-acetylmuramoyl (UDP-MurNAc) pentapeptide (-L-Ala_1-D-γ-Glu_2-Lys/DAP_3-D-Ala_4-D-Ala_5-COOH) (Park's nucleotide) to the membrane-soluble C_{55} isoprenoid carrier lipid known as bactoprenol-phosphate (bactoprenol-P), resulting in the formation of lipid I (undecaprenyl-pyrophosphoryl-MurNAc-pentapeptide).[6]

MraY enzyme (translocase I) is the target of nucleoside antibiotics, class of natural products containing a nucleoside core structure.[7] The muraymycins, belongs to the family of ribosamino-uridines class of nucleoside antibiotics, were first discovered as promising structures acting against MraY enzyme in year 2002.[8] Though naturally occurring muraymycins quenched the contemporary need of novel structures acting against clinically unexplored target MraY, the challenge faced, to move forward in drug discovery, was their complex and synthetically challenging structures. To address this issue, we are investigating a bioactive, structurally simplified muraymycin analogues acting against a range of bacterial strains.

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A19. Rational design, synthesis and biological evaluation of galectin-8*N* antagonists

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Galectin-8 is a β-galactoside recognising protein that contains two carbohydrate recognition domains (*N* and *C*-CRD) in tandem, linked by a variable length amino acid linker.[1] Galectin-8 plays an important role in rheumatic, autoimmune and inflammatory disorder.[2, 3] Recently, it was found as a potential target for osteoporosis.[4] High binding affinity of galectin-8 with anionic oligosachharides is probably due to its *N*-terminal carbohydrate binding site.[5] The X-ray crystallography study explains that the high affinity with galectin-8*N* is due to presence of unique amino acid residue Arg59, which is present on unique S3-S4 loop. Monosaccharide galactose-based compounds have been designed, synthesized, evaluated for *in vitro* binding affinity by isothermal titration calorimetry and analysed ability to inhibit gene transcription in cell culture study.

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A20. Metal and metal oxide based nanomaterials for advanced diagnosis and treatment of cardiovascular diseases

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Here we report innovative nanotechnology approaches for advanced and reliable diagnosis and treatment of cardiovascular disease (CVD) such as thrombosis and atherosclerosis. The central aim of the project is to develop novel targeted contrast agents with improved functionality and efficacy based on well-known non- or low toxic materials and materials approved by FDA, which enables easy translation to clinical use. We have developed targeted dual positive/negative contrast agents for molecular imaging of atherothrombosis. The simultaneous use of positive and negative MRI imaging that employs the same contrast agents will significantly improve the detection accuracy. Using these dual contrast agent, both T1- and T2-weighted MRI of thrombosis can be recorded simultaneously which enables self-confirmation of images and leads to a greater diagnostic accuracy. We have also developed smart MRI nano-sensors that can not only detect, but also sense and report the stage or progression of CVD such as thrombosis. The accurate characterization of life-threatening diseases such as thrombosis is critical to the design of treatment. Knowing whether a thrombus in a blood vessel is new/fresh or old/constituted is very important for physicians to decide a treatment protocol. Theranostic nanoparticles based on iron oxide and cerium oxide have also been developed in our group as potential materials for diagnosis and treatment of reactive oxygen species related inflammatory diseases such as CVD. Another class of theranostic nanoparticles based on iron oxide and gold/silver with NIR absorption has also been synthesised as a potential material for the simultaneous detection and treatment of thrombosis.

A21. Bisubstrate analogue as inhibitor probes to study *O*-GlcNAc transferase (OGT)

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Human O-linked β-N-acetylglucosamine transferase (O-GlcNAc transferase, OGT) catalyses the transfer of β-N-acetylglucosamine (GlcNAc) from a uridine diphosphate N-acetylglucosamine (UDP-GlcNAc) donor to specific serine and threonine residues of cytoplasmic, mitochondrial and nuclear proteins[1]. The regulation of OGT, how OGT recognises modification sites and the mechanism of OGT catalysis is still an open question[2]. The emerging roles of OGT in fundamental cellular processes as well as diseases[3] including for example cancer make tools that can perturb the OGT function of considerable interest[4-6]. The present work focuses on the design and synthesis of carbohydrate- peptide conjugates as OGT inhibitors following bisubstrate inhibitor concept. Bisubstrate analogues, in which donor and acceptor analogue are covalently attached to each other, offer donor's high affinity and acceptor's high selectivity.

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B1. Bioactive compounds and functional properties

of *Pittosporum angustifolium* (Gumby Gumby), an Australian native plant

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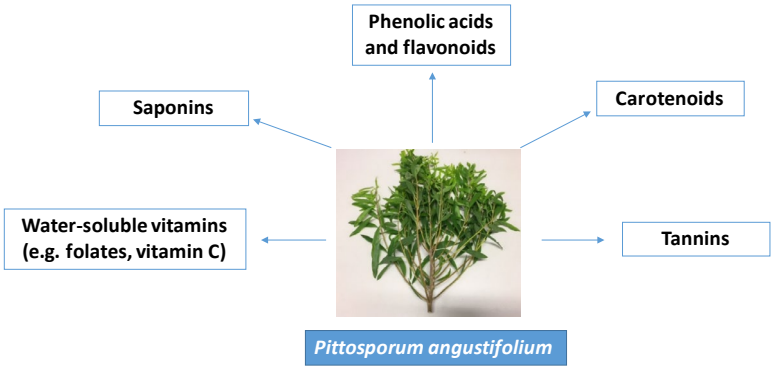
The traditional indigenous medicinal plant *Pittosporum angustifolium* (commonly known as Gumby Gumby) has received attention for therapeutical and pharmaceutical applications in Australia. The present study investigated the predominant bioactive compounds and their related bioactivities in different botanical tissues of *P. angustifolium*, collected from the wild and cultivation in Queensland and South Australia.

State-of-the-art UHPLC-MS/MS with a high resolution Q Exactive™ Quadrupole-Orbitrap or a triple quadrupole mass spectrometry was employed for identification and quantification of untargeted and targeted bioactive compounds in *P. angustifolium*.

The results showed that *P. angustifolium* contains a diverse spectrum of bioactive compounds, including polyphenols, saponins, tannins, carotenoids, and water-soluble vitamins. Among them, saponins and polyphenols were present at relatively high levels of up to 4% per dry weight. Individual phenolic compounds and carotenoids were identified and quantified, with carotenoid constituents being reported for the first time in *P. angustifolium*. The leaves contained significantly ($p<0.05$) higher levels of tested bioactive compounds compared to the stem. However, there was no significant ($p>0.05$) difference in the bioactive compounds between the wild and cultivated varieties, whereas different growing locations showed significant ($p<0.05$) effects. Extracts of *P. angustifolium* exhibited strong antioxidant and antimicrobial activity, especially against the fungi *Candida albicans*.

The present study provides important information on the bioactive compounds in *P. angustifolium,* the antioxidant capacity and antimicrobial activity against important microorganisms that are responsible for food poisoning and infection. Further studies are warranted to investigate the safety and bioaccessibility/bioavailability of its bioactive compounds in *in vitro* digestive models and also *in vivo* human studies.



B2. Structurally different anthocyanidin-glycosides and their metabolic fate *in vivo*

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Anthocyanidin-glycosides or anthocyanins are plant pigments and dietary phytochemicals, and may have potential health benefits. There is emerging evidence from epidemiological and experimental studies that suggests a higher consumption of anthocyanin-rich foods is associated with a reduced risk of heart disease and diabetes. To better understand the observed beneficial effects of anthocyanins and their underlying mode of action, bioavailability and metabolic fate needs to be studied in more detail. Healthy human subjects (10–12 in two different studies) received red grape pomace (700 mg anthocyanins/mainly as malvidin-3-glucoside) or Queen Garnet plum (QGP) juice (426 mg anthocyanins/mainly as cyanidin-3-glucoside) and an anthocyanin-free control in a randomised crossover design. Malvidin- and cyanidin-glycosides are common in many fruits and beverages such as red grapes, red grape juice, red wine, blueberry, cherry, elderberry, (Japanese) plum and are therefore of dietary significance. 24-hr urine samples were collected and analysed for intact anthocyanins and metabolites by UHPLC-PDA-MS. Methylated, glucuronidated and sulphated anthocyanins could be identified as characteristic metabolites in both studies. Furthermore, the increase in urinary hippuric acid (microbial/hepatic metabolite) was considerable in both studies after the consumption of red grape pomace or QGP juice (1.8–4.5-fold vs. control; $p<0.05$). These findings suggest that structurally different anthocyanins are exposed to a similar extensive metabolism by enzymes and the gut microbiome and that the generated metabolites are most likely the bioactive compounds *in vivo*. Therefore, more human studies are warranted to investigate the metabolic fate of dietary anthocyanins and the bioactivity of generated metabolites.

B3. Optimisation of extraction and saponification for the determination of free- and bound-carotenoids in orange capsicum and avocado

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Carotenoids are a class of fat-soluble compounds widely associated with natural yellow-to-red pigments of fruit and vegetables. A number of carotenoids are well known for providing potential health benefits to humans. Carotenoids exist in many fruit and vegetables both in the free form, and as esterified forms with fatty acids, to increase their lipophilic nature and colour capacity. Esterification of carotenoids, such is common in capsicums/chillies, and high oil content, such is found in avocadoes, are common analytical-technical problems for carotenoid profiling and quantification.

The present study optimised carotenoid extraction and saponification procedures for accurately determining the carotenoid content of avocado and capsicum/chilli fruit using ultra-high-performance liquid chromatography coupled with diode array detection and a triple quadrupole mass spectrometer or a high resolution Q Exactive™ Quardupole-Orbitrap (UHPLC-DAD-MS/MS). The combination of four solvents (hexane, dichloromethane, ethanol and water) was used to efficiently extract carotenoids from these complex plant matrices.

Using the optimised methodology, more than 30 carotenoid compounds were identified. Among them, lutein (free and esterified) was the predominant carotenoid in orange 'Bulgarian' Chili Pepper (44.6%), whilst zeaxanthin (free and esterified) was the major carotenoid in 'Orange Bell' capsicum (75% of total carotenoids). Lutein and its ester forms were determined to comprise the majority of carotenoids in avocadoes. Carotenoid concentration (mainly zeaxanthin) in the 'Orange belle' capsicum was over 100 mg/100g DW, while the carotenoid concentration of avocado was much lower, with less than 10mg lutein equivalents /100g DW.

B4. Dynamic NMR studies and conformational analyses inform stereochemical analysis of dendrillane terpenes from the nudibranch Goniobranchus coi

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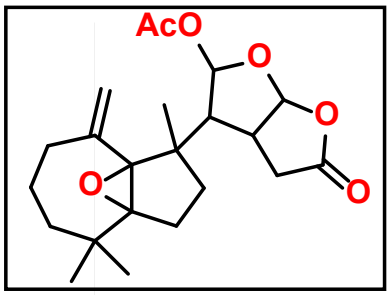
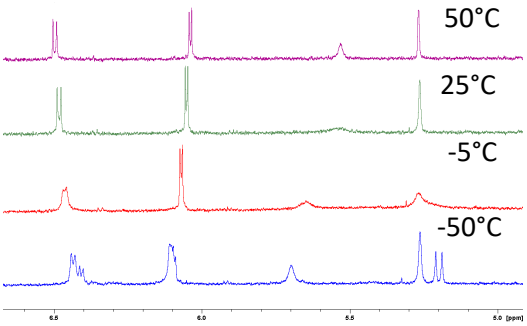
An individual *Goniobranchus coi* specimen collected from Mooloolaba, Australia, was found to contain an array of secondary metabolites. In addition to ten known rearranged oxygenated diterpenes, a series of keto- and epoxy-functionalised norditerpenes were isolated. The investigation was complicated by the conformational behaviour of the metabolites which resulted in broadened signals in both ^{1}H and ^{13}C NMR spectra.[1,2] The carbon framework and relative configurations were explored by decoupling and variable temperature NMR experiments at 700 MHz, informed by molecular modelling, DFT calculations and coupling constant predictions.[3,4] A dynamic NMR study on the bridgehead epoxide (**1**) addressed whether restricted rotation about the penta-substituted C-8/C-14 bond or a conformational change in the cycloheptane ring[5] was the major contributor to the conformational averaging effects.



