

# Findings of a Churchill Fellowship to upskill research and development providers in Australia's emerging pulse protein sector

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## Abstract

The emerging plant protein industry has led to increased research interest in pulse protein. After three years of agronomic research, it was evident there was an opportunity to engage with, learn from, and build collaborative R&D efforts with leaders in this field, internationally. This became the driver for applying to The Winston Churchill Memorial Trust to upskill research and development providers in Australia's emerging pulse protein sector. Prior to undertaking a 5 ½ week study tour to Canada, USA, UK, the Netherlands, and Spain in 2023, key stakeholders and researchers were engaged across the value chain in Australia. Current gaps in knowledge were identified and the objectives of the study were refined. The study tour identified several key research priority areas. This included: increasing the starting protein content of the raw product, methods of reducing off flavours, allergen risks and anti-nutritional characteristics through breeding and processing technologies, and the creation of new high value products from the bi-products (fibre and starch) of the pulse protein manufacturing process. Sharing the knowledge of the Churchill Fellowship aimed to support the growing pulse protein industry in Australia.

## Keywords

Pulse protein, concentrate, isolate, faba bean, field pea, lentil, chickpea, lupin.

## Introduction

The rising consumer awareness of the environmental, animal welfare and health consequences of current western diets has led to substantial demand for sources of plant-based protein. Pulse crops have an important and unique fit in meeting this growing demand. Pulse grains have some of the highest protein percentages of whole grains (ranging from 13% to 35%), which is generally more than double that of wheat as a percentage of dry weight. This in addition to pulses being a nutritionally dense food, a good source of fibre, low in fat, no cholesterol, and has a low glycemic index (Didinger and Thompson, 2022) makes it ideal to address the changes in consumer sentiment.

Pulse grains include 11 recognised categories dry beans, dry broad beans, dry peas, chickpeas, cow peas, pigeon peas, lentils, Bambara beans, vetches, lupins, and pulses nes (those that fall outside the other named categories). Australia is a significant global producer of six; including chickpea (*Cicer arietinum*), lentil (*Lens culinaris*), dry field pea (*Pisum sativum*), lupin (*Lupinus. angustifolius* and *L. albus*), dry faba bean (*Vicia faba*), and mungbean (*Vigna radiata*) (Food and Agriculture Organization of the United Nations, 2023). In Australia, pulse crops are grown on around 1.8 million hectares, with the potential to expand this to 4.2 million hectares (AEGIC, 2021). There is also a recognised need for increased crop diversification from traditional cereal crop dominated production which is due to rising input costs and the impact of climate change. Pulse crops are well positioned to provide a solution to improving the environmental impact of grain production due to their ability to fix nitrogen, this reduces the need for synthetic fertiliser application in the year of production as well as for the following crop (Lasisi and Liu, 2023).

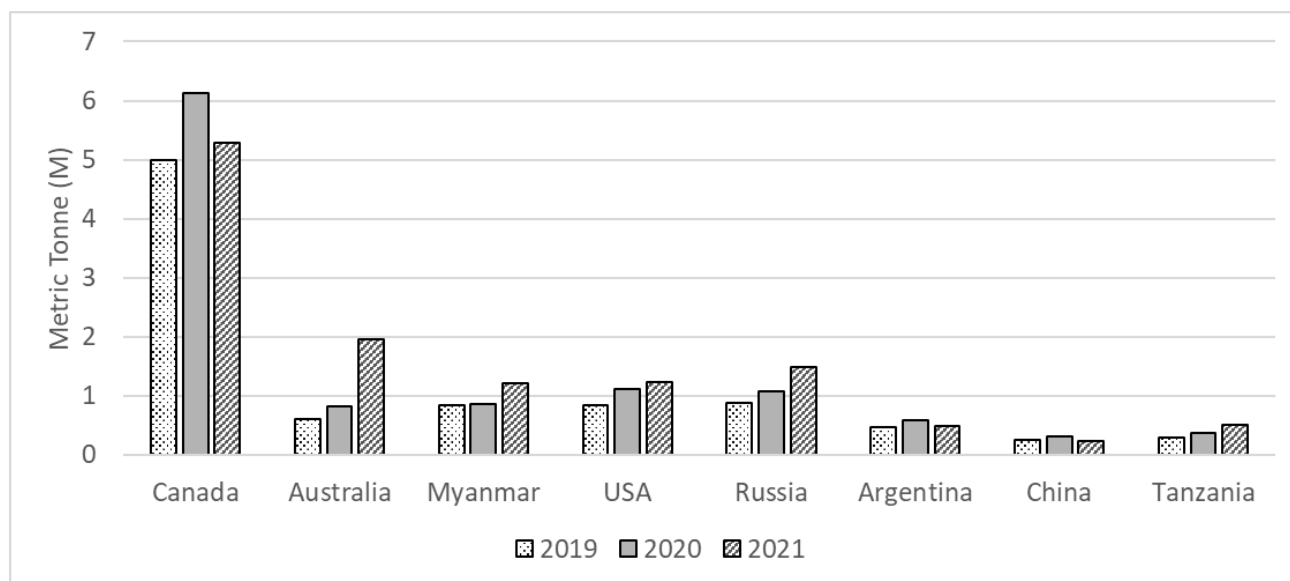
Australia is the second largest exporter of pulse grain globally behind Canada (Figure 1). Driven by market demand, particularly for lentil there was a 140% increase in pulse production in the last 4 years with production reached 4.4 million tonne in 2022-23 (DAFF, 2023). Currently, 55% of pulse crops grown are sold into export markets as whole unprocessed grain. The remaining pulse grain is sold into lower value domestic markets. Of grain exports, over 98% of pulses are exported as a raw product (AEGIC, 2021; Austrade, 2017). This represents a tremendous opportunity for value adding. Food Innovation Australia Limited (FIAL) has estimated that if Australia's protein industry shifts to match the projected global consumption of high-value proteins it could be worth an additional \$AUD55 billion in 2025 compared to business-as-usual (FIAL, 2019).

