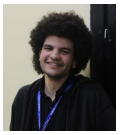
SSPC Research Ireland Centre for Pharmaceuticals

Biopharma Spotlight Part 1

Since the approval of the first monoclonal antibody Orthoclone OKT3 in 1986, our deepening understanding of these medicines combined with our ability to design and deliver them safely and efficaciously has positively impacts millions of lives worldwide. As our knowledge expands, so do the possibilities. New horizons for drug design, enhanced manufacturing techniques, and novel delivery methods are constantly emerging. Here at SSPC, our researchers are at the forefront of this revolution. Through our collective expertise and ability to drive multidisciplinary, collaborative research, we are making exciting discoveries that are shaping the future of medicine. This spotlight highlights just a few of the innovative projects where we're tackling challenges and driving innovation in the biopharmaceutical landscape.

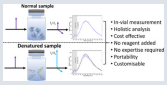
Spectroscopic Insights into the Behaviour of Lyophilised Biopharmaceuticals





Prof. Abina Crean
Dr Sonja Vucen
Dr Khaled Elkassass (PhD)
University College Cork

Protein therapeutics provide invaluable treatments for illnesses including rheumatoid arthritis and cancer. These therapies are administered as injections or infusions and manufactured as sterile solutions commonly in glass vials. Due to their relative instability, proteins can unfold or form aggregates when stored or handled incorrectly resulting in a reduction or loss. Therefore, monitoring protein stability is a critical aspect of therapeutic protein development, manufacture, and distribution. This research developed a novel spectroscopic method to monitor protein stability within glass vials. Previous methods were destructive requiring the removal of samples from product vials and analysis in quartz containers. The research here informed the design of instrumentation to detect protein aggregation by UV light scattering and protein unfolding via fluorescence anisotropy without the need to remove the sample from the vial. Analysis of the protein therapeutic within the vial provides a snapshot of protein stability in real-time without breaching product sterility. Protein unfolding and aggregation can be monitored simultaneously without the requirement of sample dilution or additional reagents. The technique can be further developed as handheld devices to monitor biopharmaceutical product stability from the point of manufacture to patient administration.



In-Vial Detection of Protein Denaturation Using Intrinsic Fluorescence Anisotropy. Chullipalliyalil, K. **| , Elkassas, K.,| McAuliffe, M. A. P., | Vucen, S., | Crean, A.M.** *(2023) Analytical Chemistry, 95 (5) 2774-2782.*

Predictive Modelling of Peptide-based Therapeutics: A Way to Accelerate Biopharmaceutical Design and Formulation Development


Prof. Damien Thompson
Dr Shubham Vishnoi (PhD)
University of Limerick

The focus of this project was to develop the computational modelling of peptide-based therapeutics for next-generation biopharmaceutical formulation design. This provides better peptide-based drug design rules to address the challenges faced by synthetic marketed drug formulations. The design and assembly of peptide therapeutics using high-performance computing-enabled modelling techniques can overcome issues with stability and membrane permeability in vivo. One of the drugs examined in this research is a chemotherapeutic prodrug for somatostatin receptors. It also incorporated work on peptide modelling for the management of diabetes, obesity and hypertension.

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Computational Peptide Design Cotargeting Glucagon and Glucagon-like Peptide-1 Receptors. Shubham Vishnoi | Shayon Bhattacharya | Erica M. Walsh | Grace Ilevbare Okoh | **Damien Thompson.** *(2023) Journal of Chemical Information and Modeling, 63, 15, 4934-4947.*

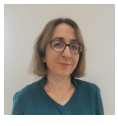
Non-Destructive ID Method for Frozen Bulk

sanofi


Prof. Sarah Hudson
Dr Mahendra Shukla (PhD)
University of Limerick

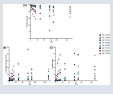
Many products have a frozen intermediate step for drug substance (DS) prior to Fill Finish Manufacturing, often DS is shipped in multiple containers from the DS site to the drug product (DP) site and as per the orange guide for parenteral biopharmaceuticals, each container is required to be identified. This usually requires liquid state sampling and testing by HPLC or Dot Blot for example. Opportunities to ID the frozen bulk would provide a significant improvement to the manufacturing process. This project addresses commercial challenges for Fill Finish Manufacturing of Lyophilised Biopharmaceuticals by the development of an in situ analytical method compliant with the orange guide requirements for ID.

Assessment of Solid-State Stability During Storage, Manufacturing, and Administration as a Means of Predicting In-Vivo Performance of Peptide Tablets




Prof. Abina Crean
Andrew Fagan (PhD)
University College Cork

Currently, there is a lack of literature on the processibility of insulin for tabletting. This research programme aims to offer an insight into the field of tabletting peptide drugs by investigating the development of a direct compression formulation for the production of insulin tablets with a focus on maintaining solid state stability during storage and manufacturing. It looks at the efficacy of the minitablets in biorelevant dissolution media in in-vitro conditions. The project also examines the interaction of insulin with other commonly used tabletting excipients which is important for understanding insulin absorption in the gastrointestinal tract.