Goniobranchus coi



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B5. Fish-derived fungi as new sources for new, rare and bioactive metabolites

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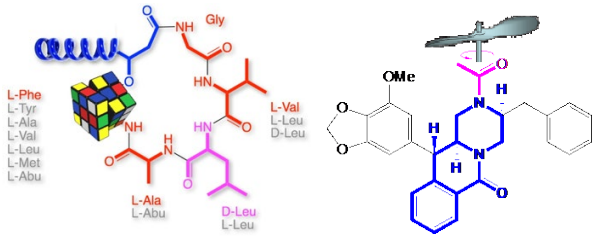
As part of our ongoing investigation into secondary metabolites from Australian marine-derived fungi, we speculated that bottom feeding fish species may act as natural myco-accumulators, and as such could be a readily accessible source of marine-derived fungi, rich in new chemistry. We previously reported on the discovery of a rare class of hydrazine containing furano Schiff bases, prolinimines A–D, from the marine fish gut-derived *Trichoderma* sp. CMB-F563.[1] Building on this achievement, we investigated the chemical profiles of the fish gut microbiome revealing promising case studies from fungi, that have the potential to produce rare chemistry. The first case study relies on a comparative global natural product social (GNPS) molecular networking analysis of ×63 co-isolated fungi, guided the isolation and identification of new lipodepsipeptides, scopularides C–H, from *Scopulariopsis* spp. CMB-F458 and CMB-F115, and *Beauveria* sp. CMB-F585 with structures inclusive of absolute configurations were assigned by detailed spectroscopic and C_3 Marfey's analysis, together with X-ray analyses and biosynthetic considerations.[2] The second case study describes the new piperazines, chrysosporazines A–E, from the fungus *Chrysosporium* sp. CMB-F214 with structures assigned by spectroscopic and X-ray analyses, and biosynthetic considerations. The chrysosporazines exist as an equilibrium of major and minor *N*-acyl rotamers, and incorporate an unprecedented hexahydro-6*H*-pyrazino[1,2-*b*]isoquinolin-6-one scaffold. The non-cytotoxic chrysosporazines reverse doxorubicin drug resistance in P-glycoprotein over-expressing colon carcinoma cells (SW620 Ad300), delivering a comparable gain in sensitivity to the positive control verapamil.[3]



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B6. Folate in strawberry and avocado – profile, distribution and total content

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Folate, an important B-group vitamin, is considered a critical vitamin in many countries, with folate deficiency being associated with neural tube defects in newborns. Strawberries and avocados are considered a healthy, tasty snack by many consumers, and may potentially be an important dietary source of natural folates, depending on variety and growing environment. A selection of Australian grown strawberry varieties and breeding lines, as well as commercial avocado cultivars, were screened for their folate content and vitamer profile by stable isotope dilution assay (SIDA). Total folate content ranged from 57-170 µg/100 g fresh weight (fw) for strawberries and 76-196 µg/100 g fw for avocados, which was well above the values in the Australian Food Composition Database (39 µg/100 g fw for strawberries and 90 µg/100 g fw for avocados, respectively). Furthermore, folate concentration in the outer strawberry tissue was found to be 1.7-fold higher than the inner tissue of the fruit, whereas the inner avocado tissue had 1.4-fold higher folate than the outer green edible tissue. 5-Methyltetrahydrofolate, the biologically active form in humans, was the principal vitamer present. With these high folate concentrations, a punnet (250 g) of Australian-grown strawberries or 200 g of Australian-grown avocados would deliver the 'Recommended Dietary Intake' (RDI) for folate (400 µg dietary folate equivalents/day/adult). Furthermore, the differences between outer and inner tissue could indicate that flatter, longer strawberries may have greater potential to accumulate folate than fruit with a more spherical shape, whereas more folate could be accumulated in a rounder-shaped avocado.

B7. ***In vitro*** **inhibitory evaluation of novel amine and amide compounds against the post-translational modifier enzyme, ARTD8.**

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The metabolic adaptations that arise in late-stage cancers make it increasingly difficult for chemotherapeutical treatments to compete with the heightened growth rate of these mutated cells. One strategy to address this adaptation in metabolism is to target the post-translational modifier enzyme, diphtheria toxin like ADP-ribosyl transferase member 8 (ARTD8). ARTD8 has been noted to influence key enzymes within the PI3K/Akt/mTOR pathway, hyperactivate PKM2, along with assisting in the repair of double stranded DNA breaks. Both *in vitro* and *in vivo* models have shown ARTD8 as a suppressor of cancer cell growth rate. Thus, this project seeks to design a selective inhibitor against ARTD8, in aims to further understand ARTD8's role in metastasis.

Nine novel amine and amide-based compounds were designed according to their likely interactions with the ARTD8 catalytic domain (3SMI.pdb) and docked using Autodock Vina to determine the computational binding affinity. All compounds were synthesized via reductive amination, and structurally confirmed prior to a comparative luminescence assay, evaluating their relative inhibitory activity against ARTD1 and ARTD8.

Compound **1** was the most selective towards ARTD8, reducing the enzymes activity to 36% ± 6% of the positive control, compared to 78% ± 2% for ARTD1 (Figure 1). This agreed with that predicted computationally. Compound **3** had the most significant inhibitory effect on ARTD8 *in vitro,* reductive the activity to only 27% ± 2% of the positive control. In conclusion, these compounds provide an informed basis for further design of ARTD8 selective inhibitors.

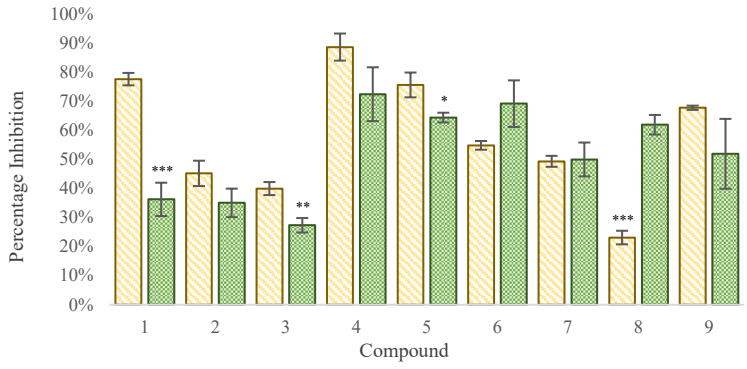

Figure 1: Percentage inhibition of inhibitor-lead molecules assessed in a library screen against recombinant ARTD1 (2.5 ng/μL, purple) and ARTD8 (10 ng/μL, orange) enzyme activity (100% = positive control, 0% = blank). Inhibitor applied at 0.1 mM (final 0.01 mM of total assay well). Luminescence values were adjusted to the blank sample and shown as a percentage of the positive control. (n = 3, ± SEM). Significance is displayed on results where the compound is significantly more effective at reducing the activity of one enzyme over the other. P-value established at <0.05 = *, <0.01 = **; < 0.0001 = ***.

B8. Palladium-catalysed transfer hydrogenation of guaiacol: effect of alternative hydrocarbons as hydrogen sources

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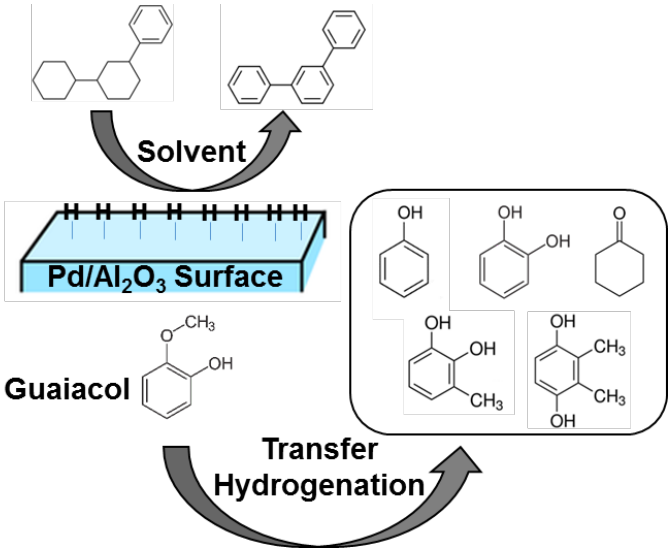
The valorisation of lignocellulosic feedstock often involves hydrogenation to remove excess oxygen. Since this typically requires harsh conditions - high pressure and temperature, leading to high capital investment and lower selectivity - catalytic transfer hydrogenation (CTH) has attracted attention as an alternative process [1]. Replacing molecular H_2 with a suitable donor molecule allows the reaction to proceed under milder conditions [2].

Isopropanol has been proposed as a suitable hydrogen donor. However, the typical reaction conditions still require temperatures that are higher than its boiling point (b.p. = 83°C), leading to increased pressures [3]. In this work, guaiacol was chosen as a model to represent lignin-based phenolic compounds, with hydrogenation taking place over a palladium catalyst (Pd/γ-Al_2O_3). Four alternate hydrocarbons were evaluated as hydrogen donor candidates: 3-phenylbicyclohexyl (b.p. = 360°C), cyclohexylbenzene (b.p. = 240°C), bicyclohexyl (b.p. = 227°C), and tetralin (b.p. = 207°C). The ultimate goal is to hydrogenate biomass derivatives under low to moderate solvent pressures. The overall hydrogenation performance of the different solvents was compared in terms of guaiacol conversion and product selectivity, at 320°C in a batch reactor.



Scheme for guaiacol CTH using 3-phenylbicyclohexyl as H-donor solvent.

The different solvents delivered the following guaiacol conversions: bicyclohexyl (83%) > tetralin (66%) > 3-phenylbicyclohexyl (60%) > cyclohexylbenzene (47%). Guaiacol was successfully hydrogenated into cyclohexanone and phenol and underwent transalkylation to catechol, methylcatechol and dimethylhydroquinone. The prospects for the solvents introduced herein as substitutes for alcohols in CTH are favourable, due to high conversions at lower operating pressures.

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B9. Exploring the potential of endophytes and fungi as sources of antibacterial compounds

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Microorganisms are one of the most important resources for providing prolific active natural products and drug leads, including clinically used drugs such as streptomycin, cycloserine, kanamycin, caperomycin and rifampicin. Here,

1) Genome- and MS-based mining methods were used to study the secondary metabolites of the phytopathogenic fungus *Bipolaris sorokiniana* strain 11134. Forty-six biosynthetic gene clusters were predicted, including PKS, NRPS, and TPS. Chlorinated chromones and meroterpenoids were identified and the antibacterial activity was evaluated.

2) Bioassay guided isolation was also used for chemical study of active endophytic and fungal extracts. High throughput screening against *M. smegmatis* gave 21 fungal and 7 endophytic extracts out of a total of 350 extracts with MIC value less than 400 µg/mL. Fifty compounds have been isolated, including 9 active compounds.

3) Based on both the activity data and chemical analysis, nine active strains were selected for co-cultivation to mimic the natural ecological situation. Preliminary results showed that the chemical profile of 17 out of 218 co-cultured extracts significantly changed during the interaction. These biological data and chemical profiles lay the foundation for all further potential new compounds study.

B10. Hydroxyl substituted benzoic acid/cinnamic acid derivatives as potent tyrosinase inhibitors: bio-evaluation.

