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Plant Breeders Have Key Role to Play in Enhancing Field Pea for the Plant-Based Ingredients Market¹

Kim Sanderson^a, Vitaliia Mishchenko^a, Sandro Steinbach^b, and Nicholas Tyack^a^aUniversity of Saskatchewan, ^bNorth Dakota State University

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Abstract

Plant breeding is key to growing the pea-processing sector. Interviews with processors revealed that attributes that enhance processing efficiency and the functional value of pea ingredients are highly valued. Concerns included undesirable traits in some high-protein pea varieties and consumer response to the use of gene editing in breeding.

1 Introduction

The demand for protein is increasing globally (Aschemann-Witzel et al. 2021), and pulse crops—including pea, chickpea and faba bean—are becoming valued sources of high-quality protein (Singh et al. 2024). Pea has been described as one of the most promising and affordable sources of plant protein (Rogers et al. 2024) and as a more sustainable alternative to meat protein. Meeting the fast-growing demand for pea protein created by the expansion of manufacturing capacity in the plant-based protein industry will require increasing supply, particularly given competing uses for pea as feed and direct human consumption as well as the expansion of manufacturing capacity in the plant-based protein industry (Byrne and Dowdy 2022; Hoehnel et al. 2022).

Pea is expected to account for approximately 20 percent of the demand for proteins in the market for plant-based meat alternatives. Global demand for pea protein doubled between 2010 and 2022, with over 4,500 new food products containing pea ingredients launched globally in 2023 and strong continued growth forecast through 2029 (Der 2024). The market for plant-based meat alternatives will potentially utilize 10–15 million tons of peas by 2035 (Ernst & Young 2023), about 3–5 times higher than Canada's current annual level of field pea production.

Pea is recognized for its significant nutritional value and properties that support human health and disease prevention (Lu et al. 2020). As a result, the high-value pea ingredient market is undergoing a rapid evolution (Sharma et al. 2024). Fractionation for protein as a food ingredient is a growing market opportunity (Byrne and Dowdy 2022), and processors are continually refining their technology and processes to enhance the desirable attributes of plant-based ingredients and versatility in food applications (Fu et al. 2023; Tachie et al. 2023; Singh et al. 2024).

While the plant protein market shows significant potential (Tonsor et al. 2023) and global demand for pea protein is growing, key hurdles to the long-term growth of the sector include insufficient supply and unfavorable sensory attributes (Raszap Skorbiansky and Saavoss 2023; Rogers et al. 2024). Among the threats to supply are climate change (Mapfumo et al. 2023) and diseases such as root rot (Hossain et

¹ This article is also linked with the following materials: [A Report on Breeding Priorities for the High-Value Pea Processing Sector in Western Canada](#); [Research Note: Breeding Priorities for the High-Value Pea Processing Sector](#); and [A Report on Breeding Priorities for the High-Value Pea Processing Sector in Western Canada \(Extended Version\)](#).

