



Ontario Genomics

# CELLULAR AGRICULTURE

CANADA'S \$12.5 BILLION  
OPPORTUNITY IN  
FOOD INNOVATION

EXECUTIVE  
SUMMARY

November 2021

# Cellular Agriculture - Canada's \$12.5 Billion Opportunity in Food Innovation - Executive Summary

Driven by an accelerating climate crisis, evolving consumer preferences, worsening global food insecurity, and the need to feed a growing global population, cellular agriculture presents an alternative and compelling route to produce proteins, ingredients and other food products<sup>a</sup> thereby augmenting global food systems. In recent years, the cellular agriculture industry has been exploding, with over US\$9.7 billion in global investments and more than one hundred active companies worldwide. This is an industry that is flourishing with opportunities for current and new food producers across diverse and multi-sectoral public and private stakeholder groups.

Cellular agriculture encompasses several innovative approaches that use cell cultures, tissue engineering, or precision fermentation to make food products and other materials. Cellular agriculture is underpinned by the platform technology of engineering (synthetic) biology, a convergence of advanced biological, engineering and computational disciplines to create products for numerous sectors in new and sustainable ways.

The first-of-its-kind in Canada, the current report, *Cellular Agriculture – Canada's \$12.5 Billion Opportunity in Food Innovation* is based on extensive stakeholder engagement and builds on the landmark whitepaper, [Engineering Biology – a platform technology to fuel multi-sector economic recovery and modernize biomanufacturing in Canada](#). Released in November 2020, by [Ontario Genomics](#) and the [Canadian National Engineering Biology Steering Committee](#), this whitepaper highlighted the opportunity to use engineering biology as a platform technology for sustainable and innovative economic recovery and growth in three vertical pillars: Food Security, Low-Carbon Manufacturing, and Advanced Engineering Health Technologies.

The analysis presented here illustrates that the Canadian cellular agriculture landscape is rapidly evolving and shows tremendous promise to develop alongside and augment Canada's conventional agriculture and food industries, with Canadian start-ups already taking advantage of growing opportunities along the supply chain. As the fifth largest exporter of agricultural and agri-food products in the world and aligning with the ambitious vision of the Economic Strategy Table on Agri-Food's vision for Canada to become the favoured protein provider globally, Canada has unique advantages to drive leadership in cellular agriculture. This includes an extensive food and beverage industry, free-trade agreements covering 60% of global GDP, readily available feedstock, and world-class expertise across required disciplines. The report's economic analysis, by Dr. Michael von Massow, indicates that there is an enormous opportunity for Canada to capitalize on cellular agriculture. This includes the ability to

<sup>a</sup>In addition to food ingredients (such as proteins, enzymes, flavour molecules, vitamins, pigments and fats) that can be incorporated with existing products to create value-added hybrid goods, fermented products include dairy, eggs, chocolate, honey, while cellular/cultivated products comprise red meat, poultry, seafood, foie gras and pet food. Non-food cellular agriculture products cover textiles such as leather, wool, silk and cotton.)

diversify and create new product categories for domestic and international markets, supporting company creation and Canadian Intellectual Property generation, as well as an opportunity to address food security concerns in Canada and globally. Optimistic scenarios suggest a \$7.5 billion a year industry and up to 86,000 jobs created by 2030, and longer-term Canadian revenues as high as \$12.5 billion per year with the creation of up to 142,000 jobs; this is achievable and aligned with Canada's current share of the global market.

Funded by Ontario Genomics and Agriculture and Agri-Food Canada, Ontario Genomics, in partnership with the Food and Agriculture Institute at the University of the Fraser Valley, conducted a series of stakeholder consultations to explore critical considerations for Canada's emerging cellular agriculture industry. Based on these consultations and a review of literature and publicly available information, this report outlines inter-connected actionable opportunities for Canada to capitalize on this rapidly expanding and high-potential global market expected to approach US\$100 billion in the next decade. To achieve success, Canada must:

- 1. *Develop a National Vision and Strategy for a Canadian Cellular Agriculture Industry in the Near Term.*** This is foundational to enable a growing domestic ecosystem and fully realize the benefits presented by this industry. An outcomes-driven national vision and strategy should be developed collaboratively, be inclusive of stakeholder requirements and include a clear plan for implementation in the short-, medium- and long-term.
- 2. *Establish a Clear and Transparent Regulatory Framework for Cellular Agriculture Products in Canada.*** Canada is encouraged to proactively develop an agile, iterative, and innovative regulatory framework by building on existing processes to support the evaluation and approval of cellular agriculture products in a timely manner, in alignment with Canada's current rigorous regulatory process and excellent food safety standards.
- 3. *Provide Supporting Mechanisms for Research and Commercial Development.*** Incentivization, through public and private investment and partnerships, and outcomes-driven networks, is critical for a thriving domestic cellular agriculture industry, with infrastructure support for research and development, training, company creation, scale-up and growth, leading to made-in-Canada product commercialization.