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Abstract

The inhibition of tyrosinase is an established strategy for treating hyperpigmentation. Our previous findings demonstrated that cinnamic acid and benzoic acid scaffolds can be effective tyrosinase inhibitors with low toxicity. The hydroxyl substituted benzoic and cinnamic acid moieties of these precursors were incorporated into new chemotypes that displayed *in vitro* inhibitory effect against mushroom tyrosinase. The most active compound, (2-(3-methoxyphenoxy)-2-oxoethyl (E)-3-(4-hydroxyphenyl) acrylate) **6c**, inhibited tyrosinase with an IC_{50} of 5.7 µM, while (2-(3-methoxyphenoxy)-2-oxoethyl 2, 4-dihydroxybenzoate) **4d** had an IC_{50} of 23.8 µM. In comparison, the positive control, kojic acid showed tyrosinase inhibition with an IC_{50} =16.7 µM. Analysis of enzyme kinetics revealed that **6c** and **4d** displayed noncompetitive reversible inhibition of the second tyrosinase enzymatic reaction with K_i values of 11 µM and 130 µM respectively. *In silico* docking studies with mushroom tyrosinase (PDB ID 2Y9X) predicted possible binding modes in the catalytic site for these active compounds. The phenolic *para*-hydroxy group of the most active compound **6c** is predicted to interact with the catalytic site Cu^{++} ion. The methoxy part of this compound is predicted to form a hydrogen bond with Arg 268. Compound **6c** had no observable toxic effects on cell morphology or cell viability at the highest tested concentration of 91.4 µM. When dosed at 91.4 µM onto B16F10 melanoma cells *in vitro* **6c** showed anti-melanogenic effects equivalent to kojic acid at 880 µM. **6c** displayed no PAINS (pan-assay interference compounds) alerts. Our results show that compound **6c** is a more potent tyrosinase inhibitor than kojic acid and is a candidate for further development. Our exposition of the details of the interactions between **6c** and the catalytic pocket of tyrosinase provides a basis for rational design of additional potent inhibitors of tyrosinase, built on the cinnamic acid scaffold

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B11. Optimisation of Free Energy Calculations for use in Structure-based Drug Design

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Despite a rigorous theoretical framework and the potential for high accuracy calculations, free energy perturbation or integration methods have not found routine use in structure-based drug design. One of the main challenges is transferring methodology optimized for small, generally rigid ligands carrying a single charged group to that of larger (> 40 atoms) flexible systems containing a range of diverse chemical moieties. The type of molecules increasingly of interest in structure-based drug design. This is further complicated by the desire to develop automated high throughput protocols that can efficiently exploit advances in hardware. In this work the suitability of a range of protocols involving single and dual topologies, various soft core potentials and different ways to combine ligands have been compared exploiting a series of molecules used to validate the OPLS[1], GAFF[2] and ATB[3] force fields.

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B12. Design, Synthesis, and Evaluation of Potential Inhibitors for PARP1 and PARP14

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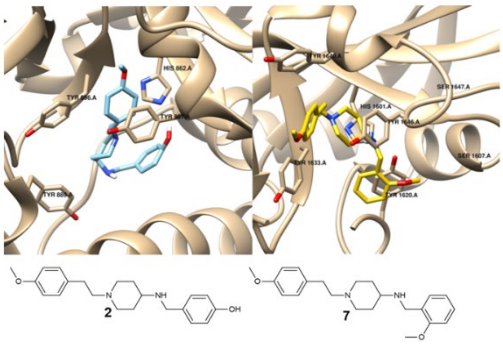
Poly(ADP-ribose)polymerase (PARP) members PARP1 and PARP14 belong to an 18 membered superfamily of post-translational modifying enzymes, all of which share a highly conserved catalytic domain. PARP1 and PARP14 have been identified as molecular targets in cancer treatment. However, there are currently no selective PARP1 or selective PARP14 inhibitors on the market. A small library of nine novel, non-NAD analogue amine compounds were designed, synthesised and evaluated for inhibitory activity against the poly(ADP-ribose) polymerases PARP1 and PARP14. All compounds were evaluated *in silico* towards PARP1, PARP2 and PARP14 and *In vitro* inhibitory assays were performed on commercially available PARP1 and PARP14 chemiluminescence kits at 10 µM per well. All compounds docked *in silico* with PARP1, PARP2 and PARP14, revealed key interactions for **2** (hydrogen bonds to SER864, SER904, and Pi interaction to TYR907 in PARP1) and **7** (Pi interactions to TYR1620 and TYR1646 in PARP14). Both the *in silico* studies and *in vitro* assays identified compound **2** as a PARP1 preferred inhibitor (reducing the activity of the enzyme by 93% ±2% from the positive control) and compound **7** as a PARP14 preferred inhibitor (91% ±2% by the same measure). In summary, compounds **2** and **7** have been identified as lead compounds for PARP1 and PARP14, respectively.



B13. Synthesis and biological evaluation of butenolides as anti-cancer agents

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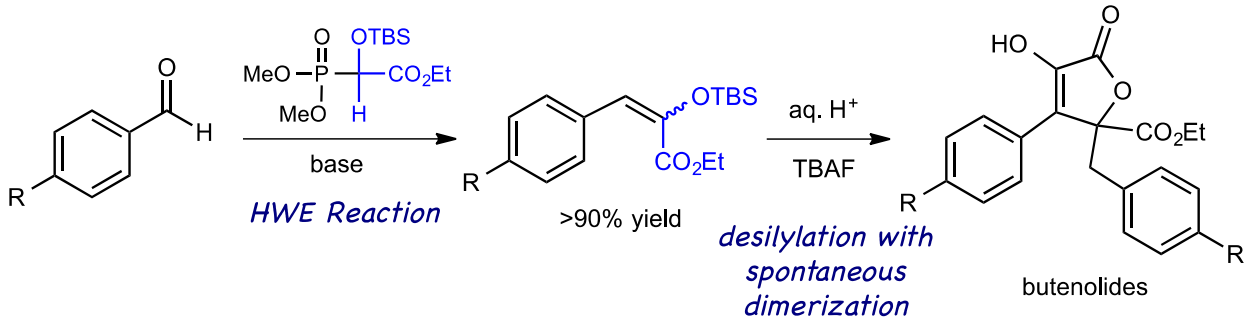
Cancer has become one of the largest health challenges of the 21st century, with an estimated 396 new cases diagnosed everyday in Australia.[1] In the search to find novel chemotherapies, nature often provides the best lead. Butenolides, a class of γ-lactone furanones originally isolated from the marine fungus *Aspergillus terrus*, have been shown to possess cytotoxic activity against numerous human cancer cell lines,[2] due to the inhibition of the CDK1 and CDK2 enzymes which are key regulators in the human cell cycle.[3] Despite this knowledge, research into butenolides has been limited, due in part to their structural complexity. In late 2018, the Kiefel group (Institute for Glycomics, Griffith University) developed a new method, based on the Horner-Wadsworth-Emmons (HWE) reaction, to produce butenolides through a robust, two-step process.[4]



This presentation will report on the synthesis of five novel butentolides using the HWE reaction (as shown in the scheme above), as well as describe the results from preliminary cytotoxicity studies against PC-3 prostate cancer cell line. Our results show that aromatic substitution directly impacts on the cytotoxic activity of butenolides, with electron-withdrawing groups being more potent than neutral or electron-donating groups. This preliminary study provides useful insights into potential future directions with these butenolides.

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B14. Design of a potent peptide inhibitor of PCSK9 for treating familial hypercholesterolemia

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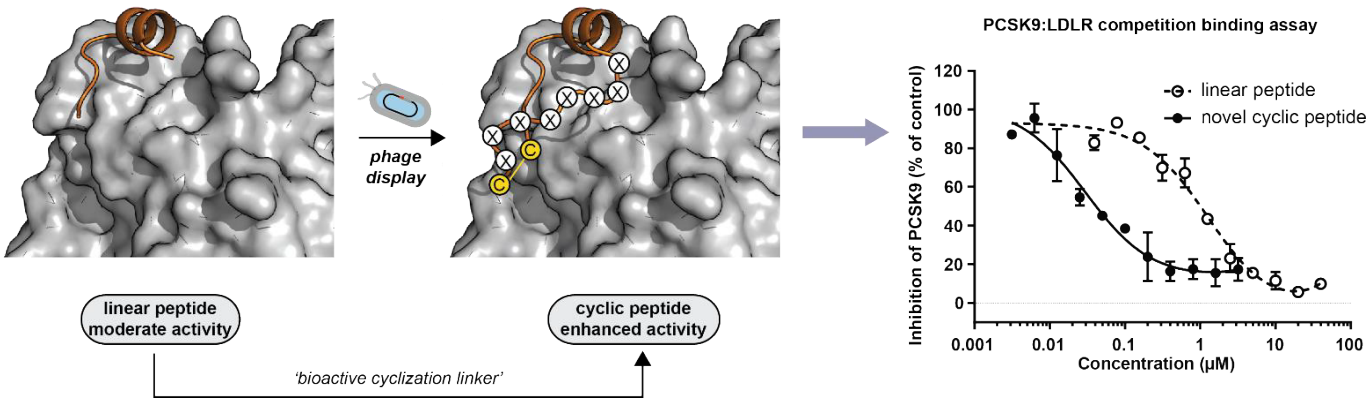
Proprotein convertase subtilisin/kexin type 9 (PCSK9) is a validated drug target for the treatment of familial hypercholesterolemia, a disease that affects over 30 million people worldwide. Attempts to discover non-antibody based PCSK9 inhibitors have so far proved challenging due to the low efficacy of chemical molecules in blocking the PCSK9:LDL receptor (LDLR) interaction.[1] Here, we investigate a novel strategy involving phage display to cyclize a previously reported peptide inhibitor of PCSK9 (Pep2-8) with a randomized C-terminal extension to improve its bioactivity.[2] We screened a disulfide-constrained phage-displayed peptide library against PCSK9 and identified one of the most potent chemical inhibitors of PCSK9 reported to date – namely P9-38_cyc. This peptide was produced by using solid phase peptide synthesis, and was shown to have a 40-fold improved activity compared to Pep2-8 in a PCSK9:LDLR competition binding assay (P9-38_cyc IC_{50} value of 30 nM). ITC revealed that P9-38_cyc had a much higher affinity for PCSK9 compared to Pep2-8, with K_D values of 17 nM and 251 nM, respectively. SPR determined the increased affinity is due to a slower dissociation rate constant for the P9-38_cyc:PCSK9 complex ($K_{off} = 8.4 \times 10^{-3}$ 1/s) compared to Pep2-8:PCSK9 (K_{off} = 0.5 1/s). We solved the structure of P9-38_cyc using NMR spectroscopy which suggested the phage-derived cyclization linker was orientated towards PCSK9. An alanine scan confirmed linker residues were involved in binding to PCSK9. Overall, we have demonstrated that P9-38_cyc is a high affinity novel drug lead for PCSK9 inhibition and may help design next generation cholesterol-lowering therapeutics.



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B15. Discovery of Ligand Structure-activity Relationship by Mass Spectrometry:

Identification of New Tuberculosis Inhibitors

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A set of tuberculosis fragment inhibitors has been discovered by mass spectrometry. The method is based on the observation of protein-ligand complexes by mass spectrometry.[1] These fragments may compete for common binding sites on the target protein or bind at different sites. Mass spectrometry enables identification of ternary complexes in which two ligands bind to different sites of a target.[2-3]

For a specific target, the result $(P+L_1) + (P+L_2)$ indicates binding to the same site (competitive), while the result $(P+L_1) + (P+L_2) + (P+L_1+L_2)$ shows that L_1 and L_2 bind to different sites (non-competitive). Compound design relies on using a number of competitive fragments linked to a non-competitive fragment. In the next step, the structures of these fragments will be modified using synthetic methods to enhance their activities and produce novel inhibitors.