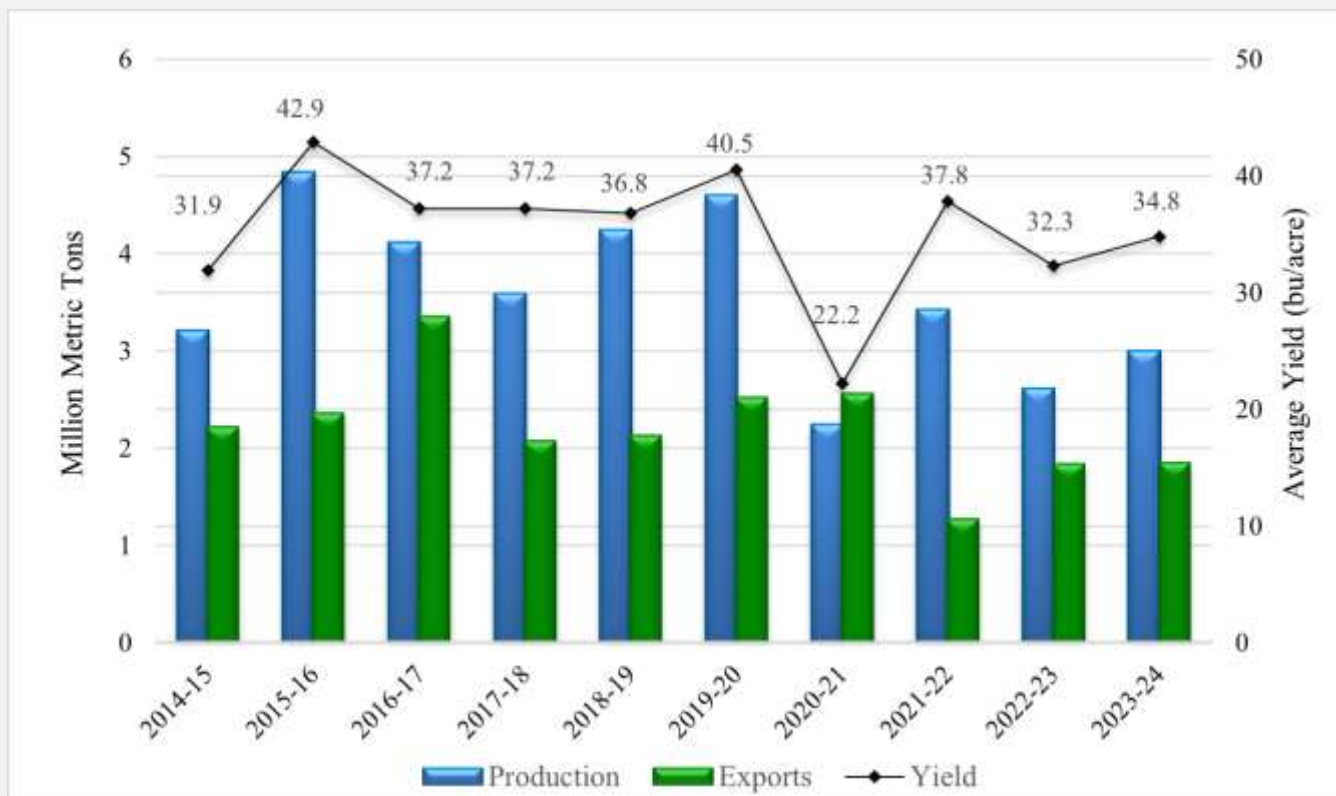


Figure 1. Canadian field pea production, exports, and yield

Note: This figure presents field pea production levels (million metric tons) in Canada, average pea yield (bushels per acre), and exports (thousands of tonnes) by marketing year, from 2015 to 2024 (Government of Canada 2025; Statistics Canada 2025).

al. 2012; Asare et al. 2022). Field pea production and yields in Canada have declined in recent years, partly due to increasing disease pressures (see Figure 1).

At a time of heightened competition and uncertainty in global markets, plant breeding is anticipated to play a key role in maintaining North America's competitive advantage in supplying the quality and volume of pea needed to meet market demands through the development of more resilient varieties that possess the attributes demanded by plant processors. The ability to utilize plant proteins in food ingredients is heavily dependent on their functional properties, including how the components of the seed behave during processing as well as how the proteins contribute to the texture, stability, appearance, and nutritional quality of food products. Innovations in biotechnology have the potential to contribute to the development of new high-protein pea varieties with desirable traits for the food ingredient market, as in the recent use of gene editing to remove the bitter taste from yellow peas (Watson 2023). In addition to addressing end-product innovation needs, it is necessary to develop varieties suitable for evolving processing technologies.

Recognizing the significant potential of the fractionation sector in this challenging environment necessitates enhanced communication and coordination among members of the plant-based protein supply chain to overcome barriers. Growth in functional applications in the food ingredient market that enhance the physical, chemical, and sensory properties of end products is dependent on the interaction between breeding and processing innovations in product formulation. Consulting processors as part of the plant-breeding process has the potential to identify issues with new varieties that have implications for value-added markets that would not otherwise be assessed. In this study, we report the results of

qualitative interviews with pea processors to gain an understanding of varietal traits valued by the plant-based food ingredient market and how breeding activities can support growth in the sector.

2 Interview Process and Data Analysis

Thirty-four prospective participants were invited to interviews, with 12 agreeing to participate, representing a range of small, medium, and large Canadian companies involved in primary processing, food ingredient processing, and food manufacturers. The processors interviewed were anticipated to represent the majority of processing in Canada and utilize a variety of processing technologies (milling, wet and dry fractionation).² Virtual interviews (45–90 minutes) were conducted and recorded between May and November 2024. The semi-structured 10-question interview format allowed respondents to share their opinions on the high-value pea market and provide information relevant to pea breeding.³ Topics included the future of the plant-based food market, attributes valued by processors when sourcing and processing peas, the use of gene editing in pulse breeding, and the marketing potential of climate-smart peas (Sanderson et al. 2025). Market focus was dependent on size, with small to medium processors focusing on domestic markets and exports to the United States and specific European markets, while large multinational companies were almost exclusively exporting into global markets. Respondents held diverse positions within their organizations—including chief executive officer, export sales, procurement, operations, and product development—providing a variety of unique perspectives and adding to the breadth and depth of information gathered through the interview process.

