

# Synthetic Biology Research Centre Newsletter

University of Nottingham

Issue 4 – May 2016

Synthetic Biology Research Centre - Nottingham are working with Biotechnology Company CHAIN Biotech and industry partner Calysta Inc.

Scientists are trying to find a new way to produce the nutritional fatty acids called Omega 3 that are currently sourced from fish oil from the world's declining natural fish stocks.

In an ground breaking branch of new science – synthetic biology – the team at The University of [Nottingham's Synthetic Biology Research Centre](#) is working with biotechnology company [CHAIN Biotech](#) and industry partner [Calysta Inc.](#) to develop microbial technology that uses microorganisms to ferment methane gas into valuable nutritional supplements. The pioneering project is called PUFA (polyunsaturated fatty acids). It will run for a year and is being funded by industrial biotechnology catalyst grants from [Innovate UK](#) and the [BBSRC](#) with potential further significant scaling up investment from Calysta, a sustainable nutrition company based in the US. Omega 3 fatty acids are essential for the growth, development and healthy maintenance of the brain and are incorporated in many kinds of foods and infant nutrition products as well as animal feed and health products. Currently Omega 3 fatty acids are sourced from fish oils, but wild fish stocks are under pressure and there is an urgency to find alternative sources that are both sustainable and economical.

Leading the research at Nottingham's Synthetic Biology Research Centre, Professor Nigel Minton said: "We specialise in the use of fermentation of certain gases to produce sustainable industrial chemicals and biofuels, and now through this project to produce vital feedstock ingredients like Omega 3 fatty acids. We will be engineering the Methanococcus microbe to produce polyunsaturated fatty acids from a cheap and replenishable feedstock – methane gas. There are huge potential benefits in terms of reducing dependency on fishing and also creating a new use for a plentiful gas that has a harmful effect on the environment if unharnessed. Methane is a low cost and sustainable feedstock that can be produced from a variety of renewable sources, including anaerobic digestion which is now prevalent in the UK and EU."

Dr Basil Omar, Chief Commercial Officer at CHAIN Biotech Ltd said: "This is a great example of how publicly funded, early-stage research is being leveraged and commercially exploited with an industry partner to scale-up successful discoveries made in the lab. This highly innovative project will draw upon CHAIN's world leading expertise in Synthetic Biology to improve production characteristics by targeting both cell growth and product yield simultaneously with a focus on Omega 3 fatty acids. We hope it will offer a cheaper route to a high demand product with positive environmental and social knock-on effects."

Calysta, the project's commercial partner, specialises in the production of microbial proteins for the commercial fish feed and livestock markets. Microbial proteins are already used to make foods like the popular savoury spreads made from yeast extract. Fish farming is growing in response to increased global demand for seafood and Calysta has developed and is commercialising a new patented product called FeedKind™ protein to provide a sustainable fish food ingredient for the fish farming industry. The company will offer a fast track to scaling up of the PUFA manufacturing process. Calysta is based in California and will open a market introduction facility for FeedKind in Teesside, England, later this year. A commercial-scale plant in the US is expected to come online in 2018.

Alan Shaw, Ph.D., Calysta President and Chief Executive Officer, said: "We are delighted to partner with the University of Nottingham and CHAIN Biotech to develop the next generation of FeedKind protein.

"FeedKind protein is a natural, safe, high-quality, non-GMO protein source produced by a single cell organism, using a natural, proprietary fermentation process. By replacing fishmeal, fish oil and soy protein concentrate with a nutritious naturally occurring protein, the aquaculture industry can reduce its impact on the environment and on wild fisheries while continuing to grow to feed the world's population.

"Successful completion of this research will result in a step-change in sustainable human nutrition and will be welcomed by the food industry, retailers and consumers globally."

More information is available from:

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## Industrial Biotechnology Research Priority Area

One of the long-term objectives of the SBRC is sustainability. Part of our strategy is to strengthen research in gas fermentation through securing additional funding to investigate new pathways, new applications and new chassis. A further aspect of the strategy is to broaden out our interest in Industrial Biotechnology and Bioenergy (IBB) to create significant critical mass and strength at the cutting edge of Synthetic Biology (SB) and IBB. We are working on building a community in IBB at UoN and building links with industry. We have already held one networking event to stimulate collaborations. In May a further event is scheduled whose focus is to engage academics with industry. Fourteen IBB and SB companies will be coming to the event and there will be presentations from companies and academia to identify industry challenges and routes to addressing those challenges. Through this type of networking event we intend to strengthen our links with industry and make our research increasingly relevant to the Bioeconomy.

## Recent Publications

**1.** The dilemma of raising awareness “responsibly” The need to discuss controversial research with the public raises a conundrum for scientists: when is the right time to start public debates?