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B16. Bio-evaluation of Tyrosinase Inhibitors as Potential Anti-melanoma Agents

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Abstract

Tyrosinase (TYR) is known to be rate-limiting in melanin production via conversion of L-tyrosine to L-DOPA and L-DOPA into L-dopaquinone. The melanin accumulation after long-lasting UV radiation may lead to serious dermatological and esthetic problems and even melanoderma. TYR inhibitors can reduce the melanin biosynthesis and thus have become the basis for a new class of the therapeutics for melanoma. The study aims to investigate: (i) the TYR inhibitory activity of the compounds via enzymatic assay using mTYR, (ii) the antitumor activity of the compounds on human melanoma cell lines and normal cell lines (iii) and the potential mechanism of actions.

This study underlines TYR inhibitory action of the novel synthetic compounds and their potential antitumor properties on human melanoma cells. Novel TYR inhibitors were synthesized and assessed by an enzymatic assay using mushroom TYR (mTYR). Compounds that are more potent than the reference compound kojic acid were identified and further investigated for their potential anti-tumor activity in a human melanoma skin cell lines (WM164, WM1366, and D24) and will be evaluated in both zebrafish and mice models. Some compounds showed specific targeting for mutated melanoma cells, and could be a tool for understanding the molecular mechanism in future studies.

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B17. A Novel Ketol-acid Reductoisomerase Inhibitor with Potential as a Tuberculosis Drug

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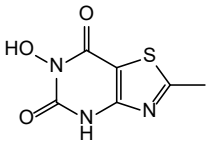
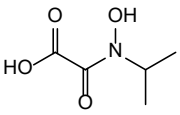
Tuberculosis (TB) is an infectious disease which poses a significant threat to global human health. TB is so problematic due to the development of multi-drug resistant strains. Therefore, there is an urgent need to develop new TB drugs. Ketol-acid reductoisomerase (KARI) is a metallo-enzyme present in bacteria which is involved in the synthesis of branched chain amino acids. This pathway is vital for bacterial survival, yet not present in animals, allowing potent inhibitors of KARI to be toxic to bacteria without impacting the human host. In order to find novel inhibitors of KARI a National Cancer Institute (NCI) library of 2,500 compounds was screened for activity against the *M. tuberculosis* (*Mt*) KARI enzyme. A hit compound (NSC116565) was found which shows good inhibition of Mt KARI. This compound is particularly interesting as it is somewhat structurally different from the well-known transition-state analogue KARI inhibitors (such as CPD, IpOHA, HOE704, and E4P, shown in the figure below). In addition, it has been shown by ITC that NSC116565 is able to bind to the enzyme in the absence of the NADPH cofactor, whereas it is hypothesised that the transition-state analogue inhibitors require NADPH to bind to and inhibit the enzyme. We have obtained a 2.6 Å crystal structure of NSC116565 bound to *S. aureus* KARI (98% active site homology with *Mt* KARI).



116565



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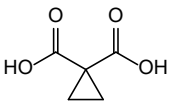
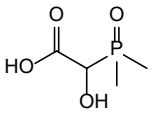
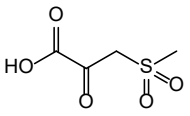


CPD



HOE 704



E4P

B18. Development an oral-delivery system for peptide based nano vaccine against Group A *Streptococcus*

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GAS infection are responsible for over 500,000[1] deaths each year, and this number is still increasing. Vaccination is considered as a useful approach to enhance the host immunity against infection, and it has helped to prevent and even eradicate many infectious diseases so far. Herein we developed a potent peptide-polymer based vaccine against GAS infection. Our fully synthetic peptide vaccine candidates against group *A streptococcus* (GAS) were composed of J8 GAS B-cell epitope alongside with a universal helper T-cell epitope PADRE. Alkyne based peptide (J8-PADRE) was conjugated with azide based polymer named Poly methyl acrylate (PMA) by Copper-Catalyzed Alkyne-Azide Cycloaddition (CuAAC). PMA-J8-PADRE formed nanoparticle size (146±8) and PDI (0.190±0.02) measured using dynamic light scattering (DLS). PMA is one of the most widely explored bio-medical polymers because of its biocompatibility[2]. Lipids including 1,2-dihexadecanoyl-*sn*-glycero-3-phosphocholine (DPPC), Didodecyldimethylammonium bromide (DDAB) was used for liposome formulation and PMA-J8-PADRE loaded into liposome. The liposomes were coated with a layer by layer approach based on charge-charge interaction between cationic trimethyl chitosan (TMC) and anionic Sodium alginate (Alg), vaccine candidates alone and CTB-adjuvants. Mice (C57/BL) were immunized with seven different compounds by oral gavage. PBS was used as negative control with a single oral immunization (100µg of the respective vaccines in 30µL PBS). All groups of mice that received GAS vaccine developed anti-GAS antibodies as determined by ELISA. The addition of CTB did not result in greater anti-GAS antibody titres. In fact, mice immunized without CTB had greater anti-GAS antibody titres than mice immunized with CTB because CTB can lower the immune response to oral vaccination. Liposomes and coating liposomes did not enhance vaccine efficacy, thus we demonstrated that single antigen-polymer conjugate. The enhanced vaccine efficacy, lowered dose, and simple and cost-effective process of producing the coated nanoliposomes should be particularly useful in developing potent peptide-based vaccines to prevent infection.

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B19. Flavonoid-Nitroxide Hybrid Antioxidant Drugs for the Treatment of Neurodegenerative Diseases

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The pathogenesis of neurodegenerative diseases is not entirely understood but is frequently attributed to a prolonged state of oxidative stress in neuronal cells. Oxidative stress, caused by an excess of reactive oxygen species (ROS) can damage biomolecules like DNA and proteins, leading to apoptosis. A possible therapeutic intervention into oxidative stress is the administration of small molecule antioxidants to neutralise, or prevent the generation of, ROS. More potent antioxidants are desired that can possess various antioxidant mechanisms. To design more potent small molecules antioxidants, a polypharmacology approach can be applied to hybridising small molecule antioxidants. This work aims to increase the potency of flavonoids, a biosynthetic small molecule antioxidant produced in plants, by synthetically hybridising it with the stable free radical nitroxide, 1,1,3,3-tetramethylisoindolin-oxyl (TMIO), in order to form novel multifunctional antioxidants which can act through metal chelation, SOD mimicry and free radical scavenging. This was achieved by the design of a library of flavonoid-nitroxide hybrids with varied regiochemistry and stoichiometry of the nitroxide on the flavonoid scaffold. The library consists of the parent flavonoids; flavone, 3-benzoyl chromone and 3-benzoyl flavone, their flavonoid-nitroxide hybrid compounds as well as their methoxyamine derivatives. Both parent and methoxyamine flavonoid hybrids were synthesised by the same stepwise Baker-Venkataraman methodology to form corresponding 1-(2-hydroxyphenyl)-3-phenylpropane-1,3-diol intermediate. From the key diketone intermediate, all desired flavonoid scaffolds could be accessed by various ring closure reactions. The methoxyamine flavonoid hybrids could subsequently be oxidised, resulting in quantitative yields of the target flavonoid-nitroxide hybrid compounds. The formation of this library of hybrid antioxidant pharmacophores can be used to understand the structure property relationships to antioxidant capacity in future assays.

B20. Liposomes vs Micelles; a comparison study to deliver therapeutics to macrophages

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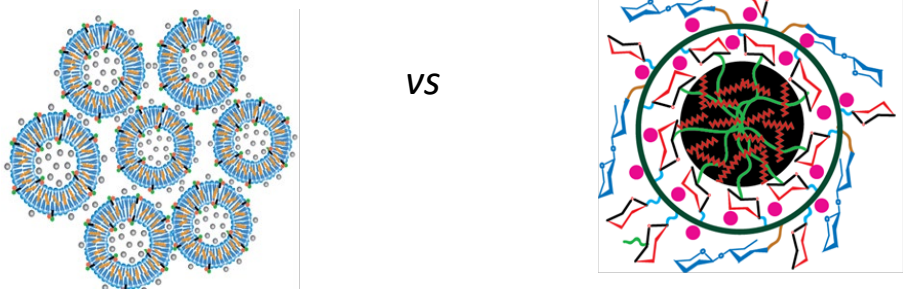
Bacterial infection is still one of the leading causes of hospitalization and mortality, although antibiotics are used comprehensively to treat these infections.[1] Many deadly infectious diseases are produced by microorganisms that are able to survive in macrophages. The intracellular location of these pathogens protects them from the host defence systems and from some antibiotics with poor penetration into macrophages.[1] Therefore, the use of non-viral nanoparticulate systems for the delivery of therapeutic agents is receiving considerable attention to improve the penetration of drugs into macrophages.[2] This presentation will describe the design and synthesise of antibiotic-encapsulated glyconanoparticles (GNPs) and glyco-coated liposomes for active targeting of macrophages to treat a range of infectious diseases. The hydrophobic antibacterial agents *N*-alkylsulfonylacetamide (DSA)[3] and hydrophilic aminoglycoside were loaded into the artificial nanocarrier system, along with sugar-based targeting agents to enhance drug concentration into the infected immune cells and explore their ability to inhibit bacterial growth. The physicochemical and immunopotentiating properties of the prepared glyco-coated liposomes and GNPs will also be described. Finally, the intracellular antibacterial activity indicated the bacterial growth inhibition capability of the DSA and amikacin-loaded liposomes and GNPs demonstrating this artificial nano-drug carrier has great potential for targeted delivery of antimicrobial agents.



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B21. Can you dig it? Exploring an Extinct Volcano Crater Soil Microbiome as a Prolific Source of Microbial Natural Products

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Microbes have long been an established source of relevant small molecules for a wide variety of applications. The discovery of new microbial natural products starts with culturing bacteria and fungi from diverse environments and investigating the microbial secondary metabolites. In the search for new chemistry, 22 soil samples were collected from the Goondicum Pastoral Station, which occupies an extinct volcano crater inland from Gladstone. Soils were plated with stamping and heat shock methods and were inoculated into two isolation media, M1 and ISP2 agar. Standard microbiological technique of sampling and replating was used to acquire pure isolates of individual colonies (x356 microbes). Extracts were subjected to chemical profiling using UHPLC-QTOF mass spectrometer, with data analysis by Global Natural Products Social (GNPS) molecular networking dereplication function.