Kinetics of human insulin degradation in the solid-state: an investigation of the effects of temperature and humidity. Fagan, A., | Bateman, L.M., | O'Shea, J.P., **| Crean, A.M.** *(2025) J Pharm Sci, 114 (2), 1368-1375.*

Towards the Rational Design of Biopharmaceutical Drugs: Formulation and Stability of mRNA and mRNA Lipid Nanoparticles


Assoc. Prof. Steven Ferguson
Dr Aswathy Balakrishnan (PhD)
Dublin City University

The stability of mRNA during long term storage has always been a challenge. Here, solid state hydrogen-deuterium exchange with mass spectrometric analysis (ssHDX-MS) of protein formulations coupled with mechanistic modelling and analysis of mRNA and mRNA lipid nanoparticles (LNP) is explored with a view converting mRNA to solid state in order to improve stability. The work involved modelling the biexponential behaviour of deuterium uptake observed during the ssHDX process, studying the RNA-excipient interactions using ATR-FTIR. It studies the physical and chemical stability and degradation of mRNA-LNPs and analyses the effect of lyophilisation and freeze-thaw on mRNA-LNP stability. There is potential for impact for the production of mRNA-LNP vaccines.

The Monitoring and Optimization of Cell Culture Medium Preparation to Support Bioprocess Intensification


Dr Jessica Whelan
Claire Boles (PhD)
University College Dublin

In collaboration with Canty, this research project investigates the monitoring and optimization of cell culture medium preparation to support bioprocess intensification. Using the Canty image analysis system as a tool, it aims to determine the endpoint of dissolution in media prep. The project will develop a process analytical technology (PAT) tool that will enable a fundamental understanding of media prep processes. Insilico experiments are performed to propose an optimisation strategy that will ensure robust, reliable media prep at scale.

Meet the SSPC Researchers

Professor Abina Crean
Professor Anne Moore
Professor Andrew Kellett
Professor Lidia Tajber
Professor Brendan Griffin
Professor Damien Thompson
Professor Sarah Hudson
Professor Jakki Cooney
Associate Prof. Ioscani Jimenez del Val
Associate Prof. Emmet O'Reilly
Associate Prof. Steven Ferguson
Associate Prof. Constantina Papatriantafyllopoulou
Associate Prof. Jessica Whelan
Associate Prof. Luis Padrela
Associate Prof. Joanna McGouran
Associate Prof. Paula Meleady
Dr Marco Monopoli
Dr Sonja Vucen
Dr Katie Ryan

Commercialisation

Associate Prof. Ioscani Jimenez del Val
University College Dublin

The GlyvantisBio solution is a proven, robust cell engineering technology that maximizes monoclonal antibody (mAb) galactosylation. This peak galactosylation enhances product consistency, improves the therapeutic function, and enables precise control over the pharmacokinetic and pharmacodynamic properties of therapeutic mAbs to deliver a new generation of optimised cancer therapies.

Associate Prof. Emmet O'Reilly
University of Limerick

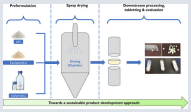
Developing a unique Process Analytical Technology (PAT) tool capable of providing "contactless" scientific measurements. Designed for use in sterile environments such as biotherapeutic manufacturing it provides real time information facilitating reduced manufacturing times, improved process consistency and enhanced regulatory compliance.

Further Publication Highlights

Monosaccharide coatings on nanoparticles affect protein corona formation but not the interaction with their binding receptor. Clemente, E.| Mateu, R.| Ferreira, A.| Ludtke, T.| Lopez, H.| Moya, S.E.| Lay, L.| Soliman, M.G.| **Monopoli, M.P.** *(2025) Frontiers in Nano Technology. 6.1505757.*

Advancing algorithmic drug product development: Recommendations for machine learning approaches in drug formulation. Murray, J.D.| Lange, J.J.| Bennett-Lenane, H.| Holm, R.| Kuentz, M.| O'Dwyer, P.J.**| Griffin, B.T.** *(2023) European Journal of Pharmaceutical Sciences. 191, 106562.*

Automated assembly of hybrid dynamic models for CHO cell culture processes. Doyle, K.| **Tsopanoglou, A.| Fejér, A.| Glennon, B.| del Val, I.J.** *(2023) Biochemical Engineering Journal. 91, 108763.*



The challenge of downstream processing of spray dried amorphous solid dispersions into minitablets designed for the paediatric population – A sustainable product development approach. Autzen Virtanen, A.| **Myślińska, M.| Healy, A.M.|** Power, E.**| Madi, A.|** Sivén, M. (2024) European Journal of Pharmaceutical Sciences. 196, 106752.