A thematic analysis following Braun and Clarke (2006) was employed, using a systematic and iterative approach to identify, analyze, and report patterns and themes within the transcripts. Initial coding involved the identification of key ideas and concepts, with labeling of relevant segments of the text. Then, the data were systematically organized to reflect recurring ideas. Each transcript was read completely a third time, and statements were labeled based on the key concepts they represented. The transcripts were then reviewed again to organize the key concepts into themes and categories. Theme development occurred through identifying connections and patterns within the data, after which the transcripts were reread in their entirety, guided by the emerging themes to ensure that all data relevant to the identified concepts had been captured and the concepts validated.

3 Processor Priorities for Plant Breeding

Figure 2 ranks the relative importance of the pea attributes based on the frequency with which the trait was mentioned and the importance assigned to it by processors. This was assessed based on responses to questions about the most important attributes considered when purchasing peas for processing, the constraints posed by current pea varieties, and the attributes processors thought plant breeders needed to focus on to address the future needs of the pulse-based food industry. Respondents were also asked to indicate what they believed to be Canada's competitive advantage in global pulse markets and what role they felt pea breeders could play in maintaining and growing that advantage. A simple scoring scheme was applied to quantify the importance of the attributes identified through the interview process. Each attribute raised by a respondent during the interview received a score of 1 or 2. A score of 1 was assigned for mentioning the attribute at least once as being of interest or importance. A score of 2 was assigned if the attribute was raised more than once during the interview or if the attribute was described as of high importance.

² Two respondents stated that processing volumes and capacity at their facilities was proprietary information, and we believe this may explain the low participation rate.

³ More detailed information on the methodology employed as well as the results can be found here.

