Erasmus+ Research Placements

in *Life Sciences*

(pharmacy, chemistry, optometry, and archaeology)

2021/2022

(October – December 2021)

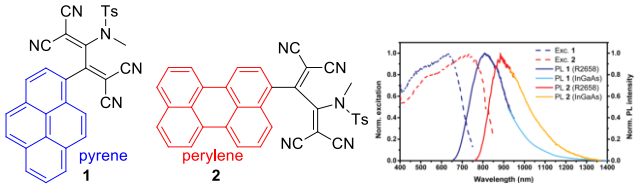
List of research projects:

Project no.	*Title*
1	Liposomal preparation of poorly water-soluble drugs using microfluidics technology **(PI: Dr Mohammad Isreb.** Email: m.isreb1@bradford.ac.uk)
2	Solvent-free melt granulation for solid dosage form formulations **(PI: Dr Mohammad Isreb.** Email: m.isreb1@bradford.ac.uk)
3	Synthesis of Small Organic Near-Infrared Luminescent Molecules **(PI: Dr Anna Wu.** Email: n.wu1@bradford.ac.uk)
4	Regulation of mitogenic signalling in prostate cancer **(PI: Dr Jürgen Müller.** Email: j.muller@bradford.ac.uk)
5	Investigation of effect of compounds of animal origin on the DNA **(PI: Dr Raj Gopalan.** Email: r.c.gopalan@bradford.ac.uk)
6	Development of Biodegradable Porous poly-MOF Composites for Biomedical and Agricultural Applications **(PI: Dr Sanjit Nayak.** Email: s.nayak@bradford.ac.uk; CoIs: Prof. Adrian Kelly, and Dr Maria Katsikogianni
7	Adaptation and community dynamics of the human oral microbiome over centuries of evolution **(PI: Dr Andrew tedder & Dr Conor Meehan.** Email: a.tedder@bradford.ac.uk; c.meehan2@bradford.ac.uk)
8	Experiences during the adaptation of two commercially available myopia contact lenses **(PI: Neema Ghorbani Mojarrad.** Co-I: Lindsay Rountree & Kathryn Webber. Email: n.ghorbanimojarrad@bradford.ac.uk)
9	Building Virtual Heritage Resources for Conservaton, Tourism and Wellbeing **(PI: Dr Adrian Evans.** Email: a.a.evans@bradford.ac.uk)

Project number	1
Project Title	Liposomal preparation of poorly water-soluble drugs using microfluidics technology *(PI: Dr Mohammad Isreb. Email: m.isreb1@bradford.ac.uk)*
Project outline	Liposomal preparations are commonly used in pharmaceutical formulations to enhance solubility of drugs, enhance intracellular uptake or improve permeability. This project will involve formulation of a poorly water-soluble anti-cancer treatment using microfluidics technology. Microfluidics offers the advantages of scalability and continuous manufacturing ability within a closed system.
Activities involved	• Preparation of the liposomal formulations with various levels of the model drug. • Process optimisation to produce homogenous liposomes with sub 100 nm vesicles. • Stability study of the liposomes size and drug content over 3 weeks.
Deliverables	• Documentation of results and final report. • Weekly meetings with the research group. • Presentation of the work in the pharmaceutics group meeting. • Opportunities to learn and practice on microfluidics and imaging techniques such as SEM and to co-author research publications.
Prerequisites	Basic background knowledge of liposomes and emulsions.
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	1
Funding	Selected students will receive an Erasmus+ Grant

Project number	2
Project Title	Solvent-free melt granulation for solid dosage form formulations *(PI: Dr Mohammad Isreb. Email: m.isreb1@bradford.ac.uk)*
Project outline	Melt processes such as granulation or extrusions offers the advantages of scalability and continuous production capability. The lack of solvent reduces the risk of degradation and polymorphic changes. The challenge, however, is to ensure processing the materials within an acceptable temperature and viscosity range. This project will be assessing the behaviour of polymeric formulation based on their mechanical and rheological properties under a range of temperature and shear forces similar to those experienced during extrusion. Thermomechanical and rheological properties of incorporating various additives will be also evaluated.
Activities involved	• Preparation of the formulations with various levels of additives.

