



# THE PIVOTAL ROLE OF RESEARCH IN THE EMERGENCE OF PLANT-BASED PROTEIN

By Dr. Jenn Walker, APG Research Manager, with files from Saskatchewan Pulse Growers

The Canadian pulse industry is intensely focused on building new end-use markets for pulse crops and has set the goal of “25 by 2025”, meaning 25% of Canada’s pulse production will go to new-use markets including food ingredients, foodservice, and pet food markets by 2025. The growing desire of food companies to include plant-based proteins in their products presents a golden opportunity for pulse growers.

It is a complex market involving complex processes and, by funding research focused on addressing industry needs, Alberta Pulse Growers (APG) is helping the pulse industry meet its stated goal of expanding the use of pulses through new market opportunities.

Expanding the value and use of pulse crops by having targeted end uses for the starch, fibre and protein components in addition to the traditional markets for whole seed could push demand for Western Canadian pea, lentil, chickpea, faba bean and dry bean crops to new heights. The increasing interest in plant-based proteins is difficult to overlook, with plant-based “meat” products being offered by several popular fast food chains. Pulse fractions have the potential to revolutionize the food industry for the better. These products answer consumer demands for healthy and sustainable food options in a powerful way.

It is not a new industry, Dr. Rick Green pointed out, but it is gaining

momentum from a new generation of consumers. “The millennial consumer is looking for new sources of protein,” said Green, President, Intellectual Capital Generation with KeyLeaf in Saskatoon (formerly POS Biosciences), a company that specializes in the commercialization of plant-based ingredients.

Dr. Chris Marinangeli, Pulse Canada’s Director of Nutrition, Scientific and Regulatory Affairs, credits consumer awareness of the impact of food choices on the world with the recent push to develop more protein choices.

“With respect to food, transitioning to dietary patterns that facilitate better health has been a priority for some time,” he said. “However, over the last decade, the effects of dietary patterns and food production on climate change has been given significant attention by key opinion leaders and governments. Consumers have also become aware of the impact of food choices on both health and environmental sustainability, which has driven their desire for plant-based foods. The consumer’s quest for protein is supported by this trend with an influx of plant-based protein foods that are nutrient dense and can lower the ecological burden of dietary patterns.”

Pulse crops are at the forefront of this industry because they offer reliable and sustainable proteins and starches that are highly prized by food companies. The challenge

therefore is to ensure that the pulses Canadian farmers grow are bred to provide the precise qualities food companies are looking for, and to ensure that they are both functional in the food manufacturing process and that they taste good.

What is the role of the farmer in this trend? How can we ensure that the volume and quality of product is known and available? Are there certain ways of managing our pulse crops that favour use as fractions? APG is working diligently alongside the scientific community to have answers to all these questions.

## **Breeding High Protein Pulses**

Pulse crops have always been set apart from other broad-acre crops simply for their high protein content. Not only do they fix their own atmospheric nitrogen, reducing the need for synthetic N-fertilizer application, they provide benefits to the soil environment and have one of the lowest footprints of all the crops. Breeding efforts traditionally have focused on increasing yield per acre, standability and resistance to diseases. With the potential for added value to the farmer, Dr. DJ Bing, pea breeder at Agriculture and Agri-Food Canada’s Lacombe Research Centre, has added a third dimension to his variety selection.

Traditional pea varieties have protein content ranging from 19-24%, and high protein lines are approaching 28-30% protein. Testing these lines in a variety of locations will ensure varieties are well-adapted to

deliver acceptable yields in Alberta environments, environments, along with high seed protein content, to take advantage of the growing plant protein market.

Making sure these high-yielding peas also process well and taste good is the other component of this project, which is led by Dr. Jay Han, Senior Food Scientist with Alberta Agriculture and Forestry's Food Processing Development Centre.

"Over the last 20 years, the target was to increase yield, but pea protein content has gradually decreased as yields increased," Han said. "We've been able to get protein content to an average of about 20% now. Our next target is to move the protein into the high 20s sought after by processors."

With the protein content target within striking distance, Han is setting his sights on easing field pea's signature strong flavour and improving its functional food characteristics to give processors more of what they want.

"We're working with processors building in Alberta who will be doing fractionation and extraction," Han continued. "We want to show that our capacity and expertise can support our Alberta growers and the processors too."

Bing and Han are collaborating on a project called "Development of genetically improved field pea varieties and germplasm for the Canadian pulse industry, and evaluation of flavour, physicochemical and functional characteristic in high protein breeding lines." This is a five-year project due to end in 2023. Alberta Pulse Growers, Manitoba Pulse and Soybean Growers, Saskatchewan Pulse Growers, Alberta Agriculture and Forestry, and the University of Alberta are also partnering in the project worth up to \$2.7 million. The

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*-Dr. Jay Han*

project received funding through the Canadian Agricultural Partnership.

#### **Managing for Quality**

Equally relevant to the plant protein discussion is investigation into management strategies and environmental conditions that allow plants to reach their genetic potential. Best management practices have focused on minimizing disease, seeding rates and fertility packages that work to maximize yields. As specific quality attributes, such as fibre content or resistant starch content, become increasingly relevant to providing marketing opportunities so does the way the crop was grown. In an effort to understand how growing region and management impacts protein and starch quality of pulses, Pulse Canada, Manitoba Pulse and Soybean Growers, Saskatchewan Pulse Growers along with APG are ramping up quality testing across western Canada.