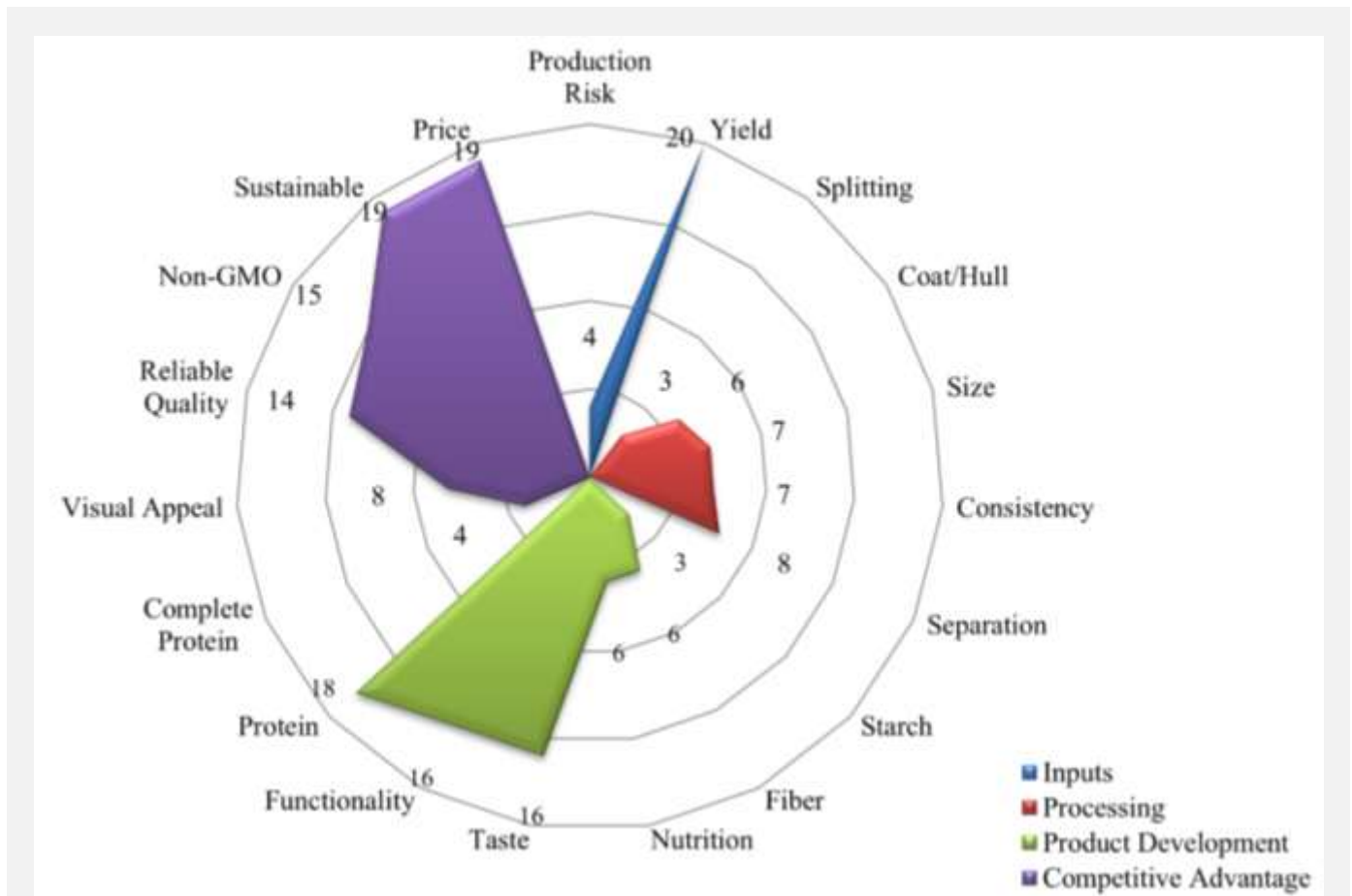


Figure 2. Pea attributes of value to processors

Note: This figure ranks the relative importance of pea attributes based on the frequency with which the trait was mentioned and the importance assigned to it by processors during the study interviews.

Responses to these questions provided the context for associating the attribute priorities with four areas: supply, processing, product development, and market competitive advantage. High importance was placed on yield as a breeding priority to help guarantee supply and keep input costs lower. Reducing production risks (such as disease and drought) through breeding was also raised as a supply issue, to ensure that producers are willing to grow pea in their rotations. Identifying the attributes of importance to processing was a primary focus of the interview questions. Responses were diverse, leading to less agreement and lower scores for attributes in this category. Size, consistency in quality, and ease of separating the protein from other components received the highest importance scores in this category.

The graph provides evidence that the highest priority attributes are market-driven, fueling product development and competitive advantage. The attributes of highest importance for product development were protein, functionality, and taste. The final category of competitive advantage includes attributes that processors mentioned when describing what was required to access key markets or compete with other plant-based food ingredients. Several of these were credence attributes, including Canada’s reputation in international markets for providing quality, sustainably produced, non-genetically modified peas. The yellow appearance of pea ingredients and the fact that peas do not contain all nine essential amino acids were cited as negative attributes. Price received the highest score in this category, with the ability to maintain cost-competitiveness frequently mentioned as key to pea remaining a viable

input. Recent studies support the importance of price (Raszap Skorbiansky and Saavoss 2023; Adhikari et al. 2025; Chenarides et al. 2025; Sun et al. 2025).

As food trends evolve and new products are introduced to address consumer dietary preferences, the food industry has become more competitive (Bashi et al. 2019). Our interviews revealed that plant-based food ingredient processors compete on technology and product differentiation, focusing on developing functional pea ingredients that add value to food manufacturers' products. The competitive nature of the industry aligns with the finding that processors value pea attributes that enhance processing efficiency or the functional value of pea as a food ingredient. Processors view the supply of low-cost peas as key to remaining competitive, placing a high importance on improving yields through plant breeding. Respondents understood the need for producer incentives to increase pea production. They agreed that addressing disease and production issues that will enhance yield and reduce risks for producers should remain a priority for breeding:

What if he (the farmer) could get 75 (bushels) in drought?... So, if he can do that, I am guaranteed supply. That is more important to me than sending me a 27% protein versus a 20% protein.

Price was described as a key consideration for pea ingredient buyers. They commented that any additional cost resulting from purchasing higher-protein pea or establishing certification programs could not be passed on to buyers but would instead have to be absorbed by processors or producers. Buyers were often described as being overly sensitive to any price increases to the pea protein ingredients they purchased. To remain profitable, companies focused on finding ways to keep the prices of their products low while increasing sales volumes through product innovations. To support product innovation, the sector has developed processing technologies to improve specific attributes of pea, including taste and solubility (Isleroglu 2025):

My most expensive costs are my peas going in, and the food manufacturers on the other end are saying you can't cost (more)... So, whatever I pay my farmers, I'm just going to take the hit because I can't pass that on.

This price sensitivity was an underlying driver and an important lens for understanding the sector's assessment of the attributes of value to the plant-based food ingredient market. When asked about the need to focus on breeding pea with higher protein content, all respondents agreed that while higher protein content was beneficial and an important breeding priority for dry fractionators, it was not the overall highest breeding priority or a primary concern for most stakeholders interviewed. There was no current market "pull" from ingredient buyers to increase the protein content of the pea flour, concentrates, and isolates that are available. Processors believe that in the current market environment, their customers would not be willing to pay more for a product with higher protein content.