	• Thermomechanical and rheological evaluation of the performance of the formulation. • In vitro drug release studies
Deliverables	• Documentation of results and final report. • Weekly meetings with the research group. • Presentation of the work in the pharmaceutics group meeting. • Opportunities to learn and practice thermomechanical and imaging techniques such as DSC, DMA and SEM and to co-author research publications.
Prerequisites	• Basic knowledge of formulation science, polymers and pharmacokinetics is expected. Students with experience in polymeric formulations and drug delivery will be able to take advantage of the advanced characterisation techniques in our lab such as SAXS, WAXS and Raman mapping.
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	1
Funding	Selected students will receive an Erasmus+ Grant

Project number	3
Project Title	Synthesis of Small Organic Near-Infrared Luminescent Molecules *(PI: Dr Anna Wu. Email: n.wu1@bradford.ac.uk)*
Project outline	Luminescent probes that emit visible light with a wave-length of 400–700 nm upon visible light absorption–has been extensively in biomedical research.[1] However, several shortcomings greatly limit the applications of visible light in deep tissues: (1) limited tissue penetration depth; (2) high phototoxicity.[2] Near-infrared (NIR, 700–1700 nm) light has longer wavelength and lower energy, which possesses a minimal tissue scattering and absorption (phototoxicity) and deeper tissue penetration depth in living systems as compared with ultraviolet/visible light, thereby, making it a promising non-invasive tool for in vivo imaging applications. Current NIR fluorophores, *i.e.*, carbon nanotubes, quantum dots and polymer nanoparticles[3] are large in size and sometimes perturb bioactivity of luminescence–labelled drugs as a result of the structural modifications. Thus, the design of compact small organic NIR-luminophores undoubtedly remains a challenging task that may provide considerable advance in deep-tissue imaging. Recently, the Trolez group discovered unusual NIR small organic fluorophores  **Figure 1.** Structure of small organic NIR-luminophores tetracyanobutadienes that emit light in the solid state in the NIR-I-to-NIR-II

	region: *i.e.* excitation is performed in the NIR-I (700-1000 nm) window while emission is detected in the NIR-II (1000–1700 nm) window (Figure 1).[4] This feature is remarkable due to the small HOMO–LUMO energy gap and the aromatic frameworks that might determine the nature of the low excited state. **Hypothesis** Inspired by this, we propose to synthesize a novel type of compact small organic NIR-luminophores which bear a strong electron-donating amino group that would contribute to a narrower HOMO-LUMO energy gap and thus will improve their luminescence in solution, shifting it into the NIR range! **Reference**: 1. E. C. Greenwald *et al.*, *Chem. Rev.,* **2018**, ***118***, 11707. 2. G. S. H *et al., Nat. Biomed. Eng.,* 2017, **1**, 10. 3. G. Chen *et al.*, *Adv. Sci.*, 2020, **7**, 19037 4. Yann Trolez *et al.*, *Chem. Commun.*, 2020, **56**, 3571.
Activities involved	• Synthesis of fluorescent molecules and their precursors - ynamines. • Study their optimal properties (fluorescent absorption and emission).
Deliverables	• Documentation of results and final report. • Weekly meetings with the research group. • Presentation of the work in the synthesis group meeting. • Opportunities to learn and practice NMR, spectra and imaging techniques
Prerequisites	• Basic knowledge of formulation science, organic synthesis and catalysis is expected. Students with experience in organic synthesis will be able to take advantage of the advanced synthetic skills in our lab such as Schlenk line technique, anhydrous anaerobic operation.
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	1
Funding	Selected students will receive an Erasmus+ Grant

Project number	4
Project Title	Regulation of mitogenic signalling in prostate cancer *(PI: Dr Jürgen Müller. Email: j.muller@bradford.ac.uk)*
Project outline	Prostate cancer is one of the most common causes of cancer death in men and limited treatment options exist for advanced prostate cancer. The cause of the cancer is likely multifactorial and involves changes in cell proliferation and cellular metabolism. Zn2+ is an essential metal ion that plays a highly specialized role in prostate physiology. Zn2+ levels are particularly high in normal prostate cells, which leads to specialized changes in their metabolism to support their function. On the other hand, Zn2+ levels are dramatically reduced in prostate cancer, which leads to a more energy-efficient metabolic state. Interestingly, Zn2+ has also been shown to reduce cellular MAPK signalling, a major driver of cellular proliferation. We therefore hypothesize that the loss of Zn2+ in prostate cancer leads to a reduction in MAPK inhibition, thus leading to an increased proliferative capacity of the prostate cancer cells.