# Canada's Actionable Opportunities for a Thriving Cellular Agriculture Ecosystem

Based on the input from our stakeholder consultations, along with a review of literature and other publicly available information, we articulate the inter-connected actionable opportunities to inform a policy framework and implementation plan for a thriving Canadian cellular agriculture industry worth up to \$12.5 billion a year and creating up to 142,000 jobs.

*1. Develop a National Vision and Strategy for a Canadian Cellular Agriculture Industry in the Near Term* to enable a domestic ecosystem that fully realizes the benefits presented by this industry. Founded on a clear value proposition and rationale, this strategy should be national in scope and developed collaboratively and cohesively by federal, provincial and territorial governments, industry (including large corporates, start-ups and conventional agriculture), academic and research institutions, not-for-profits, regulatory agencies, and policymakers.

The strategy should define a framework with concrete steps for implementing an action plan in the short, medium and long-term and have clear success metrics. Considerations for the value proposition and rationale include economic and export opportunities, environmental and ethical concerns, current and future domestic and global protein requirements, trade considerations, the changing food and agriculture employment landscape, opportunities in the sector, food security, resiliency in the face of climate change or other shocks, and alignment with Canada's strengths and priorities. In addition, promoting the integration of new production systems with existing conventional ones is critical, with ongoing monitoring to prevent undue disruption to either sector. The framework should include the strategy for government incentivization at both federal and regional levels. In the development of this Canadian-specific framework, models from currently leading cellular agriculture countries should inform pathways for incentivization and funding mechanisms that leverage government support for private sector investment.

Taking the value proposition into account, the action plan should specifically include steps for:

- Substantial and sustained investment in cellular agriculture for dedicated research and development;
- Support for start-up creation and growth through pilot scale-up to commercial-level production;
- Building a talent development pipeline.

The action plan should ensure coordination of and access to essential and existing infrastructure. Upfront investment is necessary to help Canada catch up with other jurisdictions currently ahead in this sector.

Broad communication and outreach are integral to the success of a national strategy. This needs to occur in parallel with technology development to ensure widespread uptake of cellular agriculture products and optimal return on investment. Critical consideration is required to understand consumer perspectives and use for

appropriate messaging to reach various people across different demographics - from children to the elderly, as well as those facing food insecurity - to articulate benefits, address concerns, and overcome potential barriers early.

**2. Establish a Clear and Transparent Regulatory Framework for Cellular Agriculture Products in Canada.** Canada is encouraged to develop an agile, iterative, and innovative regulatory framework by building on existing processes. The framework should be informed as early as possible by engaging industry stakeholders and other experts with the relevant regulatory departments and agencies (e.g., AAFC, CFIA, Health Canada and Environment and Climate Change Canada), and including cellular agriculture subject matter experts within regulatory bodies. This will ensure that any new policies and regulations have expert input and consider the perspectives of both regulatory agencies and the ultimate end users, and would help simplify and strengthen the Canadian process. A timely, reasonably priced and predictable regulatory process, and a smooth and transparent evaluation process with high approval confidence, can be achieved through an iterative approach. Early engagement between regulators and companies also allows issues to be flagged and addressed promptly. This will be crucial to attract and retain cellular agriculture companies in Canada while ensuring the domestic industry remains globally competitive under Canada's rigorous regulatory process and food safety standards. This process can be further fostered through continuous, clear, and comprehensive communication between the industry and regulators, as well as broad dissemination of positive engagements and success stories. A delineated regulatory pathway that is aligned with the industry's needs has shown much success in Singapore, the most advanced jurisdiction in regard to approvals of cellular agriculture product offerings.

