

2024 Summer School in Applied Molecular Microbiology Report

This was the tenth John Innes/Rudjer Bošković Summer School in Applied Molecular Microbiology and was held between the 7th and 14th September 2024 in the historic UNESCO World Heritage Site Croatian city of Dubrovnik.

The first in this series of summer schools was held in 2007 at the Mediterranean Institute for Life Sciences (MedILS) in Split. Eight of the following schools (in 2008, 2010, 2012, 2014, 2016, 2018, 2022 and 2024) took place at the [Inter-University Centre \(IUC\) in Dubrovnik](#), while the 2020 event took place on-line. Summer School alumni now number around 450, many of whom are now Principal Investigators.

The co-directors of the course were Mervyn Bibb, Barrie Wilkinson, Matt Hutchings and Andy Truman from the John Innes Centre, Greg Challis from the University of Warwick and Monash University, and Duška Vujaklija of the Rudjer Bošković Institute.

In addition, the internationally recognised faculty consisted of Lona Alkhalaf (University of Warwick, UK), Katharine Duncan (University of Newcastle, UK), Marie Elliot (McMaster University, Canada), Paul Jensen (Scripps Institution of Oceanography, USA), Roberto Kolter (Harvard University, USA), Flavia Marinelli (University of Insubria, Italy), Mônica T. Pupo (University of Sao Paulo, Brazil), Gerry Wright (McMaster University, Canada) and María Mercedes Zambrano (Corporación Corpogen, Colombia). Administrative support was provided by Naomi Wang and Sarah Tolland (from the John Innes Centre).

Financial support for the Summer School from the Boehringer Ingelheim Stiftung is gratefully acknowledged.

Course content, participants and faculty

The summer schools were founded to recognise the growing interest in microbial metabolites that resulted from recent developments in sequencing technology, bioinformatics and chemical analysis, coupled with the need for new natural products with applications in medicine (for example, as much needed antibiotics) and agriculture.

A particular aim is to make connections between the roles of small molecules in microbial communities, including cell-to-cell signalling and interactions between microbes and other inhabitants of their ecological niches, and the exploitation of the metabolites as drugs and other pharmaceuticals.

The following lectures were presented:

The wonderful world of microbes and their specialised metabolites
Natural product discovery and development
Natural product biosynthesis 1: An overview and polyketide biosynthesis; Introduction to the computer workshop
Practical purification and characterisation of microbial specialised metabolites
Natural product biosynthesis 2: Peptides and alkaloids
Control of natural product biosynthesis
Specialised metabolism in Gram-negative bacteria
Combined 'omics approaches to biodiscovery
Chemical ecology of insect-microbe symbiosis
Phylogenetic approaches to natural product discovery

Specialised metabolites and host-microbe interactions
Ecology and antimicrobial resistance
Ecological interactions
New methods for natural product discovery
Resistance-guided antibiotic discovery

The 44 applicants selected for the Summer School were based in 17 different countries from all over the globe, with several additional nationalities represented.

Two minute flash talks and posters

Each student gave a two minute – two slide flash talk to outline their current research followed by detailed discussion at one of three poster sessions. Students and faculty alike thought that this format was highly successful and enjoyable.

Computer workshops

Lona Alkhalaf, assisted by Barrie Wilkinson and Andrew Truman, ran two computer workshops that used bioinformatics tools that are freely available on the internet and that are commonly used for the analysis of specialised metabolite biosynthetic gene clusters. They used a gene cluster encoding a cryptic modular PKS assembly line in the model actinomycete *Streptomyces coelicolor* A3(2) as an example. It taught how to identify putative catalytic domains within the PKS and how to decide whether they are likely to be functional. The substrate specificity of the acyltransferase domains within the PKS were predicted, as well as the stereochemical control imparted by the ketoreductase domains. This culminated in a predicted structure for the fully assembled polyketide chain attached to the final module of the synthase and a hypothesis for the mechanism of chain release from the PKS.

Small Group Discussions

To complement the lectures, students and faculty participated in Small Group Discussions, with the topics chosen by the students. Topics included: Microbial interactions and chemical ecology; Regulation of specialised metabolism; Natural product purification and structural determination; Elucidating enzyme function and mechanism - interrogating biosynthetic protein interactions; Techniques for genetic manipulation; Industry or academia (or both?); Evolution of specialised metabolism; How do we find/develop new antibiotics?; Bioinformatics for natural product discovery.

Summer School attendees 2024



SSAMM
Dubrovnik 2024



In addition to the academic programme, students and faculty were able to continue to discuss science and career development during a relaxing boat trip to the beautiful village of Cavtat and the equally impressive island of Lokrum.



2026

The eleventh summer school in the series will be held at the IUC between 12-20 September 2026 and will be advertised towards the end of 2025.