Brigitte Nerlich 1,2 and Carmen McLeod 1,2

EMBO Reports 2016 17:4 DOI: 10.15252/embr.201541853

<http://onlinelibrary.wiley.com/doi/10.15252/embr.201541853/abstract>

**2.** Mutant generation by allelic exchange and genome resequencing of the biobutanol organism *Clostridium acetobutylicum* ATCC 824.

Ehsaan M, Kuit W, Ying Z, Cartman ST, Heap JT, Winzer K, Minton NP

Biotechnology for Biofuels 2016 9:4 DOI: 10.1186/s13068-015-0410-0

<https://biotechnologyforbiofuels.biomedcentral.com/articles/10.1186/s13068-015-0410-0>

**3.** Whole genome sequence and manual annotation of *Clostridium autoethanogenum*, an industrially relevant bacterium.

Christopher M. Humphreys, Samantha McLean, Sarah Schatschneider, Thomas Millat, Anne M. Henstra, Florence J. Annan, Ronja Breitkopf, Bart Pander, Pawel Piatek, Peter Rowe, Alexander T. Wichlacz, Craig Woods, Rupert Norman, Jochen Blom, Alexander Goesman, Charlie Hodgman, David Barrett, Neil R. Thomas, Klaus Winzer, Nigel P. Minton

BMC Genomics 2015 16:1085 DOI: 10.1186/s12864-015-2287-5

<http://link.springer.com/article/10.1186%2Fs12864-015-2287-5#page-1>

# Conferences and Workshops

## Warwick Integrative Synthetic Biology Centre WISB-Launch

On 6 & 7<sup>th</sup> April, Louise Dynes and Prof Brigitte Nerlich attended the Warwick Integrative Synthetic Biology Centre WISB-Launch at The University of Warwick. Day 1 of the launch featured talks from industry including; Green Biologics Ltd, DNA2.0inc and Ginkgo Bioworks amongst others, this gave attendees the opportunity to network with industry as well as fellow academics. Day 2 of the event consisted of an academic symposium including keynote speakers and a poster session. It was a well-attended launch event and evident that there is a strong UK synthetic biology research community spirit forming with both academic and industry interest.

WISB has 4 integrated research themes which address specific, industrially relevant design challenges across the scales of biological organizations. This research will help drive advances relevant to pharmaceuticals, high-value and commodity chemicals (HVCCs), treatments for disease, environmental bioremediation and food security.

For more information visit: <http://www.wisb-uow.co.uk/>

## SynbioBeta - London 2016

SynBioBeta London 2016 showcased some really exciting areas of science where synthetic biology is opening up new ways to more efficiently and effectively create sustainable solutions for many real-world problems. The one area which is still a challenge for synthetic biology is integrating wet and dry science. There is simply not enough wet science data to feed into the metabolic models. However, with Moore's Law continuing to be relevant, with tumbling costs of gene synthesis, and the use of CRISPR / Cas9 technologies being highlighted in almost every scientific talk, offering much quicker routes to generating optimal chassis, there is real hope that the speed of data generation will increase and remove the wet/dry bottle-neck.

For more information about the conference please visit:

<http://synbiobeta.com/conferences/synbiobeta-london-2016/>

<http://synbiobeta.com/>





# Conferences and Workshops

## CALENDAR of Key Synthetic Biology Activities and Events

### 24-25 May 2016

SINAL bio-industrial Event  
Châlons-en-Champagne, France  
<http://meetings.advbe.com/sinal/2016/>

### 14-17 June 2016

Synbiobeta, Beijing, Shanghai & Shenzhen  
<http://synbiobeta.com/synbiobet-a-announces-firstactivate-china-event/>

### 26-30 June 2016

Metabolic Engineering 11, Awaji Yumebutai  
International Conference Center, Awaji Island, Japan  
<http://www.aiche.org/sbe/conferences/metabolicengineering-conference/2016>

### 3-7 July 2016

2016 Synthetic Genome Summer Course,  
University of Edinburgh  
<http://syntheticgenomes.wordpress.com/>

### 4-6 October 2016

Synbiobeta, San Francisco  
<http://synbiobeta.com/conferences/san-francisco-2016/>

### 18-20 October 2016

The European Forum for Industrial Biotechnology and the Bioeconomy  
SECC, Glasgow  
<http://www.efibforum.com/>

## Workshop in Brazil

Thanks to International Partnership Award funding from BBSRC, the SBRC-Nottingham with colleagues from the Universities of Bath and Aberystwyth, has established links with key academic and company researchers in Brazil. We held a first workshop in December 2015 at CTBE, Campinas, Brazil to explore areas of mutual research interest and to identify funding sources to support new research projects in the area of bacterial fermentation for industrial products. Research funding applications have already been made and the next planned step is to exchange early career researchers between Brazil and the UK to further build the collaborative links.