To aid companies in navigating the regulatory process, a government program that appoints industry liaisons or "concierges" could be established. This would particularly benefit start-ups and early-stage companies that are navigating the process for the first time. It is anticipated that, before seeking regulatory approval, standardized safety testing of cellular agriculture food products could provide confirmation of product composition, nutritional profile, and (lack of) toxicity profile. Consideration should be given to an expedited review of products that have already been "passed" by an accredited, external standardized test. As the global cellular agriculture industry grows and matures, Canada will need to ensure its cellular agriculture standards align with emerging international standards to maintain its reputation as a producer of safe, high-quality foods and not impede exports. Currently, this is an underdeveloped area, and being an early mover in standardized safety testing will allow Canada to have substantial input into international standards as they progress. Cross assessment of regulatory processes with other jurisdictions (e.g., Singapore, Australia and New Zealand) should be continued and expanded, as appropriate.

Early development of regulatory guidance for the labelling of these products is also essential for transparency and to empower consumers to make informed choices. Cellular agriculture product labelling should be descriptive, communicate the nature of the product in clear and relatable language, while maintaining appeal as a food item. Labelling should differentiate cellular agriculture products from those in the traditional protein market while creating a positive impression and ensuring both types of products are on a level playing field and competitive in consumer markets.



### ***3. Provide Supporting Mechanisms for Research and Commercial Development.***

Incentivization, through both public and private investment and partnerships, and outcomes-driven networks, is critical for a thriving domestic cellular agriculture industry, with infrastructure support for R&D, training, company creation, scale-up, and growth leading to made-in-Canada product commercialization.

#### *Research and training the next generation of skilled workers*

Early government investment would catalyze invention, help de-risk opportunities, and attract private sector investment while incentivizing innovation and driving company creation and entrepreneurship within Canada. Funding could support:

- Both fundamental and industry-driven research to ensure that the necessary and foundational tools and technologies are in place and that research is directed to industry needs.
- Open science to reduce redundancy and speed up product development.
- Alignment with strategic government focus areas or grand challenges, such as climate action, to encourage industry growth through sustainable practices and innovations.
- Key areas of multi, cross- and trans-disciplinary research (e.g., 'omics, engineering biology, AI, food sciences and others) for advancing cellular agriculture technologies that are also applicable to other business verticals (e.g., health, low carbon economy).
- LCAs, TEAs and other analyses that are objective and independent.
- Social sciences research playing a critical role in driving consumer engagement, addressing risk perception and public trust, and developing appropriate communication strategies.

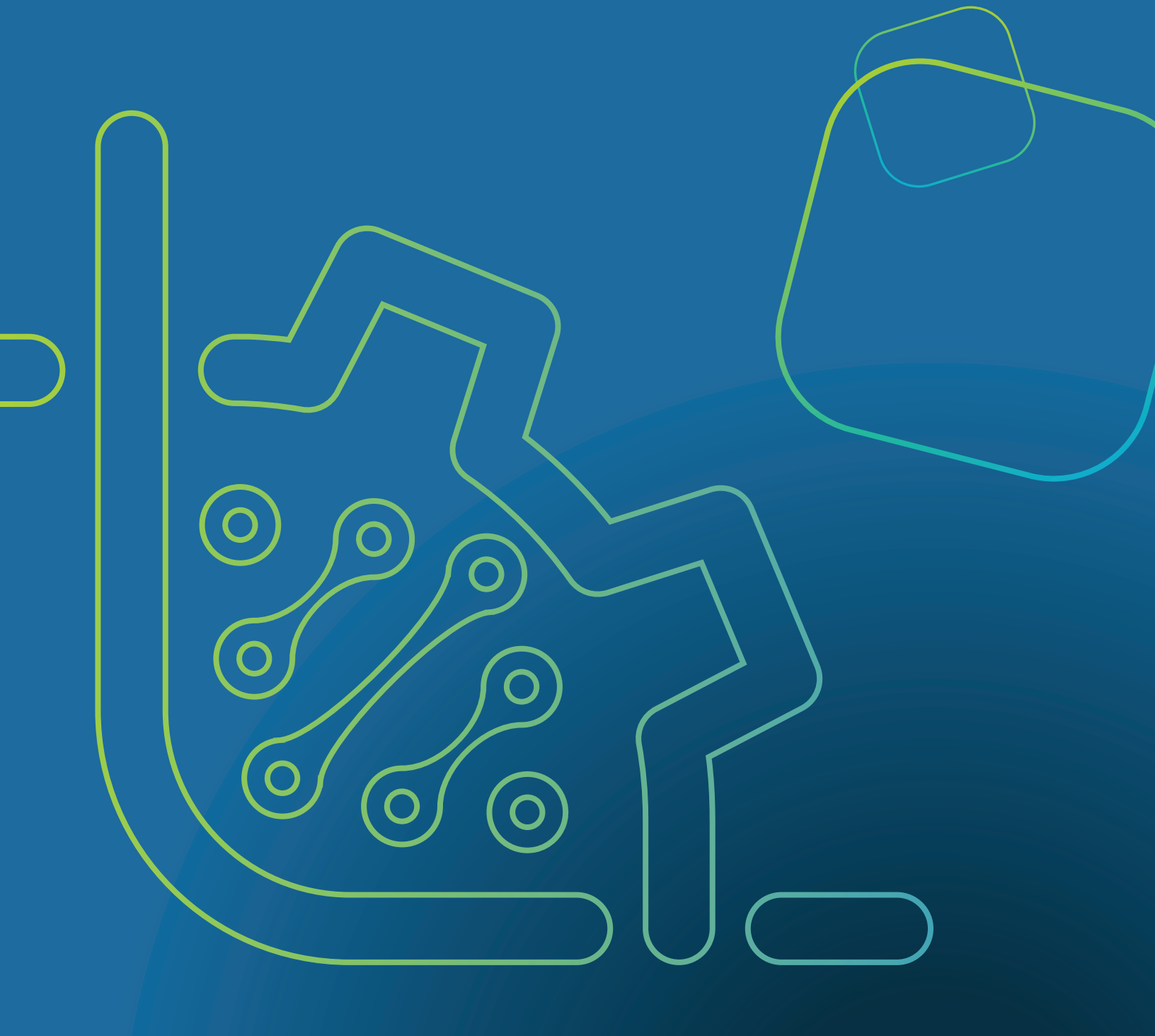
New training programs that offer targeted and cross-disciplinary opportunities and industry placements related to cellular agriculture and engineering biology are critical. There are also opportunities to train and up-skill those with related expertise in other sectors. This would ensure that a domestic talent pipeline of skilled High-Quality Personnel (HQP) could fill the high-quality jobs that the cellular agriculture industry will create.