Respondents were asked about their thoughts regarding the use of gene editing to achieve desired attributes through breeding. While respondents recognized the value of gene editing for plant breeding, they raised concerns about consumer acceptance of the technology. Processors generally felt consumers may not understand or accept gene editing technology and might not distinguish it from genetically modified pea. Most processors believed that introducing gene editing into pea breeding at this time could be detrimental to the food ingredient market and the entire pulse industry in Canada, impeding the marketability of all products containing pea. Employing gene editing in pea breeding introduces new challenges related to regulatory distinctions and traceability, potentially creating new regulatory and trade issues (Sprink et al. 2022). For developers of new pulse varieties intended for international

markets, awareness and understanding of the regulatory environments of current and potential trading partners are crucial (Vora et al. 2023).

An important finding of the interviews was that with existing technology capable of processing a variety of pulses, alternative pulse crops are already emerging as contenders to pea in the protein ingredient market. Processors spoke of the quickly evolving needs of the plant protein ingredient market and growing demand for customized products. With an eye to future market needs, processors are beginning to discuss the attributes of faba beans that make them an attractive plant-based protein alternative to pea (Dhull et al. 2022; Martineau-Côté et al. 2022). Food ingredient manufacturers are also beginning to use chickpeas as a source of plant protein (Boukid 2021). If production increases sufficiently, these pulse crops may potentially eclipse pea as the functional protein ingredient of choice:

Where we're seeing some issues is the root rot... A lot of growers that used to grow peas are not at all... So, what we are seeing is some switching to Faba beans because they're resistant to that. So that's why we're trying to figure out if we can use faba beans in the same way.

4 Marketable Pea Attributes in the Plant-Based Food Ingredient Sector

The plant-breeding priorities identified by the processors interviewed varied, reflecting the diversity of processing technologies employed and the specialized nature of the end products. Consistent with a recent study of pea protein isolate (Moll et al. 2023), the types and functional properties of the pea proteins were identified as important to processors. For most respondents, the functionality, how the physical and chemical properties of pea protein behave in food applications, was a higher breeding priority than increasing the protein content. Processors described pea functionality as a key strength that can be leveraged in the ingredient market.

Although more protein content has value, most processors were looking for improvements in other breeding traits that would facilitate the separation of the elements of the pea, improve processing efficiency and consistency in the final pea products, or enhance specific attributes in the pea necessary to expand the functional applications, including replacing alternative proteins, starches, or fibers in food products:

Pea protein, but it's a collection of proteins. It is not just one protein. And so, understanding how each one of those fractions of proteins contribute to its performance in an application. That is how we could really leverage the breeding.

Processing challenges focused on the need for a consistent quantity and quality of peas to meet operational needs at an affordable price. Specific concerns raised included size, water absorption, and hull thickness. Separating the protein from other pea components was recognized as a processing challenge. Pea protein taste was described as limiting its use as a functional ingredient in food manufacturing. Processors are additionally engaged in product innovation of other pea components, including fiber and starch, reflecting the desire to maximize value from the entire pea. Processors use pea starch and fiber in their own products or sell them as ingredients to other food manufacturers (such as dairies):

We actually sell pea fiber that's greater than 90% total dietary fiber... if you're extruding something and you're having trouble making your extrusion work, we just add pea fiber in.

5 Discussion

In the highly competitive food ingredient market, the price of peas is the primary driver in the processor purchasing decision and therefore an important consideration for breeders developing new varieties for the high protein market. This finding is supported by recent studies which demonstrate that consumer price sensitivity has limited purchases of plant-based foods (Raszap Skorbiński and Saavoss 2023; Adhikari et al. 2025; Chenarides et al. 2025; Sun et al. 2025).

Our findings suggest that regulatory inconsistency, limited experience with gene editing technologies, and uncertainty regarding consumer acceptance have created hesitancy to support the use of gene editing in pea breeding, even though the benefits are well understood by processors. The release of even a single gene-edited pea variety could damage the industry given the challenges of identity-preserved marketing systems and the reputation of pea as a healthy, non-GMO food ingredient. These insights underscore the need for more information regarding consumer acceptance of gene edited food and for coordinated policy actions. Government prioritization of science-based regulatory clarity, investment in public communication strategies, and collaboration with international bodies to harmonize standards may help reduce perceived risk and foster trust (Ahmad et al. 2023).