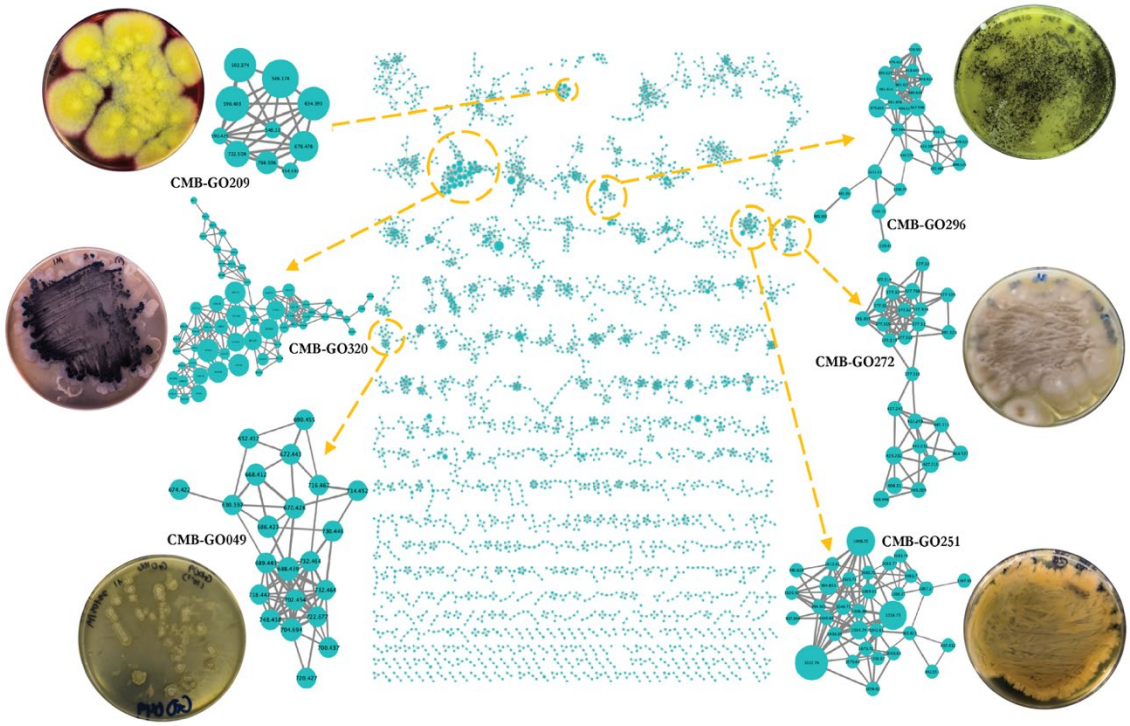

Figure: LC-MS/MS derived molecular networks generated by GNPS for 356 extracts. A total of 7072 nodes were observed. Single- and double-node clusters were pruned for visualization purposes. Large clusters from prioritized strains are highlighted and further expanded for clarity.

GNPS is a molecular network tool that allows the visual display of the chemical space present in tandem mass spectrometry (MS/MS) experiments. This visualization approach can detect sets of spectra from related molecules even when the spectra themselves are not matched to known compounds.

C1. Lignocellulosic biomass hydrothermal liquefaction to generate feedstock for polyhydroxyalkanoate production

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Traditional plastics are not readily degraded in the natural environment and leakage from our existing plastics manufacture and recovery systems has led to a growing global environmental problem. Polyhydroxyalkanoates (PHAs) are bacterially synthesised plastics that show efficient and complete biodegradation in all natural environments where bacteria are present, including soil and marine [1]. However, the commercial application of PHAs is critically restricted by their high cost, with the carbon feedstock playing a pivotal role in the overall production costs [2]. Lignocellulose represents the most important portion of the global biomass inventory. It is an abundant and cheap, which makes it a very suitable feedstock for industrial biotechnology [3]. Consequently, the conversion of cheap lignocellulosic biomass into a suitable carbon stream for the production of PHAs would represent a significant breakthrough for the commercialization of this biodegradable polymer.

Hydrothermal liquefaction of biomass produces a carbon rich aqueous stream, containing carbohydrates and acids, that could be suitable for the production of PHAs [4]. Here, the liquefaction process will be used for converting of lignocellulosic biomass into carbon sources for PHA production as shown on Figure 1. In the experiments, wood and water are used as feedstock and solvent, respectively. The reaction is carried at different temperatures, from 200˚C to 320˚C, leading to a conversion of wood into aqueous soluble products from 19.3 to 12.9%, respectively (Carbon Basis). The production of organic acids was favoured at higher temperatures, i.e. 350˚C, and a maximum production of 3.6 g/L (C_2-C_7) was observed.

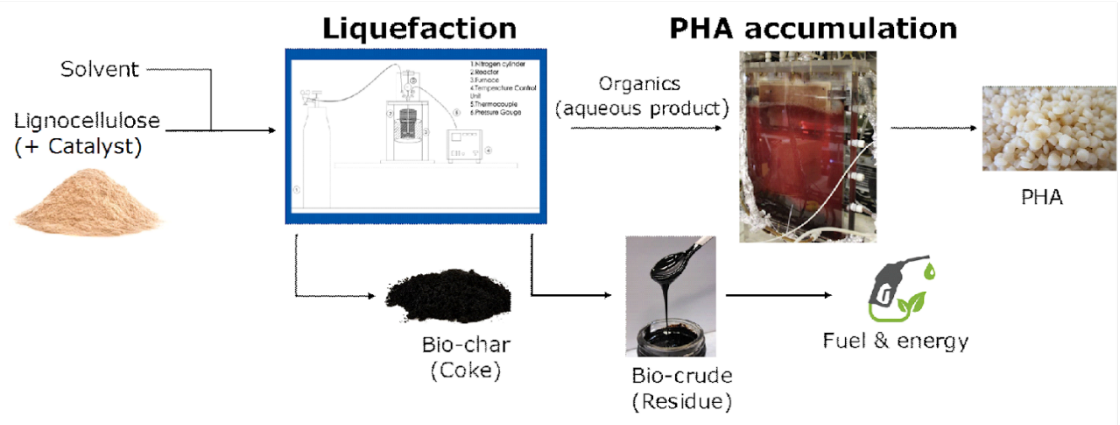

Figure 1. The approach of using lignocellulose liquefaction to generate feedstock to produce PHA

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C2. Design and Synthesis of High χ Galactose-based Block Copolymers for Next Generation Nanolithography

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Abstract

The semiconductor industry is in desperate need of new economic techniques to improve photolithography as producing microelectronics with sub-10 nm features has become increasingly expensive [1]. Directed self-assembly (DSA) of high-χ/low molecular weight block copolymers (BCPs) has shown to be an effective method that can alleviate the burden on photolithography as a multiplicative technology [2]. A potential candidate for DSA is poly(6-O-methacryloyl-1,2;3,4-di-O-isopropylidine-D-galactopyranose-*block*-styrene) P(MAIpGal-*b*-St). Deprotection of the isopropylidene would significantly increase the immiscibility between blocks, thus reducing the molecular weight required to phase separate into lamella morphologies. This research utilised the RAFT polymerisation technique to synthesise poly(6-O-methacryloyl-D-galactopyranose-*block*-styrene) P(MAGal-*b*-St) and develop strategies to achieve a sub-10 nm pitch size on a silicon wafer. ^{1}H NMR, size exclusion chromatography (SEC) and pycnometry were used to determine the molar ratios of monomers needed to produce a library of low molecular weight BCPs with a volume fraction (f_{MAGal}) close to 0.5. Figure 1 (b) shows the small-angle X-ray scattering (SAXS) profile of a highly ordered lamella morphology for the deprotected BCP after annealing at 140 °C. SAXS analysis also showed that the χ value could not be obtained using the intensity above the order to disorder transition temperature (T_{ODT}) due to the thermal sensitivity of MAGal. Atomic force microscopy (AFM) analysis demonstrated the morphological transitions during solvent annealing, where wafers spun coated with vesicles, phase-separated, thus, suggesting the potential to obtain lamellar morphology. Overall, our results indicate that glycopolymer-based BCPs are a promising candidate for DSA to achieve a sub-10 nm resolution.

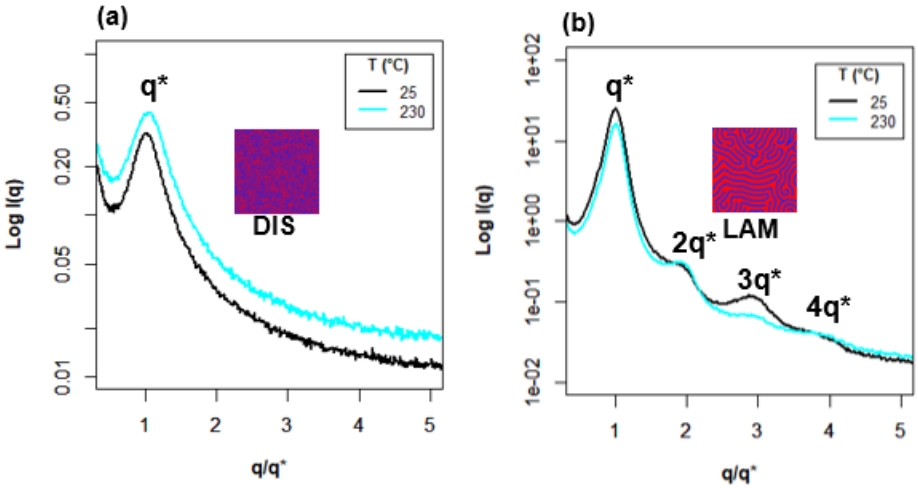

Figure 1: SAXS intensity profile of Log I(q) against q/q* for (a) P(MAIpGal-*b*-St) disordered morphology and (b) P(MAGal-*b*-St) lamella morphology at 25 and 230 °C.

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C3. Catalyst--Electrolyte Interactions in Aqueous Reline Solutions for Highly Selective Electrochemical CO_2 Reduction

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We examined how interactions between polycrystalline Ag foil and reline (a mixture of choline chloride and urea) led to remarkable increment in selectivity of CO in aqueous reline with a maximum CO faradaic efficiency of of (96±8) % as compared to (64±2) % in 0.5 M $KHCO_3$ at - 0.884 V vs. RHE. In this presentation we will share insights from our research that was recently published in *ChemSusChem* (Garg 2019) During CO_2R in reline, in-situ nanostructuring of Ag foil occurs from (i) dissolution of silver oxide and (ii) subsequent electrodeposition of dissolved Ag on Ag foil. Specifically adsorbed choline ions and urea on the restructured Ag foil (having low-coordinated sites) limit the availability of protons near the cathode surface and stabilize the CO_2R intermediates (*COOH). Equipped with this understanding, manipulating catalyst-electrolyte interactions for efficient electrocatalysis could be applied to other key electrochemical applications such as energy coversion and storage, water splitting, and nitrogen reduction.

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C4. Novel nanotechnology approach for diagnosis and treatment of ROS related inflammatory diseases

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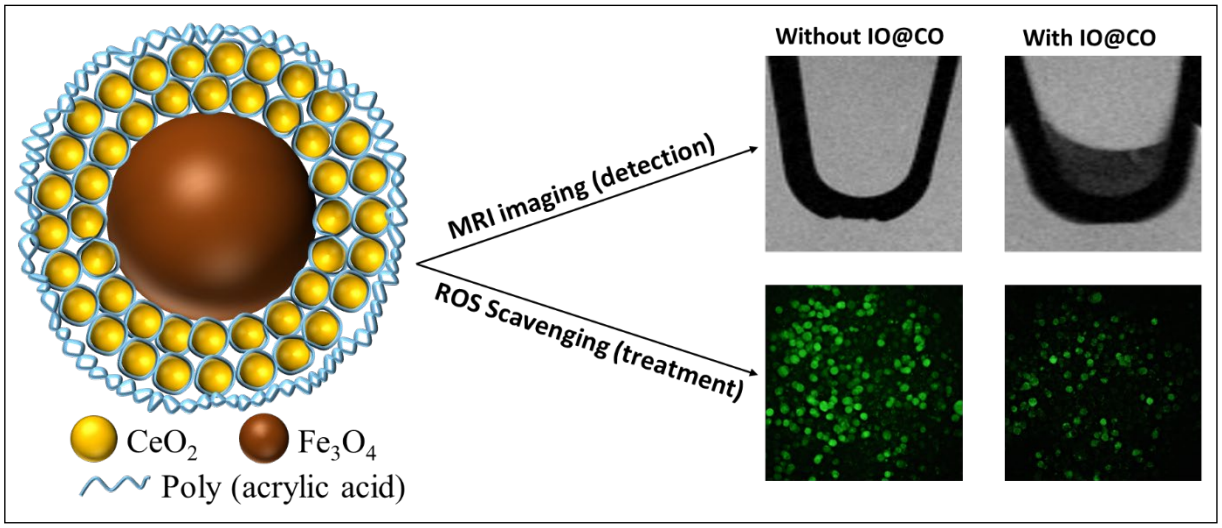
Reactive oxygen species (ROS) and reactive nitrogen species (RNS) are key signaling molecules that play an important role in the inflammation and progression of many diseases such as cardiovascular disease, especially atherosclerosis. ROS are in particular a significant factor in the development of rheumatoid arthritis and other autoimmune diseases such as allergies. In this study, novel Fe_3O_4/CeO_2 core–shell theranostic nanoparticles capable of reacting with ROS and of being detected by MRI were synthesized and thoroughly characterized. In vitro studies, such as measurement of cell uptake, magnetic resonance imaging, toxicity and ROS scavenging, were conducted. The results indicate that the novel Fe_3O_4/CeO_2 theranostic nanoparticles are effective for scavenging ROS and show excellent magnetic resonance (MR) imaging performance. These theranostic nanomaterials, therefore, show great potential for the treatment and diagnosis of ROS-related inflammatory diseases.[i]