To capitalise on this potential, the development of the protein industry will require local and international investment in processing facilities in Australia to ensure the value added is retained in the Australian economy. Currently six plant protein ingredient suppliers are based in Australia, with scope to increase

processing capacity to meet local and international growth and demand. The development of this sector will also require significant research and development focused on growing suitable pulse grain and processing efficiencies.

For the last three years, I have been part of a team on a pilot research project focused on understanding the suitability of pulse grain grown in South Australia to the processing and ingredient manufacturing industry. Through this work we have identified genetic variation within different pulse crop types for total protein. Further, we have preliminary indications of environmental factors such as rainfall, frost, background soil rhizobia and rhizobia inoculation that influences grain protein in both faba bean and field pea in contrasting ways.

As we look at further understanding opportunities for improving pulse protein and developing the next phase of research work, it is clear we have a lot to learn by engaging with and building collaborative R&D efforts with leaders in this field, internationally.



**Figure 1. Eight largest countries for international exports of pulse crops for years 2019 to 2021. Data Source: AgriXchange, APEDA (<https://agriexchange.apeda.gov.in/IntTrade>). Accessed 10/09/2023.**

### Methodology

With the support of a Churchill Fellowship, Dr Penny Roberts undertook a 5 ½ week study tour aimed at gathering information and connections to upskill research and development providers in Australia’s emerging pulse protein sector. Prior to commencing the international component of the project, Dr Roberts engaged with key stakeholders and researchers across the value chain to further scope current gaps in knowledge and refine the objectives of the study. This included Australian based fractionation companies Australian Plant Protein, Unigrain and Integra Foods. Also engaged were pulse crop breeders from private and public breeding companies, grain marketers and researchers from government and universities. During her travels, Penny attended 47 meetings with processors, industry bodies, growers and researchers in Canada, the USA, the UK, and the Netherlands. The final component of the tour was attending the 4<sup>th</sup> International Legume Conference in Granada, Spain.

### Conclusion and Recommendations

Whilst there is a slowing of growth and a retraction in some market segments of the pulse protein sector, notably meat analogs, there is still growth in the market. There is an international view pulse protein as an overall market segment will continue to grow, creating opportunities for countries such as Australia. To capture market opportunities for greater levels of on-shore processing, considerable research and government support is needed to create a successful industry that is internationally competitive. A status quo approach will see Australia lose this market sector opportunity to other pulse growing countries that are investing in processing infrastructure. To be competitive, pulse protein products need to be efficiently produced with a low environmental footprint. To achieve this, it will take a whole supply chain approach from breeding through to ingredient manufacturing. Focus and investment into high value usage of bi-products from the manufacturing process will also be important.

One of the reported drivers for the growing interest in plant protein by consumers is the environmental and sustainability credentials of a plant-based diet compared to predominantly animal protein-based diet (Estell et al., 2021). I was interested to understand how different countries were addressing this, if at all. In May 2023, Canada published the National Index on Agri-Food Performance. In addition, Pulse Canada has undertaken lifecycle assessments for key pulse crops pea, lentil, and bean. The reports demonstrated the low environmental impact of Canadian grown pulse crops. It is acknowledged determining the environmental footprint for pulse crops and pulse protein is challenging as each production and processing system is different. The EU has a Farm to Fork strategy aimed at a “fair, healthy and environmentally-friendly food system” (EC, 2020). This strategy includes a legislative framework that is focused on food loss and waste prevention, sustainable food production, sustainable food processing and distribution, and sustainable food consumption. Plant protein plays an important role in achieving this goal. Recently, Australia’s CSIRO has published the “Reshaping Australian Food Systems” report, which presented a roadmap for achieving a healthier, more environmentally friendly, food system. Using the Canadian and EU examples, the development of plant-based protein is cited as an opportunity to create lower emission food products. There needs to be investment into research that supports the reduction of emissions, food loss and waste. Additionally, the development of a framework that allows for the demonstration of environmental credentials will provide Australian based companies with an important market tool. This is something that should be invested in by federal and state governments.