Processors felt it was important for plant breeders to understand the needs of the entire supply chain in setting breeding priorities and be aware that those needs were becoming increasingly specialized. The potential trade-offs associated with breeding higher-protein pea, either in terms of the loss of desirable attributes, such as yield, or the creation of undesirable characteristics that negatively affected the processing or quality of pea protein ingredients were a concern for processors. Past breeding efforts that have focused on attributes of value to producers have occasionally led to the release of varieties that proved difficult to process or market because of undesirable traits. If new varieties are to be successful in the market, it is important to consider whether the attributes developed to address production issues could be delivered in varieties that also meet the needs of the entire supply chain:

I would want them to be cautious on the trade-offs. Be very aware of the trade-offs. Higher protein means what? What is the trade-off... What we've seen is a ripple effect... When they remove the bitter taste, what is the trade off? There's always something on the other side.

By changing the percentage of protein versus starch and fiber, it changes my wet fractionation process. It changes the way it acts. So, we are changing the genetics of that pea, therefore it's changing the way that the proteins will release.

Processors believed that improved communication and collaboration among supply chain stakeholders would help ensure the quality and marketability of future pulse varieties. These relationships can be promoted by policymakers, industry associations, and plant-breeding programs by funding interdisciplinary research combining economics, consumer behavior, and biotechnology, and developing incentives for collaborative platforms that connect breeders, processors, and retailers. Several processors indicated a willingness to offer input and feedback to breeders as varieties are being developed. As a more informed participant in varietal development, processors felt they could also play a role in promoting new varieties for adoption by growers:

If you have the best product, it's really easy to market... We very much want you [plant breeders] to be there and want you to be giving the information and hearing the information.

6 Conclusion

Processors emphasized the importance of aligning plant-breeding priorities with market needs to maintain and grow the competitive advantage of the Canadian pea-processing sector. Negative experiences processing specific pea varieties developed without market consultation reinforce the value of ongoing communication. Our work begins to address the identified need for improved communication and interaction between stakeholders in the plant-based food supply chain. It reinforces the crucial role plant breeders will need to play in overcoming the challenges facing the plant-based ingredient sector. Processors are heavily reliant on the functional properties of pulses to supply the increasingly specialized plant-based ingredients necessary for successful participation in the food industry. This is supported by our finding that processors breeding priorities included attributes affecting product quality and innovation. The highly competitive nature of the industry is further demonstrated by the value processors place on breeding for pea attributes that enhance processing efficiency and improve varietal yield and resilience necessary to ensure a stable and affordable supply of pea for processing.

Processors recognized the functionality of pea as a significant strength that could be leveraged in the ingredient market. Pea may have benefited from recent price inflation in other food ingredients, making it a more affordable alternative that consumers perceive as contributing “health” value to final food products. The importance of this consumer image of pea as healthy has led to reservations regarding employing gene editing in plant breeding. The industry’s priority is a consistent and low-cost supply of pea that meets the product and process specifications to continue to leverage this image in the food ingredient market. This has led to a growing reliance on, as well as a vested interest in, both the process and outcomes of plant breeding.

About the Authors: P. Kim Sanderson (Corresponding Author Email: kim.sanderson@usask.ca) is a Research Officer, Department of Agricultural and Resource Economics, University of Saskatchewan, Saskatoon, SK, Canada. Vitaliia Mishchenko (v.mishchenko@usask.ca) is a Research Scientist, Department of Agricultural and Resource Economics, University of Saskatchewan, Saskatoon, SK, Canada. Sandro Steinbach (sandro.steinbach@ndsu.edu) is an Associate Professor, Department of Agribusiness and Applied Economics, North Dakota State University, Fargo, ND. Nicholas Tyack (nicholas.tyack@usask.ca) is the Van Vliet Assistant Professor of Agricultural Economics, Department of Agricultural and Resource Economics, University of Saskatchewan, Saskatoon, SK, Canada.

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Additional Research: This article is also linked with the following materials: [A Report on Breeding Priorities for the High-Value Pea Processing Sector in Western Canada](#); [Research Note: Breeding Priorities for the High-Value Pea Processing Sector](#); and [A Report on Breeding Priorities for the High-Value Pea Processing Sector in Western Canada \(Extended Version\)](#).