"In order to position Canada as a preferred supplier of peas for the food manufacturing and processing sectors, there is a need to better understand how Canadian peas perform for quality attributes that are relevant to these markets and applications," said Greg Bartley, Pulse Canada's Manager of Crop Protection & Crop Quality. "Having regional quality data for the current and emerging pea varieties is necessary

to determine if there is a specific variety or varieties in a region that are suited to the needs of the ingredient and processed food markets. This data can also be used to market the quality advantage of Canadian peas and identify breeding efforts that are needed to meet the quality needs of our non-traditional customers."

While protein content of your pea crop doesn't currently impact sale price, the spike in demand for pulse ingredients could be a game changer. Understanding what to grow where for specific end markets may soon provide farmers with closed loop contract opportunities and grower organizations want to be sure that we have the agronomic knowledge to support consistent supply of highly desired product.

#### **Making Protein Functional**

Simply having a high protein pulse crop is not a one-way ticket to the food ingredient market. It has to physically work as a food ingredient, it has to taste good – and the two do not necessarily go hand-in-hand.

This is where Dr. Lingyun Chen, Professor and Canada Research Chair in the Faculty of Agricultural Life and Environmental Sciences at the University of Alberta, comes in. Her APG-funded research is looking broadly into value-added applications for pulse proteins in human foods. An additional



component is whether or not a pulse's variety, growing conditions, and the way it is processed have impacts on protein functionality.

"Protein is used as a macronutrient and also as a functional ingredient, like how egg whites function in a sponge cake, for example," explained Chen, adding that she is looking at pea, lentil, and faba bean protein in her study.

To become a food ingredient, pulse protein must be extracted from the seed to create an isolate – a lentil protein isolate (LPI), for instance.

"Currently, the industry is focused on getting high yields from the extraction process," Chen said.

"This certainly increases the protein yield, but it can result in a protein structure change, so we are looking at how the processing parameters can affect functionality, not just yield." To be functional as a food ingredient, that protein has to be useful as an emulsifier, a gelling agent, or offer foaming properties.

"All pulses have a different protein structure," Chen explained. "Lentil has very good foaming capacity, better than pea or faba bean, and we think it could be good at providing aeration in baked goods." She added that faba bean protein has strong gelling capacity and pea protein is good in most capacities but has a beany flavour that for some uses may be undesirable.

Efficiency in extracting these high-value fractions to make them cost effective ingredients has been an area of focus for University of Alberta Professor Thava Vasanthan. Known as Air Currents-Assisted Particle Separation (or ACAPS) technology, it was developed by Vasanthan in 2012 with cereal crop fractionation in mind.

"It works very much like a tornado, operating in a chamber," Vasanthan said. "As with a tornado, the air is

coming from a particular direction and it swirls around to lift particles higher."

ACAPS can produce dietary fibre concentrates from barley at less cost than using conventional air classification (or AC) technology. Once the dietary fibre component is separated, what's left is a 65% starch, 32% protein concentrate. For a food processing company, the capital cost of ACAPS is another attraction. It requires an initial investment that's far less than with AC.

### **New Markets, New Profitability?**

For a pet food manufacturing company, the trend to plant-based pet food offers an interesting opportunity. Dry pulses are much easier to handle than perishable meat products and cost far less per tonne of raw material. Vasanthan believes that as the fraction recipe is refined and the manufacturing process is improved, pulse crops stand a good chance of growing their footprint in the multi-billion-dollar North American pet food market.

"Over the past year and a half, with funding from the Alberta Pulse Growers, we started the characterization of the grains and how to concentrate the protein," Vasanthan said. "If you take field pea and faba bean, nearly 50% of the seed is starch, 25% to 30% is protein and the rest is fibre and other. But, high-fibre and high-starch is bad for dogs. So, we'll try to process the grains to minimize the starch and the fibre but maximize the bioavailability of the protein through cost-efficient technologies."

Back at KeyLeaf, Rick Green sees a big future for pulse-based plant protein. "The food industry has realized the potential, globally," he said. "Even beef companies are investing in plant protein – it is not beef or plants, it is both."

He noted that it can take a long time and a lot of experimentation to successfully get plant-based

protein into common foods, but once it is done, it is hard to turn back, meaning this could be a very secure market for Canadian pulse producers. "Once the industry starts using your ingredient, they cannot change it easily," he remarked.

"For farmers, this market adds so much more value and provides the opportunity for them to have greater influence on the utilization of their crops," Green said, adding he can see a day when producers can sell their crops into a higher-value specialty ingredients market. "I do not see why the farm community should not benefit from this."

### **Future is Bright**

Yield is no longer the sole yardstick by which new field pea varieties will be measured. With expanding processing capacity in Alberta and pulse processors looking for functionality that will ultimately please the consumer's palate, the future belongs to high-yielding, high-protein varieties that process well. APG, through research partnerships, is ensuring that farmers will have the genetics and agronomic knowledge to meet the demand. It's an exciting time to be in pulses.

*For more information on current APG research projects, visit <https://albertapulse.com/growing-pulses/research/>.*

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