SUSTAINABLE PROTEIN INNOVATION

PROPOSED MANITOBA PROTEIN RESEARCH STRATEGY

Defining Manitoba's Research Ecosystem

Developed by Dr. James House, Professor at the University of Manitoba

Imagine Manitoba as the acknowledged global leader in sustainable protein. Though sustainability is our greatest challenge, it is also our greatest opportunity. The dream is an achievable one.

Industry, academia, government and non-profits are collaborating to make Manitoba the world's preeminent jurisdiction for sustainable protein production. Working together, these stakeholders created the Manitoba Protein Advantage – a comprehensive action plan to accelerate strategic sustainable protein initiatives. The strategy calls for robust work on knowledge and information generation.

Dr. James House, professor at the University of Manitoba in the Department of Food and Human Nutritional Sciences, with the support of Research Associate Dr. Erin Goldberg of the University of Manitoba developed this proposed Manitoba Protein Research Strategy to advance Manitoba's Protein Advantage.

Manitoba already has a robust research ecosystem. With strategic direction and targeted resources, the province can leverage that to become the world leader in sustainable protein innovation. The proposed Manitoba Protein Research Strategy is a guide for Manitoba to achieve this goal. With a growing world population and increasing income levels in emerging markets, the global demand for sustainable protein sources is continually rising. Protein produced and processed in Manitoba is among the world's highest quality and most sustainable. Identifying key research opportunities and potential challenges in the protein sphere is critical for Manitoba to maintain and extend its leadership position in sustainable protein.

Challenges Present Opportunities

Manitoba faces varying disruptions of the food markets people rely on. Disruptions include supply chain interruption, land management and consumer preference. Rising consumer awareness of adequate protein intake and its associated health benefits, concurrent with rising wealth in developing nations, has driven growing demand for sustainable protein.

Our planet faces a need to feed a growing population sustainably, as global food systems must feed 8.6 billion people by 2030, but current practices are unsustainable and account for more than a third of global emissions. The status quo is not enough.

By embracing agriculture's potential to help solve climate challenges, while meeting market demand for sustainable products and actively participating in the new economy, we can enhance the province we are proud to call home. There is reason for optimism.

The proposed Manitoba Protein Research Strategy highlights 46 strategic research projects under four main themes:

1. Climate resiliency of protein food systems
2. Novel protein product development and processing
3. Digital agricultural and food systems
4. Management and utilization of waste, water, by-products and co-products

Priority Areas in Sustainable Protein Research

CLIMATE RESILIENCY OF SUSTAINABLE PROTEIN FOOD SYSTEMS

- Crop nutrient management aimed at the reduction of greenhouse gases targeting net-zero emissions
- Relationship between a changing environment and genetics in yield, crop quality, and the nutritional, functional and sensory properties of protein foods
- Building resilient production systems with a focus on soil health, including the use of cover crops, crop rotation and annual legumes to improve resiliency
- Crop and livestock *adaptation to extreme weather events, and targeted breeding for climate stressors such as drought, heat, flooding etc.
- Understanding and overcoming early indicators of climate stress below ground in complex root systems
- Focus on circular bioeconomy and the interface between livestock and plant protein sectors
- Restoring natural cycles for carbon, nitrogen, water in regenerative agriculture and ecological restoration
- Breeding plants for quality and defined parameters focused on processing needs
- Developing metrics for the ruminant industry, with a focus on the cow-calf relationship
- Balancing profitability with sustainability (i.e. crop diseases with rotation limits such as peas)
- Marketing research to translate knowledge base around sustainability and biodiversity to the public and industry
- Understanding the synergies between animal and plant based proteins
- *Valuing ecosystem services provided by livestock producers to support environmental sustainability and climate resiliency while

NOVEL SUSTAINABLE PROTEIN PRODUCT DEVELOPMENT & PROCESSING

- Reducing grain oil content to support efficient protein extraction
- Development of ethical luxury food branded functional foods using traditional, minimally processed methods of production with recognition of Traditional Knowledge in collaborative efforts
- Understanding processing impact on human health and consumer acceptability, and removal of undesirable flavours in both food and animal feed
- Reducing allergens during processing
- Understanding the interactions between protein and non-protein components to optimize novel product formulations
- Understanding the potential health benefits of anti-nutrients
- Development of sustainable and functional packaging
- More research into alternative protein (ie. single-cell) production to feed the growing world
- Determining appropriate metrics to evaluate sustainability of protein production and processing.
- Optimizing quality and nutrition through next generation blends of animal, plant and alternative protein
- Novel technologies to improve the functionality and purity of starch-rich concentrates and protein using clean label friendly processes
- Optimized assessment measures for protein quality without the use of animal testing