References

- Adhikari, S., B.R. McFadden, T. Malone, and J.L. Lusk. 2025. "Plant-Based Versus Animal-Based Proteins: Does It Have to Be Either/Or?" *Journal of Agricultural and Resource Economics* 50(1):1–20. <http://doi.org/10.22004/ag.econ.344678>
- Ahmad, A., A. Jamil, and N. Munawar. 2023. "GMOs or Non-GMOs? The CRISPR Conundrum." *Frontiers in Plant Science* 14:1232938. <https://doi.org/10.3389/fpls.2023.1232938>
- Asare, E.K., D. Bulani, T. LaForge, and V. Zhang. 2022. "Production Strategies Management to Minimize Root Rot Disease in Field Pea Grown on Infected Southwestern Saskatchewan Soils." *Journal of Plant Nutrition* 45(19):3024–3044. <https://doi.org/10.1080/01904167.2021.2020821>
- Aschemann-Witzel, J., R.F. Gantriis, P. Fraga, and F.J. Perez-Cueto. 2021. "Plant-Based Food and Protein Trend from a Business Perspective: Markets, Consumers, and the Challenges and Opportunities in the Future." *Critical Reviews in Food Science and Nutrition* 61(18):3119–3128. <https://doi.org/10.1080/10408398.2020.1793730>
- Bashi, Z., R. McCullough, L. Ong, and M. Ramirez. 2019. *Alternative Proteins: The Race for Market Share is On*. McKinsey & Company. Available online: <https://www.mckinsey.com/industries/agriculture/our-insights/alternative-proteins-the-race-for-market-share-is-on>
- Boukid, F. 2021. "Chickpea (*Cicer arietinum* L.) Protein as a Prospective Plant-Based Ingredient: A Review." *International Journal of Food Science and Technology* 56(11):5435–5444. <https://doi.org/10.1111/ijfs.15046>
- Braun, V., and V. Clarke. 2006. "Using Thematic Analysis in Psychology." *Qualitative Research in Psychology* 3(2):77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Byrne, B., and R. Dowdy. 2022, January 21. "Demand for Plant-Based Meat is Growing. We Must Ensure Our Supply Chain Can Keep Up." *The Good Food Institute*. Available online: <https://gfi.org/blog/meeting-plant-based-meat-demand/>
- Chenarides, L., J. Cuffey, W. Li, S. Zhao, and B. Adamo. 2025. "Consumer Spending on Plant-Based Meat Alternatives." *Choices* 39(3):1–6. <https://doi.org/10.22004/ag.econ.352133>
- Der, T. 2024. "State of the Market: Pulses in Food, Pet Food and Feed." Paper presented at the 2024 Pulse and Special Crops Convention, Winnipeg, MB, Canada, September 17–19.
- Dhull, S.B., M.K. Kidwai, R. Noor, P. Chawla, and P.K. Rose. 2022. "A Review of Nutritional Profile and Processing of Faba Bean (*Vicia faba* L.)." *Legume Science* 4(3):e129. <https://doi.org/10.1002/leg3.129>
- Ernst & Young, LLP. 2023. *Global Market Forecast and Competitiveness Study for Canadian Plant-Based Proteins*. Protein Industries Canada. Available online: <https://www.proteinindustriescanada.ca/uploads/Market-Forecast-and-Competitiveness-Study-EY-for-Protein-Industries-Canada.pdf>
- Fu, Q., J. Zhao, S. Rong, Y. Han, F. Liu, Q. Chu, S. Wang, and S. Chen. 2023. "Research Advances in Plant Protein-Based Products: Protein Sources, Processing Technology, and Food Applications." *Journal of Agricultural and Food Chemistry* 71(42):15429–15444. <https://doi.org/10.1021/acs.jafc.3c02224>
- Government of Canada, Canadian Grain Commission. 2025. *Archive of Canadian Grain Exports (annual)* [database]. Available online: <https://www.grainscanada.gc.ca/en/grain-research/statistics/canadian-grain-exports-annual/> [Accessed May 21, 2025]
- Hoehnel, A., E. Zannini, and E.K. Arendt. 2022. "Targeted Formulation of Plant-Based Protein-Foods: Supporting the Food System's Transformation in the Context of Human Health, Environmental Sustainability and Consumer Trends." *Trends in Food Science & Technology* 128:238–252. <https://doi.org/10.1016/j.tifs.2022.08.007>
- Hossain, S., G. Bergkvist, K. Berglund, A. Mårtensson, and P. Persson. 2012. "Aphanomyces Pea Root Rot Disease and Control with Special Reference to Impact of Brassicaceae Cover Crops." *Acta Agriculturae Scandinavica, Section B-Soil & Plant Science* 62(6):477–487. <https://doi.org/10.1080/09064710.2012.668218>
- Isleroglu, H. 2025. "Processing Technologies for Plant Protein Products." In K. Younis and O. Yousuf, eds. *The Future of Plant Protein*. Springer, pp.121–162. https://doi.org/10.1007/978-981-96-4190-1_6