	This project seeks to investigate the molecular mechanisms by which Zn2+ suppresses the proliferative (mitogenic) signalling in prostate cells and how this suppression is lost in prostate cancer. This information can ultimately be used to improve the diagnosis of prostate cancer and to define better strategies for re-silencing mitogenic signalling in prostate cancer.
Activities involved	• Growth and pharmacological treatment of prostate cancer cells • Analysis of MAPK signalling using western blotting and related techniques. • Determination of subcellular localization of signalling molecules by confocal microscopy
Deliverables	• Documentation of results and final report. • Regular meetings with the research group. • Presentation of the work in group meetings. • Obtain skills in cell biological and biochemical methods and advanced imaging techniques by performing hands-on laboratory experiments.
Prerequisites	• Basic knowledge of cell biology and biological molecules. Basic understanding of experimental laboratory work.
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	1
Funding	Selected students will receive an Erasmus+ Grant

Project number	5
Project Title	Investigation of effect of compounds of animal origin on the DNA *(PI: Dr Raj Gopalan. Email: r.c.gopalan@bradford.ac.uk)*
Project outline	Genotoxicity is one of the important causes of cancer. It refers to the ability of a substance to cause damage to the genetic material within the cell. There are several compounds in nature that can cause damage to the genetic material and others capable of protecting the genetic material from damage. This project will be investigating the genotoxic/genoprotective effect of compounds of animal origin in different cell lines using Comet assay. The identification of genotoxic/genoprotective properties of compounds would be useful in protecting humans against undesirable effects of these compounds and identification of genoprotective compounds would be useful in the fight against cancer
Activities involved	• Cell culture • Comet assay • In vitro genoprotection/genotoxicity
Deliverables	• Documentation of results and final report. • Weekly meetings with the pharmacology research group. • Presentation of the work in the pharmacology group meeting.

	• Opportunities to learn and practice cell culture, comet assay and to co-author research publications.
Prerequisites	• Basic knowledge of cell culture and microscopy and experience of working in a tissue culture lab following all the health and safety regulations.
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	1
Funding	Selected students will receive an Erasmus+ Grant

Project number	6
Project Title	Development of Biodegradable Porous poly-MOF Composites for Biomedical and Agricultural Applications *(PI: Dr Sanjit Nayak. Email: s.nayak@bradford.ac.uk; CoIs: Prof. Adrian Kelly, and Dr Maria Katsikogianni)*
Project outline	Porous metal-organic frameworks (MOFs) are a class of materials that shows high adsorption capacities for small guest molecules due to their extremely high surface areas. Besides many other applications, MOFs have recently been studied extensively for drug delivery. However, their limited stability has been identified as one of the critical barriers for practical applications. This problem can be mitigated by developing polymer-MOF composites which can improve stability of the MOFs with added processability for use in biomedical and agricultural applications. This project will involve synthesis of MOFs and then preparing and optimizing biodegradable polymer-MOF composites for drug and pesticide delivery applications. A range of known MOFs will be identified based on their porosities and suitability for biological/environmental applications. The composite materials will be characterised by a wide range of analytical techniques, and loading and release of selected drugs and pesticides will be studied towards the end of the project.
Activities involved	• Synthesis of MOFs and biodegradable polymers. • Blending and optimising the above two components to prepare a polymer-MOF composites. • Characterization of all materials and testing of the poly-MOF composites for drug/pesticide delivery.
Deliverables	• Detailed documentation of works. • Weekly meetings with the research group. • Presentation of the work in group meeting. • Prepare a draft report that can contribute towards a potential publication.
Prerequisites	• Basic knowledge of chemistry, and knowledge/experience about polymers and will be additional advantage. • Any knowledge on analytical techniques will be useful.
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end