#### *Growing the economy through start-up support, public private partnerships, and networks*

Early start-ups require support in the form of lab space, facilities, and infrastructure, but also public and private seed funding for initial company growth. Canadian and international investors should be incentivized to invest in Canadian companies through clear and well-publicized government support for the industry. As seen in leading cellular agriculture jurisdictions, investment in public and private sector-partnered innovation hubs, including incubators and accelerators, can effectively support companies in their early stages. In addition to physical facilities, these hubs would need to include access to expertise, mentorship, and investment opportunities. While Canada has some capacity in Nova Scotia and New Brunswick, a lack of facilities for pilot/demonstration scale-up and at commercial scale is viewed as the most significant bottleneck globally, and is a primary reason for companies to leave Canada for other jurisdictions, such as the United States or Europe. The initial outlay to establish domestic scale-up capacity in localized ecosystems would be high, but fee-for-service operations could provide a global leadership opportunity to Canada, with potential to attract foreign companies. Such infrastructure can also be adaptable to serve different industries, such as to the production of vaccines in a health emergency or to bypass disruptions in the supply chain of critical materials to support a low carbon economy.



Supporting applied research and commercial development through industry and research collaboration is valuable to ensure the success of the domestic cellular agriculture industry. Partnerships between established companies and start-ups/ academics (public-private partnerships) bridge the gap between research and translation, provide access to infrastructure, and create linkages and entry routes into the supply chain for B2B companies. The larger partner benefits from priority access to innovations, diversification and the creation of new product categories with strong market pull. Effective industry partnerships are vital to inform and drive policy and regulation and advocate with a common voice for a clear path to market for Canadian companies. On a larger scale, outcomes-driven networks are crucial to bringing together diverse stakeholders from industry, academia, government, and non-governmental organizations. Such networks should include diverse fields of multi-, cross-, and trans-disciplinary expertise and platforms and include regional, national, and international partnerships for interdisciplinary cross-pollination of ideas to breakdown silos between sectors and geographic regions and facilitate dialogue between disciplines. Network participants can benefit from and provide benefits to other sectors (e.g., health, low carbon economy) through knowledge exchange and parallel applications of novel technologies. These networks must include representation from the food production and conventional agriculture industries to foster mutually beneficial relationships, and transition or expansion to new food products market.



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