- Lu, Z. X., J. F. He, Y. C. Zhang, and D. J. Bing. 2020. "Composition, Physicochemical Properties of Pea Protein and Its Application in Functional Foods." *Critical Reviews in Food Science and Nutrition* 60(15):2593–2605. <https://doi.org/10.1080/10408398.2019.1651248>
- Mapfumo, E., D.S. Chanasyk, D. Puurveen, S. Elton, and S. Acharya. 2023. "Historic Climate Change Trends and Impacts on Crop Yields in Key Agricultural Areas of the Prairie Provinces in Canada: A Literature Review." *Canadian Journal of Plant Science* 103(3):243–258. <https://doi.org/10.1139/cjps-2022-0215>
- Martineau-Côté, D., A. Achouri, S. Karboune, and L. L'Hocine. 2022. "Faba Bean: An Untapped Source of Quality Plant Proteins and Bioactives." *Nutrients* 14(8):1541. <https://doi.org/10.3390/nu14081541>
- Moll, P., H. Salminen, O. Seitz, C. Schmitt, and J. Weiss. 2023. "Characterization of Soluble and Insoluble Fractions Obtained from a Commercial Pea Protein Isolate." *Journal of Dispersion Science and Technology* 44(13):2417–2428. <https://doi.org/10.1080/01932691.2022.2093214>
- Raszap Skorbiansky, S., and M. Saavoss. 2023. "Premiums for Plant-Based: Often About Twice as Much, but Declining." *Choices* 36(4):1-11. <https://doi.org/10.22004/ag.econ.339582>
- Rogers, H., M. Dora, N. Tsolakis, and M. Kumar. 2024. "Plant-Based Food Supply Chains: Recognising Market Opportunities and Industry Challenges of Pea Protein." *Applied Food Research* 4(2):100440. <https://doi.org/10.1016/j.afres.2024.100440>
- Sanderson, K., S. Steinbach, and N. Tyack. 2025. "A Report on Breeding Priorities for the High-value Pea Processing Sector in Western Canada (Extended Version)." Working paper. University of Saskatchewan, Department of Agricultural and Resource Economics. <https://doi.org/10.22004/ag.econ.358976>
- Singh, R., A. Kadam, and F. Koksel. 2024. "Plant-Based Meat Alternatives: Innovation Through Advanced Processes and Ingredients." In F. Boukid, C.M. Rosell, and N. Gasparre, eds. *Handbook of Plant-Based Food and Drinks Design*. Academic Press, pp. 117–132. <https://doi.org/10.1016/B978-0-443-16017-2.00012-7>
- Sharma, N., N. Yeasmen, L. Dube, and V. Orsat. 2024. "Rise of Plant-Based Beverages: A Consumer-Driven Perspective." *Food Reviews International* 40(10):3315-3341. <https://doi.org/10.1080/87559129.2024.2351920>
- Sprink, T., R. Wilhelm, and F. Hartung. 2022. "Genome Editing Around the Globe: An Update on Policies and Perceptions." *Plant Physiology* 190(3):1579–1587. <https://doi.org/10.1093/plphys/kiac359>
- Statistics Canada. 2025. "Table 32-10-0359-01 Estimated Area, Yield, Production, Average Farm Price and Total Farm Value of Principal Field Crops, in Metric and Imperial Units." [database]. Available online: <https://www150.statcan.gc.ca/t1/tbl1/en/cv.action?pid=3210035901> [Accessed May 21, 2025]
- Sun J., V. Caputo, and H. Taylor. 2025. "What Explains the Recent Slowing Growth of the Plant-Based Meat Alternatives Market?" *Choices* 40(3):1–15. <https://doi.org/10.22004/ag.econ.376317>
- Tachie, C., I.D. Nwachukwu, and A.N. Aryee. 2023. "Trends and Innovations in the Formulation of Plant-Based Foods." *Food Production, Processing and Nutrition* 5(1):16. <https://doi.org/10.1186/s43014-023-00129-0>
- Tonsor, G.T., J.L. Lusk, and T.C. Schroeder. 2023. "Market Potential of New Plant-Based Protein Alternatives: Insights from Four US Consumer Experiments." *Applied Economic Perspectives and Policy* 45(1):164–181. <https://doi.org/10.1002/aapp.13253>
- Vora, Z., J. Pandya, C. Sangh, and P. R. Vaikuntapu. 2023. "The Evolving Landscape of Global Regulations on Genome-Edited Crops." *Journal of Plant Biochemistry and Biotechnology* 32(4):831–845. <https://doi.org/10.1007/s13562-023-00863-z>
- Watson, E. 2023, March 16. "Israeli Startup Deploys CRISPR to 'Virtually Eliminate' Bitter-Tasting Saponins in Yellow Peas." *AgFunder Newsletter*. Available online: <https://agfundernews.com/plantae-bioscience-deploys-crispr-to-eliminate-bitter-taste-in-yellow-peas>

DOI: <https://doi.org/10.71162/aeee.715729>

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