Places available	1
Funding	Selected students will receive an Erasmus+ Grant

Project number	7
Project Title	Adaptation and community dynamics of the human oral microbiome over centuries of evolution *(PI: Dr Andrew tedder & Dr Conor Meehan. Email: a.tedder@bradford.ac.uk; c.meehan2@bradford.ac.uk*)
Project outline	The human microbiome is composed of two categories of microbes: commensals (beneficial to the host) and pathogens (detrimental to host health). While much analysis has been done on modern samples in relation to composition, commensal recruitment, pathogen establishment and environmental factors, little is known about the historical evolution of the human microbiome, how commensals and pathogens have co-evolved over the years and how the genetic and metabolic interdependencies allow for both to adapt. Understanding these three aspects of the human microbiome (evolution, adaptation and interconnectedness) would better allow us to examine the effect of diet and human health on our resident microbes and in turn understand how shaping the microbial community in our bodies could better benefit our health. This project aims to address these questions, focussing on the human oral cavity microbiome. Using dental calculus microbiome whole genome data collected over 5000 years from Yorkshire archaeological skeletons, we will reconstruct the evolution of the human oral microbiome in Northern England and examine the influence of diet, antibiotic exposure and urbanisation on this community
Activities involved	• Data curation and quality control • Classify metagenomic sequence at the phylogenetic and functional levels
Deliverables	• Documentation of results and final report. • Weekly meetings with the research group. • Presentation of the work at group meetings. • Opportunities to develop skills in handling and analysing big data, and to co-author research publications.
Prerequisites	• Background in either Evolutionary Biology or Microbiology would be useful. • Experience of bioinformatic analysis a plus.
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant

Project number	8
Project Title	Experiences during the adaptation of two commercially available myopia contact lenses *(PI: Neema Ghorbani Mojarrad. Co-I: Lindsay Rountree & Kathryn Webber. Email: n.ghorbanimojarrad@bradford.ac.uk)*
Project outline	Soft daily disposable contact lenses for myopia (short-sightedness) management have been licenced recently in the UK. They use specialised peripheral optics to implement defocus in the peripheral vision, which can reduce the progression of myopia. A study looking into experiences of participants wearing two myopia management contact lenses found that although the lenses performed evenly in comfort and vision, and had similar reported overall satisfaction scores through the sample, 50% of participants reported a strong preference for one of the lens types over the other (≥25% difference when satisfaction was expressed as a percentage). Of this 50%, half preferred one lens, and half preferred the other. However, this sample only assessed experience over the course of the first day of wear, and was not able to identify any specific factors that would indicate which lens would be preferred by a particular participant. This project aims to investigate this preferred difference further, by performing a randomised cross-over study of these lenses over the course of several weeks.
Activities involved	• Recruit established contact lens wearers into the study. • Perform optometric measures and tests on participants. • Conduct statistical analyses to identify lens preference and any factors associated with preferred lens choice on the collected data sample
Deliverables	• Weekly progress meetings. • Anonymised participant data within a spreadsheet. • A project report including any relevant analyses • Opportunities to learn and practise clinical research and co-author manuscripts for peer-review.
Prerequisites	• An optometry student would be well suited for this project. Any student who is enthusiastic about research and wants to experience clinical data collection would be ideal.
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	1
Funding	Selected students will receive an Erasmus+ Grant

Project number	9
Project Title	Building Virtual Heritage Resources for Conservaton, Tourism and Wellbeing *(PI: Dr Adrian Evans. Email: a.a.evans@bradford.ac.uk)*
Project outline	Heritage is an important element of culture and spaces places and objects. Heritage often become centre points for celebration of those cultures, tourism, and as a tool for improving wellbeing. A track record of research

	excellence at Bradford has created a hub around the creation of 3d resources and the facilities to explore virtual reality. Work to date on this has been utilised in the museum sector and in the international aid sector. This project will increase this capacity and explore new uses of datasets from the Jordan Museum and from heritage assets around the region (Jordan, Syria, Lebanon, Iraq)
Activities involved	• Auditing 3d models of objects and sites (Quality control) • Optimisation of models for different use cases • Creating virtual resources for use in VR and AR applications • Testing and capturing feedback on these resources ahead of distribution
Deliverables	• Documentation of QC pathways • New assets for mixed use cases • Virtual environments of 1) real locations, 2) personalised museum experiences • Assets for Oculus/Vive etc
Prerequisites	• Computer science background. Experience in unity/unreal or of a range of 2D and 3D Multimedia software such as 3D Maxs, Unity, Blender, Cinema 4D, Toon boom, and the Adobe Suite collection. • Interest in archaeology/heritage or historic architecture
Level:	Undergraduate and Postgraduate
Recognition	The participant will receive a certificate of participation at the end
Places available	2
Funding	Selected students will receive an Erasmus+ Grant