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C5. Modelling the controlled release of toxins in a rumen environment

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Pimelea poisoning in grazing cattle has been a long-time pestilence for the pastoral industry throughout arid regions of inland Australia.[1] The causative native *Pimelea* species have been confirmed with the secondary metabolite simplexin, a daphnane orthoester, being extracted and identified as the principal toxin. There is no effective prevention or remedy for *Pimelea* poisoning, however naïve calves have previously been demonstrated to develop detoxification capability following prolonged low-dose simplexin intake. In parallel with the ongoing search for potential rumen microflora able to decompose simplexin, a variety of biocomposites are being manufactured by encapsulating *Pimelea* plant material or a crude simplexin extract in biodegradable and biocompatible polyesters, aiming to develop a slow sustained toxin release mechanism via hypothesised surface erosion (Figure 1). In this project, a method to quantify simplexin within these biocomposites was established and validated utilising solid phase extraction combined with UHPLC-Q-Orbitrap MS/MS. Based on this assay, the release kinetics of simplexin from these complex systems when exposed to rumen environment *in vitro* and *in vivo* will be revealed. The effects of factors such as matrix formulation, matrix geometry, filler dimensions, types and crystallinity of the polymeric material on microscopic and macroscopic biodegradation patterns and the resulting *in vitro* releasing behaviour of simplexin will be investigated. Mathematical models reflecting the underlying mass transport mechanism of simplexin will be ultimately built from the simplest assumptions to increasing complexity as needed to deliver robust prediction, which holds the potential to guide the development of new intra-ruminal devices with tailored releasing performances.

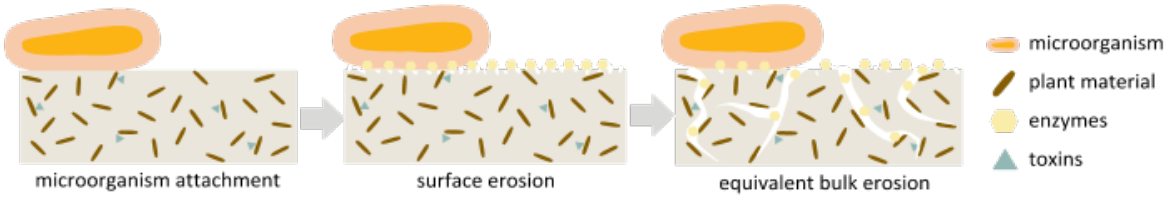

Figure 1. Hypothesised releasing mechanism of toxins from a matrix fabricated from *Pimelea* plant material and biodegradable polyester

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C6. Removal of PFAS compounds in water using a Combined Adsorption and Electrochemical Regeneration Technology

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Remediation studies of Poly- and perfluoroalkyl substances (PFASs) in water have been rapidly growing due to the increasing concerns in PFAS contaminated water resources and associated adverse toxicological effects on wildlife and humans. More regulatory attention to this new class of emerging contaminants is now becoming a higher priority. There are thousands of "PFAS precursors", which can transform in the environment and in higher organisms to create persistent perfluoroalkyl acids (PFAAs). Hence, new health and environmental regulatory standards are being established, commonly in the parts per trillion (ppt) levels. PFASs including perfluorobutane sulfonic acid (PFBS), perfluorooctanoic acid (PFOA) and Perfluorooctane sulfonic acid (PFOS) are used as model pollutants in this study.

There are various PFAS treatment technologies available in Australia and around the world. Limitations in traditional adsorption technologies such as Granular Activated Carbon and Anion-exchange resins as well as advanced oxidation and reduction, reverse osmosis and nanofiltration prompts us to investigate more efficient and cost-effective methods. They all have limitations in commercial applications based on costs, energy use, adsorption efficiency, and regeneration efficiency.

Expandable Graphite is used to adsorb PFASs in water and an innovative electrochemical oxidation step is applied to regenerate the adsorption capacity. This simultaneous adsorption and regeneration technique could be more cost effective but has not yet been tested for PFAS removal. However, it could create undesirable by-products including fluoride; and breakdown products from PFASs and other contaminants in water, if electrochemical oxidation is not fully completed. This research aims to investigate the PFAS oxidation and generation of PFAS breakdown products and optimisation of electrochemical oxidation process.

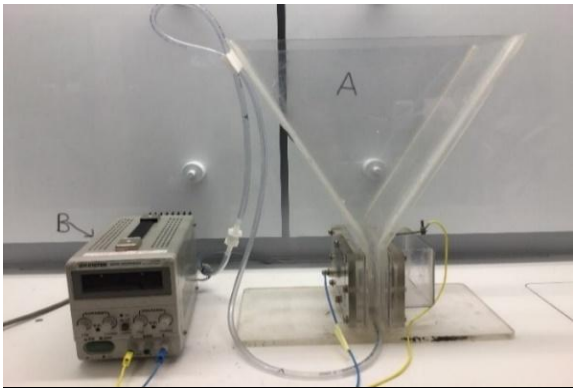

Figure 1 - Laboratory bench scale Reactor will be used in this research

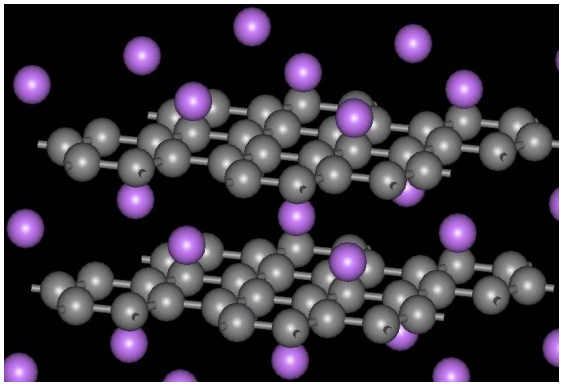

Figure 2 - Structure of Expandable Graphite (EG) / Graphite intercalated Compound (GIC) adsorbent.
Source:https://en.wikipedia.org/wiki/Graphite_intercalation_compound#/media/File:CaC6structure.jpg

C7. Application of Transition State Force Field in the Prediction of Asymmetric Catalysts Efficiency

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Asymmetric synthesis is a chemical synthesis technique that yields an unequal ratio of stereoisomeric products (enantiomers or diastereomers). This technique is commonly used to prepare enantiomerically pure molecules, especially in the synthesis of pharmaceuticals, where one enantiomer has the desire activity, but another can bring damaging effects. Various efforts have been done for the search of efficient catalysts for asymmetry synthesis. However, currently available techniques are too expensive in terms of time and material. In my research, I propose a new method for organic catalysts efficiency prediction. This method involves the use of “transition state force field” in molecular mechanics calculations. In this talk, I will discuss the method to generate “transition state force field”.

C8. A tale of two fates: Modelling cytochrome P450 catalysed dehydrogenation

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Promiscuous, ubiquitous, and versatile, the superfamily of heme-thiolate monoxygenases known as cytochromes P450 (P450s) can catalyse a wide range of organic transformations and are important in many biological contexts. Specifically, P450 catalysed aliphatic dehydrogenation serves a vital role in sterol biosynthesis and the formation of toxic metabolites for some drugs. The mechanism of this dehydrogenation, however, remains ambiguous.

To gain insight into this process, molecular modelling using both quantum mechanics (QM) and molecular mechanics (MM) methods was undertaken to model CYP199A4, a bacterial P450 known to both dehydrogenate and hydroxylate *para*-alkyl substituents of benzoic acids. Current mechanistic hypotheses propose P450 catalysed hydroxylation and dehydrogenation proceed through the same radical intermediate. The task, therefore, becomes understanding the factors controlling bifurcation from the intermediate state.

Density functional theory (DFT) calculations with the UB3LYP functional on a small model system of CYP199A4 with *p*-isopropylbenzoate established the intrinsic preference for hydroxylation over dehydrogenation, contrary to experimentally observed product distributions. Thus, it seemed environmental effects were involved. Molecular dynamics (MD) simulations using AMBER 18 (ff14sb) showed that the substrate could adopt an alternate binding mode which might disfavour hydroxylation. Ongoing hybrid QM/MM calculations will establish how the protein environment influences the potential energy profile for the two reaction pathways.

The use of P450s for biocatalysis has great potential, from industrial scale biofuel production through to synthesis of fine chemicals. In order to efficiently design these enzymes for catalysis, as well as understand the biosynthetic/biodegradative processes they are involved in, understanding their mechanisms remains fundamentally important.

C9. Molecular Modelling of Covalent Inhibition of Bruton's Tyrosine Kinase by Cyanoacrylamides