## The 3rd India-UK Workshop

The 3rd India-UK workshop was hosted by the International Center for Genetic Engineering and Biotechnology (ICGEB) in New Delhi on the 11th and 12th March. All partners in RICEFUEL project updated their progress and future work/joint experiments were discussed during the workshop. Dr Lili Sheng and Dr Ying Zhang both gave short talks regarding SBRC research developments in *Geobacillus* and saccharolytic Clostridia. While in their Newton Bhabha placement at ICGEB, 3rd year SBRC PhD students Jennifer Spencer and Rob Habgood also attended the workshop. They have been working with our Indian colleagues over the last three months and really enjoyed it.

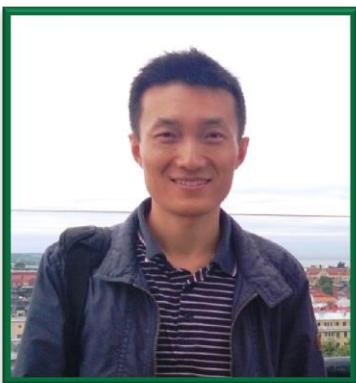


For more information about RICEFUEL visit:  
<http://www.ricefuel.net/>

# New to the Team

## Dr Kai Schuchmann

*"I'm a microbiologist born in Germany and interested in the metabolism of anaerobic bacteria since my first days in science. I studied microbiology in Frankfurt am Main, Germany and worked on the biochemical characterization of a novel type of hydrogenase during my diploma thesis. After a research stay at Yale University, New Haven, USA where I studied incorporation of non-canonical amino acids I moved back to Frankfurt for my PhD thesis. My thesis was focused on the energy metabolism of acetogenic bacteria and their biotechnological application for hydrogen storage. Here, I'm looking forward to combine my biochemical and metabolic experience with the genetic expertise of the group to engineer Clostridium pasteurianum for the production of chemicals from glycerol."*



## Dr Yamming Wing

*"I joined SBRC in January 2016 as a research associate. Studied biochemical engineering during my PhD training, I will be exploring the exciting field of gas fermentation, together with other SBRC researchers. Prior to Nottingham, I was a research scientist at the VTT Technical Research Centre of Finland, doing fermentation process development and optimisation for industrial biotechnology sector. I am very happy to be in such an interdisciplinary work environment and to have the opportunity to learn from many talented minds here. Plus, I have always been interested in English culture and history. I'm looking forward to making many new friends and experiencing life in England."*

## Dr Frederik Walter

*"I recently joined the School of Life Sciences as a Research Associate in the Synthetic Biology Research Centre after completing the CLIB doctoral programme in Industrial Biotechnology, which is a joint initiative between three German universities. I conducted my previous research at the Center for Biotechnology (CeBiTec) at Bielefeld University, in which I focused on the functional genome analysis and metabolic engineering of Corynebacterium glutamicum for the production of L-arginine and other amino acids. I developed LC-MS methods for metabolome analysis and contributed to the development of LC-MS analysis software with special emphasis on the use of stable isotopes for improved metabolite identification and quantitation. During my masters studies in Genome-Based Systems Biology, I was a member of the first Bielefeld iGEM team in 2010, and had a research stay at the Institute of Systems Biology at ETH Zurich. Now I am looking forward to apply my experience in OMICS analysis in order to contribute to our understanding of Cupriavidus necator physiology and transform this organism into an efficient chemical production platform strain."*



# New to the Team

## James Fothergill

*"I have recently joined the school of Life Sciences as a research technician in the Synthetic Biology Research Centre. Since graduating from the University of Salford with a BSc Honours degree in Chemistry with studies in North America, I have spent about twenty years working in analytical chemistry laboratories mainly looking at the analysis of organic pollutants by Gas Chromatography-Mass Spectrometry. Later I worked for the University of Lincoln firstly within the National Centre for Food Manufacturing (NCFM) and then the Department of Chemistry looking at the analysis of novel psychoactive substances ("Legal Highs"). I am currently writing up an MSc by research based upon my work for NCFM. I am looking forward to helping out and learning from my new colleagues."*



## Dr Mohit Dalwadi

*"I recently joined SBRC as a Postdoctoral Research Fellow on the dry side, and will be formulating and solving mathematical models for a range of physical topics encountered within the group. My initial work has involved modelling metabolic pathways."*

