UQ Summer Research Project Description

Please use this template to create a description of each research project, eligibility requirements and expected deliverables. Project details can then be uploaded to each faculty, school, institute, and centre webpage prior to the launch of the program.

Project title:	**Sustainable wound dressing made using spray nebulisation of bioactive materials**
Hours of engagement & delivery mode	For the Summer program, students will be engaged for 6 weeks only. Hours of engagement must be between 20 – 36 hrs per week and must fall within the official program dates (13 Jan – 21 Feb 2025). Please outline if the project will be offered on-site, remotely or through a hybrid arrangement- **On-site**
Description:	Wound healing is a complex process requiring an optimal environment to promote tissue regeneration and prevent infection. Hyaluronic acid (HA), a naturally occurring biopolymer, has gained significant attention in wound care due to its hydrating, anti-inflammatory, and tissue-repairing properties [1]. Traditional methods like electrospinning have been employed to incorporate HA into bandages, but they have limitations, including the potential denaturation of sensitive biomolecules, limited scalability, and high production costs [2-4]. This project aims to explore spray nebulisation as a superior alternative for producing HA-loaded bandages. Spray nebulisation offers several advantages, such as maintaining the integrity of HA, enabling uniform coating, and being more scalable and cost-effective. However, making a pure blend of HA and spraying it onto surfaces is challenging. Therefore, this project seeks to demonstrate the formulation development of HA blended with synthetic polymers such as Poly Caprolactone (PCL), etc. The formulation development aspect will explore two key formulation attributes that are conducive to the spray nebulisation process: (a) flow mechanics using Rheology, (b) mechanical strength using Texture analyser. This project would demonstrate that formulation rheological attributes are critical in the nebulisation, that consequently produce HA-loaded wound dressing with enhanced wound healing properties, better structural integrity, and greater commercial viability. 1. Longinotti, C., The use of hyaluronic acid based dressings to treat burns: A review. *Burns & trauma* **2014,** *2* (4), 2321-3868.142398. 2. Augustine, R.; Kalarikkal, N.; Thomas, S., Electrospun PCL membranes incorporated with biosynthesized silver nanoparticles as antibacterial wound dressings. *Applied Nanoscience* **2016,** *6*, 337-344. 3. Miguel, S. P.; Figueira, D. R.; Simões, D.; Ribeiro, M. P.; Coutinho, P.; Ferreira, P.; Correia, I. J., Electrospun polymeric nanofibres as wound dressings: A review. *Colloids and surfaces B: Biointerfaces* **2018,** *169*, 60-71. 4. Miguel, S. P.; Sequeira, R. S.; Moreira, A. F.; Cabral, C. S.; Mendonça, A. G.; Ferreira, P.; Correia, I. J., An overview of electrospun membranes loaded with bioactive molecules for improving the wound healing process. *European Journal of Pharmaceutics and Biopharmaceutics* **2019,** *139*, 1-22.
Expected learning outcomes and deliverables:	**Expected gains from this project:** 1. **Expertise in Formulation Development:** Student will gain hands-on experience in developing and optimising formulations of hyaluronic acid (HA) blended with various synthetic polymers. This will involve understanding the chemical and physical interactions between HA and these polymers, which are crucial for creating a stable and effective blend suitable for spray nebulisation. 2. **Advanced Knowledge in Rheology:** Student will learn how to assess and optimise the flow mechanics of different formulations using rheological techniques. This will provide you with an understanding of how rheological properties, such as viscosity and shear thinning, affect the sprayability and uniformity of the HA-loaded bandages.

	3. **Proficiency in Mechanical Characterization:** Student will develop skills in evaluating the mechanical strength of the formulated bandages using a texture analyser. This will involve testing the tensile strength, and durability of the bandages to ensure they meet the required standards for wound dressing applications. 4. **Understanding of Wound Healing Applications:** Student will gain insight into the biomedical applications of HA-loaded bandages, particularly in wound healing. This includes understanding the biological and clinical relevance of the materials you are working with and how your formulations can be translated into real-world healthcare solutions. 5. **Experience in Research Methodology:** Student will learn critical research skills, including experimental design, data analysis, and interpretation of results. This experience will be valuable for future research or industry roles where formulation development and product testing are key components. **Expected Tasks and Responsibilities:** 6. **Formulation Preparation:** Student will be responsible for preparing and optimising blends of HA with the selected synthetic polymers. This will involve adjusting concentrations, solvent systems, and mixing techniques to achieve stable and homogeneous formulations suitable for nebulisation. 7. **Rheological Testing:** Student will conduct rheological analyses of the formulations to determine their flow properties. This includes using a rheometer to measure parameters such as viscosity, shear stress, and flow curves. Your task will be to identify the optimal rheological profile that supports effective spray nebulization. 8. **Mechanical Characterisation:** Student will perform mechanical testing on the HA-loaded bandages using a texture analyzer. This will involve measuring the tensile strength, elongation, and other mechanical properties to ensure the bandages are strong enough for practical use. 9. **Collaboration and Communication:** Student will collaborate with other team members, sharing your findings and contributing to discussions on formulation improvements and process enhancements. Effective communication of your progress and results will be expected throughout the project.
Suitable for:	1) **Understanding of olymer Science**: Understanding the properties and behaviour of synthetic polymers like PCL, PVP, Alginate, PLA, and PU while not critical but a basic understanding is necessary. 2) **Experience in Formulation Development**: This project requires expertise in developing and optimising formulations for specific applications. Candidates with a background in pharmaceutical formulation, biomaterials, or chemical engineering will be well-suited.
Primary Supervisor:	Masood Ali
Further info:	Students can contact me through email: m.ali7@uq.edu.au. I am also open to student contacting me prior to submitting an application.