# Faculty of Science and Engineering

**2021 Australian Government Research Training Program Scholarships**

**Strategic Project Profile**

**PROJECT TITLE:** Bioactivity-informed optimisation of pilot-scale process for lupin gamma-conglutin purification

**FIELD OF RESEARCH CODE:** 0904

**PROJECT SYNOPSIS:**

Australia is the world's largest lupin seed producer and it is one of our largest legume crops. However lupin is undervalued as sold as animal feed and thus does not attract a premium. Lupin has many advantages for the Australian agri-food system being an ideal rotation crop in the Western Australian wheat belt, where its nitrogen fixation assists with soil quality. Due to its current low value, lupin has lost some favour with farmers, therefore it is vital that value-added human uses are found. Lupins are high in protein and human trials, though limited, have indicated that one protein, γ-conglutin may help in control of blood glucose through hypoglycaemic effects.

CRICOS Provider Code: 00301J

This project is aimed at addressing a major challenge in utilising γ-conglutin, namely, development of an efficient food-grade scalable process to extract and purify γ-conglutin in a cost-effective way. The conventional method for legume protein isolation has been aqueous alkaline solubilisation of the protein from milled kernels, separation of the insoluble fibre residue and acidification of the alkaline extract at the isoelectric point of the globulin fraction. This results in the precipitation of the main classes of globulins, α- and β-conglutins. The protein precipitate is recovered by centrifugation, and then spray dried. However, up to 20% of the alkaline extracted protein is acid soluble and therefore remains in solution after acid precipitation. Further processing to recover this “acid soluble protein” is therefore required to prevent its loss in the waste stream. The acid soluble protein fraction has been reported to be rich in γ-conglutin that is both higher protein nutritional quality than the more abundant acid-precipitated α- and β-conglutins as well as demonstrating glucose-modulating bioactivity. The basic isoelectric point (pI) of γ-conglutin makes it a peculiar protein and difficult to purify, since seed proteins usually have acidic pIs. The protein has been shown to undergo pH related association-dissociation equilibrium between monomeric units and an oligomeric assembly and attempts to crystallise the protein have been unsuccessful. Further, under acidic condition the protein undergoes site specific denaturation, aggregation and loss of activity, thus a careful selection of extraction media as well as purification conditions is required to isolate the native γ-conglutin. Currently a technology for large scale manufacture of high-purity γ-conglutin is not available. We have recently developed a method for selective extraction of conglutin-γ. Compared to reported literature, this method improved the extraction yield. An accurate assessment of γ-conglutin during purification process development has up-to-now been hampered by the lack of an absolute quantitation method for this protein, however we have resolved this by very recently developing and validating an isotope dilution LC-MS method for this purpose. We have further investigated the purification by process chromatography using macroporous adsorption resins and isolated a highly pure fraction of γ-conglutin. For this development, we were awarded the 2017 Curtinnovation award for commercial development in Health Sciences category.

While the process demonstrates possibility of obtaining highly pure γ-conglutin at lab scale, it is still a batch process. There remain a number of challenges and barriers to translating this batch process into continuous process for economic production of large quantities γ-conglutin. These challenges include less flexibility of each production step, careful design and optimization of process conditions to maintain bioactivity, both of which result from long run times. Additionally, process understanding remains relatively poor due to the complex nature of the biological systems. Approaches such as integrated continuous downstream processing need to be explored in order to judiciously translate the batch process to continuous. The PhD project will focus on evaluating various strategies for scale up of the process. The knowledge gained will fill a significant gap in isolation and purification of biological molecules.

The new knowledge obtained from this research could lead to benefits for several sectors of the community. The nutraceutical/biotechnology industry will benefit through new technologies for efficient manufacturing of the glycaemic modulating peptides; the agricultural industry will benefit through greater demand and return on lupin crops; and eventually development of a highly profitable new Australian manufacturing opportunity for γ-conglutin-based nutraceuticals; increased quality-of-life of consumers with high blood glucose.

**FEASIBILITY AND RESOURCING – DESCRIPTION OF THE SUPPORT THIS PROJECT WILL RECEIVE:**

1. ARC-L project LP190100130; “Process development for purification of the bioactive legume protein γ-conglutin as a nutraceutical for maintaining healthy blood glucose levels”
2. Selection of the project area for funding by DVCR as an up-scalable research for Emerging Strategic opportunities

**THE SIGNIFICANCE OF THE PROJECT/ PROGRAM FOR THE ENROLLING SCHOOL OR INSTITUTION:**

West Australian School of Mines: Minerals, Energy, and Chemical Engineering has a very high emphasis on translating academic research into industrial practice. The project is directly relevant to industry and will lead in developing a stronger bioprocessing industry in Australia. Thus it is significant for the school. The project also demonstrates active collaboration between various schools and faculties across the university.

Students must express interest in this scholarship opportunity by emailing the Project Lead listed below. Please provide a copy of your current curriculum vitae and detail your suitability to be involved in this strategic project.

**PROJECT LEAD CONTACT:**

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