DIGITAL AGRICULTURE TO ENABLE SUSTAINABLE FOOD SYSTEMS

- Precision livestock farming, applied demonstration of feed efficiency in commercial herds, and enhanced knowledge exchange
- Internet of things (IoT), connectivity of sensors and proper interpretation of data from sensors
- Artificial Intelligence to target commercial traits associated with high quality seed protein
- Technology to improve production performance
- Defining a framework to conceptualize digital agriculture in its ability to improve efficiency, productivity and sustainability
- Translating digital information into actionable management for producers
- Defining the social aspects of digital agriculture including behavioural economics, and industry and consumer behaviour to understand which technologies are needed
- Characterizing specific traits in pulse flours (beyond isolates and concentrates)
- Demonstrating the economic value in digital agricultural tools to producers (i.e. pest surveillance)
- Using digital agriculture and modelling in understanding the linkage between soil health, nutritional quality and human/animal health

WASTE, WATER, BY-PRODUCT & CO-PRODUCT UTILIZATION

- Second generation biofuel development, like manure bioenergy
- Life Cycle Analysis on waste, co- and byproducts (i.e. LCA on manure to demonstrate impact on soil health and carbon storing)
- Full characterization of co-products and by-products and overcoming regulatory hurdles for their use in the animal feed industry
- Relationship between feed and manure composition for further utilization
- Fish by-product as fertilizers or other uses
- Geographic indicators for identifying attributes and connecting them to intellectual property
- Finding new uses for starch (i.e. new fermentation uses, pharmaceutical formulations, microbiological testing, packaging etc.)
- Using lignocellulosic biomass in food and non-food applications (i.e. packaging, adhesives, platform chemicals, industrial chemicals, biomaterials)
- *Improving management of plant by-products and finding new uses for plant protein ingredients

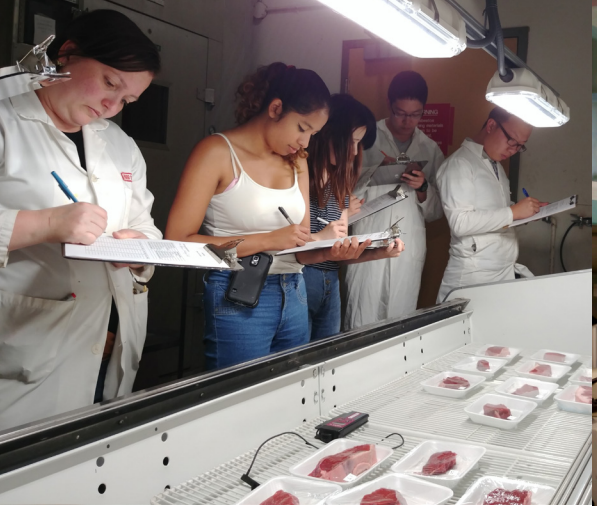
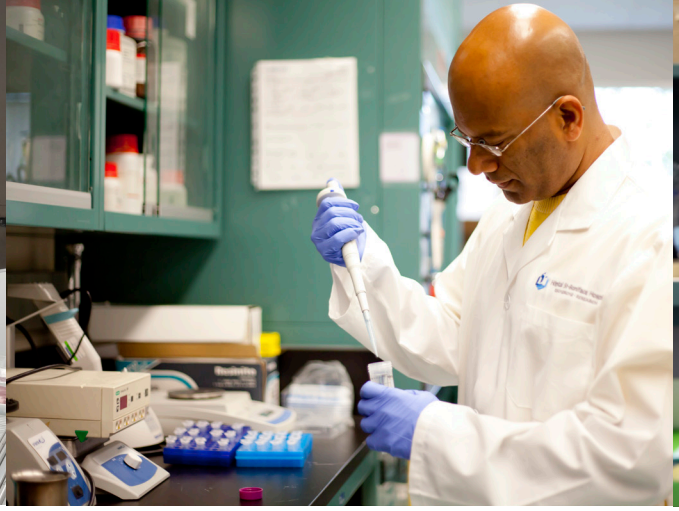
Reducing water and energy use in food processing through novel technologies (i.e. dry fractionation) and improvements to existing technologies (i.e. wet extraction)

The role of water management in environmental sustainability and climate resiliency (i.e. water remediation, reuse, waste water reduction, water reuse in extraction solvents, water usage, water infiltration, water reduction in processing, impact of water management on carbon content)

Investigation of environment x genotype x processing interactions

Processing optimization of protein foods for high quality biofuels and livestock feed

*Note: *In addition to the research gaps identified through the gap analysis, top priorities from our initial surveys were included if they were not already represented.*


Key Recommendations

The recommendations focus on funding, collaboration with industry, training of highly qualified personnel and better understanding of provincial infrastructure.

- Focus efforts on the research priorities identified under the four themes and future policy and programming should be designed to advance them.
- Develop targeted programming to fund the identified research priorities. Program design should consider both the capacity of SMEs and public versus private outcomes.
- Continue the evolution of the proposed Manitoba Protein Research Strategy under the leadership of a Strategic Research Chair in Sustainable Protein.
- Leverage existing committees and structures to support the Strategic Research Chair in Sustainable Protein to strengthen collaboration within Manitoba's robust protein research ecosystem and guide programming to advance the proposed Manitoba Protein Research Strategy.
- Strengthen synergies between industry, academia, government and non-profits through networking opportunities and digital tools through the development of a Sustainable Protein Research Network.
- Build momentum on the proposed Manitoba Protein Research Strategy by collaborating with global experts and institutions to advance common strategic priorities in protein research and innovation.