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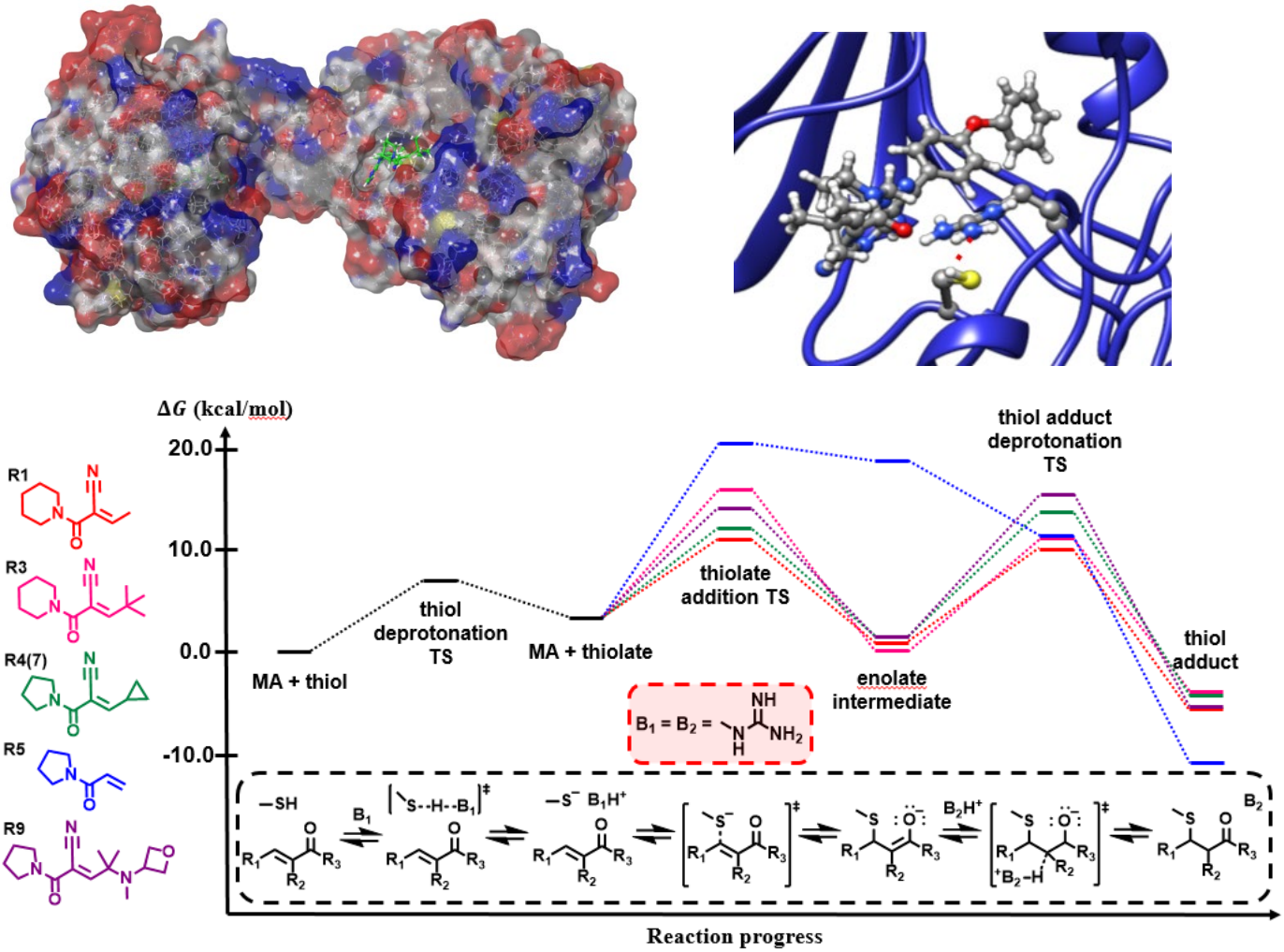
Historically, researchers have been reluctant to develop covalent drugs due to the risk of side effects arising from their irreversible binding nature. Bradshaw et al. have discovered that the installation of nitrile groups on the -positions of acrylamides could allow reversible covalent inhibition of Bruton's Tyrosine Kinase (BTK) over a wide range of residence time.[1] The thiol-Michael addition of the cysteine of BTK to the cyanoacrylamide inhibitors involves an E1cb mechanism, but the identity of the base is yet to be found out. As such, we have conducted a computational study to identify the potential base catalysts and investigate the effect of base choice on the intrinsic reactivities of these Michael acceptors. The reactivities of the reactive moieties of the inhibitors were first studied using quantum mechanical calculations. Assuming that methanethiolates were the participating base catalysts, the predicted rankings of the elimination barriers were found to match the experimental data qualitatively but the relatively magnitudes among the inhibitors did not agree well. This was thus followed by molecular dynamics simulations of several BTK-inhibitor complexes in search of the base species. The analysis on the trajectories of the relevant residues over time led to the proposal of arginines being the base participating in the forward and reverse Michael reactions in BTK active site. The incorporation of a model arginine as participating in the quantum-mechanically calculated energy profiles has indeed showed improved agreement between the predicted and experimental elimination rates.



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C10. The Reversibility of Michael Additions: What controls reactivity?

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The design of enzyme inhibitors is one of the main research goals in medicinal chemistry. Enzyme inhibitors work by binding to a target protein to attenuate its activity. This can happen through non-covalent and/or covalent interactions. This study will focus on covalent inhibitors in drug discovery. Typically, covalent inhibitors present an electrophilic functional group capable of reacting reversibly or irreversibly with amino acid residues containing a nucleophilic group. The α,β-unsaturated carbonyl system (known as a Michael acceptor) is one of the most important reactive electrophilic functionalities. Designing selective covalent inhibitors remains a challenging task as the electrophilic groups present can act as irreversible non-selective enzyme inhibitors. Non-selectivity is generally deemed undesirable by medicinal chemists because the of the potential for side effects arising from off-target inhibition.

In this study, density functional theory calculations have been employed to investigate the fundamental features of the reactivities of Michael acceptors that contribute to reversible inhibition.

C11. Molecular dynamics simulations for the prediction of self-diffusion coefficients of confined fluids

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Confined fluids are fluids under a geometric constraint in the nanometric scale. In general, they present thermodynamic and transport properties that differ largely from the ones observed under bulk conditions. Due to the inhomogeneous characteristics of the fluid, such properties are not constant throughout the system, but rather a function of the distance from the solid-fluid interface. Molecular dynamics simulations have shown to be an essential tool for the understanding of fundamental phenomena governing the behaviour of confined fluids. In this work, we explore different methodologies for using molecular dynamics simulations to predict local self-diffusion coefficients of different fluids under confinement. Furthermore, we focus on how this information can contribute to the improvement of nanofluidic and electrochemical devices. This is of particular interest when we have systems containing ionic liquids as confinement contributes to increasing their natural spatial and temporal correlations. For example, in supercapacitors it is known that higher diffusion coefficients of electrolytes are related to higher power densities. Besides that, experimental and computational studies have shown that highly confined electrolytes lead to a more efficient charge storage. Therefore, having a methodology that can appropriately predict the diffusion of confined and highly correlated electrolytes can contribute towards the optimization of the performance of supercapacitors.

C12. Influence of Simulated Weathering on Polyethylene and Polypropylene Types of Microplastics, Characteristics, Quantification and Analysis

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Plastic debris has become ubiquitous in terrestrial and marine environments, and its consequent degradation into microplastics (< 5 mm in size) has the potential to be taken up by organisms, posing great concern. Although there are no standardized analytical methods, recent advancements have identified and quantified microplastics in environmental samples using Pyrolysis Gas Chromatography/Mass Spectrometry (Pyr-GC/MS). To assess the reliability of Pyr-GC/MS for measuring microplastics in environmental samples, studies have used virgin polymer standards to correct for matrix effects and to select markers specific to the polymers investigated. However, little is known about how natural weathering processes could possibly impact inherent properties of microplastics, and consequently their analysis in environmental samples. So, weathered microplastic properties could be different from the original standards used for quantitation. The hypothesis presented is that weathered polymers in the environment will not influence the qualitative and quantitative assessment of microplastic polymers using Pyr-GC/MS. The objectives of this study were therefore to perform accelerated weathering of polypropylene (PP) and polyethylene (PE) microplastics and examine if this impacts their quantitative estimation using Pyr-GC/MS techniques. We further investigated degradation of microplastics through surface chemistry changes using Fourier-transform Infrared (FTIR), Raman and X-ray photoelectron spectroscopy (XPS), morphology changes through atomic force microscopy (AFM), and crystallinity change through differential scanning calorimetry (DSC).

C13. Design of surface-modified polycaprolactone: considering degradation and fate of modified biomaterials

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Polyesters including poly(ε-caprolactone) (PCL) are commonly used as biomaterials in tissue engineering. PCL is biodegradable and can be easily processed using different techniques to achieve a variety of implantable structures. However, PCL is hydrophobic and lacks functionality required for interaction with biological material (e.g. proteins). PCL can be surface-modified to introduce desired functionality and allow for protein binding.

The majority of recent studies investigating surface-modified polyesters have primarily focused on cell studies and very few have considered the degradation of these modified materials. While polyesters are readily biodegradable, some types of surface modifications would yield non-degradable surface coatings that are too large for clearance from the body.[1] Some studies also used modifications (e.g. aminolysis) that would yield toxic by-products after degradation of the underlying polyester.[1] It is clearly important to consider how the materials will interact *in vivo* at all stages, particularly after degradation of the polyester.

In the present study PCL has been modified by gamma irradiation-induced grafting using two different monomers to introduce two different types of functionality. 2-Aminoethyl methacrylate (AEMA) can be used to introduce amines for conjugation to biopolymers that have good binding affinity for bone growth proteins, and 3-sulfopropyl acrylate (SPA) can be used to introduce sulfonates for direct protein binding.

Optimisation of the grafting process is required as the graft copolymers are not biodegradable. Parameters including monomer concentration, radiation dose, and presence of homopolymer inhibitor will be varied in order to yield graft copolymers that are small enough to be cleared from the body.

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C14. Using Quantum mechanical simulation of ion hydration to predict electrolyte solution properties

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Electrolyte solutions are ubiquitous and play a central role in a vast range of important biological and industrial processes. They carry the electrical currents that make life possible, they transform electrical energy into chemical energy in batteries and they can absorb carbon dioxide from air. The prediction of the properties of electrolytes solutions has been a central and ongoing challenge of physical chemistry from the early research of Debye, Onsager and Born. Unfortunately, the early models they developed are limited to very low concentrations. As a result, for chemical engineering applications we must rely on systems of equations with numerous fitted parameters. This limits our ability to predict the properties of new electrolyte solutions. A key reason for the failure of these early models was the lack of accurate molecular scale information on the properties of these solutions. In recent years fast and accurate quantum mechanical molecular dynamics (QM-MD) simulation of these properties has become possible. Here, I will outline some successes in the simulation of the properties of electrolyte solutions using QM-MD. I will then demonstrate a strategy for using the information and insights gained from these simulations to build accurate and low-cost predictive models of the important properties of electrolyte solution. These models have dramatically lower cost than quantum mechanical simulation and so can be used for predicting the properties of novel electrolyte solutions.

C15. Development of Profluorescent Micelles for the Use in Optoacoustic Imaging

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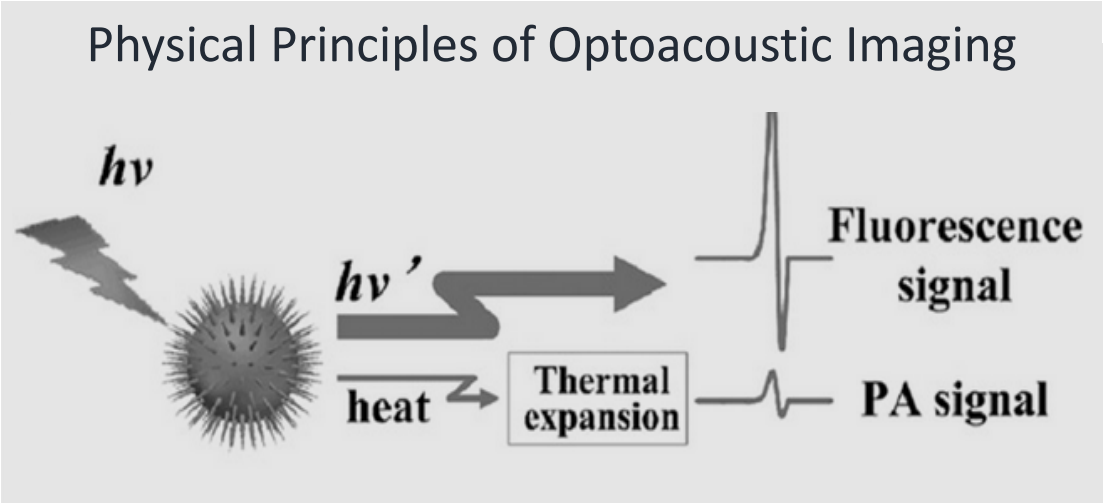
The current state of medical and molecular imaging consists of modalities with various strengths and weaknesses, however none manage to combine high resolution, deep tissue penetration, and logistical ease of use. Consequentially there exists a need for innovations in imaging in order to provide less expensive, highly selective imaging modalities with improved tissue penetration and resolution; such as optoacoustic imaging. We hypothesise by incorporating a nitroxide radical and a fluorescent dye into a polymeric micelle, it could be possible to develop a *profluorescent* micellar imaging agent. This project has explored the self-assembly parameters for the development of these micelles, including solvent, flow rate of cosolvent addition, and them method of cosolvent removal. Using an optimised protocol, it was possible to introduce the profluorescent elements into the micelle, a polynitroxide core with near infrared cyanine fluorescent dye. This presentation will discuss the physical and chemical characterisation of these micelle optoacoustic imaging agents. The potential benefits of highly tuneable/specific contrast agents for optoacoustic imaging would be profound on diagnostic medicine, improving early diagnosis' in any number of pathologies, and hence improving therapeutic outcomes.