*Before coming to SBRC, I held a postdoctoral position at the University of Oxford, where I also obtained a PhD in Applied Mathematics. In my postdoctoral work I studied membrane filtration, and in my PhD I investigated the fluid mechanics of a biological experiment used to grow artificial body tissue."*

## Matt Abbott

*"I started at the SBRC full-time at the start of 2016 as a Research Technician to co-manage the analytics lab. I did my undergraduate degree in Biomedical Science at the University of Sheffield and followed that up with an MSc in Neuroscience at Nottingham Trent University. Previously I've worked in admin within the clinical trials industry and as an analytical technician in a pharmaceutical quality control laboratory. In my spare time I enjoy obsessing over music, trying to see as many films as I can at the cinema, and hopelessly following Liverpool FC. I am excited about the challenges and experiences of working in an academic lab and am looking forward to working with and getting to know you all."*



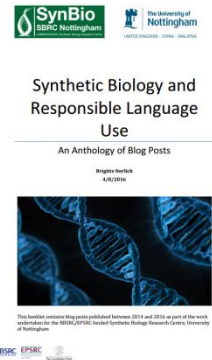


# RRI & Outreach Activities

## Blogs Blogs Blogs!

Responsible Research and Innovation lead; Prof Brigitte Nerlich has combined all her recent synbio blog posts into an anthology which can be found at:

<http://sbrc-nottingham.ac.uk/perch/resources/blogbooklet2016finalpdf.pdf>



## Nottingham European Student Parliament

Some half term fun was to be had when SBRC members Dr Klaus Winzer, Prof Brigitte Nerlich and Bart Pander became "expert witnesses" at Nottingham's local "European Student Parliament" held in the Council House, Nottingham on 18-19 February 2016.

This Europe wide project is coordinated by Wissenschaft im Dialog and funded by the Robert Bosch Foundation and Bayer Science & Education Foundation with aim of promoting scientific exchange between young people. It involves 17 local parliaments across the breadth of Europe from Cork to Jerusalem, with one at Nottingham!!

In each parliament, students between the ages of 16 to 19 had the chance to discuss issues and questions on the overall topic "The Future of the Human Being" with experts on hand. In July 2016, the final 3 day event of the 'European Student Parliaments' will take place in Manchester as part of the EuroScience Open Forum 2016 (ESOF) and will involve around 100 student delegates from all over Europe. More information can be found here: <http://www.student-parliaments.eu/>



## Science in the Park 2016!



On Saturday 19th March, Science in the Park took place at Wollaton Hall in Nottingham. More than 7,000 people attended the event! The SBRC-Nottingham and C1net hosted an activity stand called "Synbio Bugs". Demonstrators from the group engaged younger children with making model microbes from Plasticine which they took home in Petri dishes. They went away happy with an "I ♥ Microbes" sticker and the message that not all microbes are bad. They also had a go at isolating bacteria using pretend bacteria made from Plasticine in our mock anaerobic cabinet.





# RRI & Outreach Activities



Older children learned about gas fermentation from a bioreactor we had on display and PhD students Christian Arenas and Sophie Vaud gave DNA extraction from fruit demonstrations which were very popular! *"Many thanks go out to all those who volunteered at our stand and helped make the day so successful."* Louise Dynes (SBRC Outreach & Communications Officer)



## SBRC Microbes Learning Journey

Louise Dynes (SBRC Outreach & Communications Officer) recently organized a microbes learning journey for year 5 & 6 pupils at Henry Whipple Primary School in Nottingham. The learning journey took place over a month with 3 visits to the school by scientists from the SBRC. The activities carried out during the visits were agreed between teachers and scientists beforehand in order to support the schools' curriculum and showcase the expertise of the scientists, as well as excite pupils about the topic of microbiology and raise aspirations.

Visit 1: Each scientist spent the whole afternoon with a class, introducing themselves and the subject of microbiology. They enabled the pupils to each take a Petri dish containing agar and swab a part of their classroom. Pupils decided what to swab, choosing books, doors, light switches, and much more! Scientists then took away the Petri dishes to incubate them and note microbial growth. The pupils were asked to research a famous scientist and present this to the group during the next visit.



Visit 2: The pupils presented what they found about their scientist and one group made a song about what they had found out! The scientists presented the class with images of the growth since last visit, and discussed what could be seen. The pupils also had a go at streaking out plates using our mock anaerobic cabinets and jelly filled Petri dishes!

Visit 3: During the final visit to the school, the pupils had a go at making a microbe from craft materials with help from the scientists. They also give their microbe a name; decided whether it was good or bad and where it lived.



*"The learning journey was a great success, I would like to thank everyone who took part and for their hard work, we have had some really positive feedback from the school and they would like us to come back"* Louise Dynes (SBRC Outreach & Communications Officer).