To support local and international processes and manufacturers to invest and develop the industry in Australia there needs to be support from government. An example of how this would be achieved includes:

- setting targets for the level of on shore commodity processing
- strategic research and development investment to achieve these targets, similar to Canada and the EU
- investment in understanding of raw product production and production stability
- supporting access to market and transport
- support access to the required natural resources including water and electricity
- support investment into management and re-use of bi-products and waste

I identified several opportunities for international collaboration and research that could be undertaken to support the growth and development of the pulse protein industry in Australia. Collaboration opportunities for research with key international organisations involved in pulse, canola, and cereal protein research will be advantageous. Currently, the testing and reporting of pulse protein and pulse functional traits have no agreed standards, in fact three different conversion factors for protein were cited. These results therefore cannot be compared within or between different countries. This is further impacted by the use of different preparation methods prior to testing, this includes testing at different moisture contents and different seed preparation (de-hulling vs whole grain vs ground samples both de-hulled and hulls included). Currently, Canada, USA, and Australia are all investing into the development of pulse protein and ingredient databases, this is an obvious starting point for collaboration. It is recommended an international meeting of the research community actively involved in pulse protein (breeders, food and ingredient, and agronomic researchers) with the aim of developing databases with common terms and ideally on common platforms that would facilitate the linking of these databases in the future. This is an important consideration given the challenges and expense faced when industry embarked on the process of trying to retrospectively link pulse breeding databases. A further area of collaboration includes the development of new and high throughput testing for protein and other key functional traits. There is little commercial value in the development of these test methodologies as they will be published in peer reviewed literature. Similarly, the development of framework focused on the environmental credentials of the pulse protein supply chain is an opportunity for collaboration. The global plant-based protein market is competitive. However, in the current development phase there is greater value to be had in collaboration across all aspects of the industry, public and private.

The three main drivers for governments to support the development of this market sector is improved human health, improved environmental footprint, and greater economic value through on-shore processing. Government investment will be critical to long term success and ensure rapid short-term progress. In addition to highlighting areas of research for potential collaboration, I was able to gain insights into several ideas for research project(s) that have the potential to support the growing industry in Australia. Of particular interest were projects that focused on increasing consumption of pulses as part of the everyday diet. There is increasing concern in many developed countries around poor diet and the link to chronic health issues. Pulses offer many benefits including being a nutritionally dense food, a good source of both fibre and protein, low

in fat, no cholesterol, and has a low glycemic index (Didinger and Thompson, 2022). However, many of the ready to eat plant-based products use highly processed ingredients and are at the higher end of price point. To utilise the benefits of pulses to improve human health focus needs to be on including pulses grain with low levels of processing in everyday foods. Additionally, it is important to increase the intake of whole pulses in everyday meals and cooking. Good examples of this approach include the Raising The Pulse project in the UK, Leg4Life in Finland, and the Lentil Learning Hub in the USA. Adopting similar research strategies that link multiple parts of the value chain and focus on improving health outcomes through increased consumption of pulses presents opportunities for transformational change.

The Churchill Fellowship to upskill research and development providers in Australia's emerging pulse protein sector provided me with an invaluable opportunity to fully immerse myself in understanding a complex topic. It allowed me to learn from a range of people and organisations involved in the pulse protein supply chain in the northern hemisphere. It highlighted how much we still have to learn about plant-based foods, and how important this market is in improving human health and the environmental footprint of food production. The Fellowship not only allowed me to learn, but it also provided an opportunity for me to grow my personal networks. As a result of this experience, I am actively sharing my newly gained knowledge and experience to benefit the further development of the pulse protein industry in Australia.

## References

- AEGIC (2021). Pulses. (<https://www.aegic.org.au/australian-grains/pulses>).
- Austrade (2017). Grain, Pulses and Oilseeds. (<https://www.austrade.gov.au/ArticleDocuments/2814/Grains-pulses-oilseeds-ICR.pdf.aspx>).
- DAFF (2023). Insight – Australia is a key global exporter of pulses. (<https://www.agriculture.gov.au/about/news/insight-australia-key-global-exporter-pulses>)
- Didinger C and Thompson HJ (2022). The role of pulses in improving human health: A review. Legume Society, volume 4, issue 4.
- Estell M, Hughes J and Grafenauer S (2021). Plant Protein and Plant-Based Meat Alternatives: Consumer and Nutrition Professional Attitudes and Perceptions. Sustainability, volume 13, issue 3.
- EC (2020). Farm to Fork Strategy. European Commission, Brussels.
- FIAL (2019). Protein Market: Size of the prize analysis for Australia. Food Innovation Australia Ltd Report. ([https://fial.com.au/Protein\\_Report\\_2019/protein-market](https://fial.com.au/Protein_Report_2019/protein-market)).
- Food and Agriculture Organization of the United Nations (2023). FAOSTAT 2021. (<https://www.fao.org/faostat/en/#compare>).