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C16. Metallosupramolecular polyhedra for inclusion in multicomponent co-crystals

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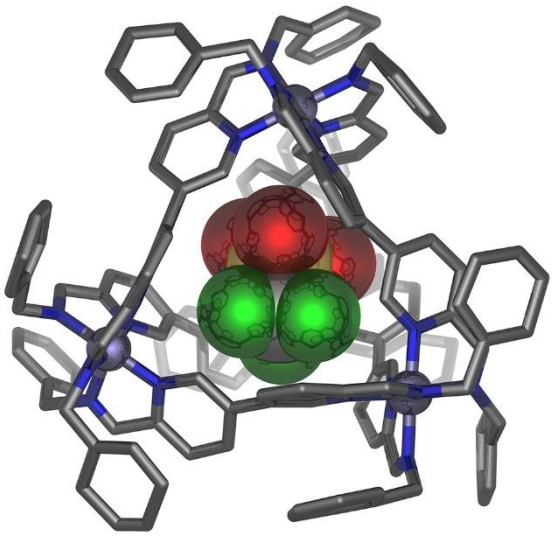
This project is concerned with the formation of novel metallosupramolecular cages, and their co-crystallization through halogen bonding as well as other non-covalent intermolecular interactions for manipulating the crystal packing of relatively bulky supramolecular polyhedra. This will provide a handle with which to tune the distance between metals, relative orientations in space and potentially their properties. The main goal is to investigate the potential of halogen bonding to form higher order metallosupramolecular networks. The results will lead to a better understanding of large cage-like complexes, how their geometries affect the supramolecular motifs in their crystals, and whether the principal properties of the co-crystals (solubility, chemical stability, magnetism, spin-crossover, fluorescence, etc.) can be altered when compared to pure crystals of discrete cages. The ultimate goal is to determine a new approach for the fine tuning of the properties of supramolecular crystalline materials, as well as to find better and more efficient ways to exploit the central cavity of metallosupramolecular cages for a variety of host/guest, halogen bonding and solid-state applications.



C17. Bis-Dithiocarbazate Ligands and their Non-Innocent Relationship with Copper

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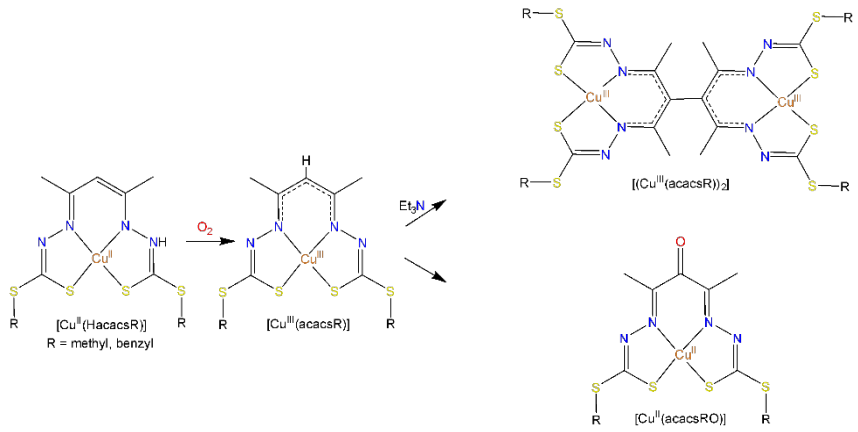
The ability for acetylacetone derived dithiocarbazate ligands to stabilise high oxidation state metal complexes has been demonstrated previously in complexation with copper due to their extensive charge delocalisation and ability to deprotonate the acetylacetone moiety to provide a trianionic ligand.[1] These ligands can be categorised as non-innocent and have provided some interesting properties in the past with comparable thiosemicarbazone complexes of nickel and copper.[2,3] Herein, ligands derived from acetylacetone and S-methyl or S-benzyl dithiocarbazates complexed with copper under anaerobic conditions provide reactive Cu^{II} complexes, which upon exposure to O_2, oxidise to an intermediary Cu^{III} complex. This Cu^{III} intermediate was found to convert to two products, a ligand oxidised derivative with a ketone group installed at the apical C of the acetylacetone moiety or a binuclear complex connected via C-C coupling of two respective Cu^{III} complexes through the apical C of the acetylacetone moiety. This bifurcating pathway can be controlled through the use of base to only observe the dimer.



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C18. Self-Assembled Highly Positively Charged Crowns: Study of the Counterion Effect

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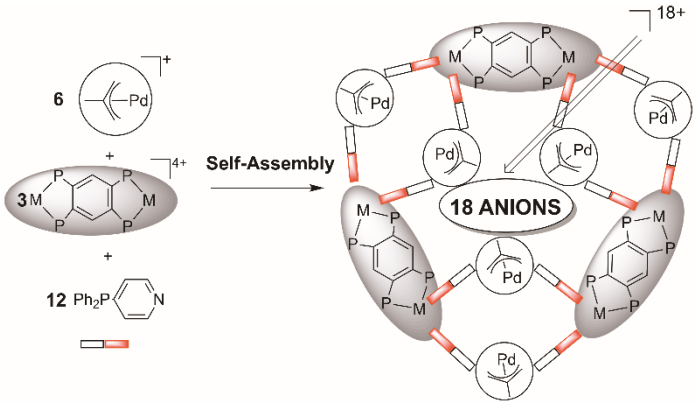
Coordination-driven self-assembly has presented a breakthrough in obtaining novel metallomacrocyclic species with interesting applications in catalysis, sensoring, biometrics, etc. In these processes, the choice of appropriate building blocks are crucial to obtain supramolecular structures with specific properties.

We have prepared, and fully characterized a series of self-assembled highly charged homo- and heterometallamacrocycles containing organometallic allyl-palladium $[Pd(\eta^3\text{-}2\text{-}Me\text{-}C_3H_4)(4\text{-}PPh_2py)_2]^+$ and $[M_2(1,2,4,5\text{-tetrakis(diphenylphosphanyl)benzene})]^{2+}$ (M = Pd, Pt) fragments and fluorinated anions with varied steric and electronic properties, namely BF_4^-, $CF_3SO_3^-$, PF_6^-, SbF_6^-, and BAr_F^-.

The new metallamacrocycles have shown remarkable differences both in their NMR and mass spectra depending on the anion. On the basis of the observed differences, the metallacycles have been tested as catalytic precursors in allylic substitution reactions. The anion-depending activity and selectivity has been analysed and compared with that of the corresponding monometallic allylic corners $[Pd(\eta^3\text{-}2\text{-}Me\text{-}C_3H_4)(4\text{-}PPh_2py)_2]^+$.



C19. An investigation of the antimicrobial efficacy of silver coated glass

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Abstract

Silver has long been known to possess disinfectant activity. Bacterial contamination of water is a serious problem in many countries. Silver can interrupt cell proliferation and cause cellular lysis through binding to bacterial surface, penetrating into cell directly and peroxidizing the lipid of cell membrane. A novel silver coated glass was developed to test the potential antimicrobial ability of this product. In this study, 4 repeat experiments were performed, utilizing spectrophotometry to determine the CFU of bacteria and colony counting to measure the bacterial load reduction after exposure silver coated glass. The results demonstrate that silver coated glass has the antimicrobial ability against both Gram negative and Gram positive bacteria within 30 minutes. It is possible that the treatment is more effective with Gram negative organisms, compared to Gram positive bacteria. It was surprising that the silver treated glass remained active after being rinsed 5 times with 20 mL of water in between experiments. In future research, additional experiments can be performed to investigate the effect of the grain size of the product, exposure time and exposure method. In addition, the experiments can be changed to test the effects against human saliva and waterborne bacteria from dental unit waterlines as well as those found in swimming pools.

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C20. Construction of Photoactive Supramolecular Coordination Cages

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The construction of metallosupramolecular coordination cages has traditionally relied on rigid organic ligands and kinetically labile coordination chemistry involving metals such as Fe, Cu, Zn, and Co to drive formation of a thermodynamically favoured product.1 However, the nature of this approach is somewhat restrictive on the incorporation of kinetically inert metal ions which often have important physical and chemical properties. For this reason, the construction of cages incorporating photoactive components derived from inert metals such as Ru[1](II) and Ir(III) remains a significant scientific challenge. Instead, the use of functionalised metalloligands (as shown in Fig. 1) can facilitate the preparation of a variety of supramolecular assemblies that incorporate kinetically inert metals, including edge-capped and/or face-capped tetrahedra and/or cubes.2,3 Our most recent results will be presented using this approach for the construction of supramolecular cages incorporating photoactive Ru(II) and Ir(III) complexes, which may have a variety of applications including catalysts for organic photoredox reactions.

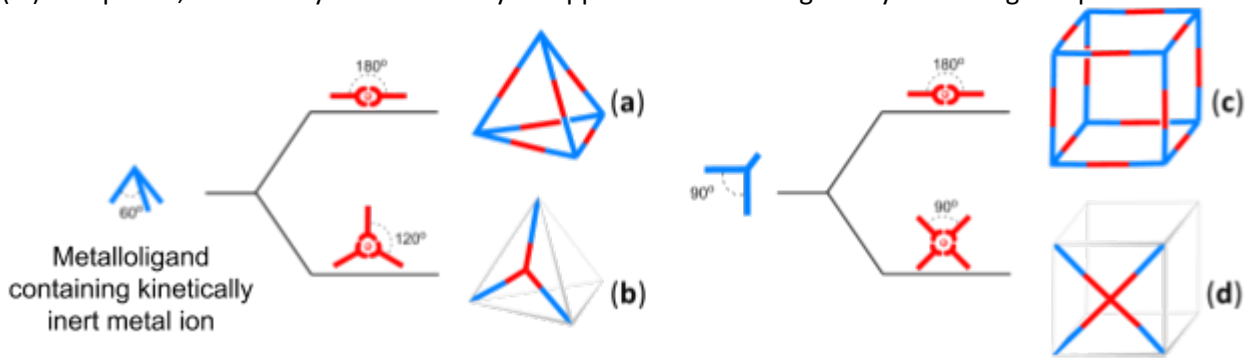

Figure 1 (above) Construction of different supramolecular assemblies using functionalised metalloligands (blue) with preorganised C_2, C_3 or C_4 symmetric linkers, resulting in edge-capped (a) or face-capped tetrahedra (b), and edge-capped (c) or face-capped cubes (b).

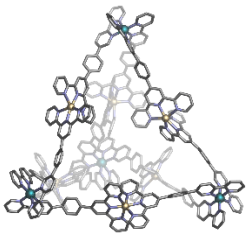

Figure 2 (right) X-ray crystal structure of coordination cage that emulates the structure from **Figure 1a**, containing Ru(2,2′-bipyridine)$_3$ subunits at the vertices (inert metalloligand) and a Cd(2,2′:6′,2″-terpyridine)$_2$ subunit along each edge (labile C_2 symmetric linker).

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C21. Fragment-Based Drug Discovery Library from Traditional Chinese medicine

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Fragment-Based Drug Discovery (FBDD) is a relatively new method of drug discovery, which is based on the detection of potential drug targets and small compounds (fragments) with a molecular weight under 250Da. Traditional Chinese medicine (TCM) is one of the oldest treatment systems. TCM components have proven safety records and have been used to treat chronic diseases for centuries. In this study, a valuable TCM, *Ligusticum Chuanxiong*, was selected to determine if the TCM has many low molecular weight components that could be used to build a pooled (peaks) fragment library for FBDD. 860g of crude extract from 10kg *Ligusticum Chuanxiong*, was separated by Sephadex LH-20, and analyzed using NMR and LC-MS to identify a 'peaks' library with MW under 250Da. The known TCM compounds was analyze for the chemical space diversity with structures by self-organizing map (SOM).